

# **Evaluating the Impact of Buildability Assessment and Value Management on Construction Project Delivery**

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## **ABSTRACT**

The economies of the countries of the world are constantly changing and the need for more efficient and effective delivery of construction projects is forcing stakeholders to seek ways of improving the productivity of construction projects to better meet the key performance indicators of time, quality and cost of a project. This research focuses on highlighting the importance of buildability assessment and value management on the performance of construction projects. A survey research was conducted on industry practitioners within the Nigerian construction industry to obtain primary data on the knowledge and implementation of buildability assessment and value management and a SWOT analysis was carried out based on findings from the survey which revealed the lack of knowledge and implementation of buildability assessment and value management in a formal context within the Nigerian construction sector. A framework was then developed showing how buildability assessment and value management can be integrated and implementation steps was provided. The implementation of buildability assessment and value management would enable the construction industries compete with other industries such as manufacturing in terms of productivity improvement and position it to become an integral part of the nation's economy in terms of its contribution to the gross domestic product (GDP).

Keywords: Buildability, value management, construction, project.

## **INTRODUCTION**

The economies of the countries of the world are constantly changing and the need for more efficient and effective delivery of construction projects is forcing stakeholders to seek ways of improving the productivity of construction projects to better meet the key performance indicators of time, quality and time of a project. These three indicators provide the definition for a successful project as a project is said to be successful when a sort of equilibrium is realised between them. However, achieving this equilibrium is

difficult as there are multitude of factors responsible for the success of projects. Typically, a delay in the anticipated project delivery date nearly always leads to an increase in the overall estimated cost of executing the project.

On the other hand, minimising duration without compromising quality is critical to success in any construction project and this has in turn led to buildability increasingly becoming a major requirement in building practice. Over the years, there has been an increase in the cost overrun and schedule slippage associated with construction projects in both developed and developing countries and the reasons for failure are similar across the regions and countries of the world. Yet, the issue of schedule slippage and cost overrun is still a recurring decimal in the construction industry leaving lots of clients dissatisfied. Walker (2007:101) posits that it is important to define and implement client requirements in a project due to the high level of influence they have on the success of projects. It therefore becomes important for organisations to adopt a broader range of procedures and greater flexibility in seeking ways to meet the expectations of the clients.

Leeuw (2001) reveals the importance of maximising the function to cost ratio of a project by scrutinizing all decisions from conception to completion against a value system determined by the client/owner in order to improve the possibility of providing value for money for the client. Research has shown that change orders resulting from design variation or change of scope as one of the causes of low productivity in construction (Hanna and Gunduz 2004; Moselhi et al. 1991, 2005) with the cumulative effect of client dissatisfaction. Design variation can usually result from a lack of buildability assessment before the commencement of the project or due of changing client requirements which can be indicative of the absence of a value management workshop before the commencement of the execution phase of the project. It then becomes imperative to ensure that design variations and changes in client's requirements are reduced and this is where buildability assessment and value management studies become invaluable.

## **LITERATURE REVIEW**

Buildability and constructability are two words that cannot be found in most conventional dictionaries. However, the idea behind both concepts have been in practice in the construction sector for a long time. Buildability aims at enhancing the efficiency of the building process through the development of construction-sensitive designs. The construction industry research and information association (CIRIA 1983) defines buildability as the extent to which the design of a building facilitates the ease of its construction. All the definitions proposed by various researchers (Bamisile 2004; Chen and McGeorge 1994; Ferguson 1989; Griffith and Sidwell 1997; Jergeas and Put 2001; Moore 1996) have the same central theme "ease of construction".

Takim and Akintoye (2002) assert that the development of any nation is usually first assessed by the development of its physical structures. It therefore follows that the importance of buildability is directly linked to the importance a nation attaches to the development of its physical structures. Construction processes are becoming more demanding due to design complexities resulting from more innovative designs. Therefore, the implementation of buildability assessment becomes increasingly important to ensure that projects can satisfy time, cost and quality constraints.

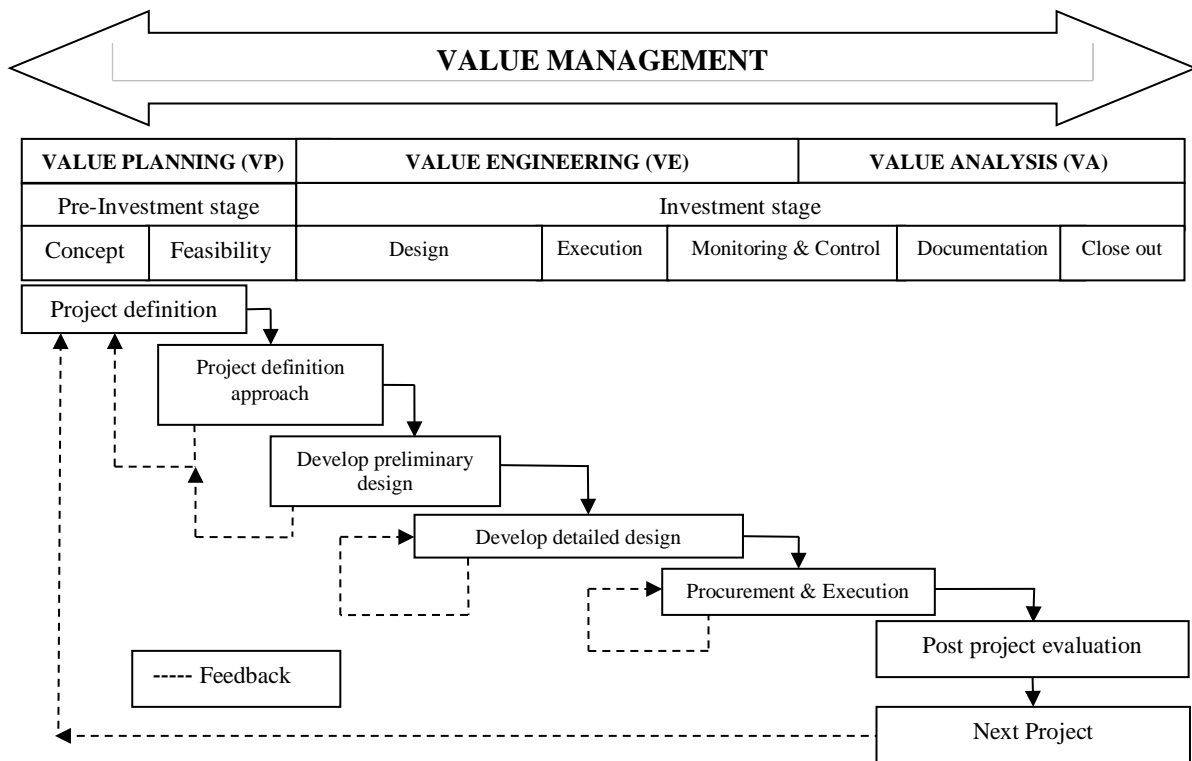
The implementation of buildability starts at the design stage (Aina and Wahab 2011; Eldin 1999; Hiley and Yagci 2001; Mbamali et al. 2005) although Anderson et al. (2000) contends that it is best applied during the project definition stage where the project

objectives, characteristics and scope are defined and went further to provide four basic steps which must be followed in developing a buildability plan. One important consideration for implementing buildability assessment is that it is done proactively and not reactively. Some important factors that should be considered to improve buildability includes: well defined specifications, site investigation/access to site, the use of prefabricated elements (modular construction), standardization and repetition, design for buildability using 3D, use of 4D for buildability reviews consisting of spatiotemporal clash detection and site safety considerations.

According to Koo and Fischer (2000), a 4D model defined as a 3D model linked to the construction schedule presents an excellent opportunity to enhance buildability as it provides a basis for analyzing time-space conflicts, safety issues,, and site workspace management. This is possible because the 4D model shows the logical, temporal and spatial information of the construction process.

Regardless however of the perceived importance of carrying out buildability assessment on projects, there are some barriers mitigating against its successful implementation. The Construction Industry Institute (CII 2016a) reveal that the biggest obstacle to the practice and implementation of buildability is the “review” syndrome and this situation arises when construction personnel are only invited to review completed or partially completed products from designs. Song and Chua (2006) claim that the difficulty inherent in measuring the benefit of buildability to the construction industry poses a barrier to its successful implementation. Other barriers include lack of practical construction knowledge by designers (Wong et al. 2004), lack of a systematic method of integrating the knowledge and experience gained in the industry overtime into the project development phase (Anderson et al. 2000), rigidity of clients and consultants in accepting alternative construction methods (Pheng and Abeyegoonasekera 2001). CII (2016b) broadly categorized the barriers to the implementation of buildability into four general areas; cultural, procedural, awareness and incentive barriers. The top five common barriers were also identified and this consists of; complacency with status quo, reluctance to invest additional money and effort in early project stages, limitations of lump-sum competitive contracting, lack of construction experience in design organisation and designers perception of “we can do it alone”.

One way to remove the barriers mitigating the successful implementation of buildability assessment is through the implementation of value management workshops/studies. A summary of the value management concept is shown in **Figure 1**.



**Figure 1: Value management concept (Adapted from Merna and Al-Thani 2008)**

There are three techniques typically adopted in conducting a value management study namely; value planning (VP), value engineering (VE) and value analysis (VA). Value planning is the first step in the value management process and its focus is on identifying project objectives and developing general approaches to meet the project objectives. The VE phase commences after the VP and focuses on identifying and eliminating unwanted costs with the aim of increasing the value of the project by considering the availability of materials and their alternatives in respect to cost and adherence to the project specification.

Chen et al. (2010) asserted that value engineering is a systematic process which combines technical knowledge and common sense to identify and eliminate unimportant projects costs. Several research (Blyth and Worthington 2010; Kelly and Male 2003; Lin and Shen 2007; Norton and McElligott 1995; TAM 2004) provided different definitions for value management consistent with the concept of improving cost, schedule and buildability of a construction project.

From **Figure 1**, it can be observed that the value planning phase provides an excellent opportunity for the clients to make their requirements known to the design team. There is also the possibility of implementing buildability assessment within the value engineering phase of the value management process.

Value management studies involve the completion of three phases (pre-study, workshop and post study). According to Kelly et.al. (2014), the workshop stage is the most important phase of the value management exercise encapsulated by the job plan. **Table 1** shows the three major different steps adopted in the job plan as proposed by Kelly and Male (1993).

**Table 1: Job Plan Procedure (Adapted from Kelly and Male 1993)**

<p style="text-align: center;"><b>Pre-study Phase</b></p> <ul style="list-style-type: none"> <li>• Gathering and blending of information, agenda production and presentation, team building.</li> </ul>
<p style="text-align: center;"><b>Workshop/Study Phase</b></p> <p><u>Information sub-phase</u></p> <ul style="list-style-type: none"> <li>• Gathering, blending and sharing of information, task and process analysis.</li> </ul> <p><u>Creativity sub-phase</u></p> <ul style="list-style-type: none"> <li>• Brainstorming by team members to generate a host of ideas.</li> </ul> <p><u>Evaluation sub-phase</u></p> <ul style="list-style-type: none"> <li>• Sorting and refining of ideas for further development, function analysis, cost/worth analysis.</li> </ul> <p><u>Development sub-phase</u></p> <ul style="list-style-type: none"> <li>• Development of implantation of selected ideas.</li> </ul>
<p style="text-align: center;"><b>Post-study Phase</b></p> <ul style="list-style-type: none"> <li>• Presentation of sketch drawings and cost calculations to project sponsor.</li> <li>• Feedback which involves giving the opportunity to test the designs and cost predictions.</li> <li>• Comments and/or criticisms about the study from all project stakeholders.</li> </ul>

Kelly et al. (2004) provided ten critical success factors (CSF) necessary for the success of value engineering workshops. The factors help to differentiate value management studies from other group decision making processes while focusing on key issues surrounding the conduct of a value management study. Fifteen CSF were identified by Shen and Liu (2003) with the focus of success being the composition of the value management team. However, their research failed to highlight the significance of the implementation of the job plan.

## **DEVELOPMENT OF INTEGRATED CONCEPTUAL FRAMEWORK FOR THE IMPLEMENTATION OF BUILDABILITY ASSESSMENT AND VALUE MANAGEMENT**

The conceptual framework was developed from extensive study of existing literature and the model implementation steps were from the outcome of interviews conducted with project managers within nine construction companies in Nigeria with an average work experience of 9.5 years. The participants were chosen mainly based on their work experience and their decision-making capabilities within their organisations and their knowledge of buildability assessment and value management. The conceptual framework is shown in **Figure 2**.

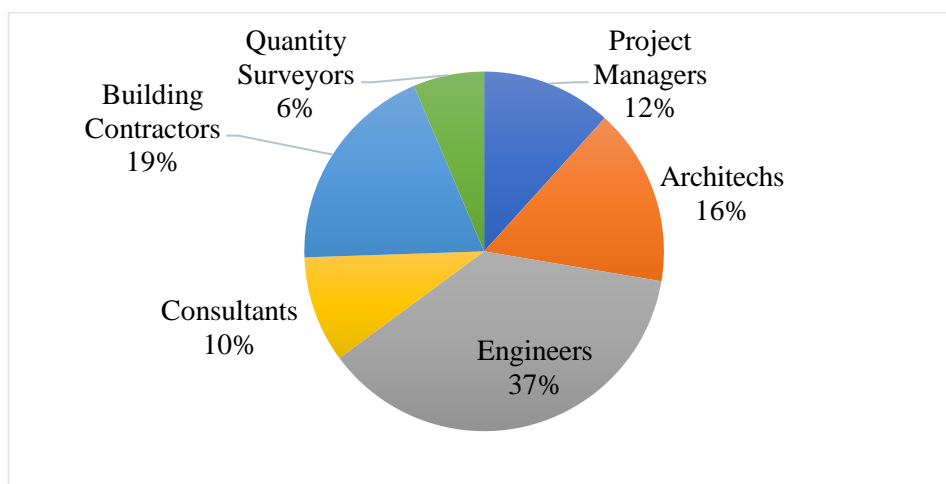


5. Conduct function analysis to analyse the functions of the constituent parts of the project.
6. Carry out a buildability review of the design drawing using building information modelling (BIM) and 4D BIM.
7. Generate, sort and refine ideas for the construction process as well as construction materials.
8. Make corrections to the design drawings if the need arises and present sketch drawings, recommendations and project cost implication to project sponsor.
9. Commence the construction process.
10. Document lessons learn for use in future projects.

### CASE STUDY

To evaluate the impact of buildability assessment and value management on the delivery of construction project, a case study approach was adopted using the Nigerian construction industry. Amade (2016) reveals that the state of the Nigerian construction industry does not suggest the deployment and use of buildability practices by professionals within the industry and this could in part be responsible for the poor performance of construction projects in the country. Akpan et al. (2014) further assert that the cases of project delays, abandonment, cost overrun and failures can be blamed on the lack of adequate knowledge and non-implementation of constructability principles in the project delivery process.

A survey methodology was adopted using a questionnaire administered to practitioners within the Nigerian construction industry. A total of 310 copies of the questionnaire were distributed via email and the sample size included project managers, architects, engineers, consulting engineers, building contractors and quantity surveyors. 94 valid responses were received representing a total response rate of 30.3%. **Figure 3** shows a breakdown of the valid responses received based on the respondent type.



**Figure 3: Breakdown of valid questionnaire responses**

The questionnaire was structured into two parts, the first part was used to conduct an industry strength, weakness, opportunity and threat (SWOT) analysis of the Nigerian construction sector. The SWOT analysis is presented in **Table 2**.

**Table 2: SWOT Analysis of Nigerian Construction Sector**

<p style="text-align: center;"><b><u>STRENGTHS</u></b></p> <ul style="list-style-type: none"> <li>• Availability of cheap and affordable labour.</li> <li>• Large labour force.</li> <li>• Large number of foreign graduates.</li> <li>• Availability of local raw materials.</li> </ul>	<p style="text-align: center;"><b><u>WEAKNESS</u></b></p> <ul style="list-style-type: none"> <li>• Poor credit facilities and access to finance.</li> <li>• Lack of suitably experienced and motivated professionals.</li> <li>• Poor integration of people with construction knowledge in the design process.</li> <li>• Poor documentation of lessons learnt from previous projects.</li> <li>• Poor implementation of health and safety policies.</li> <li>• Lack of research and development aimed at developing innovative construction approach.</li> <li>• Low quality standards and poor enforcement of construction specifications.</li> <li>• Poor inspection and control</li> <li>• Poor remuneration of indigenous staffs in comparison to expatriates.</li> </ul>
<p style="text-align: center;"><b><u>OPPORTUNITY</u></b></p> <ul style="list-style-type: none"> <li>• Large construction market.</li> <li>• Adoption of lean thinking.</li> <li>• Collaboration with foreign construction companies presents opportunities for technology transfer.</li> </ul>	<p style="text-align: center;"><b><u>THREATS</u></b></p> <ul style="list-style-type: none"> <li>• Harsh and unpredictable business environment.</li> <li>• High level of extortion by local communities.</li> <li>• Lack of social security.</li> <li>• Over reliance on foreign expatriates.</li> <li>• High inflation levels.</li> </ul>

The second part of the questionnaire sought to provide answers regarding the knowledge and implementation of buildability assessment and value engineering within the respondent's organisation. The findings of the survey revealed that 95% and 90% of the respondents were familiar with the concepts of buildability assessment and value management respectively. However, only 20% of the respondents claim the use of value management workshops on projects they have been involved in within the last 5 years while 45% reveal carrying out buildability assessment on designs prior to commencing construction.

The research findings revealed a lack of implementation of buildability assessment and value management on construction projects within the Nigerian construction sector, hence a framework was developed showing how to integrate both concepts to enhance the knowledge and facilitate the implementation.



## **DISCUSSION**

The construction industry is often criticised for its poor performance in quality, cost, safety and speed of delivery. One of the main reasons for this criticism is the degree of fragmentation that exists in the construction sector. This “bridge” can be mended using value management workshops which seeks to bring together all the major stakeholders typically involved in a project early in the project. The ease of implementation of the value management workshop is facilitated by choosing a project delivery method that promotes early interaction of the project stakeholders such as the integrated project delivery method (IPD). However, Ghassemi and Becerik-Gerber (2011) contends that this delivery method is beset with legal, financial, cultural and technologies barriers while Azari et al. (2014) revealed that the IPD is best suited for complex, dynamic and fast projects.

The reviewed literature highlighted the importance and role of buildability assessment and value management in improving a projects performance indicators as both practices are structured towards providing value to clients in terms of better and more buildable designs, speed of delivery, improved quality and helping to identify cost saving potentials in a project regardless of the project delivery method adopted. Through value management workshops, more innovative ways can be discovered which would seek to add more value to the project. Some schools of thought however view value management as a cost saving exercise because it seeks to provide the best value for clients at the most affordable cost and the argument following this line of observation is that quality will be sacrificed at the alter of cost. It therefore becomes imperative to ensure that the outcome of the value management workshop is not a trade off with the quality requirements of the project.

A major observation from literature was the revelation that although there is a consensus of the benefits to be gained from implementing value management and buildability assessments on projects, both concepts are carried out differently using different personnel and this has the potential of leading to time and resource wasting as opposed to when there is an integrated team involved in both processes.

## **CONCLUSION**

Integrating buildability assessment and value management would help in reducing cost overruns while enhancing the satisfaction of the project stakeholders as it seeks to discover alternative cost-effective ways of carrying out construction processes while ensuring that the project still conforms to the expected quality standards. The implementation of an integrated conceptual framework within the Nigerian construction sector will serve as a vital step towards improving productivity, increasing profitability while increasing collaboration.

The use of building information modelling (BIM) plays an important role in answering the question of buildability to some extent. It however does not take the place of a formal buildability assessment exercise with input from construction practitioners nor does replace the ideas and innovations that a value management workshop would generate. Better designs facilitating ease of construction can be produced when the input of construction personnel are sought during the design process. Also, the potential for cost savings are at the highest during the early stages of the projects and this presents an excellent opportunity to exploit the advantages of conducting a value management workshop.

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