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# The Effect of Contractor-Subcontractor Relationship on Construction Duration in Nigeria

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### Abstract

Construction projects have become complex, hence, most projects are sub – contracted to allow for specialisation. The problem however has been the adversarial relationship between the main and sub- contractors leading to delays and at times abandonment. The main objective was to determine the causes of this strain relationship in the Nigerian context and the extent of this on project duration. A questionnaire survey was sent to fifty (50) main- contractors selected using purposive sampling and fifty (50) sub – contractors selected randomly; who had worked on the same project in Lagos State, Nigeria; eliciting information on the interface problems between them and data on project duration. The result of the survey revealed that, main – contractors viewed delay of work and neglecting main contractor’s instruction as the major causes of interface problems caused by sub – contractors. While sub – contractors viewed assigning part of the works to another sub – contractor without informing the original contractor and main contractor’s financial problems as the major causes of the interface problems. The average time overrun was calculated to be 29.92%. It was concluded that strain relationship between contractors and sub – contractors could cause time overrun but can be reduced if there is a mutual trust / understanding between them.

## 1. Introduction

The construction process is a function of many variables and is exceptionally complex both in conception and implementation. In a construction project of appreciable size, it is probable that much of the actual work will be sub-contracted [1]. Subcontractors are very important in the successful completion of most construction projects[2]. At least 70% of construction work is subcontracted by the main or general contractor[3] while on many projects, particularly building projects, it is not uncommon for 80-90% of the work to be sublet to subcontractors[4] to maximize the advantage of specialization, foster speed of erection, enhance capabilities of prime contractor, facilitate entry into otherwise closed markets. There is increased dependence on sub-contracting within the construction industry. It is widely accepted that the relationship between the main contractor and sub-contractors having a significant effect on the success of the project, but, the topic of sub-contractor management has been neglected [5], as well as the key operational interface between the main contractor and sub-contractors has been undermined[6]. However, strain in the relationship between the main contractor and subcontractor cannot be overemphasized in the construction industry because of the adversarial nature of the industry especially under the Design-Bid-Build or traditional procurement system where the many parties involved are separated and work fragmented.

Reports such as [7] and [8] have recommended that for the construction industry to

improve there is need for integration of process across companies; and building closer relationship. However in the construction industry the adversarial tendencies always show up in the construction stages where the main contractor and sub-contractor feature prominently. The main contractor and sub-contractor relationship needs to be maintained throughout procurement and construction to enable strong interface within the project team, which signifies a positive move away from the traditional adverse relationship [9].

According to [10] relationship between contractors and subcontractors are often strained and prone to dispute due to a poor sense of fairness and misunderstanding of each other's need. This is corroborated by the so-called Agency problem that occurs when cooperating parties have different goals and understanding of the division of labour. The principal and the principle agent problem i.e. the innate agenda of privacy and self-interest explain this strain from another perspective.

Main contractor-subcontractor relationship finds relevance in the Agency theory where the principal (Main contractor) delegates work to another (an agent- Subcontractor) who performs that work for a fee thereby transferring and sharing risk among many parties. The agent thus acquire legal and economic obligation towards the principal. However, problem arises if the agent has a different attitude to risk [11] as this translates to all kinds of behavior in typical construction projects. If as suggested by [12] that effective interface management and well organized solution of the interface problems would be essential for ensuring project success then it is worthwhile to study this interface problem between the main contractor and sub-contractors to determine if it leads to project success in terms of construction duration. Also [13] believe the relationships between the main contractor and sub- contractors do have significant effect on the success of projects but [6] asserted that the operational interface between the main contractor and sub-contractors has been undermined. The aim of this research was therefore to examine the interface problem between main contractors and sub-contractors in Lagos, Nigeria; rank the factors and to determine its effect on construction project duration. By being aware of these factors it might likely reduce the friction between the contractors and their sub- contractors.

## **2. Literature Review**

### **2.1. Contractor-Subcontractor Relationship**

There exists a mutual relationship between the subcontractors and the main contractors. The quality of work the subcontractors deliver affects the performance of the main contractors [1]. The ubiquitous agency relationship is prone to two types of agency problem: information asymmetry and the uneven distribution of risk between the principal and agent [14]. Because it is both uneasy and expensive for the main contractor to constantly monitor the subcontractor, the main contractor bears the residual risk of

the subcontractor's inefficiencies and variance in the quality of his performance. This makes the main contractor to presuppose that the subcontractor is opportunistic and seeks his own interests [15] and thus asks up front for "political costs". Otherwise, the subcontractor may willingly incur the same cost to affirm his commitment to the contractor's goals and principles [11, 14, 16].

Under conditions of incomplete information and uncertainty prevalent in business settings, two kinds of problems arise: adverse selection and moral hazard [16, p.58]. Adverse selection refers to the possibility of subcontractor misrepresenting his ability to do the work agreed; agent may adopt decisions inconsistent with the contractual goals. Moral hazard on the other hand refers to the subcontractor not putting forth his best effort or shirking from his task [17]. But beyond the one-sided evidence of individualism posited by agency theory and the consequent witch-hunting of the subcontractor within the building industry setting it has been proved that main contractors like every other human are also prone to fulfilling self-interest [18]. Hence the need for both contractors and subcontractors to go beyond self- interest to a more matured form of interest i.e. "enlightened self- interest". As suggested by [19] that one project involving several people, parties and units must be carefully and effectively integrated into a single unit if it aims to operate smoothly so as to prevent incurring extra costs.

### **2.2. Contractor-Subcontractor Interface Problems**

The uniqueness of each construction project and the large number of project participants with different specialties and multiple interrelated work flows is underlined by [20]. As stated by [21], a construction project involves so many parties such as owners, designers, construction main contractor, subcontractor, maintenance contractor, and material suppliers that some interface problems cannot but arise, e.g. lack of cooperation, inefficient communication, leading to an adversarial relationship among project stakeholders. Five perspective in analyzing interface management i.e. contract interface; technology interface; monitor interface; execution integration interface and the interacting behaviour in the interface was identified by [22]. However execution integration interface is seen by [12] as the most practical and comprehensive to understand interface management involved in construction projects. The contractor may face financial problems that could be due to 'non-performing' cost estimate, poor management, delay of payment by owner, delay of payment by main contractor [3]. Main contractor- subcontractor interface problems also include delay in approving finished work, delay in approving shop drawings and sampled materials, legal disputes arising from interruptions and termination of subcontractor's appointment. Also, lack of identification of responsibilities and proper record of work carried out by subcontractor may cause confusion on site [23].

As identified by [12] there are several malicious contractual issues such as “inadequate detailing”, “incomplete contract”, “design change” and so on. It is noteworthy that many subcontracts are awarded without any formal discussion taking place between the contractor and subcontractor. This may increase the probability of occurrence of a conflict after construction work has begun [4]. Also, it is not uncommon for either party to skip or neglect implementing germane portions of the conditions of contract by assuming too much at the initial stage.

The construction industry is characterized by inaccurate and untimely communication that often results in costly delays to the progress of the project [24]. Interface problems between main contractor and subcontractor may develop due to poorly communicated information, insufficient information on site, poor supervision, master and slave syndrome and a lack of proper management systems. Inevitably, this leads to poor overall management of the project, poor quality product, late project delivery and dissatisfaction between parties privy to the contract [23]. Poorly communicated information exists when instructions or requirement from the client is not explicitly transmitted or shared with the subcontractor. This maybe in the form of project objectives, milestones or urgency of the project. Sometimes information is communicated in the dying moments of its schedule. Late orders and not allowing for sufficient time in both preparation and execution of a project builds up pressure on the part of the subcontractor.

Problems may also arise if there is delay in progress payment. Delayed payments has been cited as the most significant shortcoming in the subcontracting relationship especially where the main contractor uses the “pay when paid in terms of contracting” [1]. Problems also arise if there is scheduling conflict, change orders or if either the contractor or subcontractor makes a mistake in cost estimation and pricing of materials, labour or both or if the prices escalate beyond estimation and the revised estimation cost is not approved by the other party. Clear working drawings and specifications are important for the effective execution of the construction work. Incomplete or unclear drawings create problems with far reaching effects on productivity [25], and hence construction duration.

Several studies abound on the interface problem such as the study of [26, 27], which was for interface problem between designers and contractors. Also the research work of [3, 4] was for contractors and sub-contractors; while [28] studied the interface problem between clients and designers. Also [12,29], studied the interface problem between various construction parties. But as observed by [12] all these works identified the interface problems only through a review of literature and interviews rather than using any statistical tools. The research of [12], considered the interface problems between construction parties using a case study while [30] though identified the major causes of interface problems between the contractors and sub-contractors it did not identify the effects of the problem on the project. Hence this study did not only identify the interface problems between

the main contractor and sub-contractor it looked at the effect of the problems on the duration of the projects handled.

### 3. Research Methodology

This research was carried out using a questionnaire survey administered on main contractors and sub-contractors who had completed a building project with the Lagos State Government in Nigeria. The main contractors were drawn from the list of Lagos State Tender Board registration database. In that database were eighty – eight contractors but fifty of these contractors were purposively selected for having completed at least a building project for the Lagos State government between 1999 and 2013. The sub-contractors were identified through a snowballing method, i.e. the main contractors were asked to name at least two of the sub-contractors that had worked with the contractors on their projects. Thereafter, a sub-contractor was selected randomly for each main contractor. Hence, fifty sub-contractors were identified to participate in the questionnaire survey. The sub-contractors were from various fields such as brick laying, concreting, plastering, tiling, painting, mechanical (plumbing), roofing (carpentry), and aluminum. Possible factors that could cause interface problems between a main contractor and a sub-contractor were identified based on literature. However, the major causes of interface problems used by [30, p. 101] were adopted. After a pilot survey on some of the respondents, some of these interface problems were discarded.

The respondents were asked to attach a rating from a scale of 1 to 5 points to a factor they see as causing a major interface problem between the main contractor and sub-contractors. One (1) indicates strongly disagree and 5 indicates strongly agree. Also, the main contractors were asked to supply on their completed projects, details of estimated initial contract period and the final completed period. The Relative Importance Index (RII) technique was used for the data analysis as expressed by equation 1:

Relative Importance Index:

$$\frac{\sum W}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N} \quad (1)$$

Source: [30]

where W is the weighting given to each factor by the respondents. This ranges from 1 to 5;  $n_1$  = number of respondents for strongly disagree,  $n_2$  = number of respondents for disagree,  $n_3$  = number of respondents for neutral,  $n_4$  = number of respondents for agree,  $n_5$  = number of respondents for strongly agree. ‘A’ is the highest weight which is 5 in this case and N is the total number of samples

The time overrun was calculated using the mean percentage increase on the initial contract period. This is represented in equation 2.

$$\text{Construction time overrun (t)} = \frac{t_2 - t_1}{t_1} \times 100 \quad (2)$$

Source: [31]

where  $t_1$  is the estimated period of construction in months and  $t_2$  is the final period of completion in months.

## 4. Data Analysis and Discussion of Results

### 4.1. Respondents' Profile

A total number of fifty(50) copies of questionnaire were distributed to the main contractors from those listed in this database of Lagos State Tender Board and forty(40) were retrieved, representing 80%. For the sub-contractors, fifty copies of the questionnaire were distributed but thirty – four supplied the necessary information adequate for analysis. This gives a response rate of 68%.From Table 1, out of the

forty main contractors who responded to the questionnaire survey, twenty – one (21) were private limited and wholly indigenous while nineteen (19) were private limited and wholly multinational. As for the sub-contractors, all were private limited and wholly indigenous.

As for the years of experience for main contractors, 16 (40 %) have had between 6 – 10 years of experience as main contractors, while 24 (60 %) have had more than 10 years of experience in the construction industry. Twelve (12) of the sub-contractors had worked as sub-contractors for less than six years, 11 (32.4 %) between 6 – 10 years and 11 (32.4 %) more than 10 years. The table 1 also reveals the professional qualifications of the main contractors' respondents.

### 4.2. Interface Problem Caused by Sub - Contractors

Table 1. Demographic Attributes of Respondents.

Attribute	Main Contractors		Subcontractor	
	Frequency	Percent (%)	Frequency	Percent (%)
Status of Organization				
Private limited and wholly indigenous	21	52.5	34	100
Private limited and wholly multinational	19	47.5	–	
Years of Experience				
Less than 6 years	–		12	35.3
6 – 10 years	16	40	11	32.35
More than 10 years	24	60	11	32.35
Profession				
Builders	16	40		
Quantity Surveyors	12	30		
Architects	9	22.5		
Civil Engineers	3	7.5		

Table 2. Factors causing interface problems between main contractors and subcontractors caused by sub-contractors (Main contractors' and sub-contractors' viewpoints).

Factors	Both Contractors and Subcontractors		Contractors		Subcontractors	
	RII	Rank	RII	Rank	RII	Rank
Delay of work	0.958	1	0.936	1	0.970	1
Neglecting the instruction of the main contractor	0.932	2	0.910	2	0.952	4
Absence of the subcontractor from site	0.930	3	0.910	2	0.948	5
Partnering the work with another subcontractor without getting the approval of the Main- contractor	0.930	3	0.896	4	0.964	2
Non-adherence to the condition of contract	0.926	5	0.886	5	0.964	2
Failure to preserve and take care of materials	0.864	6	0.870	6	0.858	7
Exhausting the resources of the main contractor	0.846	7	0.866	7	0.840	8
Lack of construction quality work	0.846	7	0.816	8	0.876	6
Neglecting safety measures	0.766	9	0.796	9	0.724	11
Change in material quantity	0.760	10	0.766	10	0.748	9
Involvement of the subcontractor in more than one project at a time	0.758	11	0.756	11	0.676	12
Shortage of skilled labour on the subcontractor's team	0.620	12	0.568	12	0.742	10

Both the main contractors and the sub-contractors were asked to attach weight between 1 and 5 to what each thought were the interface factors caused by sub-contractors on a construction project. Table 2 shows the responses of both groups. The Table 2 revealed that delay of work by the sub-contractors was the most important cause of interface problems by both groups. Delay of work was ranked by main contractors with RII (0.936) while the sub-contractors acknowledged that it was the main cause RII (0.970 ) of the interface problem between them and the main contractors.

Delay of work has been the bane of Nigerian construction industry. Delay of work was ranked by the sub-contractors in [30] research work as the major cause of interface problems while the main contractors ranked it as fourth. If sub-contractors see delay of work as the main problem between them and the main contractors, then sub-contractors should schedule their work packages to meet the time estimated to complete their jobs. This will likely minimize the overall project delay which is important to the main contractor and hence reduce friction between the two groups.

Neglecting the instruction of the main contractors was ranked second position by both groups. Though ranked in the fourth position by the sub-contractors and second position by main contractors, it is seen by both as also a major interface problem between both groups.

Neglecting instruction on how work should be done could lead to rework, delay of work and hence seen by main contractors as what could cause a problem between them and sub-contractors. This was however not seen by respondents in [30] research as a major cause of interface problems. It was ranked fifth position by both groups. Partnering the work with another sub-contractor without getting the approval of the main contractor was ranked the third important cause of interface problem. At times, some sub-contractor having secured a job with the main contractor do sublet it to a colleague in the same specialty. Main contractors frown at this because the “new” sub-contractors’ previous works had not been assessed by them; hence might not be sure of the quality of his work. This was not seen as a major cause of interface problems by the respondents in [30] research.

Involvement of the sub-contractor in more than one project at a time and shortage of skilled labour on the sub-contractor’s team were ranked eleventh and twelfth positions

respectively. The results reveal that both groups do not see these interface factors a major cause of friction between them. The position of the factor, involvement of the sub-contractor in more than one project at a time agrees with the work of [30] study. The last position of the factor, shortage of skilled labour on the sub-contractors’ team in this study was at variance with that of [30] intermediate position. Respondents in this study probably did not see this factor as a source of friction because lack of skilled labour is common in the Nigerian industry and the sub-contractor can easily hire one if need be.

A Spearman’s rank-order correlation was used to test the relationship between the main contractors’ and subcontractors’ rating of the factors affecting interface problems caused by subcontractors. There was a very strong positive correlation between the rankings of the main contractor and that of the subcontractor which was statistically significant ( $r=0.905$ ,  $p=0.00$ ). So there is a good agreement between the contractors’ and subcontractors’ viewpoints.

### 4.3. Factors Leading to Interface Problems Caused by the Main Contractor

**Table 3.** Factors causing interface problems between main contractors and subcontractors caused by main contractors (Both main contractors’ and subcontractors’ viewpoints).

Factors	Contractors		Subcontractors		Both groups	
	RII	Rank	RII	Rank	RII	Rank
Main contractors’ financial problem	0.900	1	0.964	2	0.932	1
Delay in contract progress payment	0.886	3	0.818	3	0.920	3
Interruption and termination of work by contractor	0.840	5	0.712	6	0.776	6
Delay by main contractor in providing necessary materials to the subcontractors	0.850	4	0.806	5	0.828	4
Failure to provide necessary clarifications to subcontractors	0.806	6	0.694	7	0.750	7
Providing low quality material that lead to low quality workmanship	0.790	7	0.818	3	0.804	5
Assigning part of the works to new subcontractors without informing the original subcontractors	0.890	2	0.970	1	0.930	2
Failure of the main contractor to use insurance in case of injury to subcontractors’ labour	0.686	13	0.606	13	0.646	15
Failure to provide the subcontractor with essential services such as water, electricity etc	0.736	10	0.582	15	0.660	12
Failure to provide security on the site	0.720	11	0.594	14	0.658	13
Frequent absence of the main contractor from site	0.756	8	0.604	11	0.710	9
Involvement of main contractor in several projects at a time	0.680	14	0.636	12	0.658	13
Using distant location for the storage of materials	0.706	12	0.688	10	0.698	10
Delay in shop drawings and sample materials approval	0.636	15	0.694	7	0.666	11
Delay of the main contractor in submitting the documents to the supervisor thereby delaying implementation of works	0.740	9	0.694	7	0.718	8

The results of the survey of the factors leading to interface problems caused by main contractors are tabulated in Table 3 according to relative index. As revealed in the Table 3, main contractors’ financial problems was rated in first position with RII of 0.90 by main contractors. The sub-contractors saw this factor as the second most important factor causing the interface problems by main contractors, both groups however rated this factor as the most important factor leading to interface problems with RII of 0.93. The survey respondents seem to agree with [3,30] respondents that “main contractors’ financial problems” leads to adversarial relationship between both parties. Some sub-contractors interviewed said they had stopped work several times when the main contractor had refused to pay for the works done.

This has been envisaged could lead to time overrun on construction projects.

“Assigning part of the works to new sub-contractor without informing the original sub-contractor” was rated by main contractors as the second position with RII of 0.89. This factor was rated first by subcontractors with RII of 0.97, hence the sub-contractors in Lagos State of Nigeria see this as major factor causing problem between them and the main contractors. Both groups however, rated this factor as second to “main contractors’ financial problems”. This result agrees with the results obtained by [12] and [30] that this factor is a major one causing interface problems. This factor causes problem between the two parties because sub-contractors see it as that the main contractor has breached the terms of

engagement; hence, poor co-operation and mistrust develops in their relationship.

“Delay in contract progress payments” was rated by the main contractors and the sub-contractors as the third most important interface problem caused by the main contractors. This factor was also rated by the respondents in [30] research work as a major factor causing interface problems. As adduced by [30], financial problems which was rated as the most important interface problem could lead to payments delay to the sub-contractor. This situation puts the sub-contractor under intense pressure in meeting its financial obligations and hence, friction develops between the two parties.

“Delay by main contractor in providing necessary materials to the sub-contractors” was rated by the main contractors, sub-contractors and both groups as fourth, fifth and fourth respectively. This factor was also rated as fourth important factor in [30] study, but as an intermediate factor to others by contractors (RII= 0.886). The survey respondents in Nigeria see it as a major interface problem because without the necessary materials, sub-contractors manpower is tied down without work and must be paid. Sub-contractors will surely frown at this and hence, friction in relationship develops.

In this study the intermediate causes of interface problems are; providing low quality materials that lead to low quality workmanship; interruption and termination of work by contractor; failure to provide necessary clarifications of the drawings to the subcontractors; delay of the main contractor in submitting the documents to the supervisor thereby delaying implementation of works; frequent absence of the main contractor from site and using distant location for the storage of materials. The factors that could cause less friction between main contractors and subcontractors as agreed by both groups are delay in shop drawings and sample materials approval; failure to provide the subcontractor with essential services such as water, electricity, etc.; failure to provide security on the site; involvement of main contractor in several projects at a time and failure of the main contractor to use insurance in case of injury to subcontractor’s labour.

Most of these interface problems were also agreed as least causing friction by [30] respondents but the least factor in this study was adjudged as intermediate factor in [30] respondents. The reason that could be adduced to this factor being the least factor is that most of the engagement of subcontractors by main contractors are not formal and hence not covered by insurance. The subcontractor cannot therefore claim for compensation when an accident occurs.

A Spearman’s rank-order correlation was used to test the relationship between the main contractors’ and subcontractors’ rating of the factors affecting interface problems caused by main contractors. There was a very strong positive correlation between the rankings of the main contractor and that of the subcontractor which was statistically significant. ( $r=0.764$ ,  $p=0.00$ ). Hence there is a good agreement between the contractors’ and subcontractors’ viewpoints.

#### 4.4. Construction Time Overrun

Construction projects are adjudged successful if completed within the estimated cost, time and quality standard. Construction period is most often estimated by the client’s consultant and the contractor. These estimated periods are always harmonized and a particular period is then agreed upon which the project is awarded. The bane in the Nigerian construction industry has been the time overrun.

The main contractors were asked to supply information on estimated construction period and the final completed period of their completed projects. A data set for forty-seven (47) projects were useful for analysis. Using equation (2), the average construction time overrun was calculated to be 29.92%. This is revealed in Table 4.

*Table 4. Mean Construction Time Overrun.*

Procurement Method Used	Number of Valid cases	Mean Time Overrun %
Traditional Approach	47	29.92

Procurement methods, type of projects, client type and cost of project have been agreed to affect construction time [31, 32, 33]. For this data set, the client was the Lagos State government, traditional contracting method was used for all projects, similar type of projects (institutional projects of not more than two floors, while the cost varies between N50 – N100 million. The major reasons adduced by the main contractors for time overrun were such as separation of the design from construction; low speed of decision making by project participants; changing orders (variation) during construction; and delayed payment. These reasons were as in [31] and [33]. Since the traditional contracting method was used for all projects and the same client, it is being explained that it was other reasons such as low speed of decision making by participants and delayed payments might be the cause of this time overrun. These other reasons were rated as major interface problems between main contractors and subcontractors.

#### 5. Conclusions

The complexity of today’s construction projects has made it imperative to involve several organisations with a particular speciality as construction team members. The main contractor and the speciality sub-contractors are always present in construction projects. However, strain in their relationship has been a source of worry to the industry hence this study.

It was concluded that, the key interface problems between the main contractor and the sub-contractor emanating from the main contractor are: main contractors financial problem; assigning part of the works to new sub-contractor without informing the original sub-contractor; delay in contract progress payments and delay by main contractor in providing necessary materials to the sub-contractors.

As for what causes strain relationship between the main contractor and sub-contractors emanating from the sub-

contractor, both groups ranked the following as the major source: delay of work; neglecting the instruction of the main contractor; absence of the sub-contractor from site; and partnering the work with another sub-contractor without getting approval of the main contractor. All these interface factors can be overcome through trust and mutual understanding.

As for the effect of the interface problems on the duration of the projects, it was determined that all the projects had an average overrun of almost 30% over the initial estimated completion duration. Hence the interface problems between the main contractor and the subcontractor affect project duration.

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