CONSTRUCTION COSTS AND VALUE MANAGEMENT: STUDY OF MULTINATIONAL PRACTICES IN NIGERIA

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ABSTRACT

The practice of multinational construction corporations (MCC) in Nigeria construction industry has been viewed as a value for money approach through construction cost management. Assessment of the opportunity cost of the initiatives is equally important in order to gauge the progress of millennium development goals (MDGs), set up by the United Nations in 2000 on human development in developing countries. The study is aimed at the evaluation of current infrastructure procurement framework, introducing novel sustainable infrastructure delivery (SID) model as a holistic value management methodology and a decision making technique. Key components of the model are Checkland's soft system methodology (SSM) and analytic network process (ANP) by Saaty. SID input data is collected from the pilot questionnaire with the professionals in Nigeria's construction industry, reinforced by a thorough literature review. Questions sought paired comparison judgements on key aspects of project management and implications on sustainable infrastructure procurement. The concept is discussed in the methodology section. Preliminary findings reveal that current practice lacks a holistic decision making technique, reflected in divergent value interests among stakeholders on infrastructure procurement through different views on the constitution of values. Though there is practical evidence regarding the growth in the construction sector, quantification of the implications on local economy and human development are less visible and require further investigations.

Keywords: Nigeria, soft system methodology, analytic network process, sustainable infrastructure delivery model.

1. INTRODUCTION

In a quest for construction cost management, Nigerian government has significantly altered modus operandi of public procurement. Following the return of governance to democratic government, which marked the start of Fourth Republic in 1999, economic reformation programmes were initiated. Purposely, policies were made to encourage better involvement of private sector in the construction sector, namely Infrastructure Concession and Regulatory Commission Act (ICRC Act 2005) and Nigerian Public Procurement Act (2007). Both Acts constitute legal framework for infrastructure concession with a goal to create a competitive bidding process as strategy for value for money. Recent publications by An Investor's Manual (2013) corroborates milestone achievements in infrastructure delivery by the Nigeria government through public private partnerships (PPP) initiatives.

Nevertheless, Ozoigbo and Chukuezi (2011) observed that the practice of multinationals has failed to create a balanced socio-economic development. Opportunity costs have been identified as constraints to capacity building and technological drain among local contractors and manufacturers, through free movement of capital, labour and materials from outside the host nation. Ilori; Nigerian Society of Engineers (NSE), expressed similar views when he asserted there are abundant technical skills at the national level (Alimi 2014). Ajufo (2013) argued that the unemployment rate has reached a new level in Nigeria, with people aged between 18 and 35 being most affected and they constitute over 60% of the total population.

While 80% are unemployed, the remaining 20% are not in full employment. This trend has been identified as the major cause of high rate of poverty and subsequent crime, social vices and insecurity in the country.

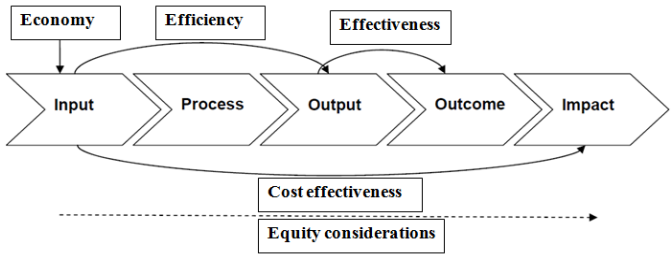
In this paper, key elements of the proposed sustainable infrastructure delivery (SID) model are introduced. In Section 2, a brief theory of value management in the construction industry is discussed. Section 3 presents an introduction to multi-criteria decision making methods and key components of the proposed model. Research methodology and discussions are presented in Sections 4 and 5 respectively.

2. VALUE MANAGEMENT IN CONSTRUCTION SECTOR

Factors that contribute to the complexity in construction value management have been identified. They include lack of theoretical rigour, scope and definitions in value studies (Francis, et al 2014). For instance, an international survey of value in construction by Lee and Barrett (2006) focus only their value appraisal on developed countries, with stakeholders that are confined to four, namely contractors; design team; manufacturers/suppliers; clients/end-users. Francis, et al (2014) further suggested that contributory factors to value issues include a large variety of linguistic usages of these terms, with 'value' being used as a verb, adjective and noun.

> *"But in reality how good any choice we make depends on how well we know our alternatives as compared with each other and with others outside the collection being compared so we can rank them as to how good they are. The drawback is that our knowledge of the alternatives may be very limited"* (Whitake R 2007)

According to LeShan, et al (1982), cited above, the validations of theories are very important in the real world with logical process applied. For instance, though, usefulness of PPP in infrastructure procurement has been acknowledged in many quotas, yet validation is still required in specific applications. This would imply what purposes it is serving and what is perceived to be serving. Previous work by the Department for International Development (DFID 2011) presents a useful starting point on the framework that is useful for the validation of value for money approach (see Figure 1).



Economy:	money; material; manpower; methods; machinery
Efficiency:	Meeting present goals
Effectiveness:	Meeting future goals
Impact:	Evaluation of present and future goals

Figure 1: DFID's 3Es Framework for value for money. Source: DFID (2011)

3. MULTI-CRITERIA DECISION MAKING METHODS (MCDM)

Despite extensive literature reviews on multinationals practices as well as challenges traditional procurement strategy in Nigeria, very little studies have attempted the application of MCDM in construction procurement model. MCDM are reliable as they

consider multiple criteria to validate the decision process. Various techniques are available in the literature and they include Checkland's soft systems methodology (SSM), multi-attribute utility theory (MAUT) multi-attribute analysis (MAA); analytic hierarchy process (AHP) and analytic network process (ANP) (Cheng and Heng 2004; Green 1999). A study by Cheng and Li (2004) concluded MAA, MAUT and AHP are very comparable methods in process and application. The uniqueness of Analytic Network Process (ANP) is the allowance for more interdependent relationships among decision factors. The technique is becoming popular in construction project management. For instance, a research by Cheng & Li (2004) applied ANP for the application of contractor selection. This paper introduces theories of ANP and SSM as the key elements of the proposed sustainable infrastructure delivery model (SID).

3.1 Soft systems methodology (SSM)

Soft Systems Methodology (SSM) is an action research technique with the approach that employs models to structure debate in which various conflicting interest and needs can be dissected and resolved among parties. Being a systemic methodology (see Figure 2), it focuses on the whole system with no bias to any part. Facilitator and stakeholders are able to think and understand the problematic situation from different perspectives. The resultant effect is problems being solved through knowledge gained from the situation, which in turn proffer solutions for improvement. Since its development by Peter Checkland et al in 1970s, the technique has evolved and successfully applied to real-world problematic situations, including agriculture and urban planning. It is identified as one of the three most established `soft' methodologies within UK value management practice (Green, 1999), capable to bring about compromised solutions.

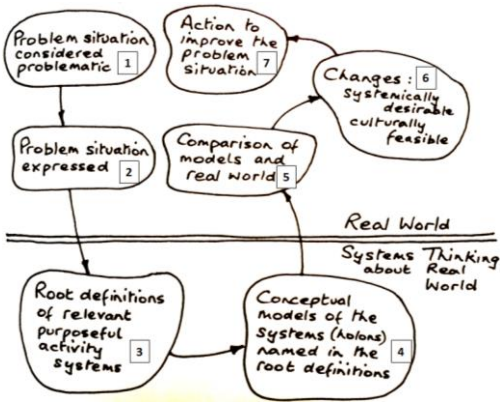


Figure 2: The conventional seven-stage model of SSM. Source: Checkland and Scholes (1990)

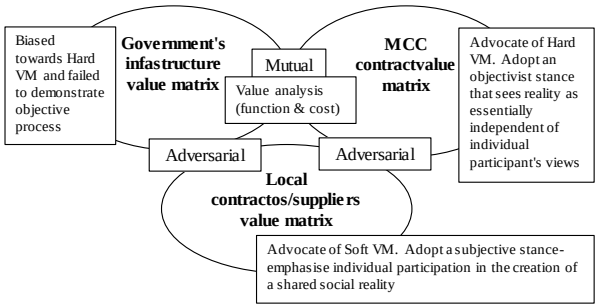


Figure 3: Current infrastructure delivery model in Nigeria

The stages of the SSM are broadly divided into 2 activities. Stages 1,2,5,6 and 7 are referred to as 'real world' activities as they are the attribute of case under study. Stage 1 and 2 involve clear definition and illustration of a problematic situation. In order to demonstrate causes and effects of actions, Checkland introduces 'rich pictures' at this stage as a graphical representation of the situation. Figure 3 illustrates real world situation of the current infrastructure delivery in Nigeria. System thinking phase of the methodology (stages 3 and 4) involves the formation of benchmark for best practice. This can be achieved through responsive and productive case studies that are relevant to the study. In order to build a conceptual model in stage 4, based on details of 'root definitions' in stage 3, Checkland introduces the formation of mnemonic:

'CATWOE'. It is a checklist of thinking in the building of a model for a desirable system. The elements are Customer; Actors; Transformation; Worldview; Owners; Environment. Conceptual model helps in the definition of relevant stakeholders whose contributions to further data collection are valuable. Another decision to be made at this stage is the choice of data analysis techniques. This is important as it may impact the validity of result.

3.2 Analytic Network Process (ANP)

Basically, ANP is the generalisation of earlier concept, AHP, by Saaty (2012). The unique feature of ANP is the shift from hierarchical to network structure of the decision process. The process starts with the definition of the problem, criteria (sub criteria if applicable) and alternatives. By considering interdependent relationship among elements, network structure is formed (further discussion in section 5). Similar to AHP, the technique uses pair-wise comparison to assign weights to all elements. The procedure for the generation of priority scale starts with the invitation of professionals in the field of study for experts' opinions. Saaty (2012) has postulated 9-point pairwise comparison scale, where 1 equal importance of paired comparison, 2 is moderate importance, 5 is Strong importance, 7 is Very strong importance and 9 is Extreme importance. 2,4,6,8 are intermediate values. Guideline for a comparison matrix formation is provided in Table 1.

Table 1: Guideline for the number of comparisons

No of criteria	2	3	4	5	6	7	8	n
No of comparisons	1	3	6	10	15	21	28	$\frac{n(n-1)}{2}$

In order to validate judgements that are made in pair-wise comparison matrix, consistency ratio of the matrices are computed. The formula is:

$CR = \frac{CI}{RI}$, where CR = Consistency Ratio, CI = Consistency Index, RI = Random Consistency Index. It allows a small degree of inconsistency in judgement due to human factor, ideally less than 10%. While consistency index is derived from the principal Eigen value, the ratio scales are derived from the Eigen vectors (eVector).

$CI = \frac{\lambda_{max} - n}{n-1}$, where [$\lambda_{max}$] = Principal Eigen value, **n** = number of criteria

Eigen value [λ_{max}] = sum of the product Eigen vector (in standardised matrix table) with the corresponding 'sum' (in pairwise comparison matrix). Random Index (RI) is a constant value. Applied RI is dependent on the number of criteria that are being compared (see Table 2).

Table 2: Random Consistency Index

n	1	2	3	4	5	6	7	8	9
RCI or RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

Further reading on the algorithm is available in Saaty (2012).

3.3 Sustainable infrastructure delivery model (SID)

In practice, it is common to have interdependent relationships between factors of production in project delivery. For instance, availability of funds may have significant effects on construction time, as well as quality of materials that are sourced may be

due to lack of funds or limited suppliers. Also, background knowledge of human resources that are employed may have significant effects on their awareness to health and safety issues in construction. These are related to the considerations by Cheng & Li (2004) study when ANP was applied to the selection of contractors. However, for a decision that involves multinationals in procurement process, even broader criteria are to be considered. A further SWOT analysis of strengths, weakness, opportunities and threats of the composition of procurement would be essential. This is simplified to cost effectiveness and equity considerations, as discussed earlier in Figure 1. The proposed SID model proficiently bridges the gap through the integration of multiple decision techniques. First, it applies qualitative approach to modelling of value for money in infrastructure procurement. Secondly, it implements mathematical analysis to arrive at quantitative data and priority weighing among procurement options.

4. RESEARCH METHODOLOGY

The paper is developed on the principle and philosophy of the Soft System Methodology (SSM) by Checkland (1990) as discussed earlier. Literature review on infrastructure delivery model in Nigeria was conducted. Initial findings in Figure 3 revealed lack of appropriate model to resolve issues of soft and hard value management and stakeholders in public infrastructure procurement. By applying CATWOE (see Figure 4), clearer structure of the transformation process was established. Review of the practice of PPP in developed countries shows that the initiatives have been a subject of continual review and improvement. The scope in its application has been widened by the EU Procurement Directives, as published in Public Sector Directive 2004/18. Modifications have seen better recognition for social and environmental considerations in the procurement process.

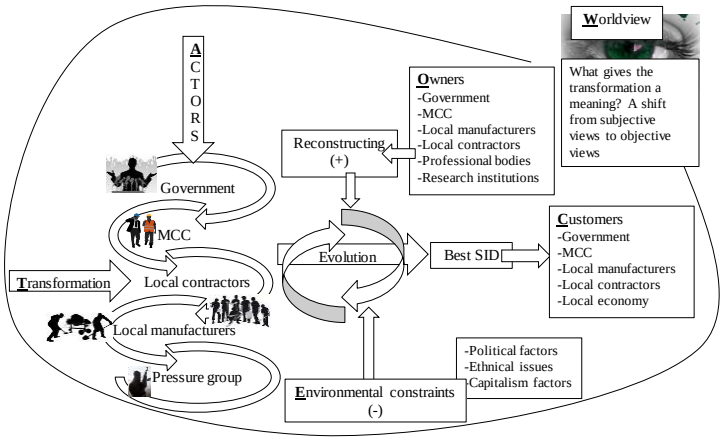


Figure 4: CATWOE model for a transformation in Nigeria construction sector

For instance, Article 26 that empowers public authorities in the use of social and environmental considerations as conditions in procurement for the execution of contract. Article 55 provides guidelines for the screening of prospective fraudulent contractors (Anon, 2004). In order to propose for systematically desirable and culturally feasible changes, primary data was obtained from experts in the construction industry that were based on best practice and acknowledged economic and ethical considerations. Weighing priorities were derived from paired comparisons of criteria that were grouped under five ‘m’ of project management. For further mathematical analysis and accuracy of ANP implementation, Super Decisions software was introduced.

5. ANALYSIS AND CONCLUSIONS

A total of 50 questionnaires were returned with only one questionnaire void as some details in demographic section were missing. Almost all of the respondents claimed to have useful knowledge of PPP in the construction sector. Analysis revealed only 9 respondents (18% of the sample population) was employed by MCC; 3 occupied managerial positions, 4 were team leaders, while the remaining 2 were team members.

Table 3: Summary of feedback

Cluster	MCC	Local contractors
1. Money		
1.1 Provider	Availability of funds	Funds not always available
1.2 Interest rate	High	High
1.3 Payback period	Long	Long if loans are offered
2. Material		
2.1 Sourcing	Mostly outsourced	Outsourced and insourced
2.2 Quality	High but may be compromised	Likely to be compromised
2.3 Cost	High	High
3. Machinery		
3.1 Affordability	Easily affordable	Not easily affordable
3.2 Operation	Have manpower to operate	Available manpower not fully tested due to lesser opportunity in production process
3.3 Health/Safety	Awareness is high but may be compromised	Awareness is low and always compromised
4. Manpower		
4.1 Management	Capable managers	Capable managers but not well tested
4.2 Labour	Capable general labourer	Capable general labourers most likely tested
4.3 Technical	Capable technicians	Capable technicians but offer little opportunity
5. Methods		
5.1 Bidding	Support competitive bidding	Little capability in competitive bidding
5.2 Labour law	Favour by weak labour regulations.	Continual regression due to weak labour regulation
5.3 Partnering	Not keen for partnering	Advocate for partnering

A network of clusters was designed with the inner and the outer dependency relationship among the nodes of the clusters (see Figure 5).

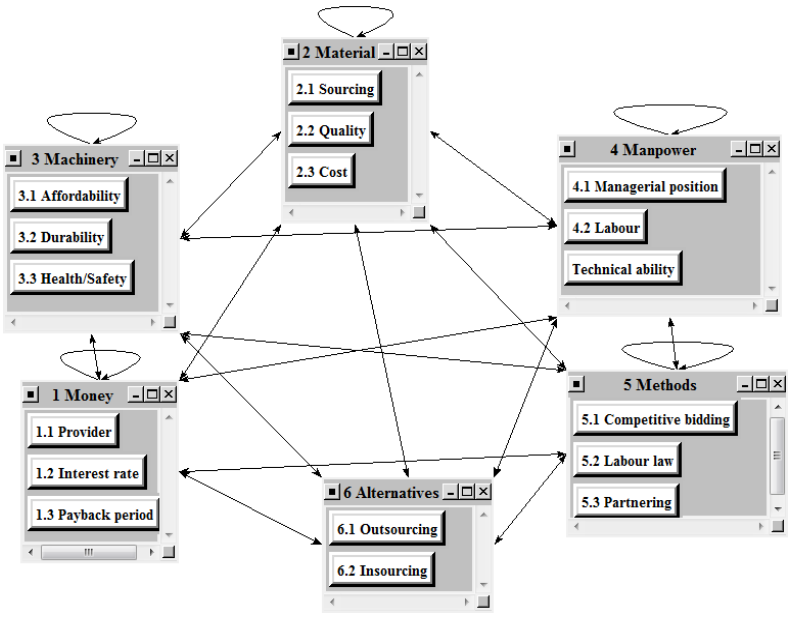


Figure 5: Network structure of essentials of sustainable infastructure delivery in Nigeria

Table 5: Priory vectors for Criteria

Inconsistency: 0.03583	
1 Money	0.27302
2 Material	0.09523
3 Machine~	0.09905
4 Manpower	0.12765
5 Methods	0.40505

Each element in a cluster (formed from questionnaire) represents a node in the system. For each of the paired comparison matrix, the software does the computation and generate consistency index, as per theory in Section 3.2. A judgement cannot always be 100% accurate. It is however consider valid if the degree of inconsistency is 10% or less. Super Decisions software would advise whenever there is inconsistency and need for a further review. Data for the paired comparisons of clusters are based on the pilot survey and thus limited, with assumptions made in the computation of Table 4 based on the summary of data in Table 3. Further survey of experts' opinion on paired comparison of clusters is currently being undertaken, with ongoing finalisation of mapping matrix for the network.

Table 4: Relevant vectors of criteria

Cluster	**Sub-criteria**	**MCC priority**		**local contractors priority**	
		Local	**Global**	**Local**	**Global**
(1) Money 27.30%	(1.1) Provider	68%	18.56%	32%	8.74%
	(1.2) Interest rate				
	(1.3) Payback period				
(2) Material 9.52%	(2.1) Sourcing	65%	6.19%	35%	3.33%
	(2.2) Quality				
	(2.3) Cost				
(3) Machinery 9.91%	(3.1) Affordability	70%	6.94%	30%	2.97%
	(3.2) Operation				
	(3.3) Health & Safety				
(4) Manpower 12.76%	(4.1) Management	50%	6.38%	50%	6.38%
	(4.2) Technician				
	(4.3) Labourer				
(5) Methods 40.51%	(5.1) Competitive bidding	35%	14.18%	65%	26.33%
	(5.2) Labour law				
	(5.3) Partnering				

The paper introduces components of the proposed sustainable infrastructure delivery model. From the summation of global priority in Table 4, MCC is 52.25% whilst Local contractors are 47.75 %. It could be deduced that MCC provide better value for the infrastructure delivery. However, conclusions at this level are based only on the consideration of cost management cluster values and clustering to account for human development and local economy impact is currently being devised. Whilst it could be deduced from the experts' opinion that it is better to outsource materials to meet project objectives, there is clear evidence of weakness in the current applied methods of management. Further survey is required to ascertain criteria for the recruitment of manpower by the MCC and likely impact by the currents methods of project management.

In order to fully implement ANP, a final survey of expert opinion is currently undertaken to gather, map and compute actual weighing factors for the clusters, as little change in one cluster may generate a significant impact in the entire system.

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