Measures of Sustainable Construction Project Performance

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INVESTOR IN PEOPLE

To God
Who Made All Things Beautiful

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About the Author

Ayodeji E. Oke is a Senior Lecturer in the Department of Quantity Surveying, and Team Leader of Research Group on Sustainable Infrastructure Management plus (RG-SIM+), Federal University of Technology Akure, Nigeria. With more than 300 publications, his research interest is in Sustainable Infrastructure Management (SIM), emphasising sustainable construction, value management, quantity surveying and construction in the digital era. He has collaborated with other authors to publish the following research books: *Sustainable Value Management for Construction Projects*; *Construction Digitalisation: A Capability Maturity Model for Construction Organisations*; *Sustainable Construction in the Era of the Fourth Industrial Revolution*; *Value Management Implementation in Construction – A Global View*; *and Smart Cities: A Panacea for Sustainable Development*.

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Preface

The construction industry has been found to be fundamental to the development and growth of any economy, both developing and developed. However, the industry has faced some challenges that have affected the delivery of projects for clients. A major issue in this industry is the proper understanding of project requirements by concerned stakeholders such as clients, financiers, sponsors, professionals, contractors, subcontractors, suppliers, statutory bodies as well as others who indirectly influence the projects. There is therefore the need for both direct and indirect stakeholders to understand the goal of any construction project during the preconstruction stage as this will set the tone for main construction and post-construction stages.

Traditionally, the performance of construction projects is measured in terms of time, cost and quality. This implies that projects are deemed to have been successful if such projects are delivered to time, within cost and to the specified quality. However, due to changing clients' demand, complexity of projects and advancement in every area of life, project goals are no longer limited to the conventional three legs of time, cost and quality. The introduction of sustainability principle in every sector of the economy especially through the United Nations' (UN) Sustainable Development Goals (SDG) has also affected the measures of project success. In construction, the principle of sustainability is gaining wider attention, and clamour for sustainable construction projects that incorporate the principles of sustainability is on the increase. There is therefore the need for construction projects to adopt sustainable principles such as reduce, reuse and recycle with a view to ensuring that projects are economical, people oriented, environmental friendly and technically appropriate.

The advent of various revolutions including the current Fifth Industrial Revolution (5IR) has not only disrupted common practices in every sector of the economy but has also paved the way for various forms of global advancements and changes. Digitalisation and other principles such as Internet of Everything (IoE), digital twin, customization, smart city and the likes are also gaining popularity among construction stakeholders. The most recent in the construction industry, termed construction 5.0 coupled with sustainability principles, collectively termed sustainable construction 5.0, has affected the view of the industry and this has given rise to other indices of project success. This book therefore provides readers with various indices, indicators and variables of measuring the success, performance and delivery of construction projects.

The book did not only discuss the fundamental measures of projects success, which are time, cost and quality, but also explain other indices such as productivity, satisfaction, profitability, communication, engagement, functionality, health and safety, collaboration, waste management, security as well as environmental requirements and operational performance. The first part of the book explained the concept of sustainability in construction with emphasis on the basis of sustainable construction. The second part consists of chapters that explain various measures of project success. The chapters are arranged starting with abstract, followed by keywords and other important sections before conclusion and references.

The book will be useful for stakeholders concerned with the management and administration of construction and infrastructure projects. These include researchers, educators, governmental bodies and agencies, clients of public and private projects, contractors and developers, professionals and consultants, regulatory bodies as well as users and customers of the construction projects. The book provides information and can serve as literature material on issues such as construction projects, sustainable construction and project performance for stakeholders in the architecture, engineering, construction and operation (AECO) industry.

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Part I
Sustainable Construction

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Chapter 1

Sustainability in Construction Projects

Abstract

The sustainability of construction projects has become something of great importance particularly in this era where the natural habitat is going into extinction. The growth in the world population, and series of changes as well as scarcity of resources created a number of environmental and social challenges to the world. Therefore, the concept of sustainability remains the much awaited hope. Companies, corporate bodies as well as national and international organisations are gradually succumbing to pressure to incorporate sustainability considerations into their project decision-making process. This chapter therefore examines the activities of construction industries in connection with sustainability activities in the industry. Different steps to be taken to achieve sustainability in the construction projects as well as the importance of sustainability in construction projects were discussed.

Keywords: Construction industry; project; project management; sustainability; sustainable development; project delivery

Introduction

Achieving sustainability is one of the most significant challenges facing society today. It is worthy of note that most companies and organisations are striving to apply the principle of sustainability in their strategies and ideology. The scholars find this as another field of research. More recently, as opined by Gareis, Heumann, and Martinuzzi (2009) as well as Silvius, Brink, and Köhler (2009), in the practice of project management through faster and effective medium, the idea of sustainability has been incorporated immensely as the construction industry strives towards enhanced functionality and relevance. The impact of construction projects can be felt fundamentally on economic, environmental, social and technical sustainability as submitted by Olowosile and Oke (2019). According to Silvius (2017), in the general context of human endeavours and activities towards growth, the concept of sustainability is fast becoming the most discussed aspect of human evolvement. This is as a result of the ever-increasing demand and needs of the clients, and the reliance of the construction industry on natural resources.

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There is therefore a need for a befitting concept that can enhance project execution within a stipulated time and the concept of sustainability comes right into the fray. This means that the economic, environment and social issues are being integrated into process of decision-making, and it implies that sustainability has been focused as key for organization success, including the construction industry (Oke & Aigbavboa, 2017).

Catarina, Luis, and Manuelz (2014) opined that the impact of construction on the environment is becoming serious concern in the last decades. There have been connections between challenges experienced in the environment and the activities of the building sector in general (Cole, 1999). This has resulted in the adoption of practices in the building sectors with the aim to mitigate these challenges and yet execute projects that are within expected scope and other performance measures. As a result of these, there are needs to develop a way of evaluating the impact of buildings environment. Consequently, it was also necessary to establish benchmarks to these metrics. In view of these many entities have worked in development of series of methodologies for assessment of sustainable building.

Construction Industry

Construction is the process that involves setting up of plants and delivery of materials to site with attendant labours to bring out an output – which is the infrastructure, that will be left behind after all resources have been removed from site. The outputs include all immobile structures, developments and infrastructures, which include airports, buildings, dams, roads and tunnels, power plants, municipal treatment plants, pipelines etc. Harry (2008) stated that the construction industry is traditionally divided into three sub-sectors: the building construction, civil/heavy engineering construction and specialty trades. It thus encompasses all the businesses that build residential houses and office buildings or highways and bridges, as well as those who do the specialised work of artisans, who get involved in different kind of construction work. The construction industry is a significant part of the economy of any country, employing a reasonable percentage of workforces.

According to Ayodele (2005), in developing countries, construction industry contributes between 3% and 6% to the gross domestic product (GDP). For instance, the contribution of the construction industry to Nigeria's GDP has hovered around 2% since 1982, and this accounts for about 69% of the nation's gross fixed capital formation. It was further propounded that in developing countries, construction industry has the considerable scope to employ an average of 5% of the labour force, while the contributions of the construction industry to employment of the workforce in most developing countries has remained steadily at 1% over the last few years. However, empirical studies have shown that 1% increase in the stock of infrastructure generates 1% increase in the GDP across all countries.

Features of Construction Industry

The features of construction industry comprise the following as illustrated in Fig. 1.1.

- *The nature of the product*: This encompasses products in various varieties of affront shapes and sizes that are necessary in different area codes across countries. Most of the components parts are manufactured offsite and tailored to customer satisfactions.
- *The use of the output*: This is the reality that the products are used as earlier planned after being executed from the designs. This is targeted towards further production with the purpose of enhancing the infrastructural development of a particular area and the economy as well. It can be social investment (e.g. hospital) or direct enjoyment (e.g. housing) investment.
- *The market force of the output*: This to a large extent depends on governmental policy and economy cycles, and it is being determined differently for different purposes.

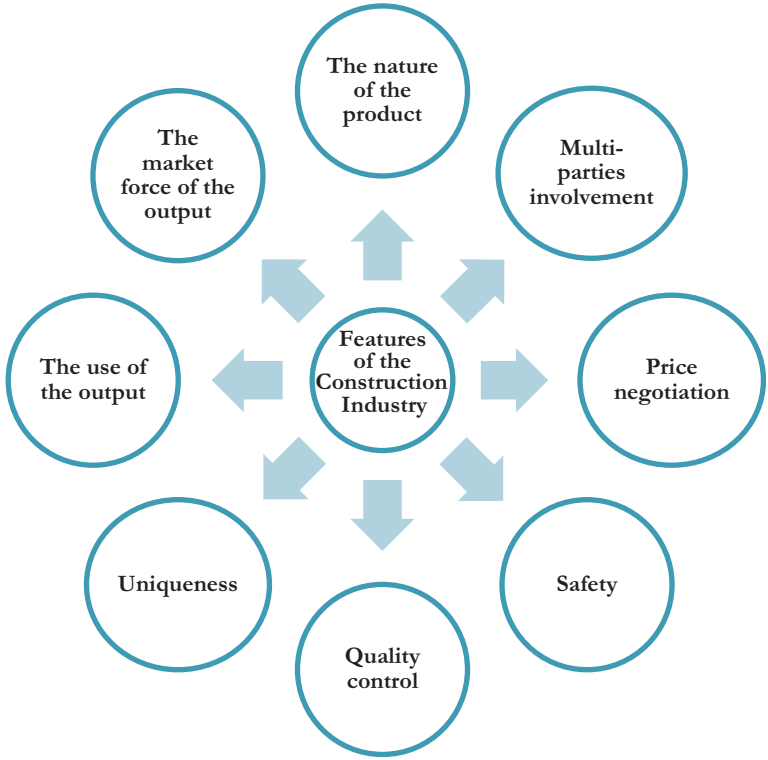

Fig. 1.1. Features of the Construction Industry.

- *Uniqueness*: Its uniqueness is on the fact that the modelling involves in it is very small (the process is gradual) from being a giant international to a multibillion contractors. Yet, it is very competitive industry with low profit margins.
- *Multi-parties involvement*: This involves clients, architect, quantity surveyors (QS), engineers, builders, contractor, subcontractors, materials and equipment suppliers, value managers, retailers, regulatory agencies etc.
- *Price negotiation*: There is no same price for all projects either heavy, civil or building projects. Every project is unique with its price figure according to the terms of the negotiated or bided contract.
- *Safety*: Construction industry has a high number of fatalities and this required a great deal of safety and precautions.
- *Quality control*: Construction industry demands quality services.

Categories of Construction Industry

The categories of construction industry as opined by Hayari, Riana, Abd, and David (2018) can be in terms of types of projects or types of owner. In some other, it involves industrial, civil/heavy engineering, commercial and residential buildings, which are further detailed as follows:

- Industrial
  - These are projects which required high technological input like petrochemical's industry, only few design firms and contractors can handle them.
- Civil/Heavy Engineering
  - The project in this category involves construction of airports, bridges, dams, tunnels, highway etc. The civil engineers are mostly in charge of these projects and it required heavy construction equipment to work on them.
- Commercial Building
  - These ones are mostly designed by architect who worked with engineers and QS to achieve the construction. Examples are hospitals, worship centre, public buildings etc.
- Residential
  - These projects are not as such capital intensive and mostly financed by private sectors and seldom by government in providing housing scheme.

When it comes to category based on the owner, projects executed can either be owned by the public or private individual or group of individuals who has the same goal. Private-owned project are solely financed private individual or company. It can be multi-contract or sole contract. While public party on the other hand is that where there is limitation propounded in laws and regulations. Also, bids for project to be executed are contracted out through bids (competitive) valued by experienced public parties. This competitive bidding is mostly the

default method engaged in executing public projects except in some cases where the nature of the project might require another form of procuring methods.

Sustainability in Construction

In summarising the concepts sustainability involves closing the gaps in the future with the present through a systematically improved systems with the aim of solving problems (Okeniyi, 2013). This implies that when construction continues to rely on material supply from the environment, a time will come when the supply will cease from the environment. In order to prevent this, Oke, Stephen, Aigbavboa, and Thwala (2021) noted that construction professionals in the built industry have been developing concepts that could prevent shortage of materials by introducing sustainable practices especially for construction materials and systems right from design to execution.

During the life cycle of a project, ethics, environmental friendliness and economic efficiency are all important considerations by construction stakeholders which have made sustainability to become critical in the project delivery. Economic, environmental and social sustainability are the three components of sustainability, which are often referred to as the triple bottom line. Having sustainable project management is adequate for all development projects that enable lasting changes in the environment with various expectations from the stakeholders. Project control systems are the yardsticks that enable achieving the project goal. According to Hirpara, Sharma, and Kashiyani (2018), the focus is on how the project organization implements sustainability during project execution, as well as how project control is employed for sustainable project management, both in terms of control methods and the project partners' alliance contract. According to Gareis et al. (2009), sustainable construction tries to create buildings that save energy and resources while also safeguarding occupants' health and assuring their well-being. According to Okeniyi (2013), there has been a tremendous increase in the rate at which national policies are adopting the sustainability system as a result of multiple changes in the socio-economic climates of nations throughout the world. According to Clifton (2007), sustainable development is the unique equilibrium that occurs between the environment, society and the economy. It is the act of planning projects in such a way that the unborn generation would not have to suffer from the consequences of previous undertakings. This method effectively assures that society suffers less damage that may have an impact on future generations (Okeniyi, 2013).

The environment, economics and society are the three main areas of concentration in the subject of sustainability; these three sectors are all interconnected. They are the foundation and bedrock to sustainability. According to the report by Klöpffer (2003), projects in developing countries tend to focus more on the environmental and social aspects, whilst those in technologically advanced countries tend to focus more on the economy. Stable nations, on the other hand, frequently seek out aspects of sustainable development that benefit their

economies. When nations are more preoccupied with the question of economic sustainability, there is a risk of environmental and social slumber. To maintain a suitable level of balance within a project, it is proposed that each of the three sectors be treated equally. Oke, Stephen, et al. (2021) suggested that all the three areas should be treated with equality to maintain and retain the balance.

However, there are some steps to be considered for sustainable construction projects (El-Mikawi, 2005). Some of these steps are explained in the next section.

Steps for Sustainability in Construction Projects

Improvement of Existing Built Assets

Not all projects building or civil engineering work required new construction. Some needs to be worked upon for improvement, alteration and conversion for its re-use.

Appropriate Localities

Before choosing any location for new projects the appropriateness of such localities should be determine less it comes a nuisance to the localities.

Adequate Infrastructure Planning

Consideration should be given to accessibility to adequate infrastructural development of the end-users of the facilities.

Minimizing WastelOptimal Use of Resources

From the design stage focus should be on projects that will minimize waste. Design should be done in a way to make optimal use of resources available for the projects.

Be Futuristic

The life span of any projects matters, because projects are not met to last for immediate moment. What becomes of the projects in nearest future should be put into consideration, like whole life costing and its usefulness after the expiration of its life span.

Incorporate Lean Construction

Every project aims to provide the best value for money. Continuous improvement in performance, waste elimination, a strong customer focus, offering value for money while maintaining high environmental quality, with high-quality project