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MODELLING THE MAGNITUDE OF CONTRACT CLAIMS ON SELECTED BUILDING CONSTRUCTION PROJECTS IN ABUJA

By

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Abstract

Claims represent extra work resulting in additional cost under the building contract, and have been studied extensively. It however appears to have been generally accepted that project characteristics have no relation to the value of claims made by contractors. This paper provided evidence that relationship, albeit weak ones do exist between seven project characteristics (contract sums, gross floor area, number of subcontractors, planned completion periods of projects, project type, number of floors in building, and experience levels of main contractors) and the value of contractor's claims. A 3-section questionnaire was served to consulting Quantity Surveying firms in Abuja, and 33 examples of projects that had been completed with claims were obtained. The data were analyzed using scatter plots, correlation and linear regression. The findings revealed that all seven characteristics were collectively responsible for only about 26% of the variations observed in the values of claims. The paper concluded that (i) project characteristics do have a potential for inclusion in models to predict the behavior of contract claims, (ii) costlier projects are more likely to have higher values of claims and (iii) projects with a higher proportion of work subcontracted out are more likely to have higher values of claims. The paper recommended that periodic data surveys could be commissioned by the Universities, polytechnics and the Nigerian Institute of Quantity Surveyors (NIQS), on other non-linear forms of relationship existing between project characteristics and the value of claims.

Keywords: Claims, Modeling, Project characteristics, Quantity Surveying,

Introduction

Changes in the initial concept of a project might give rise to modifications resulting in increase or decrease in the project size, or the amount of labour and materials used in the execution of the work. The effects of such changes are usually interpreted in terms of money. This scenario encapsulates the phenomena of claim, which had existed since ancient times. Claims have in recent years come to signify protracted disputes covering additional cost arising out of the building contract. Asawo (1998) viewed claim as "the assertion of a right or a policy of assurance when the event insured against happens". Claims are made to cover for cost of the occurrence of unforeseen circumstances which arise as a result of default by the employer or circumstances beyond the control of both parties.

Claims have been studied quite extensively in construction. However, the direction of such studies has been focused towards determining to what extent change factors impact on projects. It appears to have been generally accepted that project characteristics have no relation to the value of claims made by contractors. In Leonard (1988)'s work on change order impact on construction projects, the list of 22 factors that had significant impact did not include any of the characteristics that are commonly employed to describe projects in the Nigerian construction industry. If this is accepted as given, it then means claims do not vary in proportion with any of the parameters used to describe a project, such as size (gross floor area, number of floors), value (contract sums), or project organizational complexity (number of subcontractors, experience levels of main contractors).

This paper aimed to provide evidence that relationships do exist between project characteristics and the value of contractor's claims. The project characteristics selected are (i) contract sums, (ii) gross floor area, (iii) number of subcontractors, (iv) planned completion periods of projects, (v) project type, (vii) number of floors in building, and (vii) experience levels of main contractors. Claims represent an important source of increases in construction costs. The authors believe that the research is of timely importance and significance to the Nigerian construction industry, given the propensity for construction projects to be completed beyond planned time and cost budgets. Better understanding of the value of claims might help in the development of effective measures to mitigate their negative effects, such as cost overrun which might lead to eventual abandonment of the project.

Review of Related Literature

Contracting has been described as a high risk business by writers like Seeley (1984). The contractor, at the time of tendering, has the right to expect to proceed in an orderly manner, while the employer has the right to expect experience and competence from the contractor. These expectations may not be realized without the interference of some variables pertinent to the project. This necessitates that the extent of interference is evaluated to ascertain its monetary value. The amount thus ascertained (an increase or decrease from the contract sum) will be claimed by one of the parties to the contract accordingly. When claims are accepted and paid for, there is no dispute, because according to Okereke-Onyeri (1998), "a dispute can only arise when there is both a claim and rejection of it".

Bower (2000) proposed a mechanism for the 'evaluation of compensation due in the event of a variation order under contracts for construction work'. The research demonstrated how the indirect costs of a variation can be derived by the use of influence curves. Akpan and Igwe (2001) researched the problem of cost overrun in the construction industry, declaring it a source of friction between clients and contractors which if not properly handled, could stall the progress of work and may subsequently lead to project abandonment. They attempted to develop a suitable model for the evaluation of cost overrun during project execution, focusing primarily on 'cost effect with respect to the extent of work done, payment schedule, and government fiscal/monetary policies'.

Hanna, Camlic, Peterson and Nordheim (2002) defined change as any event that results in a modification of the original scope, execution time, or cost of work, as a result of which contractors are entitled to an equitable adjustment to the base contract price and schedule

for all productivity impacts associated with the change. The focus of their paper was to quantify whether an electrical or mechanical project is impacted by a change order (variation, which would give rise to claim). They identified groups of factors that correlate with whether a project is impacted by change orders and developed a quantitative definition of impact, using logistic regression techniques.

Ibbs, Wong, and Kwak (2001) undertook a comprehensive analysis of 67 global projects from the Construction Industry Institute's database in the USA. Their study found timesaving was a definitive advantage of design/build project delivery, but also, the project management expertise and experience of the contractor may have a greater impact on project performance outcomes than focusing on project delivery strategy only.

It should be noted that the thrust of research has not been to determine the probable amount of claims that might arise in the course of a construction project. The closest research has come to this has been the works of Hanna et al (2002) and Moselhi, Assem, and El-Rayes, (2005). In their paper Moselhi, Assem, and El-Rayes, (2005) described a study conducted to investigate the impact of change orders on construction productivity using a new neural network model for quantifying this impact. The study was based on a comprehensive literature review and a field investigation of projects constructed in Canada and the USA. They developed a prototype software system to estimate the loss of labor productivity due to change orders. This loss can be transformed into monetary terms and treated as a claim.

A claim, according to El Rufai (1989) may fall under any of the following four (4) categories; (i) *Contractual Claims,* which arise out of the process provisions of the particular contract, (ii) *Common Law Claims;* which are claims to which parties are constitutionally entitled, (iii) *Quantum merit claims* provide remedies where no price has initially been agreed or where a new contract replaces the original one (Asawo 1998) and (iv) *Ex-Contractual Claims,* which are not based on clauses within the terms of a contract.

Methodology

The next phase of the research involved the development of a questionnaire. The characteristics of construction projects that had been impacted by claims resulting from variation orders during execution were reviewed from the literature; see for example, Leonard (1988). The questionnaire approach was adopted for the collection as it is easier for the respondents to fill or answer short questions than long interviews. The questionnaire comprised 16 questions in 3 sections; an introduction, a section on characteristics of projects on which claims were experienced and lastly, information on claims experienced during project.

The questionnaire was pre-tested on three professionally certified staff members of the Department of Quantity Surveying of the Federal University of Technology Minna, and was modified based on feedback. Over 20 letters of introduction and copies of the research questionnaire were physically served to consulting Quantity Surveyors randomly selected from the membership directory of the FCT Chapter of the Nigerian Institute of Quantity Surveyors. At the end, five Quantity Surveying firms responded to our requests for data; some 33 examples of projects that had been completed with claims were obtained. The data analysis stage of the research employed statistical software to perform descriptive, frequency, correlation and regression analyses.

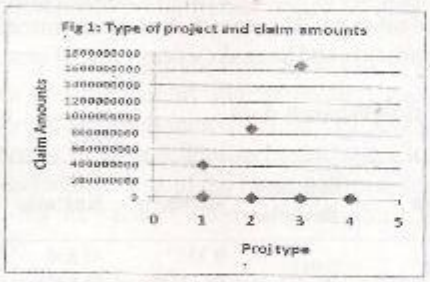
Demographically, all of the projects considered were constructed between 2000

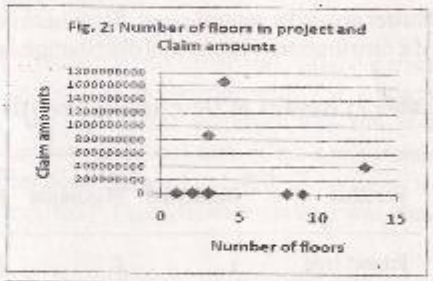
and 2009. There were 16 residential buildings, 12 institutional projects and 5 projects intended for commercial activities. Eighty-five percent of the selected projects had less than 4 floors. The sizes of the projects ranged from 110 to 987 square meters; 61% of the projects did not exceed 400 square meters. All of the information obtained on claims was in relation to the activities of both main and subcontractors.

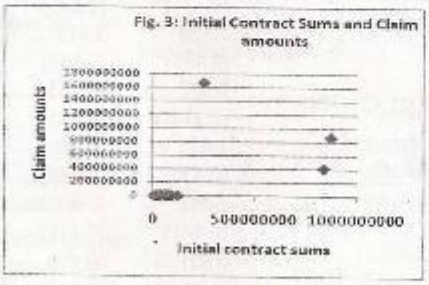
The assumptions made in this paper include that (i) the project characteristics employed as independent variables are linearly related to the value of claims, (ii) variations in the specifications of individual projects do not materially affect the relationship between project characteristics and the value of claims. A limitation of the paper was its use of total claim value, rather than details of individual claims associated with specific phases or component parts of the project.

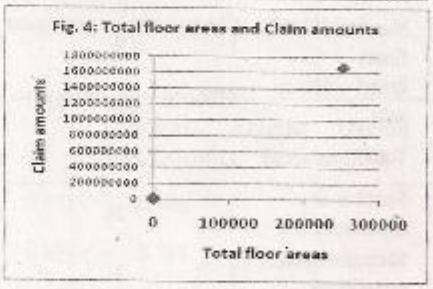
Results of Data Analysis

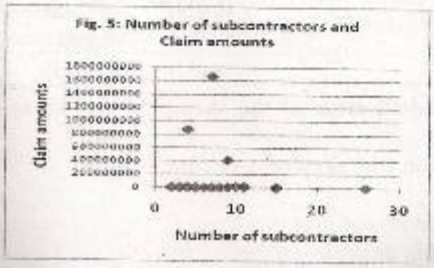
The research data, 33 building projects spanning residential, commercial and institutional developments was plotted as scatter graphs in order to allow for easy identification and removal of outliers (see Figures 1 to 7 below). A total of five projects were removed this way.

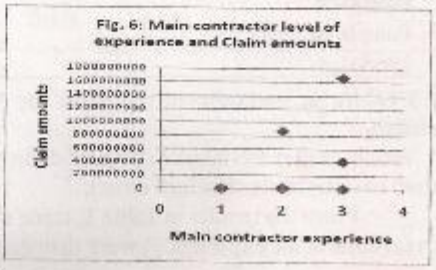


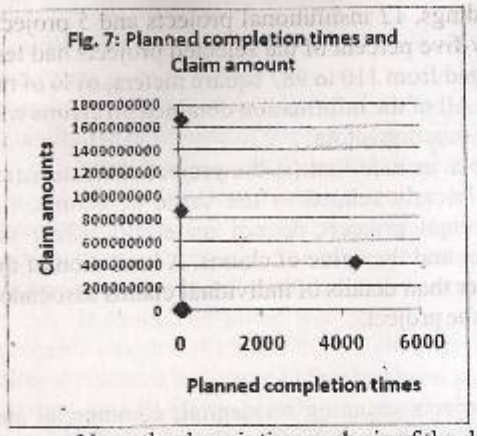












Next, the descriptive analysis of the data was undertaken, using the 'Descriptives' analysis command of the Statistical Packages for Social Sciences (SPSS 13). Parameters run included measures of dispersion (Minimum, Maximum), location (Mean, Standard Deviation), skewness and kurtosis, which is a measure of the extent to which observations cluster around a central point. Skewness on the other hand is a measure of the asymmetry of a distribution. The normal distribution is symmetric and has a skewness value of zero.

Table 1: Results of Descriptive analysis of the research data

Variable	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis
Project type	1	4	2.48	0.911	0.359 (0.434)*	-0.636 (0.845)
Number of floors	1	9	2.48	2.181	2.120 (0.434)	3.913 (0.845)
Initial contract sum	5500000	121200000	6033001.92	724583.69	0.802 (0.434)*	-0.265 (0.845)
Total floor area	110	987	431.59	244.45	1.022 (0.434)	0.249 (0.845)
Number of subcontractors	2	26	7.32	5.236	1.832 (0.441)	4.881 (0.858)
Main contractor experience	1	3	1.62	0.677	0.641 (0.434)*	-0.570 (0.845)
Completion time (weeks)	7	104	30.97	22.01	1.973 (0.434)	3.869 (0.845)

( ) values in parentheses represent the standard error of the skewness and kurtosis statistics.

* Variables that are close to normal distribution (the skewness statistic is not more than two times its standard error).

From the results in Table 1, three variables (project type, [illegible] and main contractor experience) were distributed in an almost [illegible]

variables were not normally distributed. Given this mix of pattern in the research data, Kendall's tau was adopted as measure of correlation.

Table 2: Results of Correlation analysis

Variables X	Y	Kendalls tau	Significance (2-tailed)
Project type	Claim amount	0.151	0.302
Number of floors	Claim amount	0.193	0.184
Initial contract sum	Claim amount	0.382*	0.004
Total floor area	Claim amount	-0.057	0.666
Number of subcontractors	Claim amount	0.422*	0.002
Main contractor experience	Claim amount	-0.048	0.754
Completion time	Claim amount	0.145	0.275

* Correlation is significant at 0.05 level (2-tailed).

It was apparent from the results in Table 2 that only two variables (initial contract sum and number of subcontractors) were significantly correlated with the amount claimed by contractors. Linear regression of the significant variables was run and reported in Table 3. The derived R^2 value was very low and the details of the coefficients revealed that none of the two significant variables could be used to create an equation to predict the value of claims. No variable had a coefficient significance value lower than 0.05.

Table 3: Results of Linear Regression analysis (significantly correlated variables only)

Variables X	y	Derived regression coefficients	t	Sig of coefficient	Overall R^2	Overall Sig
Constant	Claim amount	1389682	0.771	0.449		
Initial contract sum	Claim amount	0.036	0.887	0.385	15.5%	0.156
Number of subcontractors	Claim amount	198484	0.928	0.364		

Table 4: Results of Linear Regression analysis (all variables)

Variables X	y	Derived regression coefficients	t	Sig of coefficient	Overall R2	Overall Sig
Constant	Claim amount	2153991	0.462	0.650	25.9%	0.563
Project type	Claim amount	-1257797	-0.983	0.339		
Number of floors	Claim amount	53412.03	0.104	0.918		
Initial contract sum	Claim amount	0.060	1.296	0.212		
Total floor area	Claim amount	-5157.123	-1.068	0.300		
Number of subcontractors	Claim amount	234771.7	0.943	0.359		
Main contractor experience	Claim amount	1471165	0.814	0.427		
Completion time	Claim amount	22524.66	0.426	0.676		

To test whether the results would be different if more variables were introduced into the equation, another linear regression analysis was run, this time using all seven variables. The results, reported in Table 4, had an R^2 value of 25.9%; overall, the analysis was non-significant. None of the variables could be used to create an equation to predict the value of claims.

Discussion of Results and Implications of Findings

The inclusion of any factor in a predictive model is based on the amount of influence such a factor exerts over the dependent variable. In this paper, it has been shown that seven of the characteristics usually employed to describe construction projects (mostly for comparison purposes) were collectively responsible for only about 26% of the variations observed in the values of claims. Furthermore, only two of the seven characteristics correlated significantly with the values of claims. The significant results obtained in this paper are summarized in Table 5.

Table 5: Summary of significant results of analysis

Factor	*p*-value	Interpretation
Initial contract sum	0.004	Costlier projects are more likely to have higher values of claims.
Number of subcontractors	0.002	Projects with a higher proportion of work subcontracted out are more likely to have higher values of claims.

The *p*-value for the two significant characteristics lie in the region described as very strong evidence by Nordheim and Clayton (1996) in Fig. 8.

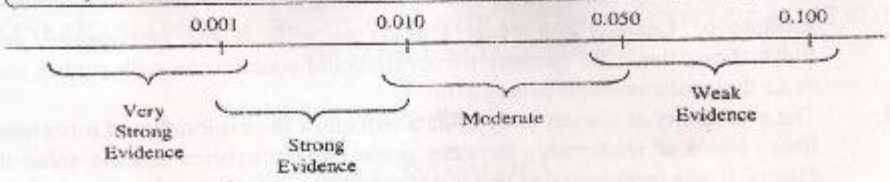


Fig. 8: Relative strengths of *p*-values (Nordheim and Clayton (1996), in Hanna et al (2002)

Although in statistical terms this paper has failed to build a model to predict the values of claims based on selected characteristics of the project, several important implications of the results exist. First, two of the selected characteristics (initial contract sum and number of subcontractors) have been found to be strongly correlated to the values of claims. Secondly, within certain boundaries (ranges of contract values and numbers of subcontractors on the project), the value of claims will vary in a manner similar to variations in the contract values and numbers of subcontractors. However, the boundaries within which such variations could be expected to occur are unknown, and should be the subject of future research. Thirdly, a major assumption of this paper has been that the selected project characteristics were linearly related to the value of claims. Future model development could explore other non-linear forms of relationship.

Conclusion

This paper has drawn the following conclusions from the fieldwork and subsequent data analysis:

The collective influence of seven project characteristics in the prediction of the value of contract claims was 25.9%. The seven characteristics were (i) contract sums, (ii) gross floor area, (iii) number of subcontractors, (iv) planned completion periods of projects, (v) project type, (vii) number of floors in building, and (vii) experience levels of main contractors. Only 2 of the 7 characteristics were of statistical significance.

The main findings of this paper could be summed up in three short points:

i. Project characteristics do have a potential for inclusion in models to predict the behavior of contract claims.
ii. Costlier projects are more likely to have higher values of claims.
iii. Projects with a higher proportion of work subcontracted out are more likely to have higher values of claims.

Recommendations

Based on the findings of the paper, the recommendations made were that: -

1. The boundaries within which claims will vary in a manner similar to variations in the contract values and numbers of subcontractors are currently unknown. This paper recommended the collection of a wider body of data on claims to aid research into the modeling of claims behaviour. In this wise, there is the need for periodic data surveys such as are mounted in the USA by the Construction Industry Institute (CII). Here in Nigeria, professional bodies such as the Nigerian

Institute of Quantity Surveyors (NIQS) as well as the Universities and Polytechnics that offer quantity surveying could commission such studies and make the results available to the public.

2. The availability of a wider body of data will allow the exploration of other non-linear forms of relationship between project characteristics and the value of claims. It was recommended that a wider selection of project characteristics be made.

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