The Impact of the Constraint Factors on Building Project Delivery in Enugu State[1]

Anthony N. Ezemerihe[1], Kevin C. Okolie[2], and Dominic A. Obodoh[2]
[1]Enugu State University of Science and Technology, Enugu, Nigeria
[2]Department of Building, Nnamdi Azikiwe University, Awka, Nigeria

ABSTRACT

The study examined the impact of the constraint factors on building projects delivery in Enugu State, Nigeria and suggested possible ways to mitigate the impact in order to deliver successful sustainable building in the state. Nine local government areas (three each from the three senatorial zones of the state) were sampled based on urbanization and population of inhabitants in the area. A total of four hundred (400) questionnaires were distributed to stakeholders in the built environment while three hundred and forty-four (344) representing 86.0% of the respondents were returned and used for the analysis. The data was analyzed using common size percentage analysis, mean score using five-point Likert rating scale, severity index/ranking, regression and correlation analysis. The results show that Database for building projects and streamline procedure to implement sustainability of building projects ranked first among the factor variables with mean score of 4.69 and severity index of 93.7% followed by un-built areas as indicated in the site plans need further landscape deign to achieve sustainable development. The least in the ranking was inadequate provision for protection of existing and future environmental issues in the master plan for proper enforcement. The work concluded that the sustainable development concepts applied to design, construction operation and maintenance with whole life assessment of buildings can enhance the economic welfare, environmental health and social well-being of communities in Enugu state. The study recommended the creation of database for sustainable building projects, articulation of strategies by liaison with existing agencies/stakeholders and legislation to back up all the recommendations for proper enforcement.

Keywords: Sustainable buildings, sustainable design and construction, impact factor variable, sustainability.

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1.0 INTRODUCTION

Construction is one of the largest industries in both developing and developed countries in terms of investment, employment and contribution to Gross Domestic Product (GDP) of any Nation. Its impact on the environment is considerable particularly in areas of energy use, soil degradation, loss of agricultural land, forests and wild lands, air and water pollution, and depletion of non-renewable energy sources and minerals (Ametepy, Ansah and Gyadu-Asiedu, 2020). The construction industry accounts directly and indirectly for nearly forty percent (40%) of material flow entering the world economy (Clement, Cheng and Hong, 2018); and in developing countries for around fifty percent (50%) of the total energy consumption (Ametepy*et al.*, 2020; Ibrahim and Price, 2005).

Aluko (2011) stated that, in Nigeria, many laws and regulations were enunciated at Federal, State and Local government levels for proper planning of the environment and building design architecture without integration of sustainability concepts. Most of the building projects are not sustainable which portends danger to the environment by degrading the natural design architecture. Although the principal indicators for sustainable development are not integrated at the planning stage for most building projects, their execution also lack proper monitoring by the policy makers (Udegbunam, Agbazue, and Ngang, 2017). These led to poor implementation during construction which drastically affects our living environment. Broman and Roberts (2017) assert that it is important to minimize the consumption because as material is consumed its chances for future use are diminishing; hence, its potential utility to future generation is lost. Embracing green or sustainable concept in design is aimed at reducing energy consumptions, operation and maintenance cost, reduce building related illness, increase the productivity and comfort of building occupants, reduce waste and pollution, increase building and component durability and flexibility. There is the need to integrate these at early stages of building, planning and construction process. However, sustainable development for building project delivery needs time, understanding, acceptance, adjustment and implementation. These can be achieved through awareness/commitment both on the part of individuals, community and professionals.

The transformation of sustainable construction policy into project level practice, are the non-technological institutional processes, which are dependent upon the industry structure, communication channels and the organization and strategic orientation of its constituent actors (Rohracher, 2001). The uptake and implementation of sustainable construction requires decision processes that are integrated across various project level interfaces demarcated by different phase of the construction life cycle. However, the challenging task may stem from the fragmented nature and complexity of the construction sector (Myers, 2005), the multi-dimensional nature of sustainable construction, the lack of a structured methodology and lack of information at various hierarchical levels (Ugwu and Haupt, 2007).

Nigeria, like other developing countries has phenomenally uncontrolled population growth with a corresponding increase in urban population and high rate of urbanization. The projected population of Nigeria as at March, 2023 is 233,859,823 based on the last 2006 census figure of 140,431,790

compared to 53.3 million in 1968. Also, the Nigerian urban population as a share of total population as at 2017 is 49.5 % from 17.5 % in 1968 with a population density of 215.1 (person per square km). The age distribution 0 – 14 years is 43.8 percent, 15 – 64-year 53.3 percent and ages 65 and above is 2.8 percent (Knoema, 2019). This gap in sustainable planning and development of building projects in Nigeria is synonymous to Enugu state of South-Eastern geo-political area of Nigeria. For example, the Nigeria population density as at 2006 is 460/Km^2 (NPC, 2006) while Enugu State has a population density of 1300/km^2 (National Population Commission (NPC), 2006). Enugu State population was projected to be 5,441,901 as at March 2023 (National Bureau of Statistics (NBS), 2023). The high rate of population growth and urbanization have plagued our cities especially in the study areas as a result of unplanned and uncontrolled development, inadequate public infrastructure and services, rising urban air and noise pollution, expanding slums and squatters settlement with chronic shortages of accommodation for residential, industrial, agro-allied/agricultural, mining, commercial and other allied activities. These are strategic social and economic factors that affect building projects delivery in Enugu state.

The government has introduced additional planning documents like the environmental impact assessment report, and site analysis report which have not improved the situation while the construction programme, quality management plan, health and safety plan, conditions survey report for maintenance projects, building maintenance manual and as built drawings have not been incorporated to strengthen the production process. There are lots of conflicting interests by professionals in the built environment which have not been harmonized for efficient sustainable building projects delivery. It is against this backdrop that the study encapsulates a holistic investigation into impact of constraint factors to sustainable building projects in order to reduce the effect towards achievement of sustainable building project delivery in Enugu state, South East of Nigeria.

2.0 Literature Review

2.1 Concept of Green and Sustainable Buildings

The term “green” and “sustainable” design is often used interchangeably though there are shades of meaning implied by each. The concept of Green buildings or sustainable buildings is not alien. What is new is the realization that green approach to the built environment involves a holistic approach to the design of buildings so that all the resources that go into a building, be they materials, fuels or the contribution of the users need are to be considered if sustainable architecture is to be produced (Brenda and Vale, 2006). In Nigeria some buildings embody one of the various verifiable characteristics of green design but, buildings with holistic approach are yet to be seen. Sustainable development encompasses challenge of meeting growing human needs for natural resources, industrial products, energy, food, transportation and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future

life and development. This concept recognizes that meeting long term human needs will be impossible unless we also conserve the earth's natural, physical and chemical system (Mustapha and Adem, 2015). There is no doubt that sustainable development concepts, applied to design, construction and operation of buildings can enhance both the economic welfare and environmental health of communities in Enugu State and Nigeria in general.

This is more apt in this era of climate change when sustainable development emerged most strongly in the environmental context. However, the evolution of the concept in the 1990's to encompass the economic, social and environmental points of view made the concept a driving force. The economic point deals with growth, efficiency and stability. The social aspect is concerned with poverty, cultural heritage and empowerment while the environmental aspect deals with biodiversity/resilience, natural resources and pollution (Nwafor, 2006). Mustapha and Adem (2015) opined that the decision made at the first phase of building design and construction can significantly affect the costs and efficiencies of other phases as recent studies have shown that green building measures taken during construction or renovation can result in significant building operation savings, as well as increases in employee productivity.

Otegbulu (2011) surmises that, flooding and loss of property arises from lack of green and sustainable design. Also, that due to poor electricity supply, households resort to informal power supply which contributes to global warming. It is critically important to get these processes right in order to deliver a sustainable building. Planning process is believed to be the strategic position to integrate sustainability considerations in order to have the most sustainable effect on the overall project (Reyes et al., 2014; Wu and Low, 2010; Hayles, 2004).

2.2 Impact of Constraint to Sustainable Buildings

Sustainable construction has to take place by understanding the political, economic social and developmental issues of a place, and that sustainable construction then becomes an integral part of sustainable development. Sustainable construction has not received sufficient attention in Nigeria even though it is an important aspect of sustainable development. The critical issue surrounding our construction activities is that construction systems have long been modeled on the experience of the developed world (Adindu, Musa, Nwajagu, Yusuf and Yisa, 2020 cited in Taylor and Norwal, 1994). They contend that it has been assumed historically that norms and systems arising from a particular set of experiences in the developed world can be readily adopted by developing countries. The implication is that this type of thinking typified the stage of economic growth, whereby the economic emergencies of nations were hypothesized to be consistently and universally similar, thus ignoring national circumstances, value systems or current priorities. This is inappropriate where principles of the developed world have been applied without modification in our construction environment with its diversity of problems. The issues of conflicts and wars, and pandemics that have implication for sustainable construction have become another perspective of the debate around sustainability in our development setting (Adebayo, 2000).

Most construction activities impact on the built environment and these projects focus on the economics angle, and negate the aspects of quality of environment, preservation of green architecture, water and sanitations etc. There are other pertinent issues such as infrastructure and services provision, energy and water as constant requirements for the success of the construction sector. The intensive consumption of these by the construction industry and their perpetual shortage result to waste disposal on construction sites disposal of byproducts of construction materials as well as unused building materials which become an environmental concern.

A favourable result in the future is achievable if the planning bridges the gap between the experience of the past and proposed action; reducing undesirable effects or unexpected happenings by eliminating confusion, wastes effect and loss of efficiency; and reaching the desired goals by determining and specifying factors, forces, effects and relationship to proposed actions. The process of planning has a significant impact on the success of a construction project (Hamilton and Gibson, 1996). The level of effort during the detailed design, construction and completion phase of the project determines the project success (Gibson and Gebken, 2003; Dumont, Gibson and Fish, 1997).

3.0 Methodology

The research study adopted a descriptive survey design approach. This is to prevent ambiguity and inconsistency in responses. The descriptive survey approach describes the characteristics of existing situation and provides insight into the research problems by describing the variables of interest in order to achieve the aim and objectives of this research study (Mugenda and Mugenda, 2003). The population of Enugu State was projected to be 5,441,900 as at 2023 based on the last census of 2006. The sample study was carried out from Nine local government areas which comprise Awgu, Enugu East, Enugu North, Enugu South, Igbo Etiti, Igboeze North, Nsukka, Oji River, and Udi of the state with a total projection population of 3,672,971 as at 2023 (NBS 2023). The study adopted the stratified random sampling techniques. This is because different disciplines of registered professionals were sampled who had varied knowledge, experience, exposure and interest based on their occupation. Sixty percent (60 %) of the sample was randomly selected using a sample frame while forty percent (40 %) was randomly selected from each of the professional disciplines in the built environment.

Nine local government areas (three each from the three senatorial zones of the state) were sampled based on urbanization and population of inhabitants in the area. A total of four hundred (400) questionnaires were distributed to stakeholders in the built environment while three hundred and forty four (344) representing 86.0% of the respondents were returned and used for the analysis (See table 1). The primary data was collected through questionnaires while secondary data was obtained from journals, textbooks, seminar papers and occasional publications. The data was analyzed using common size percentage analysis, mean score using five point likert rating scale, severity index/ranking, regression and correlation analysis. The sample population for the study comprised prospective estate developers, stakeholders in the built environment in both public and private sectors.

4.0 Results and Discussion

Results:

4.1. Analysis of Questionnaire Distributed and Category of Respondents

Table 1: Questionnaire Distributed and Retrieved

S/N	Senatorial Zone	Number distributed		Number Retrieved		Number not returned	Percentage not returned (%)
			%		%		
A	Enugu East Senatorial Zone						
(i).	Enugu North LGA	54	13.5	49	90.7	5	9.3
(ii).	Enugu East LGA	53	13.25	43	81.1	10	18.9
(iii).	Enugu South LGA	53	13.25	45	84.9	8	15.1
B	Enugu West Senatorial Zone						
(i).	Oji River LGA	40	10	32	80.0	8	20.0
(ii).	Udi Local Government Area	40	10	35	87.5	5	12.5
(iii).	Awgu LGA	40	10	33	82.5	7	17.5
C	Enugu North Senatorial Zone						
(i).	Nsukka LGA	40	10	36	90.0	4	10.0
(ii).	Igbo-Eze North LGA	40	10	34	85.0	6	15.0
(iii).	Igbo-Etiti LGA	40	10	37	92.5	3	7.5
Total		**400**	**100**	**344**	**86.0**	**56**	**14.0**

Source: Researcher Field Survey Report (2022)

From Table 1, a total of four hundred questionnaires were distributed to the respondents in the area of study. The selected local government areas and senatorial zones were shown in Table 1 indicated the questionnaires distributed and their percentages according to the various local governments in the sample survey. The total number retrieved/not retrieved and their respective percentages were also shown in Table 1. A total number of three hundred and forty-four (344) questionnaires were retrieved representing eighty six percent (86%) of the total number administered to respondents.

Table 2: Category of Respondents

S/N	**Characteristics**	**Frequency**	**Percentage (%)**
(a).	Construction Professionals		
(i).	Builders	22	6.4
(ii).	Architects	36	10.5
(iii).	Quantity Surveyors	18	5.2
(iv).	Land Surveyor	9	2.6
(v).	Estate Surveyor	16	4.7
(vi).	Town Planners	27	7.8

(vii).	Geography and Meteorologists	14	4.1
(viii).	Environmental Engineers/Managers	12	3.5
(ix).	Engineers		
	Civil/Structural Engineers	25	7.3
	Electrical Engineers	12	3.5
	Mechanical Engineers	10	2.9
	Geotechnical Engineers	6	1.7
	Total	**207**	**60.2**
(b).	Building and Civil Engineering Contractors	21	6.7
(c).	Manufacturers and suppliers of Building Materials/Products	62	18.0
(d).	Others	54	15.7
	Total	**344**	**100**

Source: Researcher Field Survey Report (2022)

In Table 2, the Category of Respondents includes all professionals in the built environment in order to benefit from their expertise on perspective of sustainable building projects delivery in Enugu State. A total of two hundred and seven (207) professionals in the built environment responses were retrieved which represents 60.2% of the respondents. The Building and Civil Engineering Contractors were twenty-one (21), representing 6.7% of the respondents. The total number of respondents for Manufactures and Suppliers of Building Materials/Products were sixty-two (62) representing 18.0% of the respondents and others which include Policy Makers, interest groups, developers etc. have a total number of fifty-four (54) respondents representing 15.7%.

4.2 Analysis of Impact Constraint Factors in the Study Area

The impact of constraint factors on sustainable building projects delivery in Enugu state were analyzed from the fifteen (15) identified impacts using the five point likert scale responses from the respondents as stated in Table 3.

The decision rule is that any of the variables with the weighted mean score of less than 3.25 or severity index of less than 65% from the results of the responses from the respondents is not considered as a major impact on the constraint factors.

Table 3: Perception of Respondents on Impacts of Constraint Factors to Sustainable Building Project Delivery

S/N	Item	SD	DA	UD	A	SA	$\sum Fx$	mean	S.I %	Rank
1.	High cost of land acquisition and obtaining certificate of occupancy	–	–	32	198	114	1458	4.24	84.8	9th
2.	Multiple payment of development levies	–	–	13	186	145	1502	4.38	87.7	8th

3.	ESWAMA levy for new projects where no disposal facilities are provided.	–	12	64	164	104	1392	4.05	80.9	11th
4,	Lack of monitoring the implementation of approved development plans during construction.	–	–	49	172	123	1450	4.22	84.3	10th
5.	Interference of local communities by collection of arbitrary levies during construction.	–	–	80	178	86	1382	4.02	80.3	12th
6.	Long period of development approval process up to one year or more.	–	11	18	114	201	1537	4.47	89.4	6th
7.	Inadequate provision for protection of existing and future environmental issues in the master plan for proper enforcement.	–	20	84	148	92	1344	3.91	78.1	13th
8.	Lack of controlled development and adherence to planning rules and regulations.	–	10	81	184	69	1344	3.91	78.1	13th
9.	Unbuilt areas as indicated in site plans need further landscape design to achieve sustainable development.	–	–	19	80	245	1602	4.66	93.1	2nd
10.	Lack of physical infrastructure e.g. standard access roads, electricity supply and water supply on existing layouts or Estates in sustainable manner.	–	–	16	122	206	1566	4.55	91.0	5th
11.	Data base for building projects and streamline procedure to implement sustainability of building projects.	–	–	–	108	236	1612	4.69	93.7	1st
12.	Lack of standard layout plan with physical, industrial functional facilities.	–	–	14	119	21	1573	4.59	91.5	3rd
13.	Blocking of drainage facilities where they existed and construction of non-existing ones on roads infrastructure.	–	–	–	146	198	1574	4.58	91.5	4th
14.	Correction of imbalance in providing housing demand for medium and low income group with the projection for future population of the cities.	–	–	4	184	156	1528	4.44	88.8	7th
15.	Proper disciplines on land use facilities and continuity in government with master plans etc.	–	–	29	212	103	1450	4.22	84.3	10th
							Grand Mean	**4.33**	**86.6**	

Source: Researcher Field Survey Report (2022)

The information in Table 3 indicates that, the highest mean score value of 4.69 and severity index of 93.7% is on "Data base for building projects and streamline procedure to implement sustainability of building projects". The next in the ranking is "unbuilt areas as indicated in the site plans need further landscape design to achieve sustainable development" with mean score

value of 4.66 and severity index of 93.1%. The third in the ranking is "lack of standard layout plan with physical infrastructural functional facilities with mean score of 4.59 severity index of 91.5%. This is followed by "blocking of drainage facilities where they exist and lack of drainage facilities on roads infrastructures" with mean score of 4.58 severity index of 91.5%. The least is the mean score values of 3.91 and severity index of 78.1% on the impact of constraint factors are "inadequate provision for protection of existing and future environmental issues in the master plan of the study area for proper enforcement" and "lack of controlled development and adherence to planning rules and regulations". All impact factors were above mean of 3.25 and severity index of 65.0%. Therefore, are considered as major impact on the constraint factors. The grand mean score of 4.33 and severity index of 86.6% indicated that all the variable factors have considerable impact on the constraint factors to sustainable building projects delivery in Enugu State.

4.3. Analysis of the Regression Function on the Information in Table 3

The mean score ratings were plotted against the impact variables on Table 3 to determine the regression functions in a graph as shown in Figure 1.

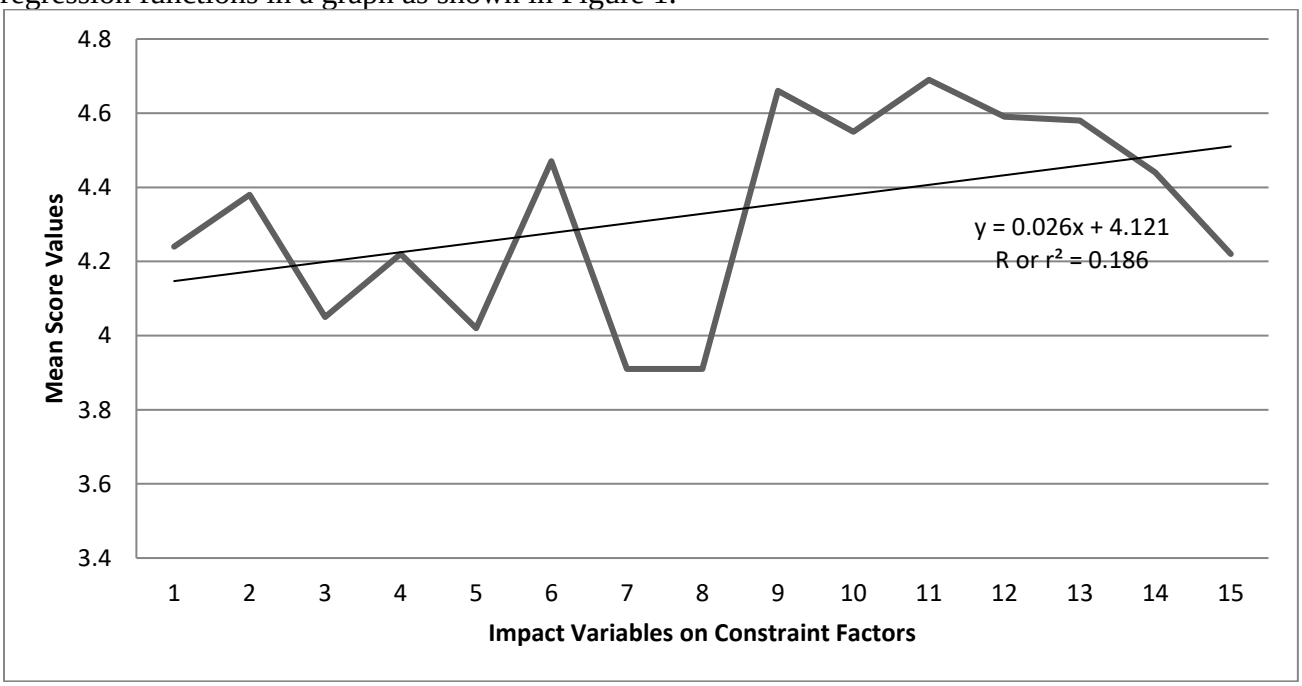

Figure 1: Mean Score Values against Impact on Constraint Factors

In Figure 1, the graph of the regression functions of Mean Score values against the Impact Variables on Constraint Factors to sustainable building projects delivery is a linear relationship which showed the line of best fit at Y = 0.026x + 4.121. The estimation of the graphical function for the coefficient of determination (R or r^2) = 0.186. The coefficient of correlation is the positive square root of the coefficient of determination r = $\sqrt{R} = \sqrt{0.186}$ = 0.4313. The results show that the total variation in the values of mean score ratings is explained by the variation in impact on constraint factors variables. The critical value of coefficient of correlation (r_c) at 0.1 level of

significance and degree of freedom (d_f) = 28 is 0.2407. This implies that since the critical value of the coefficient of correlation (r) = 0.2407 is less than the computed value of r = 0.4313, the impacts on constraints factors hamper sustainable building projects delivery in the study area.

5.0 CONCLUSION AND RECOMMENDATION

Based on the findings, we made the following conclusion and recommendations:

i. Sustainable building projects development delivery entails challenge of meeting growing human needs for natural resources, industrial products, embodied energy savings, food transportation and effective waste management while conserving and protecting environmental quality and natural resource base essential for present, and future life with well-articulated development policy and strategy. The sustainable development concepts applied to design, construction, operation and maintenance with whole life assessment of buildings can enhance the economic welfare, environmental health and social well-being of communities in Enugu State. This is apt in this era of climate change when sustainable development emerged most strongly in the environmental, economic and social points of view which made the concept a driving force.
ii. Re-orientation of building type concept to tend more to solving the housing needs of low- and medium-income group by introducing condominium with sustainable design innovations in some building estates in the state.
iii. Create database for sustainable building projects delivery and liaise with existing agencies on building projects development for articulation of strategies for successful sustainable building projects in the state.
iv. The government should have a legislation to back up all the proposals recommended for proper enforcement.

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About the Authors

Anthony Nnamdi Ezemerihe

Enugu, Nigeria

Ezemerihe, Anthony Nnamdi holds a bachelor's degree in Building from Enugu University of Science and Technology Enugu, Nigeria, Higher National Diploma in Building Technology and Quantity Surveying from Institute of Management and Technology (IMT) Enugu, Nigeria. Postgraduate Diploma (PGD) and Master of Business Administration (MBA) in Banking and Finance from Anambra State University of Technology (ASUTECH) Enugu. A master of Science (M.Sc) degree in Construction Management from Nnamdi Azikiwe University (NAU) Awka, Nigeria and he is presently rounding up his Doctorate degree in Construction Management at NAU, Awka. He is a registered Builder and Corporate member Nigerian Institute of Building (MNIOB), Nigerian Institute of Quantity Surveyors, Nigerian Institute of Management (MNIM), Nigerian Environmental Society (MNES) and passed with overall result A in Public Service Examination (PSE) from the Administrative Staff college of Nigeria (ASCON). He also obtained Doctor of philosophy (Critical and Creative Thinking) Ph.D. (CACT) (Honouris Causa) from Montclair State University, Upper Montclair New Jersey, USA. Ezemerihe Anthony Nnamdi can be contacted at ecatonia2008@yahoo.com

Prof. Kevin Chuks Okolie

Anambra State, Nigeria

Prof. Kevin Chuks Okolie holds a Doctor of Philosophy Degree in Construction Management from Nelson Mandela Metropolitan University, Port Elizabeth South Africa. His research interest lies in the development of Building Performance Evaluation Methodology, Health and Safety Management and Built Asset Management Systems. His published papers and articles on Construction and Facilities Management have appeared in many international conferences and peer reviewed journals. Prof Okolie can be contacted at kc.okolie@unizik.edu.ng

Dr Dominic Anosike Obodoh

Anambra State, Nigeria

Dr Dominic Anosike Obodoh is a Senior Lecturer in the Department of Building, Nnamdi Azikiwe University, Awka Nigeria. He holds PhD in Project Management Technology, M.Eng Civil Engineering (Structural Engineering), M.Sc Construction Management and B.Sc Building. He is a Registered Builder and a Project Management Consultant. Dr D.A. Obodoh has published many articles in reputable journals in and outside Nigeria. He has supervised many students' projects in both undergraduate and postgraduate levels. He hails from Eke in Udi Local Government Area of Enugu State, Nigeria and is happily married with children. Dr. Obodoh can be contacted at da.obodoh@unizik.edu.ng