RIBA Plan of Work Model and Classification of Constraints to Cost Performance of Construction Projects

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Abstract

The trend of construction cost performance is under scrutiny because huge amount of public funds and resources go into construction projects. Performance of construction cost in recent time is not satisfactory and has connection to certain project factors. These factors have been identified and evaluated by many studies who fail to classify and standardize these factors according to Royal Institute of British Architect (RIBA). RIBA plan of work is a universal document that classifies building construction into various stages of operation. However, this paper employs RIBA plan of work model in classifying constraints to cost performance of construction projects with a view to grouping these factors under appropriate sections of the document. Pertinent literature relevant to the study was reviewed and primary data were collected by means of stratified random sampling. Both descriptive and inferential statistics were employed in data analysis. The paper reveals that the most significant stages of RIBA model in the classification of factors influencing performance of construction cost are construction and design/pre-construction stages. The paper recommends a careful consideration of the most significant stages by construction professionals and other stakeholders as outlined in RIBA document for improve construction cost performance.

Keywords: Construction cost constraints, cost performance, factors classification, project factors, Royal Institute of British Architects (RIBA).

Introduction

The measurement criteria of a construction project performance are multi-dimensional. The most widely examined and significant are cost, time and quality; eventhough the optimum achievement of these often seem impossible to most project (Odediran and Windapo, 2014). However, cost of construction is a basic criterion and driving force of project success (Azha et al., 2008). Moreover, completing project within estimated cost is receiving much attention (Ali and Kamaruzzaman, 2010; Bello and Odusami, 2010).

Construction projects final cost globally are known for overshooting their initial cost budget (Ogunsemi and Aje, 2005). This is often described as cost overrun (Choudhry, 2004; Al-Najjar, 2008) and the trend is more severe in developing countries where overruns exceed the anticipated cost of the project (Angelo and Reina, 2002). Construction industry in Nigeria is faced with the problem of cost overrun as one of the prevailing factors influencing construction cost performance (Balogun, 2005).

The incidence of cost overrun on construction projects is due to influence of many project factors on construction performance (Kaming et al., 2006; Azhar et al., 2008; Otunola, 2008; Ameh et al., 2010; Ali and Kamaruzzaman, 2010; Mahamid and Bruland, 2011; and Kasimu, 2012). These project factors are stakeholders' (clients/consultants)

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obligations and uncertainties during the execution of construction project; and these factors occur at different stages of project. Previous studies have reviewed these factors based on their level of influence on construction cost performance and did post-analysis classification of these project factors (Odediran and Windapo, 2014; Abdul-Aziz, 2013; Kasimu, 2012; Ali and Kamaruzzaman, 2010; Ameh et al., 2010) but limited number examined and classify these factors according to Royal Institute of British Architects (RIBA) outline plan of work for building/construction project. RIBA (2007) makes a comprehensive outline plan of work which explicitly organizes the process of designing and managing building/construction projects and administering building/construction contracts into a number of key work stages. RIBA classified work stages into five (5) key components including preparation, design, pre-construction, construction and use. Projects factors or activities are grouped under each stages of construction project. However, this paper examines project factors influencing performance of construction cost and classifies these factors according to RIBA work stages. The RIBA work stages were grouped into three (3) stages and these are preparation, design and pre-construction and construction stages while use stage was excluded for the purpose of this paper. These classifications were ranked by the construction professionals.

Review of Literature

Cost Performance of Construction Projects

Performance of cost of construction projects has been documented and this among numerous researches includes that undertaken by Flyvbjerg (2002) which uncovered trends of cost overrun in global construction. Flyvbjerg (2002) found out that 9 out of 10 projects had cost overrun; overruns of 50 to 100 percent were common; overrun was found in each of the 20 nations and five continents covered by the study; and overrun had been constant for the 70 years for which data were available. Al-Momani (1996) in a study of construction cost prediction for public school buildings in Jordan established that in the developing countries, cost of construction projects exceed original contract price by 30%. Mahamid and Bruland (2010) study on 169 road construction projects in West Bank in Palestine between 2004-2008 found out that 100% suffer from cost divergence, 76.33% have cost over estimation while 23.6% have cost underestimation and discrepancy between estimated and actual cost has averages of 14% ranging from -39.27% to 98.04%. Pickrell (1990) carried out a study for the US Department of Transportation covering US rail transit projects with a total value of US$24.5 billion. The total capital cost overrun for eight of the projects was calculated to be 61% ranging from -10 to +106%. Also, the study by Auditor General of Sweden (1994) covering 15 road and rail projects revealed that the average cost overrun of eight road projects was 86%. The cost overrun for road projects ranged from -2 to +182%, while the average cost overrun for the seven rail projects was 17%, ranging from -14 to +74%.

Furthermore, a study by Fouracre *et al.* (1990) for the UK Transport and Road Research Laboratory (TRRL) which covered 21 metro systems in developing countries showed that six metro projects had cost overruns above 50%. Two of these projects had cost overrun of up to 500%, three had cost overruns in the range of up to 100%, and the remaining four had cost overrun of up to 50%. Skamris and Flyvbjerg (1996) conducted a research in Denmark which compared the accuracy of cost estimates on large-scale infrastructure projects (seven tunnels and bridges) before the decision was made to build concluded that cost overrun of 50–100% was common for larger transportation infrastructures and that overruns above 100% were not unusual. Akewusola (2007) reported that the mean cost overrun in Nigeria was 46.76% during the prosperity period of 1972-1978, 65.83% during the recession period of 1979-1983 and 23.39% during the

depression of 1984 to 2007. Chindo *et al.* (2012) in an empirical study in Nigeria established that initial and final provisional sums differ averagely by 18.41%, of which inflation accounted for 61.5% of the difference. The study also revealed that of the 40.54% increase between initial and final contract sums, differences between initial and final provisional sums accounted for 45.41%.

Factors Influencing Cost Performance of Construction Projects

The performance of construction projects are influenced by many project factors and there are also significant factors influencing the cost performance of construction projects (Odediran and Windapo, 2014a,b). Through a review of previous studies on factors influencing the performance of construction cost, a list of thirty-five (35) factors were obtained as shown in Table 1. The result of industry survey on the most significant constraints to cost performance of construction projects in the Nigerian construction industry is also outlined in Table 1.

RIBA Model of Work Stages

RIBA Outline Plan of Work 2007 is a universal document which makes a comprehensive outline of work stages for building/construction project; and explicitly organizes the process of designing and managing building/construction projects and administering building/construction contracts into a number of key work stages. RIBA classification was in five (5) key stages which include preparation, design, pre-construction, construction and use. Projects factors or activities are grouped under each stages of construction project. Preparation stage covers project appraisal and design brief. Project appraisal identifies client's needs and objectives, business case and possible constraints on development. This also includes preparation of feasibility studies to assess the available design options to enable the client decide whether to proceed. Design brief ensures the development of initial statement of project by confirming key requirements and constraints; identifies procurement method, procedures, organizational structure and range of consultants and others to be engaged for the project.

Design stage covers three key sub-stages; concept, design development and technical design. Concept is the process of implementing design brief and preparation of additional data. It also include preparation of outline proposals for structural and building services systems, outline specifications and preliminary cost plan, and review of procurement route. Design development includes structural and building services systems; updated outline specifications and cost plan while technical design provides information on specification sufficient to co-ordinate components and elements of the project and information for statutory standards and construction safety. Pre-construction stage also outlines details on production information, tender documentation and tender action. Production information provides sufficient detail to enable a tender or tenders to be obtained; application for statutory approvals and preparation of further information for construction requirement under the building contract. Tender documentation is the preparation and/or collation of sufficient details to enable tender/tenders to be obtained for the project. Tender action is the process of identification and evaluation of potential contractors and/or specialists for the project; obtaining and appraising tenders; submission of recommendations to the client.

Table 1. Significant Constraints to Total Cost Management (TCM) of Construction Projects

S/N	Constraints to Total Cost Management (TCM)	Significance	
		SNCI	Rank
1	Variation orders	0.5953	2
2	Material price fluctuation	0.6932	1
3	Unstable market trends and conditions	0.5202	5
4	Additional works	0.5160	6
5	High inflation rate	0.5231	4
6	Technical/construction errors and omissions	0.5467	3
7	Poor financial/cost forecasting	0.4943	8
8	High design inaccuracy	0.4663	16
9	Inaccurate estimation of quantities of works	0.5020	7
10	Irregularity in cash flow	0.4891	10
11	Poor contract/site management	0.4687	15
12	Client' changing requirements and experiences	0.4798	12
13	Inadequate cost estimating method	0.4770	13
14	Incessant project delay	0.4897	9
15	Poor financial/cost planning	0.4757	14
16	Poor leadership style on construction projects	0.4464	20
17	Inadequate project planning and monitoring	0.4869	11
18	Frequent contractual claims	0.4367	21
19	High material wastage on site	0.4264	22
20	Inadequate project decision making	0.3991	30
21	Inaccurate labour cost and requirements	0.4233	23
22	Poor financial/cost control and monitoring	0.4657	17
23	Shortage in material supply	0.4075	29
24	Poor materials and equipment procurement strategies	0.4164	25
25	Instability in exchange rate	0.4627	18
26	Adverse weather conditions	0.4508	19
27	Incessant payment delay	0.3946	32
28	Poor project information dissemination and management	0.4094	28
29	Inadequate construction cost data	0.3965	31
30	Inaccurate contractor's pricing strategies	0.4203	24
31	Use of poor quality of materials	0.4119	26
32	Project complexity	0.4105	27
33	Poor site conditions	0.3866	34
34	Poor contract documentation	0.3813	35
35	Incessant dispute occurrences	0.3896	33

Source: Odediran and Windapo (2014b); Note: SNCI= Significance Index

Construction stage covers mobilization and construction to practical completion. Mobilization is the of process of letting the building contract, appointing the contractor, issuing of information to the contractor and arranging process handing over of site to the contractor. This stage also ensures the administration of the building contract by making

provision to the contractor further information as and when reasonably required; and reviewing of information provided by contractors and specialists. Use stage is the administration of the building contract after practical completion and making final inspections. It also involves assisting building user during initial occupation period and review of project performance in use. This captures the outline of what is expected of construction professionals at every stages of construction projects; and as a standard document will form the foundation for classifying those factors influencing the cost performance of construction projects.

Methodology

The aim of this research is to classify constraints to the cost of construction projects according to RIBA outline plan of work stages. Review of literature was made to highlight the top rated constraints which form the constructs of the instrument (questionnaire) used in the study. A list of thirty-five (35) factors influencing cost overrun of construction projects was made (Table 2). RIBA outline plan of work was also obtained and evaluated for the purpose of this study to highlight content of each work stages which was adopted in line with the aim of this paper. The study population comprised of construction professionals working in the public sector (Government ministries, departments and agencies) and private sector (consulting and contracting practices) in South Western zone (Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states) of Nigeria. The study employed stratified random sampling technique in the selection of respondents from the registers of various professional bodies. This is because the professionals are grouped in form of state chapters representing the population of the professionals. A sample size of two hundred and five (205) respondents was obtained from the zone out of which one hundred and eight (108) responded to the survey. Seventy-four (74) responses were found suitable for analysis in term of completeness and timely response to the questionnaire.

This represents a response rate of thirty-six percent (36%). The survey questionnaire was structured into two (2) sections. The first section focused on the general background of the employers/firms and the respondents. Information requested from the employers/firms include their location, years of establishment and type of organization; and information about the responding officers include their positions in the firm, professional designation & registration, academic qualification, year of work experience within the organizations/firms and construction industry. The second section addressed the classification of factors influencing the cost performance of construction projects in Nigeria. The professionals were asked to score the identified factors on the scale of three (3) stages of construction projects which include; 1-preparation (conceptual/feasibility), 2-design (planning) & pre-construction and, 3-construction (execution) stages using RIBA outline plan of work model. This shows that the rating scale was 1, 2 and 3 respectively. The values of mean score (MS) were calculated using SPSS 20 as follows:

$$MS = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{(n_5 + n_4 + n_3 + n_2 + n_1)}$$

Where $n_{5=}$ number of respondents who picked 5
$n_{4=}$ number of respondents who picked 4
$n_{3=}$ number of respondents who picked 3
$n_{2=}$ number of respondents who picked 2
$n_{1=}$ number of respondents who picked 1

Findings and Discussion

Test of Sample Adequacy and Appropriateness

The list of the factors influencing cost performance of construction projects highlighted as shown in Table 1 were subjected to factor analysis with each item treated as a variable with the aim of reducing them to few significant factors which will be used in the description of closely related factors and those sharing the same features. The adequacy and appropriateness of the factors influencing performance of construction cost was tested using Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) and the Bartlett's test of sphericity. The result presented in Table 2 shows that KMO value was 0.631. Field (2005) established that the KMO value of a set of scores should be close to 1 for factor analysis to yield distinct and reliable factors and Wiki (2007) also stated that Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (MSA) should be greater than 0.5 for satisfactory factor analysis to proceed.

Hence, from these propositions, it could be concluded that factors analysis is appropriate for the data collected for this study. Also, Bartlett's test of sphericity showed that the result was highly significant (χ^2 = 1.064E3, $p < 0.05$). The result agreed with Field (2005) recommendation and therefore confirmed the adequacy and appropriateness of factor analysis carried out for this study.

RIBA Model Classification of Constraints to Cost Performance of Construction Projects

From the result of factors analysis of 35 factors influencing cost performance of construction projects identified from literature and adopted from Odediran and Windapo (2014b), Table 3 shows how construction professionals score and classify influence of these factors on construction cost performance. The classification was done based on RIBA outline plan of work stages which include preparation (conceptual/feasibility), design (planning) & pre-construction and construction (execution) as below outlined. Table 4 shows that there are more factors influencing construction cost performance at construction stage followed by design/pre-construction stage and with least (1) factor at preparation stage; which implies a need for better mechanisms to manage every components of construction process.

i. Preparation Stage

The result shows that the only factor influencing cost performance of construction projects at preparation (conceptual/feasibility) stage was high design inaccuracy. This shows that accuracy of construction cost depends on the accuracy of design and when designs are deficiency, estimated cost will be inaccurate.

ii. Design/Pre-Construction Stage

The factors influencing construction cost performance at design/pre-construction stage are poor financial/cost planning, high design accuracy, inaccurate estimation of quantities of works and inadequate cost estimating method. Other factors include inadequacy of cost estimating method, poor financial/cost planning, inadequate project planning and monitoring, inadequate project decision making, poor materials and equipment procurement strategies, inadequate construction cost data and inaccurate contractor's pricing strategies. The design/pre-construction stage classification is related to the inaccuracy in the quantification of works, construction cost estimation and pricing, cost planning and financing, and materials and equipment procurement.

Table 4. RIBA Model Classification of Constraints to Cost Performance of Construction Projects

S/N	RIBA Work Stages	Constraints	Significance Index	Rank
1	Preparation	High design inaccuracy	0.4663	1
2	Design and Pre-construction	Poor financial/cost forecasting	0.4943	2
		High design inaccuracy	0.4663	6
		Inaccurate estimation of quantities of works	0.5020	1
		Inadequate cost estimating method	0.4770	4
		Poor financial/cost planning	0.4757	5
		Inadequate project planning and monitoring	0.4869	3
		Inadequate project decision making	0.3991	9
		Poor materials and equipment procurement strategies	0.4164	8
		Inadequate construction cost data	0.3965	10
		Inaccurate contractor's pricing strategies	0.4203	7
3	Construction	Variation orders	0.5953	2
		Material price fluctuation	0.6932	1
		Unstable market trends and conditions	0.5202	5
		Additional works	0.5160	6
		High inflation rate	0.5231	4
		Technical/construction errors and omissions	0.5467	3
		Irregularity in cash flow	0.4891	8
		Poor contract/site management	0.4687	11
		Client' changing requirements and experiences	0.4798	10
		Incessant project delay	0.4897	9
		Poor leadership style on construction projects	0.4464	15
		Frequent contractual claims	0.4367	16
		High material wastage on site	0.4264	17
		Inaccurate labour cost and requirements	0.4233	18
		Poor financial/cost control and monitoring	0.4657	12
		Shortage in material supply	0.4075	21
		Instability in exchange rate	0.4627	13
		Adverse weather conditions	0.4508	14
		Incessant payment delay	0.3946	22
		Poor project information dissemination and management	0.4994	7
		Use of poor quality materials	0.4119	19
		Project complexity	0.4105	20
		Poor site conditions	0.3866	24
		Poor contract documentation	0.3813	25
		Incessant dispute occurrences	0.3896	23

This finding to a significant extent agrees with findings and classifications of Le-Hoai, et al. (2008), Ameh et al. (2010), Kasimu (2012) and Abdul Azis et al. (2013) who classified factors influencing cost performance of construction projects into issues related to construction cost estimating, pricing, financing; construction and site management.

Table 2. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.631
Bartlett's Test of Sphericity	Approx. Chi-Square	1.064E3
	df	595
	Sig.	.000

This RIBA classification shows that for effective construction cost to be achieved at pre-construction stage; adequate effort should be made by the estimators to ensure that quantities of works are accurately taken to represent design because the top rated factor at this stage is inaccurate cost estimation of quantities of works. After quantities of construction works are taken, accurate pricing and estimating of unit price is another significant milestone for effective construction cost performance. Moreover, establishing the actual project cost is not enough than a good cost planning and adequate procurement system. These were supported by previous studies (Long *et al.*, 2008; Nega, 2008; Peeters and Madauss, 2008; Squire, 2008; Kaliba et al., 2009; Gatlin, 2013; Odediran and Windapo, 2014b; Odediran and Windapo, 2014b). This will provide a platform by which a cost check is made at the construction stage of a project; but when this fails possibility of construction cost performance is in doubt.

iii. Construction Stage

Factors influencing cost performance at construction stage of a project are variation orders, material price fluctuation, unstable market trends and conditions, additional works, high inflation rate and technical/construction errors and omissions. Other include irregularity in cash flow, poor contract/site management, client' changing requirements and experiences, incessant project delay, poor leadership style on construction projects, frequent contractual claims, high material wastage on site, inaccurate labour cost and requirements, poor financial/cost control and monitoring, shortage in material supply, instability in exchange rate, adverse weather conditions, incessant payment delay, poor project information dissemination and management, use of poor quality materials, project complexity, poor site conditions, poor contract documentation and incessant dispute occurrences. These factors according to RIBA classification shows that factors influencing construction cost performance during construction process are associated with instability in market conditions, construction and design errors, poor site/construction management, hostility of project/site characteristics. This finding agrees with previous studies (Lee et al., 2008; Azhar et al., 2008; Ameh et al., 2010; Kasimu, 2012; Rahman et al., 2013; Shanmugapriya and Subramanian; 2013; Abdul-Aziz et al., 2013).

This shows that for effective construction cost performance to be achieved, understanding of the effect of forces of demand and supply in construction markets by the estimators and project managers is necessary in achieving an effective construction cost performance. This finding is in support of previous studies (Long *et al.*, 2008; Odediran and Windapo, 2014b; Odediran and Windapo, 2014b).

Conclusion and Recommendation

This paper through previous studies evaluates factors influencing cost performance of construction project and classifies these factors according to RIBA plan of work model. The classification according to RIBA model includes preparation, design/pre-construction and construction stages excluding use stage in this paper. The result shows that out of thirty-five (35) factors identified, there are 1, 9 and 25 for preparation, design/pre-construction and construction stages respectively. This implies that there are many factors influencing the performance of construction cost at construction stage than design/pre-construction or preparation/feasibility stages. The top rated factors at construction stage are material price fluctuation, variation orders, technical/construction errors and omissions, high inflation rate, unstable market trends and conditions, and additional works. These are associated with market conditions and design inaccuracy. However, the top rated factors at design/pre-construction stage are inaccurate estimation of quantities of works, poor financial/cost forecasting, inadequate project planning and monitoring, and inadequate cost estimating method.

This paper concludes that the most significant stages in the RIBA model classification of the constraints to the performance of construction cost are construction and design/pre-construction stages. The pertinent issues raised at the significant stages of the model are market conditions, design inaccuracies, deficiencies in method(s) employed in cost estimation and project cost/financial forecasting, planning and monitoring. These are associated with the professional/contractual responsibilities, duties and obligations of designers (architects and engineers), estimators (quantity surveyors) and constructor (contractors/builders) on a construction project. However, giving adequate attention to these factors at various stages of construction project by every concerned stakeholders is an essential step in achieving cost performance of construction project and efficient project delivery.

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