

Assessing the Factors that Cause Poor Quality of Design and Contract Documentation and the Influence on Project Implementation in Ghana

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Abstract

Design and contract documentation processes which occur throughout the life cycle of the contract, is often mentioned an area that engenders contractual disputes in Ghana. This paper investigated the factors causing poor quality of design and contract documentation (DCD) and how this impact on successful project implementation in Ghana. It used questionnaire approach as the main method to obtain data which was analyzed using Relative Importance Index (RII) and Kendall's concordance testing. Out of forty factors noted to contribute to DCD deficiencies, six were identified as critical: selection of designers on the basis of lowest price, unwillingness to pay fees commensurate with design services, last minute changes by clients, insufficient design reviews, inadequate clients' briefs, slow payment systems and insufficient or missing input information from the client. To minimize or prevent DCD deficiencies in Ghana's construction industry, the research recommends that briefs are adequate, clear and precise; consultancy fees are commensurate to the required service quality; consultants to ensure adequate review of design and contract documentation with all stakeholders and clients to select consultants based on merits. The measures suggested by the paper are believed to contribute to good quality contract documentation which can consequently improve project implementation in Ghana.

Keywords: Contract documentation, Construction projects performance, Quality documentation, Deficient Design.

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1. Introduction

Typical design and contract documentation (DCD) maybe described to consist of design drawings, specifications, bill of quantities/schedule of rates, instructions to tenderers, conditions of the contract, forms of contract as well as other written correspondences and attachments (Rodriguez, 2019; Assaf et al, 2018; Buchan *et al.*, 2003; Cook, 1991). According to Tilley *et al.* (1999), there is a significant impact on the overall performance and efficiency of construction projects by the quality of design and documentation.

“Designers provide the graphic and written representations, which allow contractors and subcontractors to transform concepts and ideas into physical reality. How effectively and efficiently this transformation occurs depends largely on the quality of the DCD provided” (Tilley and Barton, 1997). This implies that poor and inefficient design and documentation may have a negative effect on the entire project. Whilst ensuring the need for “effective” design, it is also necessary to communicate effectively through documentation, i.e., specifications, drawings, bills of quantities, variation orders, correspondences, etc. (Tilley, 1997). In an ideal situation, contract documentation for construction projects should be complete and error-free and should be able to meet the client's requirements (effective). A case study conducted in the UK on the quality of tender documents by Laryea (2011) revealed that, there have been disputes and claims among contractual parties due to substandard information provided in designs and contract documentation in terms of details, accuracy, adequacy and ambiguity in design drawings, specifications, bills of quantities etc.

ACIF and APCC (2002) also stated that there is a seeming deterioration in the quality of DCD resulting in inadequacies and unascertained costs in the construction process in recent years. According to Tilley (2005b), there is a significant effect on the construction industry's efficiency due to issues regarding DCD quality and as such contributes greatly to rework in reconstruction. This paper investigated the above problems and assessed the extent to which poor quality of DCD affects the performance of construction projects in Ghana. The research specifically sought to:

- Find out the major factors causing poor quality of DCD
- Ascertain how frequent these factors occur in administering construction projects

- Find out the extent to which these factors affect performance of construction projects
- Establish preventive measures that can be put in place to minimize the deficiencies in design and contract documentation

Since the quality of DCD generated by consultants has a substantial influence on the overall performance and efficiency of construction projects, it is important that issues confronting the quality of design and contract documentation be identified and discussed. Findings could help to improve construction projects delivery. The outcome of this research is intended to inure to the benefit of all contractual parties; all professionals working with clients, contractors and consulting firms.

2. Research Design and Methodology

The research was conducted in two stages. First, existing literature was reviewed to highlight causative factors and effects of design and contract documentation deficiencies in different parts of the globe. Secondly, forty factors obtained through the literature was converted into questionnaire and tested in the study area for agreement and severity. This method was used because it is economic in nature, simpler and facilitates quicker turnaround in the collection of data (Cresswell, 2014).

2.1 Sample Population and Sample Size

Respondents' selection was limited to clients, D1 contractors and consultants mostly consisting of architects and quantity surveyors located and working in Northern Ghana. Clients approached consisted of entities implementing and managing public construction projects and who are familiar with design documentation processes. The choice of D1 class of building contractors was due to the magnitude of projects they undertake which involve large volumes of DCD that are prone to deficiencies or errors. Snowball sampling technique was adopted in the selection of D1 contractors working on public projects in the region due to the difficulty in accessing data for this category of respondents. The total sample size of all the three categories of respondents (consultants, clients and contractors) was eighty-five (85).

Construction industry Professionals (i.e. architects, civil/structural engineers, quantity surveyors etc.) with an appreciable level of experience working with consulting, construction and client organizations in these regions were surveyed to ascertain the factors affecting the quality of DCD using questionnaires. Clients were chosen because they initiate and promote projects, and hence project successes are of great concern to them. Consultants were also chosen because they produce architectural and structural designs based on the client's initiatives and briefs, quantity surveying services as well as supervision of the construction process. Contractors were also selected because they do the actual execution of projects which have been designed by consultants. Architectural and structural drawings and bills of quantities are the only contract documents that this study focused on.

2.2 Data Analysis Tools

The following statistical techniques were employed for the data analysis:

1. Descriptive Statistics: This was used in computing frequencies and percentages of the background information of the respondents such as category, professional background, years of experience etc. also mean and standard deviation was used where there is a tie in the ranking using RII.

2. Relative Importance Index (RII): $= \frac{\sum W}{(A \times N)}$: (Fugar and Agyakwah-Baah, 2010)

Where: W is the weighting given to each factor by respondents, ranging from 1 to 5, A is the highest weight (5) and N is the number of samples in the study. It was used in analysing the three main objectives of the study as follows:

- (i) Ranking the significant factors in terms of the degree of severity.
 - (ii) Ranking factors to determine the frequency of occurrence.
 - (iii) Ranking the effects of poor quality DCD to determine the degree of severity on construction projects performance.
 - (iv) Ranking of the possible remedial methods to ascertain the level of importance of each method.
3. Agreement analysis: A non-parametric statistic known as Kendall correlation coefficient was used for evaluating the level of agreement/similarity between the two sets of rank (Clients and Consultants) to the same set of possible causes of poor quality of design and contract documentation in Northern Ghana. This tool was used to assist the researcher to find out whether there is a trend of agreement among the respondents.

$$W = \left[\frac{\sum_{i=1}^k (R_i - R)^2}{n(n^2 - 1)/12} \right]$$

$n(n^2 - 1)/12$ is the maximum possible squared deviation i.e. the numerator which will occur if there were perfect agreements among k sets of ranks and the average rankings were $1, 2, 3, \dots, n$;

R_i = rank assigned by an individual judge to one factor;

$0.0 \leq W \leq 1.0$

K is number of sets of ranking (2);

n is a number of factors to be ranked (40);

R is an average of the ranks assigned to the n th factor been ranked.

4. Spearman correlation: this is an inferential statistics method and was used to ascertain whether the differences in ranking of the two groups of respondents on the possible methods of preventing deficiencies in design and contract documentation were statistically significant or not.

The research appraised existing literature in the context of contract documentation quality in the construction industry. The essence was to identify the factors influencing the quality of design and contractual documentation, their effects and ways of eliminating or minimizing these effects.

3. Literature Review

Quality of Design and Contract Documentation

Designs are normally services rendered by consultants to their clients according to the client's requirements. Quality is also defined in terms of a construction project by Arditi & Gunaydin (1997) as "meeting the legal, aesthetic and functional requirements of a project". However expressed, quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements.

According to Arditi & Gunaydin (1997), drawings and specifications issued to the contractor by the consultant contain technical information of materials and various components that affect the standard of quality required by the construction. Inconsistencies in drawings and specifications have been a headache in the construction process (Assaf, et al, 2018). The project must be constructible by the contractor contracted to construct it. Construction methods and materials that contractors will be using in the execution of the project must be familiar to the professionals producing the designs. Queensland (2005) maintained that for design and contract documentation to be adequate and of right quality, they should be coherent and explicit, precise, complete and timely.

Causes of Deficient Designs and Documentation

Design deficiency is commonly described by various researchers (Rodriguez, 2019; Assaf et al, 2018; Gatlin, 2013; Abdalaziz, 2009) to include failure to produce an accurate, complete and well-coordinated set of design and construction documentation by a design professional.

Slater and Radford (2012) observed that, some of the difficulties encountered on a site can be traced to design decisions by architects, deficient specifications, as well as erroneous documentation. According to Abdalaziz, (2009), most design deficiencies fall under one of three (3) categories:

1. Conflicting contract information: disagreements between drawings, bill of quantities and specifications.
2. Coordination errors within parties: problems of interference with consultants of other engineering disciplines such as structural, mechanical, electrical, etc.
3. Discrepancies due to technical compliance: non-adherence to the right design guidelines, building codes and specifications.

Major variations may occur if drawings and specifications are inadequate and would ultimately affect the completion of the project. If specifications or drawings are incomplete or unclear, it creates interpretation problems, thereby compromising the quality of the project (Assaf *et al.*, 1996). According to Alarcon and Mardones (1998), three main problems confront the design and construction interface: poor quality design, lack of standards in design and constructability of designs.

Classified under the type of construction document, Dosumu and Adenuga (2013) identified the causes of inaccuracies in contract documents to include the following:

Table1: Causes of Design Deficiencies

S/N	Type of Document	Error/inaccuracy/deficiency/
1	Drawings	i. Missing or deficient input information ii. Drawings being incomplete iii. Unsatisfactory planning and design work iv. Errors in design v. Professional negligence vi. Incorrect drawings
2	Specifications	i. Changes in specifications ii. Incorrect drawings iii. Unsatisfactory planning and design work iv. The experience of the designer
3	Bill of Quantities	i. Inadequate documentation ii. Poor communication between the professional and the client iii. Negligence of the professional.
4	Schedules	i. Information availability ii. Professional experience iii. Inadequate documentation iv. Inadequate computation
5	Form of Contract	i. Poor cost control method ii. Availability of detailed information iii. Lack of adequate documentation iv. Long period between tendering and award

Source: Dosumu and Adenuga, 2013

Love et al (2008) revealed that a number of factors contribute to the incidence of design errors in construction projects. For instance, the pressures from clients on design consultants to provide detailed design documentation within a short time period can result in errors in design.

Effects of Design and Documentation Deficiencies

Available literature identified several adverse effects of design and documentation deficiencies. Oversights and omissions or errors in design, and specification due to the lack of the coordination have culminated to disputes that occur in construction projects (Assah-Kissiedu et al, 2010).

According to Dosumu and Adenuga (2013), design and documentation errors results in serious effects such as projects abandonment, delays, rework, client dissatisfaction, lack of confidence in consultants, frustration of stakeholders, lack of concentration on other projects, discourages investment, and designers profit. In the

Australian construction industry, it is realized that deficiencies in contract documentation has been steadily increasing and is directly proportional to inefficiency in the construction process (Tilley, 1998). These consequences result in an increase in overall project cost and a reduction in the project quality. Also, according to Queensland (2005), poor quality of design documentation has led to 60 to 90% of all variations in the construction industry. Similarly, Kikwasi (2013) noted that design changes are considered the topmost cause of delays and interferences in projects delivery in developing countries. Other effects identified by this research include; time extensions, project cost overruns, adverse impact on social life, resource idling, disputes and arbitration. Ismail et al (2012) reported that errors and omissions in the designs were ranked the second most critical factors causing variation orders in construction projects. Also, serious concerns such as rework and wastages occur in projects due to design and construction errors which have effects on project performance and productivity aspects (Palaneeswaran *et al.*, 2007). This is supported by Hwang *et al.* (2009) who identified omissions/errors in design as the core cause of rework in construction projects and has led to cost increases.

Design Quality Measurement

Arditi and Gunaydin (1997) explained quality in the construction industry's perspective as the meeting of the requirements of all contractual parties, i.e. client, consultant, and contractor as well as regulatory agencies. The main characteristics of quality include:

1. Satisfying client's requirement in terms of adequacy of function, operation, maintenance, meeting timelines and budget, and life cycle cost.
2. Satisfying the requirement of the design consultant by providing adequate brief.
3. Satisfying the contractor's requirements by providing a well-detailed and accurate tender and contract document.
4. Satisfying the requirements of public regulatory agencies as to the protection of public property, including utilities, environmental concerns, public health and safety, and conformance with relevant laws, regulations, codes and policies.

Improving the Quality of Contract Documentation

For an improvement in the quality of contract documentation, it is necessary to change the way the design process is managed. Darwish (2007) states that at the design phase of projects, the client's requirements should be clearly specified to avoid deficiencies in the design which may result in contract variations during the construction stage. There would be an effective improvement in the overall design and documentation quality if the client and contractor were properly involved at the inception of the design stage. This will enable the consultant to have ample time to rectify and make corrections to any omissions, inaccuracies or ambiguities before the start of the construction process.

Queensland (2005) and ACIF & APCC (2002) established the following principles and protocols that are anticipated to improve contract documentation quality in the construction industry:

1. Project establishment: clearly defined client's brief comprising of important drivers and considerations such as budgets, functions, and quality.
2. Consultant selection: consultant's fees should be commensurate to the scope of work and experience of the consultant.
3. Team formation and project integration by ensuring that there is a clear understanding of the responsibilities, roles, and obligations by the parties.
4. Quality management system including project implementation and documentation by actively considering the life cycle cost of the project.
5. Consultant's obligations and functions:
 - i. Advising the project owners on the sufficiency of the brief and the risk associated with poor allowance for proper documentation in both budgets and programs;
 - ii. Creating designs and documentation, coordination roles within the project team.

- iii. Complying with the code of ethics and professional conduct requirements regarding documentation quality and propose that fees proportionate with the effort involved.

Methods of Preventing DCD Deficiencies

Adherence to project management and organizational practices and creating an atmosphere that allows individuals to learn from their mistakes can help prevent many of the errors that occur in the design and documentation of construction projects (Lopez et al., 2010). To assist in the improvement of overall documentation quality, it was suggested that vast improvement in coordination and management between disciplines should be a requirement (Flantje et al., 2012).

Johansen and Carson (2003) suggested that the most important ideas that require attention are the provision of adequate design time, the need for a working team approach, the quality of clients briefing and a clearly identified competent manager to control the process.

Dosumu and Adenuga (2013) further suggest the under-listed to control the several errors plaguing design and documentation in the construction industry;

- Enhanced partnership between designers and other team members while preparing construction documents.
- Allowing adequate time for the preparation of designs and documentation.
- Clients should use the right procurement methods for construction projects.
- Good and effective communication among the construction project team.
- The use of electronic documents management system is advised.
- There should be effective and efficient project management.
- There should be adequate financial provision.

In an attempt to eliminate design defects, Chong and Low (2006) suggested that designers should be encouraged to adopt and use standards and codes such as British Standards (BS) etc. Designers are also encouraged to abreast themselves with the latest knowledge, ideas and technologies in the industry. They are also advised to develop a file whereby hidden defects could be traced and mistakes avoided in future. The following recommendations were made in a study conducted by Laryea (2011) for the adoption of clients to increase the quality of tender documents. They are:

- Know what you want
- Describe it very clearly
- Do not assume that the other person knows what you want
- Tell them what you want
- Do not change your mind
- Allow a sensible tender period
- Be sensible about risk sharing

Asamoah and Nyako (2013) recommended that a comprehensive review of the design and contract documents is done by the design team at all times. There should be an improvement in communication between the contractual parties. Also, before the works start on site it is required by all parties to do feasibility studies and adequate planning. The implementation of design audits, design reviews and verifications, provision of adequate time for designers to produce documentation and using computer aided design (CAD) applications will help minimize the impact of errors before documentation is distributed for tender though this will not prevent errors from occurring (Reason, 2002) and (Love et al., 2008).

In their study, Aagaard and Pedersen (2013) emphasized the need for a review and control of documentation as a means of integrating tasks in the design and construction phases. It is also required that special attention is given to the review and control of the use of ICT in modeling and structural design. According to Love et al. (2008), Building information modeling (BIM) will considerably increase the performance of projects if it used as an enabler compared with other key strategic and process improvements that have been acknowledged. Penttila (2006) stated that BIM makes it explicit the interdependence that exists between architectural layout, mechanical, structural, electrical, and hydraulic services by technologically coupling project organizations.

4. Fieldwork Discussions

The professionals constituting the respondents in that category comprises of architects (19%), civil/structural engineers (21%), quantity surveyors (42%), clerks and others (17%). The research revealed that over fifty percent of the respondents have executed or is executing both private and public projects. Also, a large proportion of the respondents have experiences of between 5 to 15 years in the industry.

Over 96% of the respondents stated that they had encountered a problem regarding design and documentation deficiency or error in construction projects at one point or another in their professional career. Only a very small proportion of the respondents (3.85%) answered to the contrary. There is, therefore, a clear indication that, there indeed exist deficiencies in construction projects designs and documentation hence a critical issue that requires attention.

4.1 Factors Causing Design and Contract Documentation Deficiencies

Table 2: Factors Causing Design and Contract Documentation Deficiencies by clients and Consultants

Factors		Overall Response								
		Category	Severity				Occurrence			
			RII %	Mean	Standard deviation	Rank	RII %	Mean	Standard deviation	Rank
1	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	CF	79.51	3.98	1.332	1	79.51	3.976	1.475	2
2	Unwillingness to pay fees commensurate with the design of high-quality services	DF	79.02	3.95	0.947	2	74.63	3.732	0.895	3
3	Last minute changes by the client	DF	78.54	3.93	0.932	3	69.27	3.463	0.951	5
4	Insufficient design reviews with relevant parties	CF	78.54	3.93	1.081	4	67.80	3.390	1.046	6
5	Inadequate client's communication /relationship with design team members	CF	76.10	3.80	1.167	5	65.37	3.268	1.119	13
6	Slow payments' system for design services	DF	75.61	3.78	1.129	6	72.20	3.610	0.945	4
7	Inadequate design coordination between design disciplines	DF	75.61	3.78	1.215	7	64.39	3.220	1.061	19
8	Insufficient and missing input information from the client	DF	75.12	3.76	0.916	8	65.85	3.293	0.929	8
9	Change in project requirements by stakeholders at later stages	DF	75.12	3.76	1.135	9	62.93	3.146	0.937	22
10	Erroneous and conflicting information from the client	DF	74.15	3.71	1.123	10	62.93	3.146	0.937	22
11	Lack of time for design reviews	CF	74.15	3.71	1.146	11	63.90	3.195	0.901	20
12	Unstable client's requirements	DF	73.66	3.68	1.128	12	65.85	3.293	1.078	9
13	Allocation of staff to more than one project at the same time	DF	73.66	3.68	1.404	13	65.85	3.293	1.209	11
14	Inaccurate time estimates or tight design schedule	DF	72.68	3.63	0.968	14	64.88	3.244	0.943	15
15	Poor workload planning	DF	72.68	3.63	1.067	15	65.37	3.268	1.025	12
16	Defensive approach to variations and claims for additional cost or time	CF	71.71	3.59	1.024	16	61.95	3.098	0.889	24
17	Copying and modifying from previous work to minimize time and cost	DF	70.24	3.51	1.434	17	64.39	3.220	0.962	17

18	Lack of time available for checking and correlating all the information on all design documents	DF	69.76	3.49	1.121	18	64.88	3.244	0.767	14
19	Lack of client reviewers for each project	DF	69.76	3.49	1.143	19	66.83	3.342	1.015	7
20	Selection of designers on the basis of reputation instead of efficiency	DF	69.27	3.46	1.051	20	86.83	4.342	7.542	1
21	Long waiting for the client decision	CF	69.27	3.46	1.075	21	64.39	3.220	1.061	19
22	Tight tender times	TF	68.78	3.44	1.246	22	63.41	3.171	1.046	21
23	Absence of an experienced overall design manager	DF	68.29	3.41	1.533	23	57.07	2.854	1.276	29
24	Lack of data integration across design disciplines	DF	67.80	3.39	1.202	24	62.44	3.122	1.029	23
25	Leaving design issues to be sorted out in the construction process	DF	67.32	3.37	1.178	25	61.46	3.073	0.848	25
26	Increase in current work load of the designer	DF	67.32	3.37	1.445	26	62.44	3.122	1.029	23
27	Lack of time available for continuous and effective communication between parties	DF	66.83	3.34	1.087	27	57.07	2.854	0.937	28
28	Reluctance by tenderers to ask questions that might reveal competitive edge	TF	66.34	3.32	1.192	28	64.88	3.244	1.157	16
29	Ineffective/inadequate use of new technology	DF	66.34	3.32	1.213	29	65.85	3.293	1.188	10
30	Lack of funds for staff on the job training	DF	65.85	3.29	1.101	30	64.39	3.220	1.013	18
31	Absence of experienced design team to projects	DF	65.85	3.29	1.188	31	56.59	2.829	0.972	31
32	Lack of qualified consultant's staff	DF	64.88	3.24	1.410	32	51.71	2.585	0.948	34
33	Reduced design fees levels	DF	61.46	3.07	1.330	33	59.02	2.951	1.024	26
34	Increase in the overall complexity of projects	DF	60.98	3.05	1.094	34	56.59	2.829	0.946	30
35	Multiple "notices to tenderers" and question/answer steps and short time for amendment	TF	60.00	3.00	0.894	35	52.20	2.61	0.86	33
36	Number of staff in each specialization (Architect, Structural Engineer etc.)	DF	59.51	2.98	1.214	36	58.54	2.927	1.170	27
37	Lack of experience on similar projects	DF	59.02	2.95	1.117	37	51.71	2.585	0.974	35
38	Designer's unfamiliarity with construction materials and techniques that will be used in the project	DF	58.05	2.90	1.241	38	46.34	2.317	0.850	37
39	Increased statutory regulations, approvals and requirements	DF	57.56	2.88	1.100	39	52.68	2.63	0.97	32
40	Increase design staff members rather than increasing the number of hours of work to overcome the problem of limited time	DF	53.66	2.68	1.171	40	49.27	2.463	0.897	36

Source: Field work, 2018

Most Severe Factors

After evaluating the factors from the clients and consultants groups of respondents, the ten (10) most severe factors causing DCD deficiencies in Northern Ghana, based on agreed rankings, were identified as shown in table 3 below.

Table 3: Most Severe Factors Agreed by Clients and Consultants.

Most Severe Factors		Category	Severity								
			Clients			Consultants			Overall Response		
			RII%	Standard Deviation	Rank	RII%	Standard Deviation	Rank	RII%	Standard Deviation	Rank
1	Selection of designers on the basis of lowest price selection (lowest bid approach)	CF	92	0.966	1	75.48	1.383	10	79.51	1.332	1
2	Unwillingness to pay fees commensurate with the design of high-quality services	DF	82	0.738	6	78.06	1.012	2	79.02	0.947	2
3	Last minute changes by the client	DF	88	0.516	3	75.48	0.990	7	78.54	0.932	3
4	Insufficient design reviews with relevant parties	CF	80	1.287	11	77.42	1.024	4	78.54	1.081	4
5	Inadequate client's communication /relationship with design team members	CF	74	1.160	18	76.77	1.186	6	76.10	1.167	5
6	Slow payments' system for design services	DF	72	1.075	20	76.77	1.157	5	75.61	1.129	6
7	Inadequate design coordination between design disciplines	DF	76	1.135	16	75.48	1.257	8	75.61	1.215	7
8	Insufficient and missing input information from the client	DF	66	1.059	27	78.06	0.831	1	75.12	0.916	8
9	Change in project requirements by stakeholders at later stages	DF	90	0.527	2	70.32	1.180	16	75.12	1.135	9
10	Erroneous and conflicting information from the client	DF	80	1.054	9	72.26	1.145	12	74.15	1.123	10

Source: Field work, 2018

As contained in table 3, the research revealed that the **selection of designers on the basis of lowest price strategy** (lowest bid approach) is the number one cause of design and documentation problems in the study area. Though clients and consultants groups rated it different in terms of rankings (1st and 10th respectively), both agreed that the selection process is not appropriate. They contend that it is often driven by price rather than competence required for high level designs. This implies that the lowest bid strategy in the selection of consultants can be detrimental to the delivery quality of DCD in the sense that it might lead to the selection of incompetent consultants. The unwillingness of clients to pay fees to correspond with the design of high-quality services was noted to be one of the most severe factors causing poor DCD quality in Northern Ghana. During the study, it was revealed that

clients are the offenders or perpetrators of this phenomenon. Interestingly, the clients themselves asserts it to be a contributory factor to design and contract documentation problem. Consultants were of the view that the fees they receive from clients are not good enough to motivate their staff to put out their best performance to prevent deficiencies in DCD.

Also, late changes by clients were identified as another causative factor that adversely affect design and contract documentation. This client-related phenomenon which was agreed to by all respondent groups gave an indication that clients are aware of the consequences of late changes to the design and documentation process. Insufficient design reviews with relevant parties was one of the important factors causing design and contract documentation problems. This factor is consistent with Dosumu and Iyagba (2013) who observed that lack of reviews in design, constructability and value engineering were among the significant factors causing errors in contract documents. In addition, the research revealed that inadequate client's communication/briefs with design team members have severe consequences on DCD. This factor was identified as severe by consultants who are particularly affected by the ineffective and poor briefs by clients. When communication is effective, there is coordination and as such, deficiencies that would have resulted due to this factor are preventable. Other causative factors identified amongst the top ten included slow payment process by clients, inadequate design coordination between design disciplines, erroneous and conflicting information from the client.

4.2 Effects of Poor Design and Contract Documentation on Project Performance

Table: 4 shows the Relative Importance Indices (RII) and the rankings of the severity level the various effects of design and documentation deficiency on the performance of construction projects in Northern Ghana by the various respondents. These are discussed according to their rankings as follows.

Table 4: Effects of DCD Deficiencies on Project performance

Effects	Severity Level of Effect on Performance								
	Clients		Consultants		Contractors		Overall Response		
	RII%	Rank	RII %	Rank	RII %	Rank	RII %	Rank	
1	Projects abandonment	90	1	87.10	1	96.36	1	89.62	1
2	Delays (Time overrun)	88	2	86.45	2	90.91	3	87.69	2
3	Cost overrun	84	4	84.52	3	92.73	2	86.15	3
4	Payment claims	86	3	83.23	4	87.27	4	84.62	4
5	Variation/Change orders	82	5	76.13	6	85.45	5	79.23	5
6	Suspension of works	76	7	79.35	5	78.18	9	78.46	6
7	Client/owner dissatisfaction	72	9	72.26	7	81.82	7	74.23	7
8	Disputes (Conflicts) among parties	80	6	68.39	9	80.00	8	73.08	8
9	Rework	66	10	70.97	8	83.64	6	72.69	9
10	Arbitration/Litigation	74	8	66.45	11	74.55	11	69.62	10
11	Loss of confidence in consultants	64	11	67.74	10	76.36	10	68.85	11

Source: Field work, 2018

From table 4, there is an agreement between all the respondents, that projects abandonment had much impact on the performance of construction projects in Northern Ghana which was ranked 1st by all with an overall RII of 89.62%. This means that projects are usually abandoned and are brought to a halt and there are cost and time implications. Defective design and documentation was also considered to result in delays (time overruns) in the delivery of construction projects. This was ranked 2nd by both client and consultants with RIIs of 88% and 86.45% respectively though on the part of contractors it came 3rd with a RII of 90.91%. This is considered to have negatively influenced the time performance of public projects in Northern Ghana and this usually will trigger cost increases on projects. Interestingly, both the 1st and 2nd overall rankings agree with the work of Dosumu and Adenuga (2013) in construction industry. Other effects identified through the research as presented in table 4 included cost overruns, contractual claims with their concomitant issues, variations orders, suspension of works, client/owner dissatisfaction, contractual disputes, arbitrations/litigations and sometimes loss of confidence in consultants.

Agreement Analysis

A non-parametric statistic known as Kendall's coefficient of concordance aids in evaluating the level of agreement between the two (Clients and Consultants) sets of ranks to the same set of possible causes of poor quality of design and contract documentation in Northern Ghana. This tool assists the researcher to find out whether there is a trend of agreement among the respondents on the 40 factors.

This range $0.0 \leq W \leq 1.0$ shows the level of agreement among the Clients and Consultants. The concordance coefficients are computed by using data in table 5.

Table 5: Showing Kendall's Rank of Concordance Coefficient

Respondents' Category		Clients	Consultants
Clients	Severity	1	0.232
	Occurrence	1	0.238
Consultants	Severity	0.232	1
	Occurrence	0.238	1

Source: Field work, 2018

From table 5, W is 0.232 and 0.238 respectively for severity and occurrence. These indicate a fair level of agreements among the Clients and Consultants in their ranking of the factor in terms of severity and occurrence since they are greater than zero (0) hence there is no bias on how the ranking of the factors.

4.3 Preventive Methods for Design and Contract Documentation Deficiencies

A question on proposed methods of preventing or minimizing the deficiencies in design and contract documentation processes produced the responses illustrated in table 6. These responses were also ranked using RII in line with the methodology of the research.

Table 6: Preventive Methods for Each Group of Respondents

Preventive Methods		Importance					
		Clients		Consultants		Overall Response	
		RII%	Rank	RII%	Rank	RII%	Rank
1	Effective communication between all parties	98	1	94.84	1	95.61	1
2	Adherence to established codes and standards in the industry.	90	5	93.55	2	92.68	2
3	Willingness to spend sufficient time and money in project planning and design	92	4	91.61	3	91.71	3
4	Continuing involvement of client in the design management	96	2	88.39	6	90.24	4
5	Cooperation among project team	82	8	90.97	4	88.78	5
6	Selection of service providers on the basis of value and competence	94	3	86.45	9	88.29	6
7	Implementation of quality management systems	88	6	87.10	8	87.32	7
8	Continuing professional development for staff in industry	84	7	87.74	7	86.83	8
9	Payment of design fees commensurate with design services	74	12	90.32	5	86.34	9
10	Encourage the role of technology in projects delivery by all stakeholders	80	9	85.16	11	83.90	10
11	Identification and analysis of all risks and uncertainty in project	78	10	84.52	12	82.93	11
12	Frequent training and retraining of stakeholders on how to ensure appropriate and quality design and documentation.	66	15	85.81	10	80.98	12
13	Framing contracting arrangement around goodwill and fair dealings in an open environment	76	11	81.29	13	80.00	13
14	Adoption of lean production principles to design management	68	14	79.35	14	76.59	14
15	Early involvement of contractor in the design process.	72	13	76.77	15	75.61	15

Source: Field work, 2018

Spearman Correlation of Preventive Methods

This is an inferential statistics method and was used to ascertain whether the differences in ranking of the two groups of respondents on the possible methods of prevention statistically significant. Using the rankings of the clients and consultants, the correlation coefficients are calculated and the results are as shown in table 7 below.

Table 7: Ranks Correlation Coefficient

	Clients	Consultants
Clients	1	0.693
Consultants	0.693	1

Source: Field work, 2018

The correlation coefficient for the 15 remedial methods for both clients and consultants is 0.693 as illustrated in table 7. This connotes a high agreement on the rankings by the respondent groups on the ways of preventing or minimizing design and documentation deficiency in Northern Ghana.

5. Conclusion and Recommendation

The paper identified forty factors that cause deficiencies in design and contract documentations. These factors were tested through questionnaire on respondents and the results confirmed earlier researchers' assertion on the subject. However, ten (10) of these factors were classified as the main causes in terms of severity and frequency of occurrence out of which six are said to be critical. These include selection of designers on the basis of lowest price strategy (lowest bid approach), unwillingness to pay fees commensurate with the design of high-quality services, last minute changes by the client, insufficient design reviews with relevant parties, slow payment system for design services, and insufficient and missing input information from the client. To minimize or prevent design and documentation deficiencies in Ghana's construction industry, the research recommends that clients must ensure adequate, clear and precise contract briefs. Clients are also to ensure that consultancy fees are commensurate to the required service quality. They must also ensure that the selection of consultants is based on merits and not necessarily on lowest bidder approach. Consultants should make sure there is an adequate review of design and contract documentation with all stakeholders involved. The research further recommends that prompt changes should be tolerated if the need be as well as ensuring timely and regular payments for design service providers.

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