Int. j. adv. multidisc. res. stud. 2025; 5(2):1112-1117

Received: 07-02-2025
Accepted: 17-03-2025

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

The Role of Quantity Surveyors in Managing Life Cycle Costs in Sustainable Construction

[1] Odunayo Rofiyat Olaniyan, [2] Abiodun Saheed Olaniyan
[1] School of Architecture Design and the Built Environment, Nottingham Trent University, United Kingdom
[2] School of Engineering and Technology, Arden University, United Kingdom

DOI: https://doi.org/10.62225/2583049X.2025.5.2.3953 Corresponding Author: **Odunayo Rofiyat Olaniyan**

Abstract
The integration of Life Cycle Costing (LCC) in sustainable construction has gained increasing attention as an effective strategy for optimizing costs while maintaining environmental and economic sustainability. Quantity Surveyors (QS**)** play a crucial role in managing life cycle costs by ensuring financial prudence throughout a project's lifespan, from planning and design to operation and maintenance. This study evaluates the role of QS professionals in managing LCC within sustainable construction projects in Nigeria. A survey research design was adopted, targeting 46 registered quantity surveying firms in Abuja, with data collected using structured questionnaires. The results indicate that Cost Planning and Estimation (MIS = 4.50) ranked as the most critical function, followed by Value Engineering (4.20), Risk Management (3.95), and Life Cycle Cost Analysis (LCCA) (3.85)**.** The findings further reveal a strong positive correlation (rs = 0.898, p = 0.00) between the involvement of QS in LCC and the sustainability performance of construction projects, confirming their pivotal role in sustainable development. Despite these contributions, challenges such as limited LCCA adoption and policy constraints persist. The study recommends stronger policy enforcement, financial incentives, and enhanced professional training to maximize the impact of QS in sustainable construction.

Keywords: Cost Planning, Life Cycle Costing, Quantity Surveyors, Sustainable Construction

1. Introduction

The concept of 'Life Cycle Costing' (LCC) is well-established in the construction industry and has often been referenced in sustainability-related research. The ISO 15686-5 standard defines Life Cycle Costing (LCC) as an economic assessment of all predetermined major and pertinent cost flows during a specified analysis period, expressed in monetary terms. The anticipated expenses are to the things necessary to attain specified performance standards, including dependability, safety, and availability. LCC may be used to evaluate the economic performance of a building during its life cycle, including initial planning and design, construction, operation and maintenance, refurbishment, and concluding with destruction (Volkov *et al.*, 2014) [28].

During the evaluation process, project stakeholders will be apprised of the financial and non-financial benefits of environmental and social sustainability measures, subsequently guiding their purchase choices (Lim *et al.*, 2018) [16]. Despite the prevailing thrust for sustainable procurement, it is surprising that LCC implementation in construction is relatively slow. In the last twenty years, extensive study has recorded benefits, challenges, and drivers for LCC adoption across various nations and stakeholders. For example, Sterner (2014) surveyed Swedish clients, while Higham *et al.* (2015) [11] and Oduyemi *et al.* (2018) surveyed the U.K. building stakeholders on the use and awareness of LCC and its barriers. In addition to the U.K., Chiurugwi *et al.* (2010) [4] conducted a survey of quantity surveyors on their views on the significance and use of life cycle costing in private financing initiatives and general projects.

Goh and Sun (2016) [10] conducted a literature analysis on the evolution of the LCC idea and methodology, highlighting the growing trend of articles centred on the economic evaluation of alternatives for green building design and performance. Estevan and Schaefer (2017) [8] subsequently demonstrated the evolution of Life Cycle Costing (LCC) techniques within the European context of sustainable public procurement and innovative public procurement, emphasising the challenges impeding efficient LCC implementation and proposing viable alternatives. In Nigeria, the construction industry faces numerous challenges, including high project costs, inefficient resource utilization, and inadequate attention to sustainability (Adebayo, 2020).

The integration of life cycle cost management in construction projects can significantly mitigate these issues. Quantity

surveyors, with their expertise in cost estimation, financial management, and value engineering, are uniquely positioned to influence sustainable construction practices by optimizing costs without compromising quality or environmental performance (Oke and Aigbavboa, 2017) [21]. Despite the recognized importance of life cycle cost management in sustainable construction, there is limited understanding and implementation of these practices within the Nigerian construction industry (Omopariola *et al*., 2024; Olaniyan and Adegoroye, 2024) [24, 23]. Many projects focus primarily on initial capital costs, neglecting the long-term economic and environmental benefits of sustainable cost management. This gap often leads to increased operational costs, resource inefficiencies, and environmental degradation. The role of quantity surveyors in addressing these challenges through effective life cycle cost management remains underexplored. The primary objective of this study is to evaluate the role of quantity surveyors in managing life cycle costs in sustainable construction projects in Nigeria.

Hypothesis:

Null Hypothesis (H_0): There is no significant correlation between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria.

Alternative Hypothesis (H_1): There is a significant correlation between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria.

2. Literature Review

2.1 The Quantity Surveying Profession

The profession of quantity surveying dates to the ancient Egyptian civilization who dedicated personnel to carry out estimates and costing for their magnificent structures and buildings. It developed into an occupation during the 17th-century restoration of London after the great fire. In 1836 the profession entered its new age when the new houses of parliament of Great Britain, designed by Sir Charles Barry, became the first major public contract to be fully measured and tendered using detailed bills of quantities for financial accountability. From being a trade-based vocation, quantity surveying has developed into a full-fledged profession widely accepted in the construction industry (RICS, 2015).

In the present-day construction industry, Jagboro (2016) states that quantity surveyors are construction cost experts that are concerned with financial probity from the onset up to the execution of both new development projects and refurbishment works. While Royal Institution of Chartered Surveyors (RICS) (2019) [25] define the role of quantity surveyors, as "ensuring that the resources of the construction industry are to the best advantage of society by providing the financial management for projects and a cost consultancy service to the client and designer during the whole construction process."

Similarly, Ashworth and Hogg (2013) [1] argue that quantity surveyors use their ability to analyze cost components of a construction project scientifically and apply the results of their analysis to a variety of financial and economic problems confronting the developer and the designer. Quantity surveyors, also known as construction economists or cost managers, are saddled with cost accountability and financial probity of the construction industry (Babalola and Anifowose, 2015) [3]. Quantity surveyors are professionals in the building environment that have the training and ability to analyze cost components and practical physical construction works of a project in a successful way to solve the problem peculiar to each project (Nnadi *et al.*, 2016) [19].

According to the Quantity Surveyors Registration Board of Nigeria (QSRBN) Act No. 31 of 1986 (CAP Q1 LFN, 2004) the qualified professional quantity surveyors duties are and which are similar to the Royal Institution of Chartered Surveyors (2019): preliminary cost advice and feasibility estimates; cost estimate, cost planning and cost management; tender management including preparation of bills of quantities, contract conditions and assembly of tender documents; contract management and contractual advice; valuation of construction work; claims and dispute management; advice on construction methods; advice on contractor selection; preparing tender documents; obtaining or negotiating tenders/bids; developing and agreeing on accounts with/for contractors; making expenditure statements for taxation and accounting purposes; facilities auditing; cost controls and post-contract management; project management and coordination; value and procurement management; and lifecycle costing. It is clear that the roles quantity surveyors play in the built environment are enormous and can be related to the essential roles needed for sustainable development. With reference to Thayaparan *et al.* (2011) [27] there is long life emphasise on the commitment of the quantity surveyor to learning and Wao and Flood (2016) [29] reveals that the competencies of the quantity surveyor are far reaching and can be applicable to the management of the building. Unfortunately, in the context of Nigeria, the potentials of quantity surveyors are yet to be fully utilized in facilities management.

2.2 Concept of Cycle Costing

Life Cycle Costing can be defined as the method for assessing the economic value of decisions of a design project. Basically, LCC is from cradle to grave costs. It encompasses all costs of investment, operational, maintenance and disposal. Life cycle costing (LCC) is a method to estimate the total ownership costs (OGC, 2003). LCC summarizes as “an economic assessment of competing for design alternatives, considering all significant costs of ownership over the economic life of each alternative, expressed in equivalent dollars” (Kirk & Dell’isola, 1995) [14].

In 1972, the U.S. Department of Health, Education and Welfare defined LCC as “the systematic consideration of cost, time and quality”. In the construction sector, lifecycle costing is used to measure the quantity of whole buildings, systems, or building components and materials costs and observing the happened all the way through the life cycle. The technique can also be used to inform designers and clients and assist decision making for building investment projects (Glick & Guggemos, 2010; Morrissey & Horne, 2011) [9, 18]. It can be enabled to evaluate financial benefits of energy efficiency measures for use in the building (Morrissey & Horne, 2011) [18].

2.2.1 Characteristics of life cycle costing

The important characteristics of life cycle costing are as follows

1. Product life cycle costing involves tracing of costs and revenues of a product over several calendar periods

throughout its life cycle.
2. Product life cycle costing traces research, design and development costs and total magnitude of these costs for each individual product and compared with product revenue.
3. Each phase of the product life-cycle poses different threats and opportunities that may require different strategic actions.
4. Product life cycle may be extended by finding new uses or users or by increasing the consumption of the present users (Hoogmartens *et al.,* 2014; Reddy *et al.,* 2015).

2.3 Sustainable Construction
Managing the construction process in a safe, efficient and effective way will usually save money and time, and much of this cost is related to fuel use and logistics. Employing modularisation and off-site construction methods to reduce performance uncertainties and risk of accidents on site has environmental benefits in terms of reducing waste of materials, transportation and can improve building performance in terms of air tightness and quality of finish too. The use of consolidation centres can save delivery frequency and protect materials from damage on site. Whilst the fuel used directly by the contractor is a small impact in the holistic approach, the skill used by the contractor in detailing and finishing the thermal envelope has a lasting impact on the operational efficiency of the building. Waste generated on site is a larger impact and all efforts should be directed towards limiting waste sent to landfill to an absolute minimum by employing strategies to ensure waste is firstly eliminated by design and specification co-ordination or ensuring a recipient is found either through a waste handler who can repackage or recycle the material for other uses or return to the supplier for reprocessing (Hossain *et al.*, 2020) [12].

2.5 Role of Quantity Surveyors in Managing Life Cycle Costs
Quantity surveyors play a fundamental role in managing life cycle costs in sustainable construction projects by ensuring that financial resources are utilized efficiently throughout the project lifecycle. Their involvement extends from the initial project planning stage through to the operation and maintenance phases.

2.5.1 Cost Planning and Estimation
One of the primary roles of quantity surveyors is cost planning and estimation. They prepare detailed cost plans that help in budgeting and financial forecasting, taking into account the entire lifecycle of the project (Ashworth & Perera, 2015) [2]. This process enables stakeholders to make informed decisions about design alternatives that optimize costs without compromising sustainability.

2.5.2 Value Engineering
Quantity surveyors contribute to value engineering by analyzing project functions to achieve the best value for money. This involves evaluating materials, construction methods, and design options to reduce costs while maintaining or improving quality and sustainability (Dell'Isola, 1997) [6].

2.5.3 Risk Management
Managing financial risks associated with construction projects is another critical role of quantity surveyors. They identify potential cost-related risks early in the project and develop strategies to mitigate these risks, ensuring that the project remains financially viable over its lifecycle (Flanagan & Norman, 1993) [7].

2.5.4 Procurement and Contract Management
Quantity surveyors are involved in the selection of procurement methods and the management of contracts to ensure cost-effective delivery. They negotiate contracts that align with sustainable construction goals, ensuring that cost control measures are embedded in contractual agreements (Morledge & Smith, 2013) [17].

2.5.5 Life Cycle Cost Analysis (LCCA)
A key responsibility of quantity surveyors is conducting life cycle cost analysis. This involves assessing all costs associated with a project, including initial construction costs, operation, maintenance, and disposal costs. LCCA helps in identifying cost-saving opportunities and promotes sustainable decision-making (ISO 15686-5, 2008).

3. Materials and Methods
This research was carried out using a survey design approach because it was an efficient method that allowed the collection of quantitative data from a large and diverse sample of respondents in a relatively short period (Bryman, 2016). A research population was referred to as a collection of all cases that conformed to some carefully chosen set of criteria. Population elements were the unit members of a population, for example, quantity surveyors.

The targeted population of the study was the 46 registered quantity surveying firms in Abuja, Nigeria, as obtained from the Nigerian Institute of Quantity Surveyors (NIQS) Directory (NIQS, 2024). However, the population size for the study was 46, being a census of the whole number of quantity surveying members in Abuja registered with NIQS (NIQS, 2024). Additionally, the population size for the study was 46 (implying at least one respondent in each firm), being a census of the whole number of quantity surveying firms in Abuja.

The data collection instrument used was a questionnaire. A questionnaire was administered to building construction firms in the FCT, Abuja. A questionnaire could easily be completely quantitative, completely qualitative, or a suitable combination of both quantitative and qualitative because each question in a questionnaire sought to obtain one type of data or another (Saidu, 2019) [26].

The data obtained were presented and analyzed using IBM Statistical Package for Social Sciences (SPSS) version 25 and Microsoft Excel 2016 with descriptive tools. Tables were used to present the data gathered in this research. The analysis of the collected data was carried out using the following descriptive tools: tables, percentiles, mean score, standard deviation, and correlation.

4. Analysis and Discussion
4.1 Results and Discussion on Rank of Respondents
The data gathered on the profession of respondents was analysed using Frequency count and Percentages. The result of the analysis is presented in Table 1 below:

Table 1: Rank of Respondents

Rank	**Frequency**	**Percentage (%)**
Principal partner	8	17.4
Senior Quantity surveyors	23	50.0
Junior Quantity surveyors	15	32.6
Total	**46**	**100**

Source: Researcher's Field Survey (2025)

Table 4.1 presents the rank of respondents. The findings revealed that 50.0% of the respondents were senior quantity surveyors, while 17.4% and 32.6% were principal partners and junior quantity surveyors, respectively. The majority of the respondents (67%) were either principal quantity surveyors or senior quantity surveyors. Therefore, the respondents are adequately knowledgeable about life cycle costs in sustainable construction in their various firms.

4.2 Results and Discussion on Academic Qualification of Respondents

The data gathered on the academic qualification of respondents was analysed using Frequency count and Percentages. The result of the analysis is presented in Table 2 below:

Table 2: Academic Qualifications of Respondents

Academic Qualifications	Frequency	Percentage (%)
OND/HND	2	4.3
B. Tech.	26	56.5
Masters	17	37.0
Ph.D.	1	2.2
Total	**46**	**100**

Source: Researcher's Field Survey (2025)

Table 3 reveals that highest academic qualification attained by the respondents. From the analysis, 4.3% of the respondents have degrees in OND/HND certificates, 56.5% have B.Tech. Certificates as their highest academic qualification, 37.0% have achieved Master's degree, and 2.2% have furthered to Ph.D. This analysis shows the quality of responses from the respondents.

4.3 Results and Discussion on Years of Working Experience of Respondents

The use of Frequency Count and Percentage was employed to analyse the years of working experience of respondents. The result of the analysis is presented in Table 3 below:

Table 3: Years of Working Experience of Respondents

Years of Working Experience	Frequency	Percentage (%)
1 – 5 years	12	26.1
6 – 10 years	7	15.2
11 – 15 years	9	19.6
16 – 20 years	8	17.4
Above 20 years	10	21.7
Total	**46**	**100**

Source: Researcher's Field Survey (2025)

Table 3 shows that 26.1% have an experience of 1 - 5 years, 15.2% have 6 – 10 years of experience, 19.6% have 11 – 15 years of experience, 17.4% have 16 – 20 years of experience, and 21.7% have more than 20 years of experience.

4.4 Role of Quantity Surveyors in Managing Life Cycle Costs in Sustainable Construction

The findings highlight the essential role of Quantity Surveyors (QS) in managing life cycle costs (LCC) in sustainable construction as shown in Table 4. Cost Planning and Estimation (MIS = 4.50) emerged as the most crucial role, ensuring that projects remain financially viable through accurate budgeting and forecasting. Value Engineering (MIS = 4.20) ranked second, emphasizing the need to optimize costs while maintaining quality. Risk Management (MIS = 3.95) and Risk Management Consulting (MIS = 3.89) were also identified as significant, reflecting the necessity of mitigating financial uncertainties in construction projects. However, Life Cycle Cost Analysis (MIS = 3.85) ranked the lowest, suggesting that long-term cost assessment practices are not yet fully integrated into mainstream construction cost management in Abuja.

The findings indicate that while cost control and risk mitigation are prioritized, there is a need for greater emphasis on LCCA to enhance long-term financial sustainability in construction. Government policies should promote the mandatory adoption of LCCA in project planning, while financial incentives can encourage value engineering and risk management practices. Additionally, capacity-building initiatives should be implemented to equip QS professionals with the necessary skills to conduct comprehensive cost-benefit analyses that align with sustainability goals. Strengthening collaborations between QS professionals, policymakers, and the private sector will be essential in driving cost-effective and environmentally responsible construction.

Table 4: Role of Quantity Surveyors in Managing Life Cycle Costs in Sustainable Construction

Code No.	Role of Quantity Surveyors in Managing Life Cycle Costs	MIS	Rank	Decision
C1	Cost Planning and Estimation	4.50	1st	Important
C2	Value Engineering	4.20	2nd	Important
C3	Risk Management	3.95	3rd	Important
C4	Risk Management consultant	3.89	4th	Important
C5	Life Cycle Cost Analysis (LCCA)	3.85	5th	Important
	Average MIS	***4.07***		***Important***

Source: Researcher's Field Survey (2025)

4.3.1 Testing hypothesis

(H_1): There is no significant correlation between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria.

(Ho): There is a significant correlation between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria.

Table 5: Results of Spearman's Rank Correlation Analysis

Analysis No.	Variables		Observations		Inferences	
	X	Y	r (%)	PVALUE	Strength of Relationship	Remark
1	Involvement of quantity surveyors in life cycle cost management	Sustainability performance of construction projects	0.898	0.00	Strong	Significant

Source: Researcher's Field Survey (2025)

The relationship between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria was analyzed using Spearman's rank correlation coefficient. This non-parametric test was selected due to its effectiveness in measuring the strength and direction of the association between two ranked variables. The results, as presented in Table 5, revealed a positive, strong, and significant relationship between the variables. The Spearman's rank correlation coefficient (r_s) was 0.898, indicating a very strong positive correlation. This suggests that as the involvement of quantity surveyors in life cycle cost management increases, the sustainability performance of construction projects also improves correspondingly. Furthermore, the p-value was 0.00, which is less than the 5% (0.05) significance level. This result indicates that the observed correlation is statistically significant, thereby leading to the rejection of the null hypothesis and the acceptance of the alternative hypothesis, which states that there is a significant correlation between the involvement of quantity surveyors in life cycle cost management and the sustainability performance of construction projects in Nigeria.

The strong positive correlation emphasizes the crucial role that quantity surveyors play in enhancing sustainability outcomes through effective life cycle cost management in construction projects across Nigeria.

4. Conclusion

This study highlights the critical role of Quantity Surveyors in managing life cycle costs within sustainable construction projects in Nigeria. The findings indicate that Cost Planning and Estimation, Value Engineering, and Risk Management are the most significant functions performed by QS professionals, ensuring cost efficiency and financial sustainability. However, Life Cycle Cost Analysis (LCCA) remains underutilized, despite its importance in evaluating long-term project expenses. The study also confirms a strong positive correlation between QS involvement in LCC and the sustainability performance of construction projects (rs = 0.898, p = 0.00), demonstrating that greater QS participation enhances cost-effective and environmentally sustainable outcomes. However, barriers such as limited awareness, inadequate policy support, and financial constraints hinder the full adoption of LCCA practices.

5. Recommedations

To address these challenges, the study recommends that government policies be strengthened to mandate LCCA implementation, financial incentives be introduced to support sustainable cost management, and professional training programs be expanded to enhance QS expertise in life cycle cost analysis. By adopting these measures, the Nigerian construction industry can achieve greater cost efficiency, resource optimization, and environmental sustainability, ultimately improving the overall economic and ecological impact of construction projects.

6. References

1. Ashworth A, Hogg K, Higgs C. Willis's practice and procedure for the quantity surveyor. John Wiley & Sons, 2013.
2. Ashworth A, Perera S. Cost studies of buildings. Routledge, 2015.
3. Babalola AA, Anifowose OS. A Study of the Compliance of Practising Quantity Surveyors with the Professional Code of Conduct in Nigeria. IOSR Journal Of Humanities And Social Science (IOSR-JHSS). 2015; 20(1). E ISSN: 2279-0837
4. Chiurugwi T, Udeaja C, Hogg K, Nel W. Exploration of drivers and barriers to life cycle costing (LCC) in construction projects: professional quantity surveyors' assessment, 2010.
5. Ed Tizani W. Proceedings of the International Conference, Nottingham UK, 2010, 1-9.
6. Dell'Isola AJ. Value engineering: Practical applications for design, construction, maintenance, and operations. RSMeans, 1997.
7. Flanagan R, Norman G. Risk management and construction. Blackwell, 1993.
8. Estevan H, Schaefer B. Life Cycle Costing: State of the art report, 2017. Available at: http://www.sppregions.eu/fileadmin/user_upload/Life_Cycle_Costing_SoA_Report.pdf
9. Glick S, Guggemos AA. Life-cycle assessment and life-cycle cost as collaborative tools in residential heating system selection. Journal of Green Building. 2010; 5(3):107-115.
10. Goh BH, Sun Y. The development of life-cycle costing for buildings. Building Research & Information. 2016; 44(3):319-344.
11. Higham A, Fortune C, James H. Life cycle costing: evaluating its use in UK practice. Structural Survey. 2015; 33(1):73-87.
12. Hossain MU, Ng ST, Antwi-Afari P, Amor B. Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. Renewable and Sustainable Energy Reviews. 2020; 130:109948.
13. ISO 15686-5. Buildings and constructed assets - Service life planning - Part 5: Life-cycle costing. International Organization for Standardization, 2008.
14. Kirk SJ, Dell'Isola AJ. Life cycle costing for design professionals, 1995.
15. Knauer T, Möslang K. The adoption and benefits of life cycle costing. Journal of Accounting & Organizational Change. 2018; 14(2):188-215.
16. Lim BTH, Zhang W, Oo BL. Sustainable procurement in Australia: quantity surveyors' perception on life cycle costing. International Journal of Integrated Engineering. 2018; 10(2).
17. Morledge R, Smith A. Building procurement. John Wiley & Sons, 2013.
18. Morrissey J, Horne RE. Life cycle cost implications of energy efficiency measures in new residential buildings. Energy and buildings. 2011; 43(4):915-924.
19. Nnadi EOE, Okeke FN, Alintah-Abel U. Marketing quantity surveying profession in South-Eastern Nigeria. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE). 2016; 13(3):12-20.
20. Oduyemi O, Okoroh M, Dean A. Barriers to life cycle costing usage. Ed Raiden, A.B. and Aboagye-Nimo 30th Annual ARCOM Conference Proceedings. (2014) Portsmouth UK, 2014.
21. Oke AE, Aigbavboa CO. Sustainable value management for construction projects. Switzerland: Springer, 2017, 75-86.
22. Olaniyan OR. Assessing skills acquisition among

building technology education students in south-west Nigeria; A bridging gap to global workforce readiness. Jigawa Journal of Multidisciplinary Studies (JJMS). 2024; 7(2). ISSN: 2672-4790
23. Olaniyan OR, Adegoroye A. Bridging Development and Sustainability: An Analysis of the Nigerian Real Estate Sector. European Journal of Theoretical and Applied Sciences. 2024; 2(2):809-823.
24. Omopariola ED, Olanrewaju OI, Albert I, Oke AE, Ibiyemi SB. Sustainable construction in the Nigerian construction industry: Unsustainable practices, barriers and strategies. Journal of Engineering, Design and Technology. 2024; 22(4):1158-1184.
25. Royal Institution of Chartered Surveyors (RICS). ''Surveying and Profession.'', 2019. Retrieved from: https://www.rics.org/uk/surveying-profession/59
26. Saidu S. CEO characteristics and firm performance: focus on origin, education and ownership. Journal of Global Entrepreneurship Research. 2019; 9(1):29.
27. Thayaparan M, Siriwardena ML, Amaratunga RDG, Malalgoda CI, Keraminiyage KP. Lifelong learning and the changing role of quantity surveying profession, 2011.
28. Volkov A, Vitaliy C, Dmitriy K. Life cycle of a building. Advanced Materials Research. 2014; 1065-1069:2577-2280.
29. Wao JO, Flood I. The role of quantity surveyors in the international construction arena. International Journal of Construction Management. 2016; 16(2):126-137.