

# A SUSTAINABLE INFRASTRUCTURE DELIVERY MODEL: VALUE ADDED STRATEGY IN THE NIGERIAN CONSTRUCTION INDUSTRY

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The current economy reforms strategy by the Nigerian government promotes competition among private contractors, which are comprised of local and foreign contractors, in order to achieve value added infrastructure delivery. Resulting competitive bidding processes between multinational construction corporations (MCC) and local construction contractors (LCC) has had mixed comments among stakeholders, with a need for a more sustainable and holistic value approach identified. The aim of this research is to develop a sustainable infrastructure delivery model (SID). The key research methodology is based on extensive literature review and questionnaire survey. SID is developed on the principles and philosophy of soft system methodology (SSM) and analytic network process (ANP). In order to evaluate the significance of MCC and LCC through SID model, questionnaire surveys were conducted. Feedback was collected from experts in the Nigerian construction sector who assessed the relative importance of formulated decision criteria, which were sought under 7 key factors. Data simulation revealed that, through competitive bidding, significant achievements have been made in the delivery of constructed facilities. It was also found that the policy lacked holistic value principles that integrated ethical stance and monetary returns on investment. In this study, SID framework has been presented, clearly showing needs for integration of economic and ethical stances in order to achieve a sustainable infrastructure delivery.

Keywords: economic reforms, infrastructure, stakeholders, value, soft system methodology.

## INTRODUCTION

In order to accelerate procurement and maintenance of the national infrastructures, post 1999 Nigeria administration initiated the economic reforms agenda that embraced partnership with private construction corporations. During this period, interests were drawn to collaboration with multinationals due to their financial strength and global influences. This led to “*Look East policy*” blueprint (Babatunde and Low, 2013 pp. 19) with bilateral trade agreement with the Chinese construction firms that are being acknowledged as the largest and most competitive construction industry in the world. In theory, collaboration would promote economic growth that is instrumental to human development. More importantly, global partnership has been recommended as an instrument towards the actualisation of millennium development goals in developing countries (DC) (Du Plessis, 2007), with one of the goals to eradicate extreme poverty and hunger. Due to poor economic development, manifestation of poverty among millions of the population has soured. The severity is measured using national human development index that includes employment creation and social well-being (Ajufo, 2013).

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In spite of success of the construction sector through the reform policy (see ICRC, 2012), sustenance of the core objectives of the strategy and the guiding policy have had mixed reviews among stakeholders. For instance, Ozoigbo and Chukuezi (2011) and Idoro (2010) have argued there are significant inequalities between economic growth and subsequent development in the Nigerian construction sector. The reform policy is viewed to privilege multinationals with outsourcing of materials and human resources with no due justifications. Critics of the practice are concerned about the implications of continual marginalisation of local skills and manufacturing sectors. According to Ajufo (2013), the unemployment rate has reached a new level in Nigeria, with people aged between 18 and 35 being most affected. The group is the most active portion of the population and constitutes over 60% of the Nigerian populace. While 80% of this group are unemployed, the remaining 20% are under employed. The trend has been identified as the major cause of the high rate of poverty and subsequent social vices and insecurity in Nigeria. Values in the construction sector are, therefore, argued to be underutilised or mismanaged by the affected stakeholders. Thus, this paper is proposing a sustainable infrastructure delivery (SID) model for infrastructure procurement in the Nigerian construction industry.

## **TOWARDS VALUE FOR MONEY IN CONSTRUCTION INDUSTRY**

In the global construction industry, Latham report (1994) is a milestone in the theory of value for money in the procurement strategy. It holds that, in construction procurement, values are best enhanced when there are synergies among stakeholders and they are willing to collectively share benefits while risks are managed together. In order to effectively manage values in the construction industry; knowledge of benefits that are associated with the process can be understood through study of the construction supply chain. Whilst project delivery remains a core value, PricewaterhouseCoopers (2011) *cited in* Babatunde and Low (2013, pp. 19) elucidates values enhancement for macro-economic development through the construction industry. Multiplier effects are achieved when employment opportunities are created for the local markets either through direct labour, sourcing of materials or services. Wider economic benefits are associated with the improvement in the human development index, such as skills acquisition, purchasing power and savings culture. At the higher quality construction is the capacity building among local contractors that promote internationalisation. Higher quality construction quality' requires trust, respect, transparency and knowledge sharing in the supply chain. Prospects of achieving this level in Nigeria through collaboration with the multinationals has been questioned (Trebilcock and Rosenstock, 2015; Loxley, 2013; Ozoigbo and Chukuezi, 2011). Reasons for the notion include the "*construct*" of construction value, whereby project finance is prioritised as value of the private sector involvement in infrastructure delivery.

Furthermore, a study by Loxley (2013) argued that partnership of multinationals in DC has shifted procurement towards privatisation in nature whereby the private sector takes charge of almost all fragments of the procurement process from design, construction, ownership finance operation and/or maintenance over a long term period. The study further revealed that, between 1990 and 2003, 70% of infrastructure deliveries in DC were procured through public private initiatives. While build-own-operate (BOO) accounted for 38.9%, build-own-transfer (BOT) and built-rehabilitate-operate-transfer (BROT) accounted for 17.9% and 13.2% respectively. These are the most common form of private finance in the Nigerian construction sector where

private sector is preoccupied by the multinationals (see ICRC, 2012). Most of the infrastructures that are procured through private investors are paid through sources that include user fees and tax. Interest rate is always considerably high (Trebilcock and Rosenstock, 2014).

## STAKEHOLDERS ANALYSIS

Literature review reveals stakeholders in the Nigerian construction industry are broadly internal and external, and they form into 3 main categories; dominant, discretionary and dependent stakeholders. A dominant stakeholder is the Nigerian Government and its Ministries, Departments and Agencies (MDAs) (ICRC, 2012). With the power and authority that are bestowed on them, they commission projects for the wellbeing of the citizens. They are considered dominant because their actions are backed by the constitution of the state. ‘Discretionary’ is the second class of stakeholders, which are private construction corporations upon whom government and its MDAs entrust successful project implementations through financial resources. Studies show discretionary stakeholders are predominantly multinationals and they enjoy full support of the Government in order to achieve their business objectives. The third category of stakeholder is ‘Dependent’. In this category are private contractors that have little or no attributes to act as ‘Discretionary’. They are mostly local contractors. With the general public inclusive in this category, they refinance the cost of the infrastructure procurement through service payments over a period of up to 25 years or more. This stakeholder also enjoys limited privilege to be involved in the service provision of the construction process.

## SUSTAINABLE INFRASTRUCTURE DELIVERY (SID) MODEL

Management of values among stakeholders has been identified as a missing gap in the Nigerian Construction sector. Primary goal of SID is to achieve maximum benefits in infrastructure delivery. The novel aspect of the proposed SID is the application of managerial style to construction values. The model aims to ensure cooperation, trust and transparency among stakeholders in the decision making process through a participatory approach. Whilst tangible values are enhanced, a cautious approach is also taken on the hard values that are most associated with value engineering aspects of a project. In any value construct, needs of the stakeholders must be clearly identified. The actualisations of these needs are directly affected by the resources that are required.

The proposed SID model is comprised of subjective and objective phase respectively. In the subjective phase the values among key stakeholders are structured, see Figure 1. The construct is based on extensive literature review and personal experience of the problematic situation. Noticeably, the current value structure in adversarial in nature.

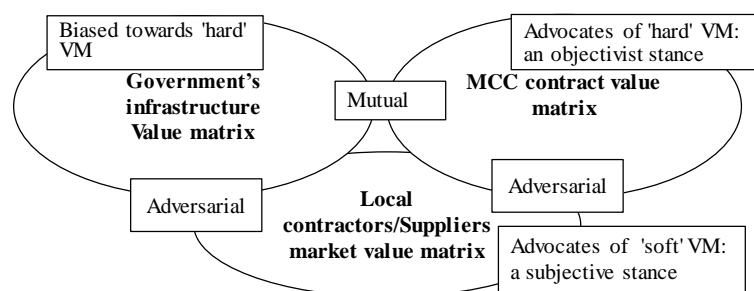


Figure 1: Current values structure in the Nigerian construction sector

Objective phase is where the logic of the integration of ‘hard’ and ‘soft’ value takes place. To achieve the aim, SID utilises merits of tested and proven multi-criteria decision making techniques (MCDM) to develop a hybrid decision model. Fundamentally, principles of modern MCDM are related to value analysis technique that was conceptualised by Miles *et al.* over 6 decades ago, in the 1940s. According to Cheng and Li (2004), multi-attribute utility theory (MAUT), multi-attribute analysis (MAA) and analytic hierarchy process (AHP) are very comparable methods in process and application. However, Analytic Network Process (ANP) technique by Saaty (2009), a generalised form of AHP, has been considered as the most suitable MCDM for SID model, following its successful application in diverse fields of study. An example is the research by Bayazit (2006) on the application of ANP in vendor selection decisions. In the study, three suppliers were studied and global priorities were derived from the synthesis of ten decision attributes (quality, on-time delivery, price, flexibility, delivery lead-time, top management capability, personnel capabilities, process capability, financial capability, and market share). The study highlights capability of ANP to input multiple variables and also consider their inter-dependent impacts. Two key MCDM in the SID model are soft system methodology (SSM) by Checkland and Scholes (1990) and ANP by Saaty (2009). SSM is a learning and meaning development tool. It is used to structure how values are perceived by the affected stakeholders and how it should be grasped in reality. To achieve an objective reality, philosophy of ANP is integrated into data collection and analysis.

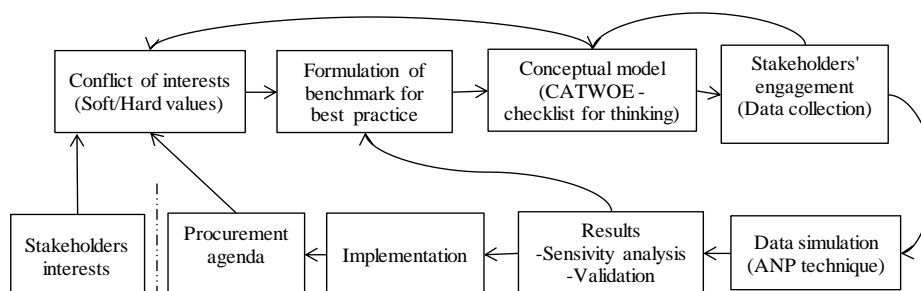


Figure 2: Formulated sustainable infrastructure delivery (SID) model

Application of SID model in Figure 2 starts with the preliminary findings in ‘subjective phase’. The findings are conflicts of interests among stakeholders on tangible and intangibles values. The next step is to review goal of the procurement agenda from stakeholders’ stances. Without prejudice, a functional and production system with reform policies is then identified as a benchmark for a best practice. Knowledge gained from the study is used for conceptualisation of transformation process that harmonise values among the affected parties.

SID engages stakeholders’ through a convenient sampling of experts in the Nigerian construction industry. They are asked about their opinions on the relative importance of the formulated decision factors to achieving delivery of both ‘hard’ and ‘soft’ values and choice between MCC and LCC. Data is simulated through Super Decisions: software that implements ANP. Once final decision is made, sensitivity analysis is carried out to establish significant of MCC and LCC in respect of each of the decision factors, which are money, material, method, machinery, manpower, society and environment. If the results are validated and accepted by the experts, implementation of action follows, or otherwise, further review of the underpinned benchmark is carried out as illustrated in Figure 2.

In this study, the conceptual model is based on reviews of private sector engagement in public procurement, as applicable in EU directives (2004/18/EC) and the Latham report (1994). Based on the reviews, 'CATWOE', part of SSM methodology, checklist of thinking, where the mnemonic stand for: C Customer; A-Actors; t-Transformation; W-Worldview; O-Owners; and E-Environment, is further applied in the design a world view of an ideal system. Details are presented in Figure 3.

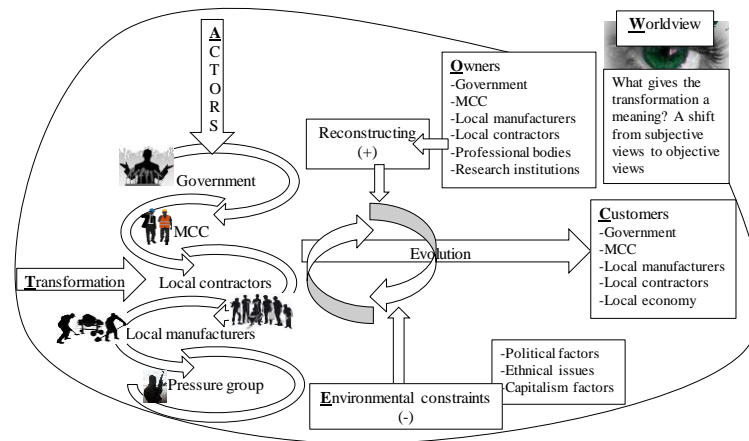


Figure 3: CATWOE model for a transformation in Nigeria construction sector

## RESEARCH METHOD

Data was collected through literature review and survey. The web based questionnaire survey was administered to professionals in the Nigerian construction industry, with a total of 135 questionnaires sent and accompanied with a cover letter, detailing the purpose of the survey with assurance of confidentiality of feedback. The survey was administered to obtain experts' opinions on the relative importance of value criteria in order to generate relative vector. The logic of the pair comparison of criteria followed ANP methodology by Saaty (2009) proficiencies of respondents were judged based on their affiliate of professional membership and field of work. The survey was undertaken in 2015 for a period of 4 months, covering Academia, Government agencies, local construction companies, foreign construction companies and local manufacturing companies. The number of successfully completed questionnaires was 49, constituting an effective return rate of 36%. Respondents comprised of Engineers (n=12), Quantity surveyors (n=19), Architects (n=6) and Construction Project Managers (n=12). The data was analysed using 'Super decisions' software package and statistic analysis computed included priority vector and sensitivity analysis.

## RESULTS

In order to test the validity of the survey questionnaire, awareness of respondents on the private initiative policy for infrastructure procurement were confirmed. 28 of the respondents acknowledged they were very aware of government economic reforms on infrastructure procurement through private finance initiatives and they represent 57% of the sample size. The remaining 43% were aware. Table 1 illustrates the number and percentage of the sample population that were received in relation to their field of work

Table 1: Field of work

Stakeholders	Field of work		
Government	Academia	8	16%
	Government agency	17	20%
Internal	Local construction company	10	35%
	Local manufacturing company	3	6%
External	Foreign construction company	11	22%
	Sum	49	100%

The highest response rate was recorded from Government agencies. The figures included respondents from Federal Ministry of Work and Housing, State Ministry of Work, teaching staff of Universities and researchers in built environment. This could be attributed to government being the largest employer. Experts were asked to assign relative importance to decision criteria that were based on pair comparison matrixes. Table 2 shows detailed sub-factors considered.

Table 2: Weighing factors for SID decision making process

Money	- Availability of funds - Cost of health and safety - Interest rate - Payback period - Welfare budget	Manpower	- Availability of manpower - Management and technical skills - Performance assessment standard - Availability
		Material	- Cost - Quality - Expertise for the application
Machinery	- Innovative machinery - Operating skills - Maintenance budget	Society	- Basic human needs - Empowerment of local contractor - Right and privilege - Affordability
		Environment	- Waste management - Carbon footprints
Method	- Construction method - Procurement route - Competitive bidding		

Figure 4 shows the outer relationships between Clusters. Loop symbol indicates interdependency among factors within Cluster. 70 pair wise comparison matrixes were considered (see Table 3).

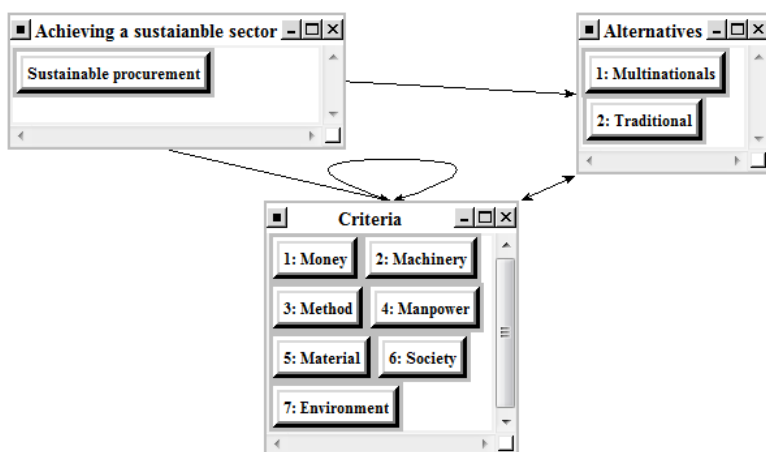


Figure 4: Clusters and nodes of decision network being capture in Super decisions software

Graphical illustration of are illustrated in Figure 4. It presents the structure that guided the number of judgement in the matrix. Line symbol shows there is outer relationship between Clusters. Loop symbol indicates interdependency among factors within Cluster. This has resulted in 70 pair wise comparison matrixes were considered (see Table 3).

Table 3: Number of comparison matrix

Sustainable procurement in respect of Criteria	21
Criteria in respect of MCC	21
Criteria in respect of LCC	21
MCC and LCC in respect of importance of each of the Criteria	7
Total	70

Altogether, 10 matrix based tables were developed. For each table with more than 2 variables for comparison, Consistency ratio (CR) was computed to validate consistency of judgements by respondents. CR is the measure of consistency in judgement that is being made by experts on decision factor. As a standard if  $CR \leq 0.1$  (see Saaty 2009), the paired comparison matrix is considered to be consistent enough.

Table 4: Sustainable procurement in respect of Criteria

2. Node comparisons with respect to 1.1 Sustainable proc~							3. Results	
Graphical	Verbal	Matrix	Questionnaire	Direct			Normal	Hybrid
Comparisons wrt "1.1 Sustainable procurement" node in "2 Criteria" cluster							Inconsistency: 0.09845	
2.1 Money is 3.57 times more important than 2.2 Machinery							2.1 Money	0.21552
Inconsistency	2.2 Machin~	2.3 Method~	2.4 Manpow~	2.5 Materi~	2.6 Societ~	2.7 Enviro~	2.2 Machi~	0.10021
2.1 Money ~	← 3.57	↑ 1.0204	← 2.71	← 3	↑ 1.1235	↑ 1.1235	2.3 Method	0.19899
2.2 Machin~		↑ 1.2658	↑ 1.0204	← 1.08	↑ 1.0204	↑ 1.2987	2.4 Manpo~	0.09818
2.3 Method~			← 2.33	← 2.33	← 2.9	↑ 1.2658	2.5 Mater~	0.14296
2.4 Manpow~				← 1.08	↑ 1.3698	← 1.27	2.6 Socie~	0.11904
2.5 Materi~					← 3.45	← 1.76	2.7 Envir~	0.12510
2.6 Societ~						← 1.76		

For Table 4, CR is 0.0985 and that confirms that the decision is acceptable.

Table 5: Criteria in respect of MCC

2. Node comparisons with respect to 3.1 MCC							3. Results	
Graphical	Verbal	Matrix	Questionnaire	Direct			Normal	Hybrid
Comparisons wrt "3.1 MCC" node in "2 Criteria" cluster							Inconsistency: 0.08499	
2.1 Money is 3.86 times more important than 2.2 Machinery							2.1 Money	0.20372
Inconsistency	2.2 Machin~	2.3 Method~	2.4 Manpow~	2.5 Materi~	2.6 Societ~	2.7 Enviro~	2.2 Machi~	0.14133
2.1 Money ~	← 3.86	↑ 1.4925	↑ 1.25	← 1.36	← 2.33	← 2.33	2.3 Method	0.18285
2.2 Machin~		← 1.09	← 1.19	← 1.09	← 2.62	← 1.93	2.4 Manpo~	0.15530
2.3 Method~			← 2.62	← 1.08	← 1.36	← 1.36	2.5 Mater~	0.17303
2.4 Manpow~				← 1.19	← 2.71	← 2.71	2.6 Socie~	0.06132
2.5 Materi~					← 3.86	← 4.14	2.7 Envir~	0.08245
2.6 Societ~						↑ 2.5641		

For Table 5, CR is 0.0850 and that confirms that the decision is acceptable.

From Table 5, correspondent pairwise judgement shows that MCC demonstrates consistency in the management of the traditional five elements of project management by the multinationals: money-machinery-method-manpower-material. Priority vectors for Society and environment were significantly low.

Table 6: Criteria in respect of LCC

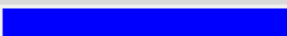

2. Node comparisons with respect to 3.2 LCC							3. Results	
Graphical	Verbal	Matrix	Questionnaire	Direct			Normal	Hybrid
Comparisons wrt "3.2 LCC" node in "2 Criteria" cluster							Inconsistency: 0.08667	
2.1 Money is 4.14 times more important than 2.2 Machinery							2.1 Money	0.38873
Inconsistency	2.2 Machin~	2.3 Method~	2.4 Manpow~	2.5 Materi~	2.6 Societ~	2.7 Enviro~	2.2 Machi~	0.08504
2.1 Money ~	← 4.14	← 3.57	← 4.71	← 3.86	← 4.71	← 4.71	2.3 Method	0.11078
2.2 Machin~		← 1.48	← 1.09	← 1.09	↑ 2.2222	↑ 2.8571	2.4 Manpo~	0.09146
2.3 Method~			← 1.48	↑ 1.4705	← 1.55	← 2.05	2.5 Mater~	0.11654
2.4 Manpow~				← 1.19	← 1.19	← 1.09	2.6 Socie~	0.12747
2.5 Materi~					↑ 1.4705	← 3.45	2.7 Envir~	0.07997
2.6 Societ~						← 3.29		

For Table 6, CR is 0.0867 and that confirms that the decision is acceptable.

In Table 6 are the results of judgement of LCC in respect of procurement criteria. The matrix result shows high disparity between priority for money and other decision factors. While priority vector for money is 39%, approximately 9.5% are scores for the remaining factors.

Further discussion that arose was what the money was being used for when it did not correlate to other decision criteria, especially material, method, manpower and machinery due to interdependency relationship among them. Finally, comparison of MCC and LCC in respect of importance of each of the Criteria was computed, with results generated serving as final input for the simulation of final assessment in Table 7.

Table 7: Global priority Vector

Name	Graphic	Ideals	Normals	Raw
3.1 MCC		1.000000	0.583818	0.194606
3.2 LCC		0.712862	0.416182	0.138727

## DISCUSSIONS

In this paper, a suitability of proposed sustainable infrastructure delivery model for Nigerian construction sector was analysed. Final results favoured MCC = 57% over LCC = 43%, (see Table 7). This implies that procurement through MCC is more sustainable than LCC based on the decision criteria that were considered in the study. Sensitivity analysis was carried out to further highlight ranking of key factors to achieve the goal of the research and continual further improvement, Table 8 presents the final sensitivity analysis.

Table 8: Sensitivity analysis

Criteria	Priority Vector	Ranking of Criteria	MCC ranking	LCC ranking
Money	22%	1st	1st	2nd
Method	20%	2nd	1st	2nd
Material	14%	3rd	2nd	1st
Environment	13%	4th	1st	2nd
Society	12%	5th	1st	2nd
Machinery	10%	6th	1st	2nd
Manpower	10%	7th	2nd	1st
<b>Total</b>	<b>100.00%</b>			

From above Table, none of the two forms of private initiatives can deliver holistic values for achieving macro-economic development. Synergy in the supply chain has been considered to be a key success factor. There was a strong argument in favour of competent local skills for construction operations. Though previous study by Idoro (2010) found that local contractors are plagued with low productivity due to factors that include skills deficiency and shortage of funds for project finance, still local skills are considered to be underutilised, marginalised and evaluated with prejudice. Ilori, Nigerian Society of Engineers, has expressed similar views when he asserted there is abundance of technical skills at the national level (Alimi, 2014). However, there is no independent body that vets the quality and quantity of foreign workers that are employed by the multinationals. The major driver for the current development is government national and international policy on economic growth that are weak and non-coherent on the integration of social factors (Taylor (2007) From experts' opinions, it was deduced that local sourcing of materials and human resources remained key success factors for sustainable procurement. This would make a reality



of benefits associated with construction that were early discussed in Figure 1. The question on favourable conducive environment for local production, though, remains unanswered. High production cost resulting from lack of supporting facilities and security have been identified as drivers for closure in many local manufacturers companies (Taylor, 2007).

*“It is important to emphasize that the performance of the Nigerian economy in the past four or more years has been remarkable, with a stable macro-economic environment and a growth rate averaging 6.3%....However, it is obvious that the associated benefits of growth were yet to trickle down to a large segment of our people....The challenges of poverty, growing inequality, coupled with increasing graduate unemployment remain worrisome....We cannot over flog the issue of infrastructural deficit that continues to becloud our investment climate”* Campbel (2011). The citation in Enweremadu (2013, pp. 71) shows concern about disparity in the Nigerian economic growth and development. The growth could be attributed to more financial commitment of foreign corporations in the economy. Gross domestic product (GDP) growth at about 6.81% was achieved between 2003 and 2013, while average record in the period in other African countries was 3.6% (ICRC 2012). However, the trend in human development index is not the same, with youth unemployment and security threats on the rise (Ajufu, 2013). Lessons from EU directives (2004/18/EC) reiterate the importance of integrating economic and socio-environmental needs in the evaluation of private sector finance initiatives.

## CONCLUSIONS AND RECOMMENDATIONS

The study highlights current value for money strategy in the Nigerian construction industry and justification for review of decision factors. Findings corroborated with the study by Babatunde and Low (2013) in which lack of standardised valued criteria was identified as the greatest challenge for value management in the Nigerian construction sector. Overall, MCC showed better competency in the management of project factors than LCC, though neither are fully committed to society and environment of pragmatic able to deliver holistic values. To achieve sustainable infrastructure model the collaboration is required among stakeholders, with objective structuring of interests, both economic and socio-environmental.

From the application of SID model, it is revealed that values in the Nigerian construction sector are underutilised and mismanaged. It is further revealed that economic reform policy lacks comprehensive sustainable decision criteria. SID model has presented a framework that effectively manages both tangible and intangible values in a more realistic and objective procedure in order to achieve a sustainable infrastructure delivery.

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