IDENTIFYING THE FACTORS CAUSING VARIATIONS IN BUILDING PROCESS IN NIGERIA

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Abstract
This paper examined the reasons; most building projects are subject to variation in Nigeria. This was done by conducting a survey of some building project in the North Central region of the country, identifying and evaluating the relative importance of various factors that cause variation in the building process and their effects. The respondents to the survey were drawn from professionals in the building industry who are currently handling some projects in the region. Opinions of the professionals on the identified factors were analyzed by ranking. The relative importance index method was used, and result showed that the complexity of project, client experience, technology adopted, duration of project and adequacy of information ranked high among causes of variation. While cost overrun, claims, time overrun disputes and total abandonment ranked high among effects factors. The results revealed that effective project planning, controlling and monitoring enhance project performance and minimise variation. The study also discovered that most of the respondents are familiar with the identified factors causing variation in building process. The study concluded by identifying cost overrun and time overrun as the commonest effects of variation.

Key words:*Building process, variation, project performance, job satisfaction.*

Introduction

The building process can be divided into three important phases. These are the project conception, project design and project construction. According to Chan and Kumaraswamy (1997) project conception is the recognition of a need which can be satisfied by a physical structure. Sidwell (1990) opines that at the project design phase, the primary concept is translated into an expression of a spatial form which will satisfy the owner's requirements. The construction phase is the creation of the physical form which satisfies the conception and which permits the realization of the design (Chan & Kumaraswamy, 1997).

Usually the vast majority of project variations according to Akinola, Potts, Ndekugri and Harris (1997), occur during the construction phase, where and when many unforeseen factors arise, Sikan (2003) opines that they arise often during the progress of the work and seldom before the commencement of work. Arian (2005) claims that variation is one of the major problems that are confronting the building industry in the contemporary dispensation. Variations according 'to Akinola et al (1997) are defined as the modification or change to design after the contract has been awarded. It is a change or deviation in design, material or workmanship from specification in the original tender document. From Akinola et al's (1997), Sikan's (2003) and Arian's (2005) submissions it is observed that variations are likely to be a major cause of disruption, disputes and claims.

Going by the definition of Sidwell (1990) on the building design phase, if the primary objectives of any design are to satisfy the owners' requirements, then the problems of variation is worthwhile. In order to fully understand variations, it is important to first understand the source, nature and why they arise. This will lead to a better management and control of the items of the project specification.

Causes and Effects of Variations

A building project is liable to variation as a result of a change of minds on the part of the client or

their consultant; or an unforeseen problems raised by the main contractor or sub-contractors, (Mokhtar, 2000). The complexity of construction works means that it is hardly possible to complete a building project without changes occurring in the initial plans or the construction process itself. Rooms are usually created for variation in building project. That is why any standard form of building contract will contain a clause that defines variation in terms of specific actions and activities (Baxendarle, 1996). The causes of variations (i.e. the need to change the initial plans) give rise to a lot of effects, such as delay in construction schedule, increase in project cost, demolition, etc. (Arain 2005).

Variations may occur any time, either during the process of the construction or prior to the possession of site. Variation can be avoided. Arian and Low (2005) submitted that this is better done at the design phase. If attention is given to factors that may cause variation right from the stage of design, variation can be avoided or reduce if it occurs eventually. Furthermore if one were to seriously consider ways to reduce problems on site, an obvious place to begin with, is to focus on what the project team can do to eliminate these problems at the design phase, (Arain 2005). As a rule, no instruction for variation will be issued after the practical completion has been certified. It is considered imperative and practical for a construction contract to have a provision for variations in its working procedure. This is because of the length of time for the completion of a project and the complexity of the design. The complexity of design depends on aesthetic excellence that the designer intends to achieve, the technology of construction and the need to comply with the changing needs of the environment.

A hypothetical example of the causes of variation is of a prestigious project whose construction was designed to take two or three years. The design was acclaimed to be of the highest quality ever. The construction technology methodically worked out and targeted completion date was adequately calculated. However, when the work started and the project gradually took shape, ideas to improve the design was conceived. These new ideas were aimed at enhancing the aesthetic qualities of the project. Thus, there must be amendments on the original design, hence a variation. This type of amendments or variation touches on the aesthetic consideration. On the technical aspect it may deal with site, underground or environmental issues.

Prior to the design work, though it is pre-requisite that the site survey and possible underground investigation are conducted to determine the prevailing conditions which will have great influence on the structural design work. It is however discovered that hardly do many designers take the pain to do this in Nigeria. It is normal to accept that the data obtained from such investigation will serve as a guideline to help the design work but may not guarantee the workability of the design. The actual conditions will only be known when they are encountered and exposed during the progress to the construction work. Since the design was mainly based on the survey report, the discovery of the actual conditions which is different from that shown in the report will make it mandatory for the designer to make relevant changes in his original design. Thus, one may conclude that variation in most cases is inevitable. Four major factors that are responsible for variation or that may be influencing variation have been identified. They are client characteristics, project characteristics, project organisation and environmental factors.

Client Characteristics:
The client is the project owner or initiator of the building project. Sometimes client is represented by an individual or organization either private or public. The expert knowledge of representative of the owner in building construction can lead to variation as the construction goes on. The nature of the business of the owner, either public or private would determine the taste and this could influence the decision making processes and lead to variation (Sidwell, 1990). For instant, a speculative property developer approving variations after the award of contract might be aware of the cost implication or impacts on the project, whereas a client who is not a property developer might not.

Project Characteristics:
The construction industry is a complex environment because of its uniqueness, the amount of

resource involved in it and the complexity of technology required (Abied & Arduit, 2003). In this complex environment, construction projects are generally unique, accommodating different designs, sites and construction methods, (Akinola, et al 1997). Each has different characteristics influencing how the project is initiated, designed, organized and managed and the final outcome of the finished product, (Bennett, 1991). Hence the type, size, time duration, and complexity of the project and the complexity of the technology which the construction industry decides to employ are characteristics that are likely to influence variation.

Project Organization:
The success of building project depends on the efficiency of the project team in managing the process, (Sidwell, 1990). The organization of the construction process is dynamic in nature. It includes generating different contract strategies and organizational structures as well as styles of management reflecting the amalgamation of specialist from different disciplines with different objectives. Individual membership of the team has its own objectives and makes contributions according to its expertise and is often concerned with a discrete functional part of the process. This often creates problems of co-ordination and communication. It may affect variations in terms of number, agreement of cost value and if disputes arise how they are resolved. The major organization factors that specifically induce variation have been identified to include the method of procurement, type of contrast, method of tendering, type of tender document used, percentage of design completed before tender, design and construction duration, adequacy of information and the number of sub-contractors used.

Environmental Factors:
Sidwell (1990) opines that the environment describes all external influences on the construction process. Thus, a building project as a temporary organization or work place for people is influenced by a variety of opportunities and constraints within the environment. Building project is also subject to these environmental influences. Hughes (1989) identifies those influences as the economy, social, political and terminological elements. Where such factors influence the project performance, they may lead to variations. Hughes (1989) further suggests that an organization is embedded in social, political, legislative, economic and technical systems which will influence the strategy.

Research Methodology

In order to identify the causes and effects of variation on building construction process, a wide range of personnel involved in construction process were used as target sources of information. Personnel were randomly selected from Architects, Civil engineers, Quantity Surveyors and Builders. For causes of variation, eighteen (18) variables were identified based on the preliminary investigation and existing literature in Nigeria building industry and grouped into four major categories namely, client characteristics, project characteristic, project organization and environmental factors. A questionnaire was then drawn up and was administered on the respondents. The questionnaire that was composed to provide for information on the research questions was structure into two sections. Section A sought to know the general particular of the respondents. While section B was designed to elicit information on the causes and effects of variations on building process. A scale of 0 to 4 was adopted to assess the importance of each variable causing variation, according to their local working experience in building industry.

For effects of variation on construction process, the factors identified were disputes, claims, time overrun, cost overrun, arbitration, litigation and total abandonment. A scale of 0 to 4 was also adopted to rank the individual effect of variations based on frequency of occurrence according to their own judgment and local working experience in the Nigerian construction industry. To facilitate the analysis of the responses, the following numerical values were assigned to the respondents ratings: Always – 4, mostly – 3, sometimes – 2, seldom – 1 and never – 0. A total of 40 questionnaires were randomly distributed to each of the respondent across North central Nigeria. Ten (10) members of each profession were selected. While the choice of location was very much limited by finance and time constrained, it is strongly believed that these locations are fairly representative of the North central part of Nigeria. Ten (10) samples were selected for each of the four groups of professionals

that are involved in a building construction project. They are:

- The Architects.
- The Civil engineers
- The Quantity surveyors
- The Builders

The respondents were selected both from public and private agencies that supervise and construct building project in the recent past.

Data Analysis
The procedures used in analyzing the result were aimed at establishing the relative importance of the various causes and effects of variation on construction process was Ghosh and Jintanapakanout's (2004) Relative Importance Index Method. This method was adopted to analyze the data collected from the questionnaire's survey. The analysis was carried out for each group of respondents (i.e. the architects, civil engineers, quantity surveyors and builders). The five point scale 0-4 mentioned earlier was transformed to relative importance indices for each of the variables of causes and effects of variations, The indices were then used to determine the rank of each item. These rankings made it possible to cross compare the relative importance of the items as perceived by the four groups of respondents. The weighted average for each item for the four groups of respondents was determined and rank (R) was assigned to each item representing the perception of the four groups. The relative importance index (RII) was calculated for each item as follows:

$$RII = \frac{4n_1 + 3n_2\ 2n_3 + 1n_4 + 0n_5}{4n}$$

Where:

- n1 = number of respondents for 'Always' and 'very important'
- n2 = number of respondents for 'Mostly' and 'important'
- n3 = number of respondents for 'sometimes' and 'some important'
- n4 = number of respondents for 'seldom' and 'minor important'
- n = number of respondent for 'never' and 'not important'
- n = total number of respondents.

Data Presentation and Discussion of Results

Distribution and Response

Respondents	Number distributed	Number of respondents	% of Number distributed	% of number of responses
Architects	10	9	25	24.4
Civil Engineers	10	10	25	25.0
Quantity Surveyors	10	8	25	21.6
Builders	10	10	25	25.0
Total	**40**	**37**	**100**	**100**

Table 1: A Table Showing the Questionnaire Distribution and Response

Table 1 above shows that ten questionnaires were distributed to the professional Architects representing 25% of the total member of questionnaire distributed and 24.4% was returned. Also the builders and civil engineers returned all the questionnaires distributed to them, making twenty five percent (25%) each of the number of questionnaire distributed. While the quantity conveyors response represents (21.6%).

Factors Causing Variation

FACTORS CAUSING VARIATION	Architects		Quantity surveyors		Engineers		Builders		Average group	All
	RII	R	RII	R	RII	R	RII	R	RII	R
CLIENT CHARACTERISTICS										
Type of client	0.72	5.5	0.63	15	0.60	10.5	0.68	7.5	0.65	8.5
Client experience	0.83	2	0.75	4.5	0.75	4.5	0.75	2.5	0.77	2.5
PROJECT CHARACTERISTICS										
Type of project	0.58	10.5	0.72	8.5	0.63	9	0.58	11	0.63	11.5
Size of project	0.58	10.5	0.59	16	0.50	14.5	0.55	12	0.56	14
Duration of project	0.75	3.5	0.72	8.5	0.75	4.5	0.73	4	0.74	4
Complexity of project	0.87	1	0.81	1	0.70	6.5	0.75	2.5	0.78	1
PROJECT ORGANIZATION										
Design duration	0.67	8	0.75	4.5	0.58	12	0.53	13	0.63	11.5
Percentage of design Completes before tender	0.58	10.5	0.75	4.5	0.55	13	0.48	14	0.59	13
Procurement method	0.44	17.5	0.72	8.5	0.48	16.5	0.45	15.5	0.52	16
Contract type	0.58	10.5	0.69	11.5	0.60	10.5	0.68	7.5	0.64	10
Selection method	0.50	16	0.78	2.5	0.48	16.5	0.45	15.5	0.55	15
Tender documentation	0.53	15	0.66	14	0.50	14.5	0.35	18	0.51	17
Adequacy of information	0.69	7	0.69	11.5	0.78	3	0.70	5.5	0.72	5
Construction duration	0.56	14	0.53	17	0.80	2	0.70	5.5	0.65	8.5
Number of sub-contract	0.44	17.5	0.44	18	0.40	18	0.43	17	0.43	18
ENVIRONMENTAL FACTORS										
Economy	0.64	9	0.78	2.5	0.70	6.5	0.65	9.5	0.69	7
Political	0.75	3.5	0.75	4.5	0.65	8	0.65	9.5	0.70	6
Technology	0.72	5.5	0.69	11.5	0.85	1	0.80	1	0.77	2.5

Table 2: The Degree of Importance Assigned to Each Factor by the Respondents

Each rank in Table 2 presents the degree of importance assigned to variables within each factor by all the respondents. In the case of major categories, the ranks are shown in Table 3. The results show that, there are several important factors underlying causes of variation on construction process. As shown in table 2, client experience ranks first by architects as factors causing variation with a relative importance index (RII) of 0,83. The complexity of project ranks second with (RII) of 0.87, while duration of project and political factors rank third and fourth respectively with the relative importance index of 0.75 each. The table also indicates that complexity of the project ranks first by the quantity surveyors with a relative importance index (RII) of 0.81, while, adequacy of information was ranked third with (RII) of 0.69.

Builders equally ranked technology factors first with (RII) of 0.80. Client experience, complexity of project and duration of project were ranked second and fourth with relative importance index of project as very significant factor causing variation, with average relative importance index of 0.75 and 073 respectively. Furthermore the engineers ranked technological factor, adequacy of information, project duration and client experience in that order with respective (R11) of 0.85, 0.78, 0.75to being major factors causing variation on building process. From Table 2 all the four parities ranked complexity of project as a very significant factor causing variation, with average relative importance index of 0,78. while, client experience, technology and duration of project were ranked second, and fourth; followed with relative importance average index of 0 77 and 0.74 respectively.

Major Factors Causing Variation

FACTORS CATEGORY	Architects		Quantity surveyors		Engineers		Builders		Average group		All
	RII	R	RII	R	RII	R	RII	R	RII	R	
Client Characteristics	0.78	1	0.69	3	0.68	2	0.72	1	0.73	1	
Project Characteristics	0.69	3	0.71	2	0.65	3	0.65	3	0.65	3	
Project Organization	0.55	4	0.68	4	0.57	4	0.53	4	0.58	4	
Environment Factors	0.70	2	0.74	1	0.74	1	0.70	2	0.72	2	

Table 3: Categories of Major Factors That Causes Variation

Client Characteristics
This factor ranked first-by all the-parties with relative importance index (11) of 0.73. It is composed of type of client and client experience. Among all the variables within this factor as shown in Table 2, the highest relative importance index (0.77) was given to client experience. The group of client characteristics received high ranking by all the parties. The highest ranked factor among these variables was client experience. This could be attributed to differences in the nature of the clients' business where this could influence the decision making processes. Giving it the highest rank could also be as a result of idea of the features added to enhance the aesthetic qualities of the project and thereby causing amendments to the original design, hence a variation.

Environmental Factors
As shown in table 3, environmental factors have relative importance index of 0.72 and ranked second by all the parties. The factor contained a combination of three variables namely: economy, political and technology. Of these variables, technology archived the highest relative importance index of 0.77. This group received a high ranking by all the parties. Technology was the most important factor in his group that was identified as factor causing variation. This aspect relates to the technology which is available to do the work, both in terms of the design work and the construction work. Ranking it high by all the parties was as a result of the dynamic, complex, diverse and hostile nature of construction project. Construction industry is a complex environment because of its uniqueness. The study discovered that all the parties are familiar with the factors but cannot to deal with them effectively without variation.

Project Characteristics
It was ranked third with relative importance index of 0.68 as shown in Table 3. This factor consists of the type of project, size of project, duration of project and complexity of project. Of the variables,

complexity of project received the highest relative importance index of 0.78. This group of variation causations was ranked high because it ranked factors among these variable was complexity of project. Complexity of project was considered very important by architects and quantity surveyors because of the lack of technological know-how and the shortage of managerial manpower. Ranking it low by engineers and builders may be as a result of contract administration.

Project Organization

As shown in Table 3, it ranked fourth with relative importance index of 0.58. It consists of nine variables namely, duration, percentage of design completes before tender, procurement method, type, selection method, tender documentation, adequacy of information duration and number of sub-contract. The highest relative importance weight within this factor (0.72) was for adequacy of information as shown in Table 2.

Project organization related factors received low ranking. Adequacy of information was among the five most important factors that causes variation. Ranking these factors high by the of engineers indicated dynamic, complex, diverse and hostile nature of construction project. The results show that, there are several important underlying factors that may cause variations during construction process.

Findings and Conclusion

The four categories of factors namely, client characteristics, project characteristics, project organisation and environmental factors and seven effects of the factors were quantitatively analysed and evaluated. The major findings of this study is that, based on the ranking (R) of average for the four groups, it was observed that the five most important factors causing variation during construction project delivery as perceived by the architects, quantity surveyors, engineers and builders in the study area were: complexity of project, client experience, technology, duration of project and adequacy of information. Other factors that were also found to be responsible for variations include the experience, technology, duration of project and adequacy of information. It is also discovered that, all the parties involved in building project are familiar with these facts, but are unable to deal with them effectively. One of the conclusions of the survey are is that the overall ranking results is an indication that the four groups of the respondents agreed that the most significant factor that causes variation is client characteristics. It is also the conclusion of this study that more attention should be given to the possible factors that may result into variation right from the design stage with a view to minimize the possibility or prepare the mind of the clients to its possibility.

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