International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 7 Issue 4, July-August 2023 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Evaluating the Benefits of Cost-Efficiency to Sustainable Building Project Delivery in Awka, Anambra State, Nigeria

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ABSTRACT

The study aimed to evaluate the benefits of cost-efficiency in sustainable building project delivery in Nigeria, specifically in Awka Anambra State. It used primary and secondary data, with 86 questionnaires and only 47 valid responses, percentage rating and relative importance index (RII) was adopted and used for analysing data. The study found that sustainable cost-efficiency could be evaluated early in design through value-engineering exercises, with (RII=.085). Poor knowledge and construction methodology were rated as the highest barriers to sustainable building and cost efficiency, with (RII=0.85). Life cycle costing could be a valuable method for achieving cost-efficiency in sustainable building projects, with (RII=0.81). Benefits of cost-efficiency of sustainable building could be achieved by better integration of all relevant professional from inception, design stage, construction stage and throughout the lifecycle of a project, with (RII=0.87). Further studies are suggested to complement the impact of this study and investigate the challenges to implementation of cost-efficiency in sustainable lifecycle costing of building projects.

KEYWORDS: *Sustainability, Cost-Efficiency, Lifecycle Costing*

How to cite this paper: Nwoyiri C. S. | Dr. Ngwu C. "Evaluating the Benefits of Cost-Efficiency to Sustainable Building Project Delivery in Awka, Anambra State, Nigeria" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-7 | Issue-4, August 2023, pp.725-735, URL: www.ijtsrd.com/papers/ijtsrd59767.pdf

IJTSRD59767

I. INTRODUCTION

The United Nations General Assembly defines sustainability as meeting the basic needs of the public and extending opportunities for a better life without compromising the ability of future generations to meet their own needs. Construction is a rapidly growing industry that contributes to 5-10% of GDP in all countries, employs up to 10% of the working population, and accounts for about half of the gross fixed capital formation. In developing economies with high unemployment rates, the construction industry employs many unemployed individuals due to labour-intensive practices. Agenda 21 for sustainable construction serves as the foundation for determining sustainability in the construction industry. It aims to create a global framework and terminology that adds value to national and regional Agendas, and to provide a source document for defining R&D activities related to sustainable construction. Sustainable buildings that meet acceptable performance requirements enhance national asset stock and Gross Domestic Product. Sustainable construction focuses on reducing the negative impact on the natural environment and includes economic, social, and cultural heritage.

Sustainable construction is one of the greatest challenges we face to mitigate the detrimental effects of climate change. Nigeria must implement sustainable development principles in the built environment to reduce the housing deficit and reduce carbon emissions. Design decisions require choice of construction structure, materials, and installations, often accompanied by errors in investment due to inadequate economic control. Rising energy costs offer opportunities for overall savings in the life of a building, which can be achieved by investing in more energy-efficient solutions and using building finishes that do not require frequent re-painting.

Life cycle costing analysis (LCCA) plays significant roles in the economics of a building project. The commonly used construction cost minimization approach should be replaced with life cycle costs

optimization. LCCA is an effective implementation of life cycle costing in construction projects, focusing on thoughtful design, construction practices, and environmental considerations. It highlights the opportunity for overall saving in building life by investing in more cost-efficient solutions initially. The lowest life cycle cost alternative is the best option, as it provides a new economic view on building design. Life cycle costing (LCC) should be an inseparable part of decision making on financially expensive investments, such as construction projects. Monali Dhaware, AjinkyasinghMarod, Shantini Bokil 2018 emphasizes the importance of optimizing life cycle costs for a project, construction, or equipment to gain maximum value for money. The optimization of life cycle costs is essential for the complex decision-making process, and LCCA is an important tool for achieving cost efficiency in construction projects. The aim of this paper is to evaluate the benefits of cost-efficiency to sustainable project delivery in Awka, Anambra State, Nigeria construction sector.

II. LITERATURE REVIEW

Sustainable construction practices are increasingly important as construction contributes to 5-10% of GDP worldwide. Agenda 21 for sustainable construction aims to create a global framework and terminology to improve the performance of the construction industry. The concept of sustainability in building construction aims to promote efficiency and reduce financial costs. Life cycle costing (LCC) helps monitor cost performance over a building's economic life span, providing the best value from a whole life perspective.

Sustainability is a crucial issue to consider in the design stage, not only due to environmental concerns but also economic and social issues. Building construction cost-efficiency can be achieved by using common, readily available components, using products with high recycled content, selecting building materials that require little maintenance, and ensuring access points are easily identified and locatable.

The cost of demolition and material recovery is rarely considered in new building designs, but adopting appropriate processes to protect materials from destructive elements is crucial. Adaptive reuse of existing projects significantly reduces waste and conserves energy used for material manufacturing and construction. In a sustainable design project, the design team conducts a tradeoff exercise, trading off optional features for those that result in energy, environmental, or social improvements. Focusing on integrated solutions and explicitly evaluating tradeoffs can result in a sustainable facility built for the same or lower cost as a traditional building.

This research explores literature on sustainable building construction delivery using life cycle costing as a tool to assess the benefit and importance of cost-efficiency in sustainable building projects. While some research has argued that sustainable construction costs more than conventional buildings, life cycle costing has proven to be the best alternative way to assess and achieve good cost-efficiency or low-cost building projects within their lifetime period, payback period, lower operating costs, and minimal maintenance costs.

2.1. SUSTAINABILITY:

Sustainability is the use of natural resources in an equilibrium condition to prevent decay, depletion, and not renewable, ensuring the continuity of human beings and natural resources for future generations. It encompasses various fields, including global development policy, energy sources, production planning, and architectural design. Green building practices can significantly reduce environmental impacts and improve existing unsustainable design, construction, and operational practices. These practices reduce operating costs, increase marketability, worker productivity, and potential liability from indoor air quality problems. A well-managed sustainable building follows rules, codes, and innovative ideas to create a user-friendly and environmentally friendly system. By following these guidelines, a building can demonstrate a commitment to sustainability and contribute to a more sustainable future.

2.2. ENVIRONMENTAL SUSTAINABILITY:

Environmental sustainability aims to provide a better world for future generations by protecting ecological balance and natural systems from destruction. It has evolved over time to include economic aspects. Environmental issues like greenhouse gas emissions, global warming, ozone layer depletion, and biodiversity have reached global dimensions due to unbalanced production and consumption policies. Environmental sustainability requires sensitivity in protecting life, biodiversity, life-support systems, sustainable use of renewable resources, resource conservation, environmental minimization, and cultural and historical environments.

2.3. ECONOMIC SUSTAINABILITY:

The modern economic development model assumes that increasing market activity leads to increased purchasing power, contributing to a higher Gross National Product (GNP). However, this model relies on limitless production and consumption, which are limited and decreasing due to excessive usage. Sustainable economic development requires creating new markets, reducing costs through efficiency, and

providing added value. This involves steady public and private investment, efficient resource usage, and social criteria for assessing economic efficiency.

2.4. SOCIAL SUSTAINABILITY:

Social Sustainability focuses on basic rights and freedoms related to human existence, aiming to ensure equality and balance among generations. This involves providing long-term basic requirements like work, housing, health, education, and cultural activities, increasing life quality, reintegrating disabled groups, and protecting the right to life of future generations. Strategies like HKU Architecture's 2002 strategies aim to achieve these goals.

2.5. THE SUSTAINABLE CONSTRUCTION AS THE ELEMENT OF THE CONSTRUCTION IMPORTANCE TO THE ECONOMY:

The European Union has emphasized the importance of the construction industry in the economy, recognizing it as one of six leading markets with great development potential. The global construction industry has made significant progress in recent decades, driven by technology and innovations. However, Africa and Nigeria face numerous challenges due to demographic changes, climate change, globalization, and declining natural resources. The industry's new objective is to develop sustainability, focusing on three areas: environment, society, and economy. The construction industry contributes 42% of final energy consumption in the EU, 35% of greenhouse gas emissions, and significant consumption of raw materials. Industry also significantly impacts the quality of life, with the average citizen spending 80% of their life inside buildings. In the European Union, the construction industry generates 10% of GDP and employs 7% of the workforce. The sustainable construction policy aims to reduce power consumption and strengthen existing solutions by involving the public and private sectors in low-energy and zero-energy homes and promoting sustainable solutions while considering optimal cost.

2.6. SUSTAINABILITY IN CONSTRUCTION SECTOR:

Charles Atombo1, *, Joseph Cudjoe Kwedza Dzantor, Aaron Agbenyegah Agbo3 2015 highlights the environmental impact of buildings on climate change, air and water quality, and solid waste in cities. Buildings consume significant amounts of energy and natural resources, affecting the quality of air and water. To address these issues, it is crucial to consider environmental, social, and economic aspects, their synergies, and the inevitable balances between them. Sustainability aims to create better-built environments for human lives, addressing the challenges faced by construction and infrastructure.

2.7. SUSTAINABLE DEVELOPMENT STRATEGIES:

IUCN, 1991; UNEP 2011; WWF, 1991; Sev, 2009 highlights the importance of sustainable development strategies in advanced countries. These strategies aim to increase human life quality, protect biodiversity, decrease unrenewable resource consumption, maintain Earth's bearing capacity, change individual behaviors, and show respect to the environment. However, not all countries prioritize sustainability, requiring a responsible approach to the environment, public and private sector awareness, and a common understanding of society. By implementing these principles, countries can create a more sustainable and resilient future for their buildings.

2.8. SUSTAINABLE CONSTRUCTION:

The construction industry is crucial for sustainable development due to its environmental and socio-economic impact. The Sustainable Construction (SC) concept aims to improve the environment, energy efficiency, and care for future generations. However, practical matters, such as macroeconomic environmental sustainability, remain insufficiently explored. Kibert's concept of sustainable construction focuses on the intersection of principles and stages, offering positive economic growth through job creation, competitive advantage, and cost savings. Paula Pypłacz, OhiomahIfije, Marina Erbanova, and Pavel Konev 2020 emphasize the importance of SC in achieving sustainable development goals.

2.9. SUSTAINABLE CONSTRUCTION INDUSTRY IN GLOBAL SCALE:

The construction sector's decarbonization is crucial for achieving the Paris Agreement commitment and the United Nations Sustainable Developments Goals (SDGs). The 2018 Global Status Report on buildings and construction revealed that 136 countries have mentioned buildings in their New Developments Goals (NDCs). To reduce emissions, nations must prioritize actions such as switching to renewable energy sources, improving building design, and using nature-based solutions. The EU and USA public opinion have revived green buildings in many countries, requiring energy consumption reduction measures through the "Energy Performance of Buildings Directive" (ISO, 2010).

2.10. SUSTAINABLE DEVELOPMENT, SUSTAINABILITY AND CONSTRUCTION:

Sustainable development and construction responsiveness are intertwined, aiming to meet the needs of present generations without compromising

future generations' ability to meet their own needs. This approach ensures a better quality of life for everyone, now and for generations to come. The global escalation of construction responsiveness and awareness is crucial for achieving sustainable development and construction responsiveness.

2.11. COST EFFICIENCY:

The construction industry faces a high amount of cash flow, requiring a focus on cost efficiency to thrive in global market competitions and profit margin compression. To achieve cost efficiency, a systematic appraisal of energy efficiency investments is essential for most economical projects. Savings on operating and maintenance costs can be achieved through using building finishes that do not need frequent re-painting. Life cycle costing analysis (LCCA) plays a significant role in achieving these objectives, as it predicts building costs from operation, maintenance, and replacement until the end of its lifetime. The effective implementation of LCCA involves a thoughtful, comprehensive design, construction practices, and environmental considerations. Optimizing the life cycle cost (LCC) of a project, construction, or equipment is crucial for the complex decision-making process, allowing for the selection of the solution with the minimum value of LCC. Life cycle cost (LCC) is an important tool for achieving cost efficiency in construction projects.

2.12. LIFE CYCLE COSTING:

Life cycle costing (LCC) evaluates the cost performance of a building throughout its life cycle, including acquisition, development, operation, management, repair, disposal, and decommissioning. It includes costs for construction, operation, maintenance, and end-of-life, as well as externalities, non-construction costs, and income. LCC helps compare costs among different investment scenarios, designs, and specifications. Sustainability development, which aims to ensure the environment is sustainable for future generations, has been advocated in recent years. LCC is applied in the building and construction industry to quantify costs of whole buildings, systems, and components and materials. Decision-makers in large construction projects often focus on initial costs, neglecting future costs. To improve long-term decision-making, life cycle cost analysis is crucial. The LCC method considers initial, operation, energy, maintenance, repair, and residual value to estimate cost effectively.

2.13. BARRIER OF LIFE CYCLE COST IN NIGERIAN CONSTRUCTION INDUSTRY:

Green buildings in Nigeria are more complex than traditional buildings due to their use of more technologies and materials with less environmental impact. However, the implementation of life cycle costing (LCC) in the Nigerian construction industry faces several barriers, including lack of quality data, unstable economic climate, and government policy. The fragmented nature of the construction industry, bureaucratic structures, and separation of capital and running costs further restrict the application of LCC. Additionally, the practice of accepting the cheapest tender and handover without interest in its future beyond the defect's liability period is due to the lack of a clear definition of buyer and seller responsibilities. To better incorporate LCC into public procurement budgeting, widespread reforms of public expenditure are required.

III. METHODOLOGY

This research was carried out in Awka, Anambra State, Nigeria using a survey method. The population of the study is 109 comprises Quantity Surveyors, Builders, Architects, Engineers, (drawn from the Ministries, Housing and Urban Renewal, Ministry of Housing, Anambra State Housing Development Cooperation, Awka Capital Development Authority, Anambra State Physical Planning Board, Nigerian Institute of Quantity Surveyors Cooperate Members, Anambra State Chapter and Six Private Construction Companies) who have practical experience in construction at least five years.

The sample size was calculated using Taro Yamane's formula as shown in equation 1.

$$n = \frac{N}{1 + N(e^2)}$$

n = sample
N = population size
e = error limit

(Using the foregoing population of professional personnels in Government agencies, professional institution, and construction companies in Awka Anambra state)

N=109

e=0.05

$$n = \frac{109}{1 + 109(0.05^2)}$$

$$n = \frac{109}{1 + (0.2725)}$$

n= 85.65

n= 86

Being survey research, data were collected through structured questionnaire administered to the selected respondents or their representatives. Relative

importance index (RII) and mean scores were used for ranking, while the results were presented in Tables. The tools used for data analysis are Microsoft excel, Mean score using Likert scale of four (4) points, percentage, and relative importance index to determine the premium placed on each variable. The mean score and relative importance index (RII) were calculated using the formula.

Like Scale of 1,2,3,4

Where
n_1= number of respondents who answered not significant.
n_2=number of respondents who answered less significant.
n_3= number of respondents who answered significant.
n_4=number of respondents who answered very significant.

Relative Importance Index (RII)

$$RII = \frac{\sum W}{A*N}$$

Where
W= the weight assigned to each strategy by the respondents.
A= highest weight (which is 4 in this study)
N= the total number of respondents.

The limits of definition of RII were 0≤0.25 =strongly disagree, 0≤0.50= disagree, 0≤0.75= Agree, 0≤1.00= strongly agree. The RII value ranges from 0 to 1 with 0 not inclusive. It shows that the higher the value of RII, the more important the variables are and vice versa. The comparison of RII with the corresponding importance level is measured from the transformation matrix as proposed by (Chen et al. 2010 cited in Waris et al, 2014). According to him, derived importance levels from RII are as follows:

High (H) 0.8 < RII < 1.0

High-Medium (H-M) 0.6 < RII < 0.8

Medium (M) 0.4 < RII < 0.6

Medium-Low (M-L) 0.2 < RII < 0.4

Low (L) 0.0 < RII < 0.2

IV. RESULTS AND DISCUSSION

Table 1 Questionnaire administration and response rate

DESCRIPTION	TOTAL	PERCENTAGE %
Questionnaire set out	86	100
Questionnaire received	47	54.65
Questionnaire not received	39	45.35

Source from: field study, 2023

Table 1 shows that 86 questionnaires were distributed to target respondents using purposive sampling. Out of these, 47 were completed and returned, resulting in a 55% response rate. This medium-high response rate was due to the use of Google Forms. The remaining questionnaires were not returned, with some respondents stating no reason or being occupied.

Table 2 Objective Nr 1: Evaluating costs efficiency of sustainable building construction in Awka, Anambra State, Nigeria by respondents.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Alternative design solutions	19	21	4	3	0.80	3RD	High
2	Selecting materials, components or techniques that result in a lower net present value	13	20	10	4	0.72	5TH	High-medium
3	Focusing on value rather than the cost in relation to the function	16	16	11	4	0.73	4TH	High-medium
4	At the early stage of design and critically looking at crucial design features by value-engineering exercise	27	15	1	4	0.85	2ND	High
5	Sustainable building feature that promotes better health, comfort, well-being and productivity of both occupants and workers.	33	10	1	3	0.89	1ST	High

Source from: field study, 2023

In the table 2 above the respondents were asked to rank the most ways costs efficiency of sustainable building construction in the Nigeria can be evaluated in their different organizations, the result shows that Sustainable building feature promotes better health, comfort, well-being and productivity of both occupants and workers with (RII= 0.89) and Early stage of design and critically looking at crucial design features by value-engineering exercise with (RII = 0.85) are the most frequent ways costs efficiency of sustainable building construction in the Nigeria can be evaluated by the organizations within the study area in sustainable building project delivery.

Table 3 Objective Nr 2: Ranked methods to consider why selecting, designing, and contracting of sustainable cost efficiency project in building construction operations for good project delivery.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Idea of selecting lowest bid tender in contracting of sustainable projects delivery	14	19	10	4	0.73	4th	High-medium
2	Poor knowledge and construction methodology of sustainable projects delivery	26	16	3	2	0.85	1st	High
3	Risk analysis method of sustainable project design	24	17	3	3	0.83	2ND	High
4	Sensitivity analysis of sustainable projects delivery	12	27	5	3	0.76	3RD	High-medium

Source from: field study, 2023

From the table 3 above, the study revealed that, Poor knowledge, and construction methodology of sustainable projects delivery (R11= 0.85), Risk analysis method of sustainable project design (R11=0.83) and Sensitivity analysis of sustainable projects delivery (R11=0.76) were identified as the top three most importance methods to consider why selecting, designing, and contracting of sustainable cost efficiency project in building construction operations for good project delivery while the Idea of selecting lowest bid tender in contracting of sustainable projects delivery (R11=0.73) were ranked as the lowest factors. Even though by viewing the analysis based on the importance levels it shows that Poor knowledge and construction methodology of sustainable projects delivery considered as highly important by the respondents with the rest of the other variables leveled as high – medium importance in terms of selection criterions.

Table 4 Objective Nr 3: Respondents ranked on the problems or barriers associated with sustainable building and cost efficiency in the building construction project delivery.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Poor knowledge of sustainable design	24	19	2	2	0.85	1st	High
2	Inadequate awareness and knowledge of the concept of sustainable building and benefits	10	24	9	4	0.71	6th	High-medium
3	Lack of technical know-how in sustainable construction	19	20	3	3	0.80	3RD	High
4	Poor working condition for workers in terms of safety	11	24	9	3	0.73	4th	High-medium
5	Lack of knowledge and availability of alternative sustainable materials	22	17	7	3	0.80	3RD	High
6	Poor understanding of the project objectives and requirements	20	22	3	2	0.82	2ND	High
7	Lack of demand for sustainable construction by clients	15	15	14	3	0.72	5th	High-medium
8	Fear of increase in cost	11	19	11	6	0.69	7th	High-medium

Source from: field study, 2023

The analysis above shows the ranking view of the respondent on the problems or barriers associated with sustainable building and cost efficiency in the building construction project delivery, Poor knowledge of sustainable design (R11=0.85), Poor understanding of the project objectives and requirements (R11 =0.82), Lack of technical know-how in sustainable construction and Lack of knowledge and availability of alternative sustainable materials with (R11=0.80) were identifies as the top likely problems or barriers associated with sustainable building and cost efficiency in the building construction project delivery. Furthermore based on the importance levels almost all the variables of the problems or barriers associated with sustainable building factors are leveled as high importance problems or barriers associated with sustainable building and cost efficiency in the building construction project delivery with the exception of Lack of demand for sustainable construction by clients, Inadequate awareness and knowledge of the concept of sustainable building and Fear of increase in cost which was considered as high –medium level

Table 5 Objective Nr 4: Respondents ranked on the degree and application of cost efficiency to sustainable building construction in Nigeria.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Life cycle costing could be a great method in achieving good benefits of cost-efficiency of sustainable building delivery but task demanding	14	19	10	4	0.81	1st	High
2	Separating the capital and running cost of project can really affect the application of life cycle costing	8	15	21	3	0.65	6th	High-medium
3	Through value-engineering exercise of sustainable building projects	19	20	6	2	0.80	2ND	High
4	Application of life cycle costing in sustainable building is the best tool or techniques for providing best result in value for money to client and maximizing profits to contractors.	11	25	6	5	0.72	4th	High-medium
5	Nigeria has the professionals with best skills of life cycle costing to accelerate the understanding and implementation of sustainable construction	13	19	13	3	0.72	4th	High-medium
6	Application of life costing approaches to sustainable building in monitoring the cost performance over the economic life span of a building.	15	24	5	3	0.77	3RD	High-medium
7	Low effect in sustainable building project delivery	11	19	9	8	0.68	5th	High-medium

Source from: field study, 2023

From the above table it shows the ranking view at the respondent on the degree and application of cost efficiency to sustainable building construction in Nigeria. From the above analysis in the table above it pointed that (R11=0.81, R11=0.80) has greater or high effect to the degree and application of cost efficiency to sustainable

building construction in Nigeria. Furthermore, based on the importance levels variables on the serial number (2,4, 5, 6, and 7) are identified as high medium effect in the degree and application of cost efficiency to sustainable building construction in Nigeria.

Table 6 Objective Nr 4: Respondents ranked on the various costs efficiency to be deploying in sustainable building construction project delivery in Nigeria construction industry.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Better integration and good synergy of the Built environment professionals	26	19	1	1	0.87	1st	High
2	Eliminating unnecessary features like expensive finishes and adding some more expensive sustainable features that not only meet goals but also reduce maintenance and operating costs	22	14	9	2	0.80	2ND	High
3	Increase in first costs of some building component could bring a better cost savings to justify cost-efficient of sustainable building	8	19	17	3	0.67	6th	High-medium
4	Design team by trading off the cost of optional feature against the cost features that will result in energy, environmental or social improvements	13	21	8	5	0.72	4th	High-medium
5	Optimizing site orientation and exploiting natural heating and cooling techniques that can lead to smaller HVAC system and lower first cost	11	22	8	6	0.70	5th	High-medium
6	Employing range of building design approaches and making commercially available technologies	17	20	5	5	076	3RD	High-medium
7	Evaluation trade off cost can result in a sustainable building construction built for the same or an even lower cost than a more conventional building	9	24	6	4	0.72	4th	High-medium

Source from: field study, 2023

From the above table it shows the ranking view at the respondent on the various costs efficiency to be deploying in sustainable building construction project delivery in Nigeria construction industry. From the above analysis in the table above it pointed that Better integration and good synergy of the design team, the client, engineers, sustainable design consultants, landscape designers, operation and maintenance staff, health, safety and security experts, the general contractor and key subcontractors, Quantity Surveyors, value engineers and other cost consultants and Eliminating unnecessary features like expensive finishes and adding some more expensive

sustainable features with (R11=0.87, R11=0.80) has greater or high effect to various costs efficiency to be deploying in sustainable building construction project delivery in Nigeria construction industry. Furthermore, based on the importance levels variables on the serial number (3,4, 5, 6, and 7) are identified as high medium effect in the various costs efficiency to be deploying in sustainable building construction project delivery in Nigeria construction industry.

Table 7 Objective Nr 5: Respondents ranked on the good benefit of cost-efficiency of sustainable building can be achieved by taken into consideration of environmental cost factors, economic cost factors and social cost factors of components of sustainable building projects.

S/N	Variables means factors	Strongly Agree	Agree	Disagree	Strongly Disagree	R11	Ranking	Importance level
		4	3	2	1			
1	Environmental cost factors	26	19	1	1	0.87	1st	High
2	Economic cost factors	22	14	9	2	0.80	2ND	High
3	Social cost factors	19	20	3	3	0.67	3rd	High-medium

Source from: field study, 2023

The analysis above shows the ranking view of the respondent on the likely benefits by consideration of Environmental, Economic and Social cost factor into cost-efficiency of sustainable building, Environmental cost factors with (R11=0.85), Economic cost factors with (R11 =0.84) were identifies as the top likely benefits cost factors to be considering in achieving good cost-efficiency of sustainable building projects. Furthermore, based on the importance levels almost all the variables of the benefit factors are leveled as high importance benefits except for social cost factors which was considered as high –medium level.

V. DISCUSSION OF FINDINGS FROM THE ANALYSIS

From the analysis carried out it is observed that B.Sc. (57.45%) was the highest respondents to the questionnaire administered. Sustainable building with feature that promotes better health, comfort, well-being and productivity of both occupants and workers (R11 = 0.89) as being responded by respondents were the best Ways costs efficiency of sustainable building construction in the Nigeria can be evaluated. Poor knowledge and construction methodology of sustainable projects delivery, with (R11=0.85) were rated higher as one of the methods to consider why selecting, designing, and contracting of sustainable cost efficiency project in building construction operations for good project delivery. Poor knowledge of sustainable design, with (R11=0.85) were rated as the highest problems or barriers associated with sustainable building and cost efficiency in the building construction project delivery. The respondent still maintained that Life cycle costing could be a great method in achieving good benefits of cost-efficiency of sustainable building delivery, with (R11=0.81). Better integration and good synergy of the design team, the client, engineers, sustainable design consultants, landscape designers, operation and maintenance staff, health, safety and security experts, the general contractor and key subcontractors, Quantity Surveyors, value engineers and other cost consultants with (R11=0.87) could keep sustainable building construction cost within budget thereby achieving good cost-efficiency and Environmental cost factor with (R11=0.85) were rated the highest on cost factors to be considering in achieving good cost-efficient sustainable building. From the research, the respondents are experienced professionals (0-15 years) and enough technical staff which includes the Architects, Quantity surveyors, builders, and engineer (civil) which made it possible for them to contribute much to the research work by their positive respondents.

CONCLUSION

The study reveals the benefits of cost-efficiency in sustainable building in the Nigerian construction industry in Anambra state, Nigeria. The concept of sustainability aims to promote efficiency and reduce financial costs, as buildings represent a large and long-lasting investment in financial terms and resources (Oberg, 2005). The Nigerian construction industry in Anambra State is highly aware of the importance of cost-efficiency in sustainable construction operations. Life cycle cost analysis (LCCA) is an economic assessment approach that can predict the costs of a building from its operation, maintenance, and replacement until its end of life.

Effective practice of cost-efficient analysis by building contractors and clients can help reduce material wastage in construction sites or projects. The construction industry addresses the three dimensions of sustainability: environmental, social, and economic. The study highlights the importance of better integration and synergy between design teams, clients, engineers, sustainable design consultants, landscape designers, operation and maintenance staff, health, safety and security experts, general

contractors, key subcontractors, Quantity Surveyors, value engineers, and other cost consultants in achieving good cost-efficiency in sustainable building construction.

RECOMMENDATIONS

The study suggests that Nigeria should focus on achieving sustainable building projects by providing clients with more orientation on the benefits of sustainable building projects and conducting cost-efficiency analyses. Governments should encourage green building development practices to support the Nigeria ecosystem. Involving all stakeholders and professionals in achieving sustainable building costs is crucial. Sustainability variables should be incorporated throughout the project lifecycle, from planning to construction and operation/disposal phases. A good sensitization to the construction industry in Nigeria is essential to promote sustainable building projects that promote better health, comfort, well-being, and productivity. Life cycle costing and better integration of design teams, clients, engineers, sustainable design consultants, landscape designers, operation and maintenance staff, health, safety, security experts, general contractors, and key subcontractors can help maintain sustainable building construction costs within budget. Environmental cost factors are rated as the highest cost factor for achieving cost-efficient sustainable building.

AREA OF FURTHER STUDIES

The study highlights the benefits of cost-efficiency in Nigeria's construction industry, aiming to achieve the lowest responsive cost for sustainable building projects. This approach helps in economic decision-making and planning. However, the industry still relies on conventional building methods, causing challenges in adopting sustainable construction processes. Further research is needed to address these issues and develop solutions for implementing cost-efficiency in sustainable lifecycle costing of building projects.

STUDY CONTRIBUTION TO KNOWLEDGE

This study has contributed to the urgent need for sustainable building construction and cost reduction in project delivery. It encourages good cost efficiency analysis and convinces the public to adapt traditional or conventional building construction to achieve efficient cost reduction throughout the project's life span. The research encourages better integration of key professionals from design, costing, construction, operational, maintenance, recovery, and disposal stages, promoting sustainable building construction and reducing costs within budget.

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