

Effect of Variations Caused by Consultants in Building Construction Delivery in Bauchi Metropolis

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ABSTRACT

A construction contract is a business that is subject to variation quality or quantity of the works as shown upon the contract drawings and described or referred to in the contract bills this includes the addition, omission or substitution of any (minor) work or the alteration of the type or standard of any materials or good to be used in the works. Many of the causes of variations affect the original contract sum, submitted and most consultants are in the habit of abusing the clause while for some it has become a face saving device for the inadequacies in their output especially design details, others are fond of issuing variation orders so that their professional fees will also increase since a proportion of the fees is based on the final cost of construction this affect the project finish time and cause cost overrun. The aim of this research is to investigate the various variations caused by the consultants with the view to ranking them based on their level of severity as it affects building projects works in Bauchi metropolis. The research design for this study was quantitative research design, this research discuss on the quantitative approach. Quantitative research was undertaken in order to prove the existing theories while supporting the research findings with theories and findings from previous researches. The target population for the studies with representatives randomly selected from each organization is 1,150 which will include the professionals and the skilled labour in Bauchi metropolis. The sample size of study was 285 from a population 1,150 using the table of Krejcie and Morgan 1970. However, most of the respondents were of the opinion that the various identified consultants are contributors to variation on site as the first consultant revealed was the structural engineers with mean value of 4.42. The Causes of Variations Based on their Severity of Occurrences in Projects in the Study Area was identified majorly as Design Variations with mean value of 3.96. The major cause was design variation which majorly occurs due to Modification of architectural or structural designs during construction, with a mean values of 4.40 the result revealed that for a unit increase in level of Delivery of Building Construction work recorded there was a 0.334 unit increase in the variation which the p-value is statistically significant at 0.028 while for a unit decreases in the variation there was a 0.134 unit decrease Delivery of Building Construction work which this variation is actually not statistically significant as seen in the reported p-value of 0.37 which is greater than 0.05. It was concluded that the major cause of variation was design variation which majorly occurs due to Modification of architectural or structural designs during construction as most of the respondents acclaimed that a design may have urgent need for modification due to the environment or terrain. It was recommended that the building professional should give a careful look at the processes in the stages of the building from the conception to finish stage to avoid alteration in the process of building works this can reduce the level of variation.

1. Introduction

A construction contract is a business that is subject to variation quality or quantity of the works as shown upon the contract drawings and described or referred to in the contract bills (Wainwright & Wood 2019). This includes the addition, omission or substitution of any (minor) work or the alteration of the type or standard of any materials or good to be used in the works and the removal from the site of any work materials or goods executed or brought thereupon by the contractor for the purposes of the works (Agbo, 2017).

It includes addition, omission or substitution of any works. Its importance in the preparation of final account is further ascertained by Agbo (2017) who claimed that variations would occur in virtually every contract. Even though it could arise from the client, designers, contractors among other, the condition of the contract only empowers the Architect to issue variation orders, hence the attribution of variation in most cases to the Architect. Under clause 11.2 of the SFBCN, 1990 variations may arise under, circumstances that could not have been reasonably foreseen before signing the contract, Additional requirement by the employer, compliance with government order

or legislation, correction of errors or omission in the contract drawings and contract bills, non-availability of materials and goods specified in the contract, substitution of materials, goods and workmanship specified in the contract (Love 2016).

Most contracts make provisions for possible variations given the nature of building construction (Finsen 2019; Wainwright & Wood 2018). A degree of change should be expected since it is difficult for clients to visualize the end product they procure (Love 2016). Unforeseen conditions may arise which require measures that have not been provided for in the contract (Finsen 2020). However, the disadvantage of the variation clause is that architects tend not to crystallize their intentions on paper before the contract is signed because they know the variation clause will permit them to finalise their intentions during the term of the contract (Wainwright & Wood 2019). An unfortunate aspect of the variation clause is that it tends to encourage to changes their minds and embark on building projects without having properly thought through their project requirements. Consultants typically forget that issuing numerous variation orders result in higher construction costs.

Variations and conflict in construction projects, at work and even in our daily lives are very common. Any addition, deletion or other revisions to projects goals and scope are considered to be variations. Whether they increase or decrease the project's cost and schedule. Most commonly, lack of timely and effective communication, lack of integration, uncertainty, changing environment and increasing project complexity are the drivers of variations. Variations are inevitable in construction projects.

Any additions, deletions, or other revision to project goals and scopes are considered to be variations, whether they increase or decrease the project cost or schedule (Ibbs, et al., 2020). A degree of change should be expected since it is difficult for clients to visualize the end product they procure (Love 2016). Most commonly, lack of timely and effective communication, lack of integration, uncertainty, a changing environment, and increasing project complexity are the drivers of project variation (Arain, et al., 2015).

Statement of the Problem

In any construction project, it is very uncommon that variation will not occur, and this causes a lot of problems in meeting-up with the contract period as agreed in the condition of contract and as well affect the initial contract sum. This problem arises due to changes in specification and scope of works, initiated mostly by project owner/consultants. Unfortunately, apart from the fact that any of these causes will affect the original contract sum, they further identified inadequate brief, design inconclusiveness, inadequate pre-contract planning, non-availability of materials labour specified for the work, unforeseen conditions and discrepancy between two or more contract documents and client's intentions as the major factors causing variation (Arain, & Pheng, 2020).

Unfortunately, apart from the fact that any of these causes of variations will affect the original contract sum, Udeh and Giwa (2017) submitted that consultants were in the habit of abusing the clause while for some it has become a face saving device for the inadequacies in their output especially design details, others are fond of issuing variation orders so that their professional fees will also increase since a proportion of the fees is based on the final cost of construction. Between 1983-1998 Aibinu & Jagboro (2020), 37 projects abandoned as a result of variation in contract prices, 27 as a result of cost escalation, 3 were because of corruption, 4 were to lopsided of foreign agreement and 3 due to political reasons.

They further indentified inadequate brief, design inconclusiveness, inadequate pre-contact planning, indiscipline on the part of consultants, non-availability of materials labour specified for the work, unforeseen conditions and discrepancy between two or more contract documents. Seeley (2020) defined a framework within which the design team can issue variation instructions without prior reference to client.

Despite, various researches on variation its inconclusive as to the main causes of variation in the building construction project works this has led to the gap and the motivation for this research work evaluation in to variations caused by consultants in Building construction industry.

(Arain & Pheng 2020) reported distinguishing the two types of variation orders, namely: beneficial and detrimental variation orders and how it affect construction cost also Mustapha, (2019) reported in a research effect of variation on the construct material and the lump sum of contract cost. However, this and more research has been done in this line but non has looking deeply into the effect of contract variation caused by consultant which has led to the effect of delay in construction works.

Objectives of the Study

- To identify the level of variation caused by consultants in the building construction
- To identify the causes of variations by consultants in Bauchi metropolis
- To determine the effect of caused by consultant on building construction delivery

2. Literature Review

2.1 The Concept of Variation

Standard form of building contract 1998 edition in clause 13(2) of JCT form defined variation as the alteration or modification of the design quality and quantity of the work including the addition, omission or substitution of any work the alteration of the kind' standard of any materials or good executed or brought there on by the contractor for the purpose of the work other than works materials or good which are not in accordance with this contract.

Variation may occur in any of the following: In JCT ('05) the term 'Variation' means: The alteration or modification of the design, quality or quantity of the Works including, the addition, omission or substitution of any work; the alteration of the kind or standard of any of the materials or goods to be used in the Works; the removal from the site of any work executed or materials or goods thereon by the Contractor for the purposes of the Works other than work, materials or goods which are not in accordance with this Contract; The imposition by the Employer of any obligations or restrictions in regard to the matters set out in this clause 5.1.2 or the addition to or alteration or omission of any such obligations or restrictions so imposed or imposed by the Employer in the Contract Bills or in the

Employer's Requirements in regard to: Access to the site or use of any specific parts of the site; Limitations of working space; Limitations of working hours; or the execution or completion of the work in any specific order.

According to clause 13 of the JCT 1980 standard form of contract, variation means the alteration or modification of original design, quantity or quality of the work as shown upon the contract drawings and described by or referred to in the contract bills.

2.2 Measuring Variation

Ramus (1981) ascertained that few, if any, variations have no effect on the contract sum. In order, therefore, to adjust the contract sum adequately and satisfactorily with the condition of the contract, the professional quantity surveyor (and the contractors Q.S) must ascertain a net extra cost or net saving involved. To do that, the affected work will have to be measured, except in those instance where the method of valuation makes it unnecessary, as discussed below. This mean that the work originally designed which will not be required as a consequence of the variation must be identified, isolated and valued, and which is required to replace, the omitted work must be measured and valued. Such measurement may be done from the drawing or, if drawings are not available, by physically measuring the substituted work on the site after it has been carried out. The same procedure was necessary where the contract is based up bills of firm quantities or on specification and drawings only. In the case of contract based on schedule of rates, the whole of the works have to be measured and described above. In all case, the valuing was done in the manner discussed in the section below headed valuing variation.

2.3 Valuating Variations

Ramus (1981) stated that, there are several ways of valuing variations. The choice in a particular case being that which is appropriate to the circumstances they are:

- By the collusion in the variation account of a lump sum in accordance with a quotation submitted by the contractor and accepted by the Architect
- By pricing measured item in the variation account
- By ascertaining the total prime cost of additional works and applying appropriate percentage additions.

It should be noted that both Join contract tribunal and general contract lay the duty of valuing variations upon the professional Quantity surveyor who has the right to decide which is the appropriate method and means of valuing them in each situation. Valuations of variations are generally made by the quantity surveyor in accordance with the following rules: Where the works is of similar nature and executed under similar condition to that in the main contract, then the measured quantities of the variation was priced at rates contained in the bills. Where however, the works is not of a similar condition to that contemplated under the term of the contract bills shall form the basis of a price to be agreed with the contract as far as is reasonable. If the works contained in the variation is totally different from any contained in the contract, then a fair valuation was made by the quantity surveyor for agreement with the contractor. Where it is impossible by the normal method of measurement or price build-up to fairly present the cost of the work shall be assessed at day work rate at the prices ruling at the date the work is actually carried out, and including any percentage addition inserted by the contractor in the contract bills.

2.5 Impact of Variation Orders on Project Delivery

Given a well-structured schedule of works, the maximum project delivery would be achieved if the work invariably flows smoothly within time limits and anticipated budget. However, it is rare that projects perform precisely to their original schedule due to various reasons including for example market conditions changes and corrections to design. Arguably, the occurrence of variation orders has an adverse impact on project delivery. Thomas et al (2002:144) believed that variability generally impedes project delivery. Ibbs (1997:308), concluded that variation orders have tremendous effect on the project delivery as they adversely affect the productivity and costs. Arain & Pheng (2005:285) argued that variation orders are unwanted but inevitable reality of any construction project. Hanna et al (2002:57) indicated that projects impacted by variation orders cause the contractor to achieve lower productivity level than planned. The discussion on the adverse impact of variation orders on project delivery will cover following areas: cost overruns, time overruns, quality degradation, health and safety issues and professional relations.

3. Research Methodology

The research design for this study was quantitative research design, the research process was designed to achieve the research aim, which is to evaluate the role of social media on construction management,

However, this research discuss on the quantitative approach. Quantitative research was undertaken in order to prove the existing theories while supporting the research findings with theories and findings from previous researches.

The target population for the studies with representatives randomly selected from each organization is 1,150 which was include the professionals and the skilled labour in Bauchi metropolis.

S/N	Professionals	Sample Frame
1	Builder	220
2	Architect	185
3	Engineer	101
4	Project manager	214
5	Surveyors	150

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6	Quantity surveyors	130
7	Structural engineer	150
	Total	1,150

QSRBN, ARCON, COREN, CORBON, (2024)

The sample frame was comprise of the Professionals within the building industry such as the builders, quantity surveyors, valuers, architects surveyors within building industry which was enable the collection of sufficient data for the analysis of the research work.

The sample size of study was 285 from a population 1,150 using the table of Krejcie and Morgan 1970, while the sampling technique is simple random technique. This method is appropriate as it will give equal tendency for each variable to be picked at a random reduce the chance for bias selection

The data collection for this research involved a well-structured questionnaires administered to the Professional such as the builders, quantity surveyors, valuers, architects surveyors within building industry. The questionnaire was structure to gather deep understanding on occupants attitudes on the variation on building contract sum and their causes within Bauchi.

4. Result And Discussion

4.1 Questionnaires Administration

A total of 285 questionnaires were administered to selected professionals in the study area (Table 1). A total number of 280 questionnaires with 98.2% response rate was retrieved. A total of 250 were used in the analyses after putting off incomplete ones and records screening for outliers. The general response rate after data screening was 87.7%.

Table 1: Questionnaire Administration

Questionnaire	Number	Response rate
Administered	285	100
Collected	280	98.2%
Screened/used	250	87.7%

4.2 The level of variation caused by consultants in the building construction in the Study Area

Descriptive statistics based on Mean ranking and Std. Deviation was first carried out to determine the level of variation caused by consultants in the building construction in projects in the study area. The result presented in Table 10 showed the results.

Table 2: The level of variation caused by consultants in the building construction in Projects in the Study Area

Variables	Mean	Std. Deviation	Rank	Remark
Design Variations	3.96	1.194	1	Agreed
Errors and Omissions in Drawings	3.86	1.178	2	Agreed
Changes in Scope of Work	3.77	0.948	3	Agreed
Poor Coordination Among Consultants	3.70	0.897	4	Agreed
Change in Material Specifications	3.65	0.916	5	Agreed
Compliance with New Regulations	3.64	1.117	6	Agreed
Technical Improvements	3.60	1.043	7	Agreed
Error in specification	3.52	1.001	8	Agreed
Late completion of design	3.49	0.987	9	Undecided
Change in design details	3.39	0.920	10	Undecided
Unclear design information	3.21	0.892	11	Undecided
Poor coordination	3.01	0.801	12	Undecided
Error in bill of quantity	2.89	0.783	13	Disagreed

The result show he Causes of Variations Based on their Severity of Occurrences in Projects in the Study Area which seven variables were identified with a mean score to be Design Variations with their mean values of 3.96, Errors and Omissions in Drawings 3.86, Changes in Scope of Work 3.77, Poor Coordination Among Consultants 3.70, Change in Material Specifications 3.65, Compliance with New Regulations 3.64, Technical Improvements 3.60, Error in specification 3.52, Late completion of design 3.49, Change in design details 3.39, Unclear design information 3.21, Poor coordination 3.01, Error in bill of quantity 2.89. However, the Causes of Variations Based on their Severity of Occurrences in Projects in the Study Area was identified majorly as Design Variations which revealed that severity of design variation was more compare to the other types of variations identifies.

However errors and omissions in drawings was ranked next, change in scope of work, poor coordination, change in material specification, compliance with new regulation and technical improvement respectively the level of severity of the causes of variation were identified respectively and were graded based on their mean ranking and relative importance index of their effect. However, this study was consistent with the study of James, (2022) in Impact of variation on the project budget and delivery in Ogun, Nigeria. He reported that variation can be very devastating to a project work and need to be given attention from the inception of the project work so as to avoid unnecessary changed that could cause cost overrun and project delay in delivery were necessary.

4.3 The Various Variations Caused by Consultants in Bauchi Metropolis

Descriptive statistics based on Mean ranking and Std. Deviation was carried out on the various variations caused by consultants in Bauchi metropolis. The decision for mean ranking was taken based on the rating scale.

Table 3: Variations Caused by Consultants in Bauchi Metropolis

Variables	Mean	Std. Deviation	Rank	Remark
Design Variations	4.40	1.151	1	Agreed
Errors and Omissions in Drawings	4.30	1.165	2	Agreed
Changes in Scope of Work	4.30	1.102	3	Agreed
Poor Coordination Among Consultants	3.92	1.157	4	Agreed
Change in Material Specifications	3.77	1.170	5	Agreed
Compliance with New Regulations	3.55	1.063	6	Agreed
Technical Improvements	3.53	1.192	7	Agreed
Design Complexity	3.50	1.101	8	Agreed
Conflict in contract document	3.41	1.091	9	Undecided
Lack of strategic planning	3.32	1.001	10	Undecided
Shortage of skilled manpower	3.20	0.921	11	Undecided
Change in design	3.01	0.890	12	Disagreed
Change in project schedule	2.89	0.831	13	Disagreed

The result shows the Variations Caused by Consultants in Bauchi Metropolis, which seven (7) variables were identified which included Design Variations with a mean values of 4.40, Errors and Omissions in Drawings 4.30, Changes in Scope of Work 4.30, Poor Coordination Among Consultants 3.92, Change in Material Specifications 3.77, Compliance with New Regulations 3.55, and Technical Improvements 3.53 Design Complexity 3.50, Conflict in contract document 3.41, Lack of strategic planning 3.32, Shortage of skilled manpower 3.20 Change in design 3.01, Change in project schedule 2.89 the research identifies this as the various causes of variation from consultants. However, the major cause was design variation which majorly occurs due to Modification of architectural or structural designs during construction as most of the respondents acclaimed that a design may have urgent need for modification due to the environment or terrain possibly the structural drawing was not adequate to carry the loading as such the need to modify may come in also some respondents were of the opinion that Change in layout, dimensions, materials, elevations, or structural system may result in this changes which is very relevant to prevent defect in the structural members, next was the errors and omission in drawing this most time occurs when there is omission in the drawings which could lead to rework, delays, or additional costs thereby increasing the cost overrun most of the respondent were of the opinion that Mistakes in design drawings or specifications and also Missing details that require clarification on-site could lead to this error and as church carries a repercussion on the cost of production and also delay in delivery. However, the finding of this study is in line with that of Mohammed, (2020) on Assessment of Causes and Effects of Variation on Construction Project Delivery in South West Nigeria he affirm that that variation had a negative impact on the overall delivery of the project as variation should be controlled and avoided by giving every section of the project kin attention from the drawing which is the conception state to the final stage to reduce the cost of rework or delay.

4.4 The Effect of Variation Caused by Consultant on Building Construction Delivery in Bauchi Metropolis

This study developed a regression model in an attempt to reveal how Variation affects the Delivery of Building Construction Works in Bauchi Metropolis. The regression model employed the techniques of identifying the causes of this variation and the level of variation in the construction industry in the study area. Delivery of Building Construction Works as the dependent variables while variation was used as the independent or predictor variable, the result are then computed and reported in Table 7 and 8 respectively.

Table 4: Model Summary									
Model	R	R Square	Adjusted Square	Std. Error of the Estimate	Change Statistics	R Square Change	F Change	df1	Sig. F Change
1	.213 ^a	.045	.031	.772		.045	3.205	2	.044
a. Predictors: (Constant), Variation									
b. Dependent Variable: Delivery of Building Project									

Table 7 records an R-value of 0.213 which can be explained that the dependent variable (Delivery of Building Construction) and the independent variables (variation) having a 21.3% relationship. Also, an R Square value of 0.045 implies that the independent variables have 4.5% collective effect on the Delivery of Building Construction works, which also translates to the fact that 95.5% of the variance in level of variation is accounted for by other factors not included in this model. A p-value of 0.044 in Table 7 concludes that the effect of variation on Delivery of Building Construction works is statistically significant since the recorded p-value is less than 0.05 as suggested by the rule of Thumb.

Table 5: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta				Lower Bound	Upper Bound
1	(Constant)	2.109	.676			3.121	.002	.773	3.445
	Variation	.334	.151	.188		2.215	.028	.036	.632
	Project delivery	-.134	.149	-.076		-.899	.370	-.429	.161

a. Dependent Variable: Project delivery

Table 5, a coefficient table generated from the multiple regression analysis goes further to report the individual contribution of each of the predictor variables to the change of the dependent variable with all other factors held constant. The Beta coefficient measures the percentage of the level of variation in association with the percentage change in each independent variable holding all other factors constant. The Unstandardized β Coefficients in Table 8 above reveals that; for a unit increase in level of Delivery of Building Construction work recorded there was a 0.334 unit increase in the variation which the p-value is statistically significant at 0.028 while for a unit decreases in the variation there was a 0.134 unit decrease Delivery of Building Construction work which this variation is actually not statistically significant as seen in the reported p-value of 0.37 which is greater than 0.05 as suggested by the rule of Thumb. This finding is consistent with the study of Yamusa, (2021) who in different circumstances asserted that the efficiency in handling project works variation can produce a corresponding delivery and result at the end of the project work. He affirm that a delivery project work delivered within the scheduled time and cost must consider the adequate control of project variation from all areas this can help in the delivery of a productive work with time schedule and cost.

5. Summary, Conclusion and Recommendation

5.1 Summary of the Findings

Objective one was achieved which was to identify various variations caused by consultants in Bauchi metropolis, where thirteen (13) variable was identified it was revealed that the major cause was design variation which majorly occurs due to Modification of architectural or structural designs during construction as most of the respondents acclaimed that a design may have urgent need for modification due to the environment or terrain possibly the structural drawing was not adequate to carry the loading as such the need to modify may come in also some respondents were of the opinion that Change in layout, dimensions, materials, elevations, or structural system may result in this changes which is very relevant to prevent defect in the structural members, next was the errors and omission in drawing this most time occurs when there is omission in the drawings which could lead to rework, delays, or additional costs thereby increasing the cost overrun

Objective two was achieved which was to assess the level of construction project delivery in the study area, which seven (13) variables were identified. However, most of the respondents were of the opinion that the level of construction project delivery can be assess as the project is considered to have satisfactory time performance when the planned activities are completed according to the approved programme and the facility is handed over on or before the stipulated completion date. Time performance is particularly important because construction delays can increase project costs, disrupt the activities of clients and contractors, create claims and disputes, and reduce the expected benefits of the completed facility.

Objective three was also achieved which was to determine the effect of variation on the delivery of building construction works in Bauchi metropolis. The result reveals that; for a unit increase in level of Delivery of Building Construction work recorded there was a 0.334 unit increase in the variation which the p-value is statistically significant at 0.028 while for a unit decreases in the variation there was a 0.134 unit decrease Delivery of Building Construction work which this variation is actually not statistically significant as seen in the reported p-value of 0.37 which is greater than 0.05. R Square value of 0.045 implies that the independent variables have 4.5% collective effect on the Delivery of Building Construction works, which also translates to the fact that 95.5% of the variance in level of variation is accounted for by other factors not included in this model. A p-value of 0.044 in Table 11 concludes that the effect of variation on Delivery of Building Construction works is statistically significant since the recorded p-value is less than 0.05. Variation has a vast effect on the Delivery of Building Construction works in the study area

5.2 Conclusion

It was concluded that the major cause of variation was design variation which majorly occurs due to Modification of architectural or structural designs during construction as most of the respondents acclaimed that a design may have urgent need for modification due to the environment or terrain possibly the structural drawing was not adequate to carry the loading as such the need to modify may come in errors and omission in drawing this most time occurs when there is omission in the drawings which could lead to rework, delays, or additional costs thereby increasing the cost overrun

It was also revealed that most of the respondents were of the opinion that the various identified consultants are contributors to variation on site as the first consultant revealed was the structural engineers which the respondents were of the opinion that they might want to review the foundation, beams, columns, or load-bearing systems often causing variations as they might want to make some adjustment to provide a standard structure that was stand the test of time this could cause variation and incurring more cost to the process, next was the architect which variation can be created from the activity of changes in layout, finishes, elevation, space requirements, or building use often this can cause variations as this are important aspect of the structure which cannot be taken lightly as the finishes brings out the beauty of the building as reported by the respondents, therefore if the building is not well laid out it tells negatively on the architect in charge of the work

5.3 Recommendation

- It was recommended that the building professional should give a careful look at the processes in the stages of the building from

the conception to finish stage to avoid alteration in the process of building works this can reduce the level of variation

- It was also recommended that professional with adequate know how should be considered form project work to be predict future challenges for alteration which can be avoided even before they arise
- It was also recommended there should be an awareness creating adequate knowledge of the severity of the causes of the variation so as to provide room for its avoidance while on site

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