

FRAGMENTATION OF CAPITAL DEVELOPMENT PROJECTS: A TOOL FOR JOB CREATION AND SKILL DEVELOPMENT

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Unemployment of engineering and the built environment professionals has a negative influence on skill development for technical personnel at the tactical level of leadership. Reflecting on the conference theme, we suggest the use of the concept of fragmentation of mega capital projects into smaller lots and engaging multiple contractors, instead of a single contractor, as a tool to ameliorate these twin problems. This research adopted a single case study method of qualitative research and comparative analysis of the organisational structure of two mega projects (Projects 1&2) in order to examine the quantity of technical personnel engaged at the tactical level in both projects. The findings revealed that Project 1 is being executed using the single contractor concept and engages one set of technical personnel. Project 2 adopted the fragmentation of the mega project into seven lots, each having a set of technical personnel at the tactical level of leadership, resulting in seven sets of employment opportunities, which translates to the ratio of 1: 7. Thus fragmentation of capital development projects can serve as a valuable tool for job creation, skill development and other economic advantages.

Keywords: fragmentation, mega projects, skill development, technical personnel

INTRODUCTION

Unemployment and skill development are twin problems deserving attention in the engineering and the built environment industry, especially at the tactical level of leadership. Several authors have researched these subjects and proffer different solutions, especially focusing on situations in the developing economies (Moavenzadeh, 1978; Rwelamila, 2007). Ianchovichina *et al.*, (2013) advocate the use of infrastructure development as tools for job creation in the Middle East and Northern Africa countries. The development of employable professionals requires the blend of educational training and practical exposure in the real world. Specifically, in the construction industry, the workplace training for leaders at the tactical level of leadership includes ability to design project implementation schemes, scheduling, monitoring and achievement of milestones, quality control, resource management, safety and risk management, and many more (Moavenzadeh, 1978; Rwelamila, 2007;

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Kululanga, 2012). None of these competence levels can be achieved through a one-off site experience. Therefore, the project procurement system and the variant adopted will serve as vehicles for the engagement of many professionals and also guarantee repeated engagements (Awe *et al.*, 2009).

This paper is a comparative study of two mega projects being executed in a higher education (HE) institution in Nigeria, referred to as Project 1 and Project 2, with the objectives of evaluating the effects project management style on the progress of the projects and quantity of the technical personnel engaged in the construction of these projects. Project 1 is being funded from an annual capital allocation from the Federal government, planned for three consecutive years. The project was awarded to a single contractor, and the construction has been going on since 2012. Conversely, Project 2 was awarded to seven different contractors; the project was commenced and completed within the year 2013. The structure of this paper progresses from literature review which provides information on the need for training of construction workforce, the influence of the procurement system and the effect of the mode of execution on the quantity of technical personnel of a typical project. The third section explains the research methodology which was a case study approach using comparative tool for data collection. The fourth section provides information on the research findings, demonstrating how the concepts of single contractor versus multiple contractors were used in the two projects and their net effect on the project success. The final section draws conclusions from the findings and makes appropriate recommendations.

LITERATURE REVIEW

Literature review allows researchers to navigate the efforts of previous research in order to harness existing information, models and methodologies to support new endeavours. The literature reviewed here provides general information on the import of training in the development of the requisite workforce in the construction industry; the role of procurement, the applicable variant and its influence on human capacity requirements.

The Training of Construction Workforce

The role of the construction industry in capital development projects and national economic development cannot be over-emphasised. Several research efforts have suggested that productivity in the construction industry is undulating; some observe that productivity is on the decline; others suggest that it is being sustained by foreigners in some countries (Moavenzadeh, 1978; Rwelamila, 2007; Manuti *et al.*, 2015). Nevertheless, Ene *et al.*, (2016) linked productivity in the construction industry to training: “A 1 percent (1%) overall increase in training days leads to 3 percent (3%) increase in productivity and 16 percent (16%) overall productivity growth” (Ene *et al.*, 2016, 213). Training generally encompasses formal education in technical trades and practical skills. Although there is a high graduate output in the engineering and the built environment (professionals/professions), there are increasingly limited opportunities for practical training and employment for continued experience in the workplace (Rwelamila, 2007; Kululanga, 2012).

Knowledge is a critical part of the learning process. An excerpt of the definition of knowledge gleaned from Ene *et al.*, (2016, 216) suggests that knowledge is an intellectual product or something learned that is acquired by thinking, judging, reasoning, reading, observing and testing. Knowledge transfer through learning is a lifelong process of cumulative components starting with basic education which

provides the foundation for individual development, initial training in core work skills, industry-based professional competence and continuous life-long workplace learning to maintain individual skills (Ene *et al.*, 2016). The workplace training in the construction industry benefits the trainee as it increases the individual's capacity and capability as well as helping the particular construction firm in improving on its productivity and competitive advantages among peers in the industry (Manuti *et al.*, 2015). Laudable as this may be, the majority of the players in the construction industry do not want to invest in training because of the volatile nature of the construction industry and high mobility of construction workers (Awe *et al.*, 2009). However, any little contribution to the training process has significant effects in solving the twin problems of unemployment and skill development in the construction industry.

Achieving the essential project outcomes, in a typical construction project, requires consistent and structured workplace training schemes. Moavenzadeh, (1978), Rwelamila, (2007) and Ene *et al.*, (2016) identified the areas of training for the technical personnel in the construction industry in developing economies as including but not limited to:

- Construction project execution design (selecting the most suitable construction method and process);
- Project planning (scheduling, supply sourcing and developing milestones);
- Project management (effective coordination of the different construction processes, effective supervision to achieve quality, milestones, prudent resource management, achievement of company's objectives, communal social responsibilities and effective management of areas of disputes) and
- Safety (mitigate incidents that threaten the safety of workers and visitors to site, conduct safety awareness and training, identify risky situations and prevent their occurrence).

Proficiency in these areas of competence is influenced by the frequency and length of practice. Furthermore, the quantity of technical personnel that can be employed during the development of any infrastructure type is influenced by the procurement system and the variants of the system being adopted (Idoro, 2012; Ogunsanmi, 2015).

Procurement Method and Human Capacity Requirements

The level of success achieved during the execution of any capital construction project is influenced by a combination of factors which include the project procurement method, execution system and especially the quality of the project personnel (Pourrashidi *et al.*, 2017). Some common project procurement methods being used for the execution of capital projects in the public and private sector in many developing economies are the traditional design/bid/build (DBB), design and build (DB) and construction management (CM) systems (Babatunde *et al.*, 2010; Idoro, 2012). Each procurement method has different variants, enabling the client to select the one most suitable for the execution of its project. The project may be executed using a single contractor or many contractors where the project is divided into smaller lots. For brevity, the succeeding paragraphs will provide information on DBB and DB only.

The traditional method of contract procurement can be described as the process where the three phases of design/bid/build (DBB) are treated as separate tasks (Babatunde *et al.*, 2010). In managing the three separate phases, there is a fourth dimension which plays a mediatory role: the client. Adopting the DBB system requires adequate

quantity and quality of human capacity in every phase of the project, by both the client and project execution team (Escamilla and Ostadalimakhmalbaf, 2016). If the client decides to adopt the variant of using a single contractor to execute its capital project, the project personnel at the tactical level of leadership for both the client and the contractor will be one set of technical execution team (TET) from the engineering and the built environment professionals (architects, engineers, builders, quantity surveyors and others). However, if the client adopts the variant of fragmenting a mega-capital project into smaller lots, the contractor executing each lot will require adequate numbers of TET professionals for the execution of its role, while the client may maintain a set or multiple sets depending on the number of projects being executed at the same time.

The design and build (DB) procurement system integrates the fragments of design, bid and build under one contract which allows the contractor to be involved in the project from inception through to completion (Idoro, 2012). There are different variants of the DB system. Two among many variants, identified by Idoro (2012), are considered relevant to this research:

Pure DB: both the design and construction team are within the same organisation, commonly referred to as a 'consortium'.

Partial integrated DB: the consortium invites other consultants or contractor(s) to execute specific or specialised functions within the project.

An optional third variant is where different organisations (consultants and contractors) conglomerate to form a consortium, using the instrument of a memorandum of understanding (MOU), similar to the one used in alliance contracting (Jefferies *et al.*, 2014). In this regard, the collaborating consultants and contractors function in their areas of expertise. Generally, during project execution, in variant 1 a single contractor is engaged, thus requiring a single set of engineering and the built environment professionals at the tactical level of leadership. However, in variants 2 and 3, multiple contractors are engaged, and each contractor employs adequate numbers of the TET professionals at the tactical level for the execution of their portion of the project.

Project Management Style and Contractor's Performance

The project management style of any construction company has great overarching effects on the performance in a construction project. The management style includes relationship between strategic and tactical leaders, demonstration of capacity to perform, and respect for the company's image and financial management. There should be symbiotic relationship between the strategic and the tactical leaders on site in order to effectively monitor compliance with schedule, resource management and meeting of the quality goals of the project (De Carvalho *et al.*, 2015). Rafat and Ahmed (2017) emphasise the need for "project sponsors and top management to reshape their project management strategy and allow for low power distance between management and project personnel for timely completion of projects" (Rafat and Ahmed 2017, 166). In the management of project 1, it can be observed that the strategic leaders are literally distanced from the tactical leaders. This is obvious in the attendance list of critical project and site meetings, as well as the complaints of the site operatives that their leaders in the head office have not responded to their request for fund or materials. On the contrary, in project 2, (as observed from the minutes of site meetings) one strategic leader, in the rank of a Director, usually attends the site meetings and periodically visits the site and holds meetings with their TET personnel.

Periodic meetings between strategic and tactical leaders are inevitable; such meetings allow both sides to keep abreast with the realities on the construction project, deal with problem situation(s), mobilise adequate resources to the site for effective operation and allow the strategic leaders the opportunities to correlate progress reports with actual performance or challenges on site (De Carvalho *et al.*, 2015). However, when there is a disconnection between the strategic and tactical leaders, which was obvious in project 1, project performance and progress will lag behind schedule.

Alzahrani and Emsley (2013) cited a company's image as a critical attribute which influences a contractor's performance on a construction project. Although the company managing project 1 has an attractive profile, is engaged in on-going mega projects in other parts of the country, and has a history of completed projects, their image management is not satisfactory. Williams's (2015) sense of image management placed emphases on "the company's sense of locality" (Williams, 2015, 109). In this regard the organisation cares about the client being served; this produces a sense of image projection and hence a motivation to keep promises and leaves a legacy beyond the project being executed, which could encourage the client to engage the contractor for subsequent projects in the future. This feature was aptly demonstrated by the contractors that executed project 2 and not by the contractor handling project 1.

Literature is awash with information on the critical role of adequate finance in project success. The discussions include the financial capability of the contractor, financial difficulties of the client and slow payment for completed work as some factors responsible for project delay (Bagayal and Song, 2016). However, very little search light has been focused on the financial management strategy of the contractors. Two components of this financial management strategy are the willingness of the contractor to source for additional money or invest substantial portion of the earnings from each payment certificate into the execution of the project. At the commencement of each capital project, the contractors are given a mobilisation fee. Unfortunately, many contractors see this money as part of their profit and do not spend it wisely. The reality is that this is loan from the client, which will be recovered progressively from each succeeding valuation. If within the first fifty percent (50%) of the project, the contractor is not willing to source for additional funds as well as invest a substantial portion of the earnings from each certificate into the project, when the portion of mobilisation fund is removed, the net value of each succeeding certificate continues to reduce; this negatively affects progress on the construction exercise. Conversely, if the contractor sources for additional funds and invests substantial portions of earnings from earlier payment certificates, the net value of each succeeding certificate will be increasing and make positive impacts on the progress of work.

From inception, the contractor handling project 1 has demonstrated that he lacked the capacity to perform, was not willing to source for additional funds or invest any substantial portion of the earnings from each payment certificate on the project. This led to reduced performance and reduced the value of succeeding payment certificates, and thus they were not able to use substantial portions of the funds made available for the first and second year. The institution obtained a special grant of Three hundred million naira (N300 million) in 2017, in order to fast-track the execution of the project and the contractor promised a performance which will qualify them to draw a minimum of Forty million (N40 million) naira every month. But eleven months into the year, the contractor has not been able to draw more than half of the available funds. On the contrary, the contractors engaged in project 2 supplemented their

earnings from each certificate in the first fifty percent (50%) of the project with additional funds, which facilitated increased earnings in subsequent valuation and enabled them to keep pace with their project timeline. Irrespective of the funding pattern, both projects were adequately resourced; but the contractor handling project 1 has low capacity to perform. However, if project 1 had been fragmented like project 2, the project would have been completed, provided employment and training opportunities for tactical leaders and the client would have had value for the money invested in the projects.

There is sufficient evidence in the literature reviewed that capital development possesses great potential for gainful employment and the variant of the procurement system suggests where the higher quantity of the technical personnel at the tactical level of leadership lies. The focus of this paper, therefore, is to demonstrate how fragmentation of capital projects into smaller lots provides more employment opportunities for technical personnel at the tactical level of leadership, compared to adopting the single contractor approach.

RESEARCH METHOD

The single case study method of qualitative research was adopted (Yin, 2014). The case study method is seen and employed as a research strategy dealing with specific issues, it allows for intense observation, provides opportunities to study different aspects, puts each part in relation to the environment where they operate and tasks the creativity of the researcher to provide 'voice to the voiceless' (Braun and Clarke, 2006). This method is useful when holistic, in-depth investigation is needed (Green and Thorogood, 2009). The population and sample for the research was the client's representative, consultant project managers and contractors' representatives for the two projects. The data collection tools include interviews, evaluation of minutes of site meetings, and the comparative analysis of the site organisational structure. An interview guide with open ended questions was used to collect information from respondents. The analyses of the qualitative data followed the principle of content analysis (Hsieh and Shannon, 2005). The re-occurring themes which accounted for the success recorded in each project are: the project management style, the variant of the procurement method, the capacity and capability of the contractors, and the quality and quantity of the technical personnel. In order to ensure reliability and validity of data, the information, on the same subject, obtained from the consultants was correlated with the information from the contractors and the client's representatives, by adopting the principle of triangulation (Turner *et al.*, 2015). The analysis of the project organisational structure showed that in Project 1, the single contractor approach was adopted; thus the technical execution team (TET) was limited to one set of engineering and built environment professionals. Conversely, Project 2 adopted the concept of multiple contractors, with each contractor engaging an adequate number of TET professionals in their organisation. The analysis of the project site meetings revealed the capacity of the contractors and their performances in achieving the planned schedule for the execution of their respective projects. The details of the findings and analysis are laid out in the findings and discussion section.

FINDINGS AND DISCUSSION

This section provides information on the projects used for this research, and demonstrating how fragmentation and use of multiple contractors, instead of single contractor, affects the quantity of technical personnel engaged in a typical capital project.

Background of the Projects

The two projects in this research are the construction of the new administrative building, to be known as Project 1 and the construction of a phase of the faculty of Environmental Sciences, tagged as Project 2. Project 1 is a two-storey building with X, Y, Z wings and a central core, in the first phase. The second phase comprises of the construction of a generator house, supply and installation of a suitable sized generator, provision and installation of a transformer, as well as external works and landscaping. Project 1 is being funded from the annual capital budget allocation from the Federal government of Nigeria. The project execution and funding was planned for three consecutive years with the provision of 50% of the project cost in the first year, 30% in the second year and 20% plus fluctuations in the third year. The projects for phase 1&2 were awarded to a single contractor at the sum of nine hundred and seven-five million, eight hundred and thirty-six thousand, seven hundred and sixty-five naira eighty-seven kobo (N975, 836,765. 87) and commenced in March 2012. However, due to the project management style, low capacity and capability, the contractor has not being able to use the statutory and specially allocated funds timely. Project 1 is still under construction (about 65% completion) as of December 2017.

Project 2 is a phase development of the infrastructure meant for the faculty of Environmental Sciences. This is also a two-storey building, divided into seven lots and awarded to seven different contractors. Work in the seven lots started simultaneously in February 2013 and the total contract sum was six hundred and nine million, four hundred thousand naira (N609, 400. 000.00). The project was funded by a special infrastructure development agency of the Federal government of Nigeria. One of the operating clauses of this agency is that all approved projects must be completed within twelve calendar months, in order to enable the institution to access further allocation of funds for other projects. Each contractor developed its timeline; cumulatively, the project was scheduled to be completed within nine months. They worked steadily and achieved the milestones set out in the project schedule and the project was delivered earlier than the scheduled nine months, with cost savings and no compromise on quality.

Comparison of the Human Capacity

The human capacity (Technical) at the tactical level of leadership (both in quantity and quality) is very critical to the successful execution of capital development projects (Rwelamila, 2007). These leaders are the prime movers of the project, translating strategic decisions into practical realities; they coordinate the execution of the project implementation design in order to achieve the project milestones, quality and resource management (Moavenzadeh, 1978; Rwelamila, 2007; Idoro, 2012). Table 1 reflects the quantity of the technical personnel for each project at the tactical level of leadership. The Civil and Electrical Engineers in Project 1 were only on site at critical times in the life of the project. The Civil Engineer supervised the foundation works, the structural frame and roof works then left the remaining builder's works to the architect. In the same vein, the Electrical Engineer supervised the conduit works and visited the site intermittently, as the need arose; he also doubled as Mechanical Engineer. During site meetings, the most regular project personnel at the tactical level were the project manager, architect and quantity surveyor.

Table 1: Quantity of technical personnel

S/No	Project	Technical Personnel At Tactical Level						
		Civil Eng.	Mech. Eng.	Elect. Eng.	Project manager	Builder	Architect	Quantity surveyor
1	Project 1	1	-	1	1	-	1	1
2	Project 2							
	Lot 1	-	-	-	1	1	1	1
	Lot 2	1	-	-	1	-	1	1
	Lot 3	1	1	1	1	-	1	1
	Lot 4	1	1	1	1	-	1	1
	Lot 5	-	-	-	1	1	1	1
	Lot 6	-	-	-	1	1	1	1
	Lot 7	1	-	-	1	-	1	1
	Total	1 (4)	0 (2)	1 (2)	1 (7)	0 (3)	1 (7)	1 (7)

On the contrary, in Project 2 each contractor had a full complement of appropriate technical personnel at the tactical level of leadership. Lots 1, 5 and 6 used builders while Lots 2, 3, and 7 used Civil Engineers to coordinate civil, structural and building works. Each lot had an architect and quantity surveyor. The most senior technical person in each lot doubled as the project manager. All technical personnel remained in the project from inception to completion; they worked steadily with their project timeline and delivered their lots on schedule. As shown in Table 1, the technical personnel in Civil Engineering/Builder, Project manager, Architect and Quantity surveyor had a ratio of 1:7 between projects 1 and 2. Similarly, Mechanical Engineer and Electrical Engineer had a ratio of 1:4. An experience gained in each construction project adds to the learning curve of the tactical leaders.

CONCLUSION

Two critical factors necessary for effective performance in a typical construction project are the project management style as well as the quality and quantity of the technical personnel at the tactical level of leadership. The management style of each contractor will show the relationship between strategic and tactical leaders, the capacity to perform, respect for company's image and financial management. In these four indices of project management style, the contractor handling project 1 was deficient in all of them, while the contractors handling project 2 demonstrated their compliance with the four indices. This data therefore suggests that if a contractor is engaged in a project beyond his capacity, progress in the project will be behind schedule; fragmentation will be a positive consideration.

Considerable efforts are being made in many developing economies in providing formal education to personnel in the engineering and the built environment professions at the tactical levels but with limited opportunities for the practical, workplace training required for skill development. Undoubtedly, infrastructure development is a viable means of providing both sustainable employment and workplace training. Nevertheless, the procurement method and the variants employed for the execution of the infrastructure project significantly influence the quantity of the technical personnel employed in any typical mega capital development project. As shown in this research, Project 1 is being executed through the single contractor concept, which engages one set of technical personnel. Conversely Project 2 adopted

the fragmentation of the mega project into seven lots and each lot had a set of technical personnel at the tactical level of leadership, resulting in seven sets of employment opportunities. If the concept of fragmentation and good project management style had been adopted in the execution of project 1, it would have provided for more employment and workplace training. The project would have been completed and put to functional use. This would have reduced the incidence of delays in the execution of construction projects and ameliorated the effects of time and cost overrun, thus allowing client to make judicious use of dedicated or borrowed funds.

Having demonstrated the advantages of the concept of fragmentation in the development of capital building project, we recommend that this concept be adopted contextually for the execution of other infrastructure projects, such as roads, railways, and electricity generation and transmission structure. This will facilitate generalisation.

ACKNOWLEDGEMENT

The authors acknowledge with gratitude the financial contribution of the University of Johannesburg and the University of Jos through their collaborative relationship for this research.

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