NAU Journal of Civil Engineering (NAUJCVE) September/October 2025

Nnamdi Azikiwe University Journal of Civil Engineering (NAUJCVE)

Volume-4, Issue-1, pp-1-14

www.naujcve.com

Research Paper Open Access

# Assessing Factors Affecting Design And Construction Interface In Civil Engineering Projects

**[1]Victor Onuche UCHOLA, [2]Tolulope Samuel FAWALE, [3]Junior AGBONTAN, [4]Emmanuel OSAWE**

*[1]Department of Civil Engineering, Ambrose Alli University, Ekpoma*
*ucholavictor@aauekpoma.edu.ng*
*[2]Department of Quantity Surveying, University of Benin*
*tolulope.fawale@uniben.edu*
*[3]Department of Civil Engineering, Ambrose Alli University, Ekpoma*
*agbontanjunior@aauekpoma.edu.ng*
*[4]Department of Civil Engineering, Ambrose Alli University, Ekpoma*
*osawe.e@aauekpoma.edu.ng*

**Abstract:** *Design and construction interface problems impede the successful delivery of construction projects within the specified time, cost and quality. During the project, many interface problems may arise and their severities may vary and affect the overall project performance. This study assessed factors affecting the Design and Construction interface in Civil Engineering Projects with a view to determining the most important factors contributing to interface problems. This was achieved through a literature review, pilot study and administration of questionnaires. Data collected were analysed using descriptive statistics. The means and standard deviations of the responses were calculated. The results revealed that the five most severe interface factors affecting the design and construction interface in civil engineering projects in Nigeria are Delaying of due payments, Delay in approvals by government authorities, Inadequate planning and/or scheduling, lack of involvement of the contractor during the design phase and lack of specialist construction manager. The three most suitable interface mitigants are Early decision making by project parties, Provision of standard guidelines for stipulated drawings and safety considerations. It is recommended amongst others that approvals by government should be issued early and adequate planning and scheduling should be made before commencement of any project.*

***Keywords:*** *interface problems, interface factors, civil engineering projects, statistical analysis*

Date of Submission: 28-08-2025 Date of acceptance:12-09-2025

## 1. INTRODUCTION

The construction industry is one of the key industries of any country (Fisk, 1997; Thomas and Priyanka, 2015). It is influenced by high changing variables and unpredictable interface factors that could result from different sources (Clough and Sears, 1994). Large and complex building projects have been built as a result of the demands of the public and private sectors. To satisfy the high demand of both the public and private sector needs, it is expected that many interface problems like errors and defects would have occurred during design and construction phase of these projects (Assaf, Al-Hammad and Al-Shihah, 1996).

Construction project traditionally involves two major professionals in the construction industry and these two professionals are the designer and the contractor (Arain and Assaf, 2006). Communication for the effective coordination between these two parties is the key factor to be considered for the successful completion of a project (Arain and Assaf, 2006). It is postulated that disagreements between these two parties have caused barriers in the design phase and construction process (Arain and Assaf, 2006).

The construction process is influenced by high changing variables and unpredictable factors that could result from different sources, these resources include: The performance of construction parties, resources availability, environmental conditions, involvement of other parties and contractual relations (Arain and Assaf, 2006). As a

consequence of these sources, the construction of project may face interface problems which could cause delay in the project completion time (Clough, and Sears, 1994).

Interfaces are boundaries between independent but interacting systems, organisations, project phases and construction elements (Weshal et al., 2014)). The severity of interface issues and the necessity of interface management IM have not received adequate recognition from both industry and academia(Qian, Georg and Yvan, 2008) . The understanding of interface issues is still insufficient and the proposed or employed measures are unilateral, which result in unsatisfactory IM performance in construction projects (Qian, Georg and Yvan, 2008). Thus, the interactive relationship in complex construction projects would increase the possibility of interface problems (Huang et al., 2008). Factors that cause design-construction interface problems involve two or more overlapping or successive events that influence engineering projects (Chien-Liang and Chen-Huu, 2017). The design phase is normally carried out with little interaction between the construction and design teams causing many problems known as the interface problems such as incomplete designs, change orders, rework, construction delays.

Interface problems impede the successful delivery of construction projects within the specified time, cost and quality (Mohamad and Sameh, 2016). Interface problems are problems or inconsistencies that mainly take place intermediate to the design and construction phase (Magi and Priyanka, 2015). Examples of design-construction interface problems factors are conflicts and problems caused by the differences in subjective and objectives views regarding functional or physical object between two or more systems (Chien-Liang and Chien-Huu, 2017), poorly written contract, inadequate time for design teams, lack of buildability studies (Almousli and Elsayegh, 2016) et ce tra. With limited time and budget often offered by clients to deliver projects, it is expected that many defects and errors will occur in the design and construction phases of these projects (Arain, Pheng, and Assaf, 2006).

Therefore, effective construction management is essential which deals with identifying the factors that cause these problems and avoiding them (Thomas and Priyanka, 2015). Interface management has been proposed to manage these interface problems. Verma (1995) sees interface management as the management of these problems that often occur between two or more project parties. Poor project performance is imminent in construction because the severity of interface problems in construction and the need to adopt interface management had not received adequate level of attention (Chen et al., 2008) as cited in Weshah et al. (2014). In 2006, the United Nation Relief Works Agency (UNRWA) reported the frequent causes of poor performance of many local construction projects, most of which were interface problems. Factors that contribute to these interface problems include: excessive amendments of design and drawings, unavailability of materials, ineffective monitoring and feedback, poor coordination among participants, and lack of project leadership skills (Mahamid, 2011). In 2006 United Nation Relief Work Agency(UNRWA) reported that the frequency of the causes of poor project performance of many local construction projects can be attributed to design-construction interface problems.

Many studies of different type of construction projects, outlined the interface problems between two parties or more, such as between contractors and owners (Al-Hammad, 1990), designers and contractors (Al-Hammad and Assaf, 1992), contractors and subcontractors (Al-Hammad 1993; Hinze and Tracey 1994), maintenance contractors and owners (Al-Hammad, 1995), and owners and designers (Al-Hammad and Al-Hammad, 1996). Few studies have identified the interfaces among all parties involved within the construction projects, for example, a study done by Al-Hammad (2000) as cited by Weshah et al.(2013) on the common interface problems among various construction parties. Thomas and Priyanka (2015), Mohamad and sameh and Shaar etal. (2016) studied interface problems between design and construction interface.

Management of design and construction interface problems that often occur among people, departments and disciplines rather than within the project team itself is necessary to mitigate design and construction interface problems across a common boundary between two organisations, phases, or physical entities which are independent. Good interface management aids uncertainty reduction and enhances complex relationships in the social network by improving coordination and cooperation of project stakeholders (Shen, Tang, Wang, Duffield, Hui and You, 2017). Since most interface problems happen at the interface between design and construction, understanding the factors affecting design and construction interface is important, to minimise or eliminate interface problems.

The factors affecting design and construction interface can hinder the progress of a building project substantially (Arain and Assaf, 2006). Design-construction interface offers a great potential for improvement. Considering these factors which can ultimately affect any construction projects at design and construction interface, there is a need to institute better and comprehensive solutions to coordinate activities at the interface (Arain and Assaf, 2006). It is important to determine the factors affecting the design and construction interface in the project life cycle (Arain and Assaf, 2006).

Many researchers have grouped the causes for interfacial issues from their perspectives. Cause and effect diagram was adopted to illustrate the causes and grouped the causes under people/participants, methods/processes, resources, documentation, project management and environment (Chen et al.,2008). People/participants are further divided into sub-factors as poor communication, co-ordination, poor decision making and financial problems. Poor communication creates design errors, assembly conflicts and delays. Methods/Process was sub-divided as inferior design in interfaces, construction and assembly problems.

Inferior design in interfaces will be created due to lack of consideration for modularity, standardization, component integration, manufacturing and construction. Construction delays, Poor quality of construction, complicated construction processes, poorly designed work sequence and handling methods creates construction and assembly problems (Chen et al.,2008). The sub factors of resources are labour issues, material issues, equipment issues, information issues, space conflicts among labour, equipment and materials. Labour issues are mainly created due to lack of labour, cross-functional trained teams being unavailable. Inferior interface between man, machine or product, proper equipment or tools being unavailable can lead to equipment issues.

Interface issues such as material issues are mainly due to material delays, inaccurate quantity take-off, special materials or long lead items. Inadequate specifications and drawings, delayed permits and shop drawing submissions and approval, inadequate contract, change order problems, lack of interface information lead to documentation issues (Chen et al.,2008).

Some researchers carried out studies on interface issues and their findings are reported below.

Abdul-mohsen and Sadi(1992) carried out a study on the design-construction interface problems in saudi Arabia. Pilot study of interviews of designers and contractors was carried out. The result of their findings suggested that working drawing details, unfamiliarity with local conditions and buildability ranked the highest causes of interface problems. Weather conditions, nationalities of both design and construction firms were ranked low.

Abdul-Mohsen (2000) carried out a study on the common interface problems among the various construction parties. Interview with various construction professionals were conducted in other to identify the factors contributing to the interface problems among them. A questionnaire survey was developed. The result of their findings revealed that three categories of the causes of interface problems were found to have a severe effect, while the remaining category was ranked moderately severe. Fourteen (14) of the detailed common interface problems factors were evaluated as severe, while the remaining five were evaluated as moderately severe. They concluded by saying that financial problems category is the most severe. They recommended the need for quality controls with the clients and the other related construction parties.

Faisal and Sadi (2006) studied the consultant's prospects of the sources of design-construction interface problems in large building projects in Saudi Arabia. A questionnaire survey was carried out to collect information on potential sources of disagreement at the project design-construction interface. Responses from twenty-four (24) consultants were analysed. Their findings suggested that the contractors lack of comprehension of drawing details and specification, Involvement of the contractor as consultant, time limitation in the design phase, design complexity and participant's honest wrong beliefs were considered as the most important sources of the project design-construction interface problems. On the other hand, project management as professional service, weather conditions, unforeseen problems and involvement of the contractor in design phase were the least important sources of problems between professionals at the project design and construction interface in large building projects. They recommended that the contractor should be involved at the design conceptual and development phases, project management services should be employed and value engineering or other value analysis techniques should be adopted for better coordination between the parties.

Fisal, Low and Sadi (2006) carried out a study on contractor's view of the potential causes of inconsistencies between design and construction in Saudi Arabia. Their findings suggested that the involvement of designer as consultant, communication gap between constructor and designer, insufficient working drawing details, lack of coordination between parties, lack of human resources in design firm, lack of designer's knowledge of available materials and equipment, and incomplete plans and specifications were considered as the most important causes of the project design and construction interface inconsistencies. On the other hand, project management as a professional service, weather conditions, nationalities of participants, involvement of the contractor in design conceptual phase, unforeseen problems, lack of involvement of the contractor in design development phase, and government regulations were the least important causes of inconsistencies between professionals at the project design and construction interface in large building projects. They recommended that project management services should be employed to help minimise conflicts between professionals.

Weshah, EL-Ghandour, Jergeas and Falls(2013) carried out factor analysis of interface management problems for construction projects in Alberta. Interface problem related to management factor was ranked the highest interface problems.

Weshah et al .(2014) developed a multiple regression analysis and risk analysis model for interface project performance enhancement in Alberta construction industry. Their findings suggested that interface problems caused by the technical engineering and site issues factor, bidding and contracting factor, the information factor were the strongest influences on the schedule and cost project performance indicators.

Thomas and Priyanka (2015) carried out a study on factors affecting design-construction interface. Survey questionnaire was developed. Interview was also carried out through online survey. Analysis of the data was carried out using the relative importance index method. Their results indicated that design complexity, time limitation in the design phase, lack of accuracy in specification and working drawings, lack of communication between designer and owner's family and participants' honest wrong beliefs are the most important causes of the interface problems that affects design-construction

interface. Whereas, effect of material changes during construction, weather conditions, involvement of the contractor in the design conceptual phase and development phase were revealed as least important problems. They concluded by saying that frequent professional meetings, maximizing standardization, regular safety meetings and preconstruction exercise done prior to any construction activity can reduce the severity of these problems.

Shaar, Assaf, Bambang, Babsail and El Fattah (2016) carried out a study on the design and construction interface problems in large building construction projects. Lack of study on the causes of interface problems in large building construction projects in Palestine necessitated their study. Pilot study and questionnaire survey were carried out. Their results revealed that the top 10 extreme significant causes are 'unstable client requirements', 'lack of proper coordination between various disciplines of the design team', 'awarding the contract to the lowest price regardless of the quality of services', 'lack of skilled and experienced human resources in the design firms', 'lack of skilled human resources at the construction site', 'delaying of dues payments', 'lack of specialized quality-control team', 'lack of professional construction management', 'delaying the approval of completed tasks' and 'vague and deficient drawings and specifications'. They recommended that interface between consultants and contractors should be improved. They suggested good communication among project parties.

Mohamad Sameh (2016) carried out a study on assessing the design-construction problems in the UAE. Lack of studies on the causes of construction interface problems in the UAE necessitated their study. A questionnaire survey was developed and distributed to construction professionals. RII was used in the analysis of the data. Their results revealed that the most significant causes of the interface problems in the UAE include lack of coordination inside the design firm, lack of specialist construction manager, poorly written contract, lack of project management as individual professional service and time limitation in the design phase. Moreover, the paper analysed the responses according to company role. They opined that most of these problems are caused by the lack of coordination and communication among the main contracting parties. Recommendations were made by these researchers to enhance the coordination and management of construction projects that lead to reduction in the design–construction interface problems. Chien-Liang and Chen-Huu(2017) explored interface problems in Taiwan's construction projects using structural equation modelling. Lack of studies on the application of structural equation modelling to study the root causes of projects interface problems among owners, designers and contractors necessitated their study. Their study had three main findings: (1) poor design causes interface problems; (2) ineffective communication and coordination among the owner, design, and construction dimensions are the main factors that cause construction interface problems; and (3) a lack of communication and coordination has a greater influence on the construction dimension than on the owner and design dimensions. The study recommended that all projects participants should 1) invest considerably more efforts in project planning and design 2) establish effective communication and coordination mechanism during the entire project life cycle.

## II. MATERIALS AND METHODS

### Data collection method

Questionnaires were used for this study. The development of the questionnaires was done in such a way that each question was clearly phrased to avoid ambiguity and checked for expression. The questionnaire was designed in three (3) parts. The first part deals with general questions to the respondents with regards to their status in the construction industry, educational qualification, years of experience in the industry, respondents' profession. This background information helped in ascertaining the reliability and credibility of data from the survey. The second part of the questionnaire dealt with information on the design-construction interface problem cause factors in Civil Engineering construction projects and the mitigating measures for interface problems which respondents used as a guide on their assessment. The questionnaire started with a brief summary of the purpose of the survey, the importance of responding and the fact that data of individual respondents would be kept confidential.

### Population of the study

To ensure adequate and reliable data collection, a sample is required to be homogenous and comprehensive and should give a true representation of the population. Therefore, the target populations of this study were respondents that have managed civil engineering projects. Purposive sampling was used to select the respondents relevant to the study.

To ensure that adequate representation of information was collected, the sample frame used was drawn using the snowballing method. To this end a systematic sampling was used to select the consulting engineers or project managers that were issued the structured questionnaires through hand delivery to their offices. The systematic sampling is a statistical method involving the selection of elements from ordered sampling frame. In systematic sampling procedure each element in the population has a known and equal probability of selection.

Analytical and quantitative statistical approaches were adopted to examine, identify, and categorize interface problems in civil engineering construction projects and the mitigating measures. The major interface factors identified from the literature were assessed based on the perceptions of the required participants. Questionnaires were delivered to participants in person to obtain primary data. This approach removed any undue pressure from the respondents and gave them the freedom to fill in the questionnaires as truthfully as possible. The Likert rating scale was used in the questionnaire. The questionnaire was designed in such a way that the stratification of the data

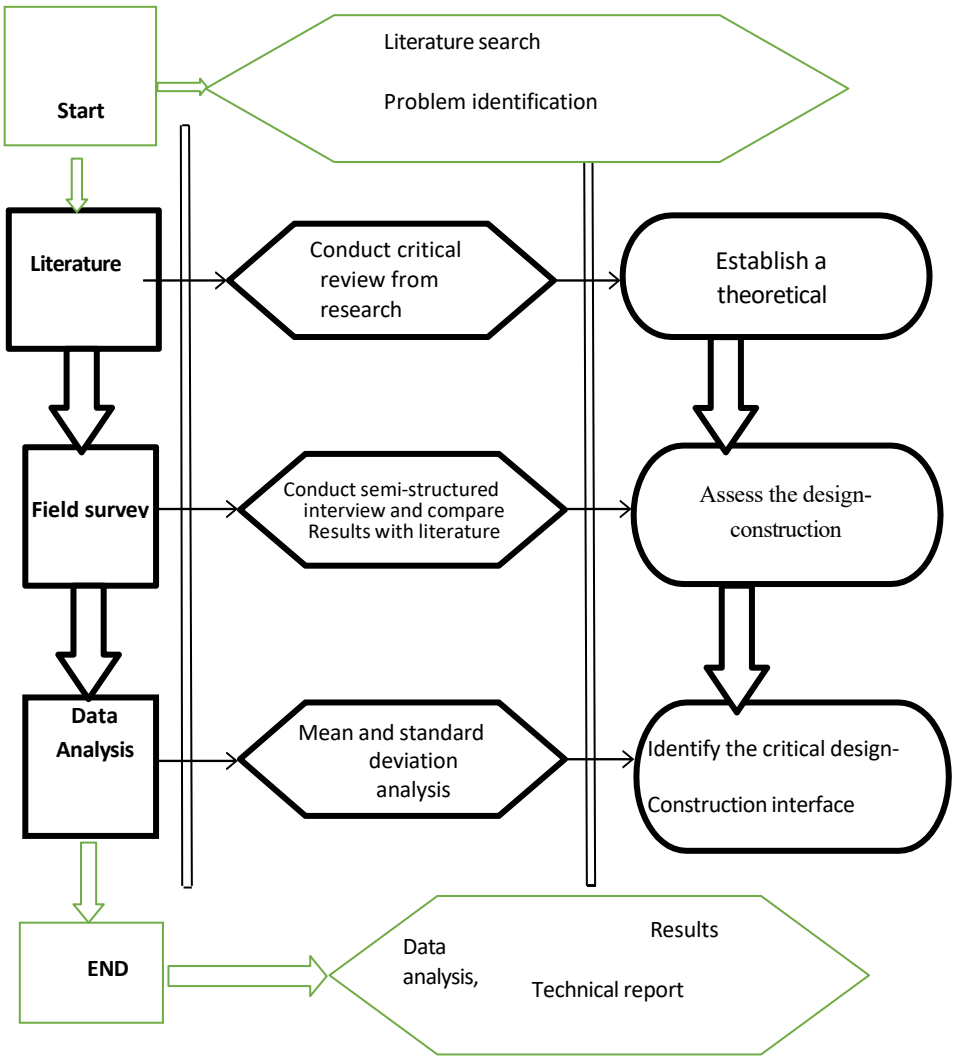
was easy for analysis. The questions involve recording the contribution of each variable to the civil engineering projects on a rating scale of: 1 – Very Low; 2 – Low; 3 – Moderate; 4 – High; 5 – Very high. The questions concentrated on past or present phenomena in civil engineering projects. The interest was to show how the past events had affected the projects.

**Data analysis Technique**

The data obtained from the questionnaire survey were analysed using mean and standard deviation index. Descriptive and analytical method were adopted to analyse the collected data. Validity and reliability tests were carried out using the Cronbach's alpha method to test the internal consistency of the data collected. Mean and standard deviation were used to determine the level of severity of the design-construction interface problem factors in civil engineering project in Nigeria.

Arain and Assaf (2006) and Arain, Pheng and Assaf(2006) adopted this method . This study adopts the mean and standard deviation for the rating of the interface factors and mitigants. SPSS and Excel were used in the analysis of the data. The mean scores were computed from the respondent's ratings.

A summary of the processes undertaken are summarized in figure 1 below


Start
Literature search
Problem identification
Literature
Conduct critical review from research
Establish a theoretical
Field survev
Conduct semi-structured interview and compare Results with literature
Assess the design-construction
Data Analysis
Mean and standard deviation analysis
Identify the critical design-Construction interface
END
Data analysis,
Results
Technical report

## III. RESULTS AND DISCUSSION

.

### Response Rate

In the survey, a total of 120 questionnaires were distributed to those that have managed civil engineering projects in Nigeria. 105 questionnaires out of the 120 distributed were returned duly completed and all were used in the analysis of interface factors and mitigants. This represents an 87.5% response rate of the field survey.

### General Information of the respondents

The general information which is the Section A of the questionnaire of this study, profiled the respondents in terms of years of experience, profession, average project size handled, mode of practice and educational qualification. The findings are presented in the tables 1 – 5

**Table 1:Years of Experience**

| Years | Number of respondents | Percentage (%) |
|---|---|---|
| <5yrs | 15 | 14.3 |
| 5-10yrs | 42 | 40.0 |
| 11-20yrs | 27 | 25.7 |
| >20yrs | 21 | 20.0 |
| Total | 105 | 100.0 |

Based on the years of experience of the respondents out of 105 respondents, 14.3% (15) have less than 5years' experience, 40% (42) have between 5-10 years' experience, 25.7% (27) have between 11-20 years' experience and 20% (21) have greater than 20years'experience.

**Table 2: Profession of respondents**

| Profession | Numberof respondents | Percentage(%) |
|---|---|---|
| Civil Engineer | 72 | 68.6 |
| Quantity surveyor | 3 | 2.9 |
| Contractor | 6 | 5.7 |
| Others | 24 | 22.9 |
| Total | 105 | 100.0 |

Based on the profession of the respondents, out of 105 respondents, 68.6% (72) were civil engineers 2.9% (3) were quantity surveyors, 5.7% (6) were contractor, 22.9% (24) represent others

Respondents were asked to tick the average project size handled in terms of cost. The result is presented in Table 3

**Table 3:Average project size handled**

| Cost | Number of respondents | Percentages (%) |
|---|---|---|
| <50 million | 21 | 20.0 |
| 50-100million | 15 | 14.3 |
| 100-500million | 15 | 14.3 |
| >500million Naira | 54 | 51.4 |
| Total | 105 | 100.0 |

Based on the average project size handled, percentage of respondents that have handled project worth less than 50million Naira are 20.0% (21),14.3% for 50-100 million and 100- 500 million and 51.4% (54) for project worth greater than 500 million Naira.

**Table 4: Form of practice**

| Type | Numberof respondents | Percentages (%) |
|---|---|---|
| Local | 72 | 68.6 |
| International | 3 | 2.9 |
| Both | 30 | 28.6 |
| Total | 105 | 100.0 |

68.6% (72) of the respondents practice locally, 2.9% (3) of the respondents practice Internationally and 28.6% (30) of the respondents practice both locally and internationally.

The results of the respondent qualifications was presented in table 5.

**Table 5: Highest qualification**

| Qualifications | Numberof respondents | Percentages (%) |
|---|---|---|
| HND | 12 | 11.4 |
| BSc | 78 | 74.3 |
| Masters | 15 | 14.3 |
| Total | 105 | 100.0 |

11.4% (12) of the respondents have HND, 74.3% (78) have BSc,14.3% (15) have Master's degree.

The reliability and validity tests were carried out on section B of the questionnaire to confirm the internal consistency of respondent's ratings on the severities and suitability of the interface factors and mitigants respectively.

A Cronbach's alpha of 0.997for the interface problems factors and 0.993 for the mitigating measures show that they are statistically significant because they are higher than the minimum value of 0.7 suggested by Nunnally and Bernstein (1994). Therefore, the internal consistency of the data collected is high.

Problem factors and interface mitigants were calculated based on the survey responses. The result is tabulated in tables 6 and 8.The range of ratings start at 1(very low) to 5 (very high). Table 7 shows the top design and construction interface problem factors in civil engineering based on rating in ascending order.

The most severe design and construction interface problem factors was delay of due payments with mean value of 3.60. Although this problem ranked first in both the overall ranking and at the design and construction phase, delay in due payment was ranked ninth based on consultants' evaluations, seventh based on contractor evaluations and sixth from both consultants and contractors' evaluations as the major

causes of design and construction interface problem by Shaar *et al.* (2016).

The second main design and construction interface problem factor that affects civil engineering project in Nigeria is delay in approval by government authorities with a mean value of 3.26. The problem was ranked second in overall ranking and second at the design and construction phase. It was ranked by Mohammad and Sameh (2016) as sixth major cause of design and construction interface problems in the overall ranking by the project participants: consultants, contractors and government authorities. Based on company role, delay in approval by government authorities ranked second from consultant evaluation, third from contractor evaluation and seventeenth from government authorities' evaluation by Mohamad and Sameh (2016). The third main design and construction interface problem is the inadequate planning and or scheduling (3.23). This was ranked as on the top major causes of delay in road construction projects in Kenya by Seboru (2015). The lowest ranked interface problem factors were the lack of coordination inside the design firm with mean value of 2.4, late issue of directives (2.46) and shortage of construction materials (2.49).

**Table 6: level of severities of the factors for the various project phases**

| S/N | Factors | Mean | Std Deviation | Partial Rank | Overall Rank | Mean Average |
|---|---|---|---|---|---|---|
| | **Design Phase** | | | | | |
| 1 | Lack of contractor involvement during the design phase | 3.11 | 1.515 | 1 | 4 | |
| 2 | Delay in preparing construction documents | 2.66 | 1.314 | 4 | 20 | |
| 3 | Time limitation in the design phase | 3.03 | 1.113 | 2 | 6 | |
| 4 | Lack of coordination inside the design firm | 2.40 | 1.363 | 6 | 28 | |
| 5 | Undefined owner scope | 2.77 | 1.317 | 3 | 17 | |
| 6 | Lack of human resources in the design firm | **2.60** | 1.342 | 5 | 22 | 2.76 |
| | **Construction Phase** | | | | | |
| 7 | Incomplete plans and specification | 2.70 | 1.545 | 7 | 19 | |
| 8 | Insufficient working drawings | 2.54 | 1.345 | 9 | 25 | |
| 9 | Lack of communication and coordination between parties during construction | 2.57 | 1.159 | 8 | 24 | |
| 10 | Complex design and technology | 2.94 | 1.314 | 4 | 12 | |
| 11 | Lack of specialist construction manager | 3.07 | 1.430 | 1 | 5 | |
| 12 | Material change during the construction phase | 2.97 | 1.259 | 3 | 8 | |
| 13 | Delay in material approval (submittals) | 2.86 | 1.130 | 6 | 15 | |
| 14 | Construction errors at job site | 2.99 | 1.197 | 2 | 7 | |
| 15 | Involvement of the designer as a consultant | 2.86 | 1.340 | 5 | 13 | 2.83 |
| | **Design-Construction phase** | | | | | |
| 16 | Lack of buildability studies | 2.86 | 1.180 | 7 | 15 | |
| 17 | Delay in approvals by government authorities | 3.26 | 1.185 | 2 | 2 | |
| 18 | Lack of professional experience and judgement | 2.94 | 1.499 | 5 | 11 | |
| 19 | Conflicts due to cultural differences | 2.63 | 1.482 | 9 | 21 | |
| 20 | Changeorders | 2.77 | 1.382 | 8 | 17 | |
| 21 | Lack of project management as individual professional service | 2.86 | 1.362 | 6 | 14 | |
| 22 | Poorly written contract | 2.60 | 1.342 | 10 | 22 | |
| 23 | Delaying the approval of completed tasks | 2.97 | 1.326 | 4 | 9 | |
| 24 | Delaying of due payments | 3.60 | 1.157 | 1 | 1 | |
| 25 | Shortage of construction materials | 2.49 | 1.233 | 11 | 26 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | Inadequate site investigation | 2.97 | 1.390 | 4 | 9 | |
| 27 | Late issue of instruction | 2.46 | 1.083 | 12 | 27 | |
| 28 | Inadequate planning and/or scheduling | 3.23 | 1.250 | 3 | 3 | 2.89 |

**Table 7: Severities of the interface problem factors in ascending order**

| S/N | Interface factors | Mean | Std.Deviation |
|---|---|---|---|
| 1 | Lack of coordination inside the design firm | 2.40 | 1.363 |
| 2 | Late issue of directives | 2.46 | 1.083 |
| 3 | Shortage of construction materials | 2.49 | 1.233 |
| 4 | Insufficient working drawings | 2.54 | 1.345 |
| 5 | Lack of communication and coordination between parties during construction | 2.57 | 1.159 |
| 6 | Lack of human resources in the design firm | 2.60 | 1.342 |
| 7 | Poorly written contract | 2.60 | 1.342 |
| 8 | Conflicts due to cultural differences | 2.63 | 1.482 |
| 9 | Delay in preparing construction documents | 2.66 | 1.314 |
| 10 | Incomplete plans and specification | 2.70 | 1.545 |
| 11 | Undefined owner scope | 2.77 | 1.317 |
| 12 | Change orders | 2.77 | 1.382 |
| 13 | Delay in material approval (submittals) | 2.86 | 1.130 |
| 14 | Lack of buildability studies | 2.86 | 1.180 |
| 15 | Lack of project management as individual professional service | 2.86 | 1.362 |
| 16 | Involvement of the designer as a consultant | 2.86 | 1.340 |
| 17 | Complex design and technology | 2.94 | 1.314 |
| 18 | Lack of professional experience and judgement | 2.94 | 1.499 |
| 19 | Delaying the approval of completed tasks | 2.97 | 1.326 |
| 20 | Inadequate site investigation | 2.97 | 1.390 |
| 21 | Material change during the construction phase | 2.97 | 1.259 |
| 22 | Construction errors at job site | 2.99 | 1.197 |
| 23 | Time limitation in the design phase | 3.03 | 1.113 |
| 24 | Lack ofspecialist construction manager | 3.07 | 1.430 |
| 25 | Lack of contractor involvement during the design phase | 3.11 | 1.515 |
| 26 | Inadequate planning and/or scheduling | 3.23 | 1.250 |

| | | | |
|---|---|---|---|
| 27 | Delay in approvals by government authorities | 3.26 | 1.185 |
| 28 | Delaying of due payments | 3.60 | 1.157 |

The mitigating measures for interface problems were analysed, using MS Excel and SPSS. The result is presented in table 8 in ascending order

**Table 8: Suitability of the interface mitigants in ascending order**

| S/N | Interface mitigants | Mean | Std.Deviation |
|---|---|---|---|
| 1 | Use of alternative project delivery method | 3.23 | 1.021 |
| 2 | Involvement of project management consultancy firms | 3.41 | 1.182 |
| 3 | Involvement of contractor at the design, conceptual and development phases | 3.47 | 1.331 |
| 4 | Use of building information modelling | 3.66 | 1.200 |
| 5 | Engaging the services of human resources in the design firms | 3.69 | .954 |
| 6 | Ability for clients to predict his budget based upon his requirement | 3.77 | 1.154 |
| 7 | Involvement of the owner during the design phase | 3.86 | 1.228 |
| 8 | Involvement of designers as consultants | 3.92 | 1.035 |
| 9 | Early shop drawing approval | 3.97 | .975 |
| 10 | Provision of training programmes | 4.00 | 1.101 |
| 11 | Investing more effort in project planning and design | 4.06 | .795 |
| 12 | Regular safety meetings and preconstruction exercise done prior to any construction activity | 4.09 | 1.030 |
| 13 | Early awareness of the weather and the geological problems of the project sites | 4.11 | .954 |
| 14 | Allocating adequate time for design phase | 4.12 | .805 |
| 15 | Application of value engineering or other value analysis techniques | 4.14 | .935 |
| 16 | Early permit for approval | 4.17 | .914 |
| 17 | | | |
| | Improving the coordination process among the design team | 4.20 | .752 |
| 18 | Client ability to set their complete requirements in advance before starting the design process | 4.23 | 1.076 |
| 19 | Establishing effective communication and coordination mechanisms | 4.23 | .683 |
| 20 | Continuous improvement in the design process in order to avoid repetition of design defects | 4.26 | 1.029 |
| 21 | Conducting frequent professional meeting | 4.29 | .616 |
| 22 | Assigning a team whose responsibilities are to create quality control check lists for project | 4.29 | .885 |

| | | | |
|---|---|---|---|
| 23 | Early progress payments by the client | 4.31 | .891 |
| 24 | Safety considerations | 4.34 | .830 |
| 25 | Provisions of standard guidelines for stipulated drawings | 4.37 | .486 |
| 26 | Early decision making by project parties | 4.40 | .598 |
| | | | |

From table 6 it can be seen that lack of contractor involvement during the design phase ranked first at the design phase and fourth for the overall ranking. Also, lack of specialist construction manager ranked first at the construction phase and fifth for the overall ranking. Similarly, delay of due payments to the designers ranked first at the design-construction phase and first for the overall ranking.

The mean average of the problems at the design phase was found to be 2.76, suggesting moderate and seen as the least source of the interface problems. Also, at the construction phase it was 2.83, suggesting moderate and seen as the second in terms of the severity. Similarly, at the design-construction phase it is 2.89, suggesting moderate and seen as the major source of the interface problems between design and construction.

The fourth most severe interface factor is the lack of contractor involvement during the design phase. It ranked first in the design phase and fourth in the overall ranking. Although the lack of contractor involvement during the design phase ranked seventeenth top interface factor by Mohamad and Sameh (2016) as this is the practice in the UAE.

The fifth most severe interface factors was the lack of specialist construction manager. It ranked first in the design phase and fifth for the overall ranking. Mohamad and Sameh (2016) ranked this factor as the second most significant interface problem factor. The specialist construction manager is the translator between the design and construction. Faridi and El-Sayegh (2006) stated that the unavailability of the construction/project management group for the project is one of the factors that delays construction projects in the UAE. The use of specialist construction manager and project management as a service is facilitated through the use of alternative project delivery methods.

Mohamad and Sameh (2016) ranked lack of specialist construction manager as the second most significant design-construction interface problem in the UAE and eight most important cause of interface problems by Shaaretal.(2016). Based on consultants evaluation Shaar *e tal*. (2016) ranked it as the fifth significant problem which is inline with this study. The factor with mean value of 3.11was ranked the least interface problem source by Shaaret al. (2016) from contractors evaluation and fifth least from consultant evaluation. Based on combined evaluation they rated it as second most significant interface problems. Interface factors at the design phase contradicts the findings of Arain and Assaf (2006), Arain, Pheng and Assaf (2006), Weshah *et al.* (2013), Thomas and Priyanka(2015), Al-Mousli and Elsayegh (2016) and Shaar *et al.*(2016).

The result suggests that the Delaying of due payments, were perceived as the most important design and construction interface problems. Delaying of due payments may hinder the progress of the project and can lead to civil engineering projects abandonment. This delay of due payments can also lead to adversarial issues.

Delay in approvals by government authorities was ranked second by the respondents. Often times in Nigeria, government contribute to delay in delivering civil engineering construction projects by delaying the approvals of the required tasks or permissions. Inadequate planning and/or scheduling was ranked third. The problem of inadequate planning and/or scheduling contribute to adversarial issues, cost overrun, schedule delay and poor quality in delivery of these civil engineering projects. Proper planning should be made prior to any civil engineering construction activities.

Lack of contractor involvement during the design phase was ranked fourth. Buildability issues sets in often times because of the lack of involvement of the contractor during the conceptual and design phases. The problem can be solved by involving the contractor early enough, so that the contractor can make input to the design to reduce or avoid conflicts that may occur during construction phase.

## IV. CONCLUSION AND RECOMMENDATION

The participants of the construction industry should be made to fully understand and address these interface problems as they affect the project time, cost and quality. Shaar *et al.* (2016) indicated that delay of due payments was one of the major causes of design and construction interface problems. Similarly, this study showed that the main design and construction interface problems are caused by delay of due payments. This top design and construction interface problem is related

to delay in providing the necessary funds. The Nigerian government's plan to provide mega infrastructure introduces a new construction market that will attract many foreign investors as construction companies that will need become familiarized with the problems that might hinder the success of their projects.
Interface problems have been considered as the main cause of poor project performance. These interface problems such as project delay, cost overrun, variations, claims, idleness, rework et cetra have been the bane of construction industry. Hence it is important to systematically identify, assess and respond to these interface problems.

These results should encourage project participants to move away from the reliance on the traditional delivery method in favour of alternative methods that encourage early payments to the appropriate quarters

**REFERENCES**

Al-Hammad A. M, Al-Hammad I. (1996). Interface problems between building owners and designers. *Journal of Performance Constructed Facilities*,10:123-126.

Al-Hammad A. M.(1995). Interface problems between owners and maintenance contractors in Saudi Arabia. *Journal of Performance Constructed Facilities*, 9:194-205.

Al-Hammad A. M. (1990). A study of interface problem between owners and contractors over the construction of residential houses in SaudiArabia. *House Science* 14:245-257.

Al-Hammad A. (1993). Factors affecting the relationship between contractors and their sub-contractors in Saudi Arabia. *Journal of Performance in Constructed Facilities*, 21(5), 194–205.

Al-Hammad, A. (2000). Common interface problems among various construction parties. *Journal of Performance in Constructed Facilities,14(2)*,71–74.

Al-Hammad, A. M, and Assaf, S.A.(1992). Design construction interface problems in Saudi Arabia. *Journal of Building Research Information* ,20:61-63.

Arain, F. M.(2008). Cost and Schedule Risk AnalysisofBridgeConstructionin Pakistan: EstablishingRiskGuidelines.https://doi.org/10.1061.1943-7862.0000857.

Arain, F. M., and Assaf, S. A. (2006). Consultants Prospects of the Sources of Design and Construction Interface problems in Large Building Projects in Saudi Arabia,. https://doi.org/10.4197/env.5-1.2

Arain, F. M., Pheng, L. S., and Assaf, S.A. (2006) Contractors 'Views ofthe Potential Causes of Inconsistencies between Design and Construction. *Journal of Performance of Constructed Facilities*, 20(1),74–83.

Arain, F.M.; Sadi, A.A.( 2006).Consultant's Prospects of the Sources of Design and Construction Interface Problems in Large Building Projects in Saudi Arabia. *JKAU Environmental Design Science*, *5*, 15–37.

Assaf SA, Al-Hejji S. 2006. Causes of delay in large construction projects. *International Journal of Project Management.* 24:349357.

Assaf, S.A., Al-Hammad, A.M. and Al-Shihah, (1996). Effects of faulty design and construction on building maintenance, *Journal of performance of constructed Facilities,* 10(4),: 171-174

Chan,W.T.,Chen,C.,Messner, J.I.,Chua,D.H.(2005)."Interface management for China's build-operate-transfer projects."*Journal of Construction . Engineering Management* 10.1061/(ASCE)0733-9364(2005)131:6(645),

645–655.

Chang AS, Shen FY, Ibbs W. 2010. Design and construction coordination problems and planning for design build project new users. *Canadian Journal of Civil Engineering* 37:15251534.

Chen, Q., Reichard, G. and Beliveau,Y.(2008). Multi-perspective Approach to Exploring Comprehensive Cause Factors for Interface Issues. *Journal of Construction Engineering and Management.*, *134*, 432–441.

Chen, Q., Reichard,G.,and Beliveau,Y.(2007)."Interface management—A facilitator of lean construction and agile project management."*Proc.,15th Annual Conf. of the Int. Group for Lean Construction IGLC 15*, East Lansing, MI, 57–66.

Chen, Q., Reichard, G., and Beliveau,Y. (2010). "Object model frameworkfor interface modelingand IT-oriented interfacemanagement" *Journal of Construction Engineering and Management.*, *134*, 432–441.10.1061/(ASCE)CO.1943-7862.0000120, 187–198.

Chen-LiangL.andChen-Huu,J.(2017).ExploringInterfaceProblemsinTaiwan'sConstruction ProjectsUsingStructuralEquationModeling.https://doi.org/10.3390/su9050822.

Clough, R.H. and Sears G.A. (1994) Construction Contracting.(6th edition) John Wiley and Sons Inc,New York.

Cochran,W.G.(1963). Sampling Techniques,2nd Ed.,JohnWiley and Sons, Inc. NewYork.

El-sayegh,S. M. and Mansour, M. H. (2015).Risk Assessment and Allocation in highway construction projects in the UAE.*Journal of Management in Engineering*, 31(6),1-11.

Faridi, A., and El-Sayegh, S.(2006). Significant factors causing delay in the UAE construction industry. *Construction Management and Economics*, *24*(11), 1167–1176.

Fisk, E.(1997). Construction project administration (5thed.).Englewood Cliff, NJ:Prentice Hall.

Hinze J,Tracey A(1994).The contractor-subcontractor relationship:the subcontractors'view.

*Journal of Construction Engineering and Management*.120:274287.

Huang R.Y,Huang C.T, Lin H and Ku W. H. (2008). Factor analysis of interface problems among construction parties: a case study of MRT. *Journal of Marine Science and Technology*. 16:5263.

Jergeas, G.F.,and Ruwanpura, J.(2009)."Why cost and schedule overruns on mega oils and gas projects?"*Practical.Period.Structure.Design.Construction.*,10.1061/(ASCE)SC.1943- 5576.0000024, 40–43.

Mahamid I. (2011).Analysis of cost deviations in road construction activities a case study from Palestine. *Jordan Journal of Civil Engineering*. 5(4),552-567.

Mohamad, H. A. and Sameh, M.E.(2016). Assessment of the design–construction interface problems in the UAE. *Architectural Engineering and Design Management*, *12*(5),353 – 366. https://doi.org/10.1080/17452007.2016.1187111

Muhammad, A. (2016).Framework for determining performance of construction projects in northern Nigeria.*Unpublished Msc Dissertation Ahmadu Bello University Zaria, Nigeria.*

Naoum S.G (1998). Dissertation Research and Writing for Construction Students. Read Education and Professional. Oxford; 23(9),38-48.

Nunnally, J. C. and Bernstein, I. H. (1994). Psychometric theory. 3rd edition, McGraw-Hill. New York.

Seboru, M. A. (2015). An Investigation into Factors Causing Delays in Road Construction Projects in Kenya,*3*(3),51–63. https://doi.org/10.11648/j.ajce.20150303.11

Shen, W., Tang, W., Wang, S., Duffield, C. F., Hui, F. K. P., andYou, R. (2017). Enhancing Trust-Based Interface Management in International Engineering-Procurement- Construction Projects. *Journal of Construction Engineering and Management*, *143*(9), 4017061. https://doi.org/10.1061/CO.1943-7862.0001351

Thomas, M., and Priyanka,R. M.(2015). a Study on Factors Affecting Design- Construction Interface, *2*(5).

Verma (1995).The human aspects of project management: Organizing projects for success.

Newtown Square,PA:*Project Management Institute*; p.15-190.

Wang, Y. (2000) Coordination issues in Chinese large building projects, *Journal of Management in Engineering*, 16(6), 54 61.

Weshah N, El-GhandourW, Jergeas G, Falls LC. (2013). Factor analysisof the interface management (IM) problems for construction projects in Alberta. *Journal of Civil Engineering*.40:848-860.