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Evaluating Risk Factors of Build-Operate-Transfer Highway Projects in Nigeria

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Build-Operate-Transfer (BOT) has been one of the preferred models of Public–Private Partnership (PPP) for attracting private finance in the Nigerian highway sector. This paper evaluates the risk factors in the Nigerian highway sector with a view to identify significant risks and drawing the attention of the stakeholders on the need to focus attention on these risks. The population for this study includes major stakeholders such as: public sector organizations (government agencies) especially those in charge of BOT/PPP projects, highway engineers, quantity surveyors, concessionaires, registered contractors and selected financial institutions who have participated in BOT projects in Lagos and Abuja, Nigeria. The list obtained from Infrastructure Concession and Regulatory Commission showed that one hundred and fifty (150) experts fall into this category in which a sample size of one hundred and ten (110) was determined. The study adopted stratified random sampling technique. One hundred and ten (110) questionnaires were administered to respondents, 72 questionnaires were valid and used for the analysis. Out of the seventy (70) risks identified, twenty-one (21) risks were rated significant by the respondents, but the most significant risk factor is interest rate volatility. Others are geotechnical conditions, exchange rate fluctuations, interest rate volatility, high cost of finance, and corruption risk and respect for rule of law etc. Majority of the significant risk factors are economy related. However, there was agreement in the rating of the respondents. The paper concluded that stakeholders should concentrate efforts on these significant risk factors to improve the BOT highway sector which has performed below expectation.

Keywords: Build-operate-Transfer, highway, infrastructure, project, risk
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INTRODUCTION

In the last two decades, execution of major public infrastructure projects through public private partnership, has been on the increase globally. Of all these, Build-Operate-Transfer (BOT) model is the most adopted approach for privatized infrastructure procurement (Awodele, 2012). In BOT projects, "the private partner builds a facility compliant with the standards agreed with the public entity which it manages for a given period of time and transfer the facility at the end of the concession period. The project should repay the investment made by the private sector during the concession period*"* (Organization for Economic Co-operation and Development OECD, 2014). Willoughby (2005) evaluated the relationship between transport and economic development, the study advocated that socio-economic development can be driven by putting infrastructure in place. The absence of these facilities and services, will make development very difficult to attain. The BOT projects are generally large-scale projects providing infrastructure facilities (Klein *et al.,* 1996). The pitiable condition

of basic infrastructure has been responsible for slow economic growth and development for most countries of the world (Shatz *et al* 2011). This assertion is relevant to the present situation in Nigeria with over 180 million people, a total highway of 196,200 km, with entire country having a land mass of 910,768 square kilometers, but only 38.9% of the entire road paved (Central Intelligence Agency CIA, 2014). This is grossly inadequate. To reduce this inadequacy of highway infrastructures, several procurement methods have been used but with less improvement (Salawu, 2016).

Risk has diverse definitions depending on the perspective the researcher is looking at it. Risk is "*perceived as possible unknown event of which its occurrences have negative effect only on project performance objectives*" (Smith *et al*., 2014). To Creedy *et al.* (2010) cited in Salawu (2016), "risk is a situation where circumstance planned in a specific chronology are changed by external factor and this affected the premeditated progression of events, resulting in time and cost impacts". Smith (2002) and Odeyinka (2003) classified risks as known, known unknowns and unknowns. They further posited that "when the probabilities of occurrence of all possible outcomes of risk and their consequences are known; then the risk is classified as known. When the possible outcomes of a risk are known and either probability of occurrence or consequences of the possible outcome are known such risk is classified as known unknowns. If the probability of occurrence and the consequences of the possible outcomes of risks are unknown, then the risk is unknown risk". Zayed et al. (2008) posited that highway construction projects have greater risks and uncertainties than other types of construction projects. This is attributed to wider geographical area coverage and many threatening underground conditions (Sameh et al., 2015; El-Sayegh and Mansour, 2015). When these risks occur, they bring about failure to keep within the cost estimate, time overrun and compromise in quality requirements (Tadayon et al., 2012). Risks in BOT highway projects are greater because of higher number of participants and conflicting interests of the parties (Low et al., 2009; Ke et al, 2010; Jin and Zhang, 2011). Hence, potential risk factors in this type of projects have to be methodically and properly managed to enhance performance. It is very important, therefore, to identify, analyse and allocate the different risks when evaluating privately promoted infrastructure projects. To achieve private provision of highway infrastructure, significant risks of BOT highway projects must be evaluated.

LITERATURE REVIEW

BOT Highway Contractual Arrangement

Tiong (1995) defined BOT as "the granting of a concession by the Government to a private promoter, known as the concessionaire, who is responsible for financing, construction, operation and maintenance of a facility over the concession period before finally transferring the fully operational facility to the Government at no cost". Hence, BOT should be thought of as an economic and financial concept rather than a legal term. Several definitions of BOT have evolved over the years. The definition indicated that for any BOT schemes, the concession company takes charge of finance, design, construction, operation and maintenance of the facility for a fixed period of time, in order to recoup the financial outlays and making a reasonable provision for equity investors' profit. After this concession period, the facility passes, without charge, to the government (Askar & Gab-Allah, 2002; Shen *et al*. 2002).

Highway projects requires huge capital outlay to develop new ones and for maintenance purposes. Till this present time, highway projects have been seen in some quarters as social infrastructure, in which governments (either Federal or State) have to be responsible for the provision of these facilities. Whereas governments at different levels have so many things to

attend to, which make it difficult to provide all basic infrastructures, as global economic recession is taking toll on many countries (Salawu, 2016; Okonjo-Iweala, 2013; Onolememen, 2013).

Risk Factors and Classification in BOT Projects

Zayed *et al.* (2008) posited that highway construction projects have greater risks and uncertainties than other types of construction projects. This is attributed to wider geographical area coverage and many threatening underground conditions (Sameh *et al*., 2015; El-Sayegh & Mansour, 2015). When these risks occur, they bring about failure to keep within the cost estimate, time overrun and compromise in quality requirements (Tadayon *et al*., 2012). Risks in BOT highway projects are greater because of higher number of participants and conflicting interests of the parties (Ke *et al*., 2010; Jin & Zhang, 2011). Hence, potential risk factors in this type of projects have to be methodically and properly managed to enhance performance. However, studies have been conducted on risk factors in PPP/BOT projects. Ibrahim *et al* (2006) and Awodele (2012) identified several risk factors in PPP projects as; unstable government, strong political opposition, legislation change, inconsistencies in government policies, lack of creditworthiness, corruption, lack of respect for rule of law, poor financial market, inadequate experience in PPP, construction time overrun, inconsistencies in government policies, bankruptcy of concessionaire; poor quality of workmanship, inflation rate volatility, weather; industrial regulation change, force majeure, excessive contract variation and project environment were significant risk factors affecting PPP/BOT projects. However, there are many studies on risk factors and risk allocation in BOT highway projects in different Asian, American and European countries. The size, complexity, multiple stakeholders and time frame of concession contracts of BOT projects according to Xenidis & Angelides (2005) have been full of risks. However, risk classification has been a matter of controversy in the construction sector. Many researchers have come up with different classification. Xenidis & Angelides (2005) classified risk on the nature of risks and source of origin. Ibrahim *et al* (2006) classified risks into endogenous and exogenous. Some studies classified risks based on the phases of project life cycle. Li *et al*. (2005) and Akintoye *et al.* (2003) adopted 3 levels classification of macro, meso and micro. Risk factors used in studies by researchers from Australia, China, UK, Canada, America, India, Malaysia, Indonesia and Singapore, such as; Bing & Akintoye (2005), Xenidis & Angelides (2005), Jin (2010), Ke *et al.* (2010), Li & Zou (2011), Xu *et al.* (2010), Chou *et al.* (2012), Herravi & Hajihosseini (2012), Hwang (2013) and Chou & Pramudawardhani (2015), who have wealth of experience in PPP were extracted. Also, studies of Ibrahim *et al.* (2006), Awodele (2012) and Salawu (2016) were also examined to get insight into the peculiarity of Nigeria as country. A total of 70 risk factors related to BOT highway projects was extracted. Also, there is possibility of existence of differences of opinions of key stakeholders in the classification. Findings from above studies show that some risk factors occur across time and places. These risks include financing, non-payment, poor pricing policies and completion risk. The list, sources and categories of the risks identified in BOT highway projects is presented in Table 1.

No	Factor group	Risk factors	A	B	C	D	E	F	G	H	J	K	L	M	Z
N1	**Political and Policy of the State**	Unstable government	❖	❖											2
		Import/ export restrictions												❖	1
		Strong political opposition/hostility	❖		❖	❖	❖		❖						6
		Government interference in choosing subcontractors												❖	1
		Lack of tradition of private provision of BOT roads.												❖	1
		Possible expropriation	❖	❖	❖	❖	❖		❖						6
		Rate of return restrictions						❖						❖	2
		Inconsistency in government policy													1
		Poor public decision-making process			❖	❖	❖		❖			❖			6
		Corruption and lack of respect for rule of law		❖	❖	❖	❖		❖			❖			6
		Non-cooperation between different public agencies			❖								❖		2
		Lack of government guarantees												❖	1
		Public opposition to projects												❖	1
2	**Macroeconomics**	Influential economic conditions (boom/recession)									❖				2
		Interest rate volatility	❖	❖	❖	❖	❖	❖	❖	❖		❖		❖	10
		Exchange rate fluctuation			❖	❖	❖		❖			❖			5
		Prejudiced and unfair process of awarding contract.												❖	1
		Inflation rate volatility	❖	❖	❖	❖	❖	❖	❖	❖	❖	❖			9
		Poor financial market	❖	❖	❖	❖	❖	❖	❖	❖		❖			9
3	**Legal**	Change in tax regulation	❖	❖	❖	❖	❖	❖	❖						6
		Excessive contract variation	❖	❖											2

		Lack of standard model for PPP agreement									❖			❖	2
		Immature juristic system			❖	❖									2
					❖	❖									
S/N	**Factor group**	**Risk factors**	**A**	B	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**Z**
		Legislation change/inconsistency	❖	❖	❖	❖	❖	❖	❖	❖	❖		❖		10
		Unsteady legal and regulatory framework												❖	1
		Improper contract			❖	❖									2
		Industrial regulatory change	❖												1
4	**Construction**	Construction cost overrun	❖			❖				❖	❖		❖		5
		Site safety and security		❖						❖					2
		Construction time delay	❖	❖		❖				❖					4
		Material/labour availability	❖	❖	❖	❖	❖	❖	❖						7
		Poor quality workmanship	❖	❖						❖					3
		Insolvency/default of sub-contractors or suppliers	❖												1
5	**Operation**	Operation cost overrun	❖	❖	❖	❖	❖		❖	❖	❖	❖	❖		10
		Technological risk			❖	❖									2
		Operational revenues below expectation	❖												1
		Operation default									❖				1
		Low operating productivity	❖	❖											2
		Maintenance costs higher than expected	❖	❖							❖				3
		Maintenance more frequent than expected	❖	❖											2
		Tariff change												❖	1

6	**Relationship**	Organization and co-ordination risk	❖	❖	❖	❖	❖		❖		❖				7
		Differences in working method and know-how between partners	❖	❖											2
		Private investor change			❖	❖									2
		Lack of consortium expertise			❖									❖	2
		Inadequate distribution of responsibilities and risks	❖	❖											2
		Inadequate distribution of authority in partnership	❖	❖											2
	Factor group	**Risk factors**	**A**	B	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**Z**
		Lack of commitment from either partner			❖									❖	2
7	**Natural**	Force majeure	❖	❖	❖	❖		❖			❖		❖		7
		Geo-technical conditions	❖	❖	❖	❖	❖								5
		War/terrorism												❖	1
		Environment	❖	❖	❖	❖	❖		❖	❖	❖				8
		Weather	❖	❖		❖					❖				4
8	**Social**	Kidnapping												❖	1
		Public opposition to projects	❖	❖											2
9	**Project Finance**	High finance costs	❖	❖											2
		Payment risk							❖					❖	2
		High bidding cost					❖					❖		❖	3
		Availability in finance	❖	❖											2
		Financial attraction of project to investors	❖	❖											2
		Bankruptcy of Concessionaire												❖	1

10	**Rezidual risk**	Scope variation		❖											1
		Design deficiency	❖	❖				❖							3
		Supporting facilities risk			❖	❖									2
		Delay in project approvals and permits	❖	❖	❖	❖	❖	❖	❖	❖		❖	❖		10
		Unproven engineering techniques	❖	❖			❖		❖						4
		Residual value	❖	❖	❖	❖	❖	❖	❖	❖					8
11	**Miscellaneous**	Prolong negotiation	❖			❖	❖		❖			❖			5
		Insufficient financial audit			❖	❖									2
		Subjective evaluation			❖	❖									2

Table 1: Risk factors in BOT highway projects

A :Bing *et al*. (2005a); **B** :Hwang *et al*. (2013); **C** : Chou *et al*. (2012); **D** : Ke *et al*. (2010); **E** : Chan *et al*. (2011); **F** : Jin (2010); **G** : Xu *et al.* (2010); **H** : Li and Zou (2011); **J** : Heravi and Hajihosseini (2012); **K** : Chou and Pramudawardhani (2015); **L** : Ibrahim *et al* (2006); **M** : Awodele (2012); **Z** = Number of Citations.

RESEARCH METHOD

This paper reported a part of a larger study. Risk identification is one of the key factors in achieving project success. It is the first step in risk management process. The study identified potential risks associated with BOT highway projects through a comprehensive literature search and review on PPP/BOT schemes all over the world. This was streamlined to highway project in the final phase. This method is widely used in construction management research. (Grimsey & Lewis, 2007; Bing & Akintoye, 2005; Lam *et al.* 2007; Chung *et al.* 2010; Jin 2010; Ke *et al*. 2010; Jin & Zhang, 2011). A long list of risks was generated which bothers on different stages and phases of risk associated with BOT highways. Secondly, to remove any ambiguities in the questionnaire, pilot-testing was carried out to test the applicability of the instrument by ten academic/ practitioners whose experience span over ten years in PPP research and practice in Nigeria, Malaysia and Australia. A risk factor was introduced which was not part of those found in the literature (Kidnapping). Over 90 risk factors were found through extant review of literature but were refined to the scope of BOT highway projects. Based on the experts' view, 70 risk factors were grouped into eleven different categories.

This paper adopted survey design. In survey research, the purpose of studying a sample is to generalize inferences about some characteristic, attitude, or behavior of this population (Babbie, 1990). The justification in adopting survey design includes the economy of the design and the rapid turnaround in data collection. The population for this study includes major stakeholders such as: public sector organizations (government agencies) especially those in charge of BOT/PPP projects, highway engineers, quantity surveyors, concessionaires, registered contractors and selected financial institutions who have participated in BOT projects in Lagos and Abuja. The lists of the organizations working on BOT highways in Nigeria was obtained from Infrastructure Concession and Regulatory Commission (ICRC), a body saddled with the responsibility of overseeing BOT/PPP projects in Nigeria. A comprehensive list of stakeholders in the BOT/PPP projects in Nigeria was obtained from ICRC from which the population size has been determined. One hundred and fifty (150) experts fall into this category. The fact that these organizations have been prequalified by ICRC is an indication that responses received from them represent those of a cross-section of firms with sophisticated organisational set-ups. The sample size was determined using Krejcie Morgan Table. Out of 110 questionnaires administered to respondents, responses were received from 75 participants with varied interest and/or experience with BOT highway projects and the survey was administered between March and August 2017. 72 questionnaires were valid and used for the analysis while 3 questionnaires were not valid. A combined questionnaire was designed for three specific purposes: to identify the most significant risks in Nigerian BOT highway projects.

A 5-point Likert scale on the probability of occurrence and severity of impact were used in the study. For probability of occurrence, 1- not likely, 2- slightly likely, 3-somehow likely, 4- likely, and 5-very likely. For severity of impact, 1- negligible, 2- marginal, 3-substantial, 4- severe, and 5- disastrous. Data were collected personally by the researchers through a cross-sectional survey using stratified random sampling. The data collected was analysed using SPSS 22 version

3.2 Tools for data analysis

Mean score (MS) was used because it measures the central tendency. It is widely used in construction management research (Chan & Kumaraswamy,1996; Cheung & Chan, 2011; Ameyaw, 2014). Other tool that is widely used is relative importance index (RII). MS is used to conduct evaluation from the survey results and to evaluate the significance of a list of

variables. This was achieved with the help of Statistical Package for Social Sciences (SPSS Version 23). Thus, using mean analysis, it is possible to establish the relative significance of each risk factor through the following equation:

$$MS = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{N}$$

Where MS denotes mean score of each risk factor; *n*1, *n*2, *n*3, *n*4 and *n*5, represent the number of survey respondents who scored the responses as *1, 2, 3, 4 and 5* respectively, and *N* is the total number of survey respondents that rated the risk factor (72 in this case).

The feedback has two streams of data (Table I), the probability of occurrence and severity of each risk factor. Nicholas & Steyn (2012) asserted that project risk is a joint function of probabilities of occurrence and severity. This can be measured by:

Risk = *f* (probability, severity)

Risk impact = (probability x severity)$^{0.5}$

This method of quantifying risk is widely used in construction management research (Ameyaw and Chan, 2015; Salawu, 2016) and is well-established in decision theory and has been used in many studies. The ranking of each risk is directly based on the product of its probability and severity. This method of risk measurement is adopted to establish the significant risk factors in BOT highway projects. That is, the high-ranked factors would be considered most deserving of public/private participants' efforts and resources. A project may be considered as "risky" whenever the probability, or impact, is huge (Nicholas & Steyn, 2012)

RESULTS

Demographic details of the respondents

The demographic details of the respondents**.** 11% of the respondents are HND holders, 57% are BSc holders, 26% are MSc/MBA holders while 06% are PhD holders. 86% of the respondents are corporate members of their respective professional bodies. The respondents comprise of 25% working in client organization, 22% in consulting, 19% in contracting, 17% in concession company, 12% in banking and 6% in academics. 75% of the respondents have over six years' experience in BOT highway projects. Over 50% of the respondents have handled 3 projects and above. This shows that the information supplied by the respondents can be considered appropriate and adequate for the study.

Determining the Significant Risk Factors

The purpose of this study is not only to generate a list of risk factors but also to establish the risk factors that have significant impact on the smooth delivery of BOT highway projects. In determining the significant risk factors, the normalized value of all identified 70 risk factors were computed by applying the equation as used by Ameyaw (2014):

$$N_v = \frac{y + (z-Y)\ x\ (b-y)}{B-Y}$$

Where N_v = normalized value of a specific risk factor, y = minimum value (0), z = mean index of a specific risk factor to be normalized. b = maximum value (1), B = maximum index of the specific risk factor, and Y = minimum index of the specific risk factor.

The results of the computation are shown in (Table 1, Column 6). Based on Xu *et al.* (2010), Chan *et al.* (2011) and Ameyaw (2014), risk factors with normalized values of 0.5 and above are considered significant. Therefore, 21 risk factors are significant in the BOT highway sector in Nigeria (Table 1, Column 7). The remaining 49 risk factors have normalized values less than 0.5 and are considered insignificant.

Overall Ranking of Risk Factors

The mean scores evaluated for the risk probability is between 1.86 and 4.49. This shows that the probability of risk occurrence spans from low to high level. The mean scores of the risk severity are between 3.06 and 4.54. This indicates that the risk severity spans from moderate to very high level. A closer look at the mean indices of the probability and severity of the risk factors indicates that the first three risk factors showed consistency from the respondents.

Table 2: Risk factors in BOT highway projects in Nigeria

RISK FACTORS	Mean(P)	Rank	Mean(S)	Rank	P*S	Normal. V.	Rank
Inflation rate volatility	4.49	1	4.54	1	20.38	1.00	1
Geo-technical conditions	4.40	2	4.49	2	19.76	0.97	2
Exchange rate fluctuation	4.07	3	4.32	3	17.58	0.85	3
Interest rate volatility	4.01	5	4.14	5	16.61	0.80	4
High finance cost	3.89	7	4.22	4	16.42	0.78	5
Corruption and lack of respect for rule of law	4.01	4	4.04	7	16.20	0.77	6
Lack of standard model for PPP agreement	3.90	6	3.92	9	15.28	0.72	7
Material/labour availability	3.79	9	4.03	8	15.27	0.71	8
Public opposition to toll payment	3.72	10	4.07	6	15.14	0.70	9
Unsteady legal and regulatory framework	3.78	8	3.81	11	14.40	0.66	10
Tariff change	3.69	11	3.79	13	13.99	0.64	11
Influential economic conditions (boom/recession)	3.57	16	3.90	10	13.92	0.63	12
Delay in project approvals and permits	3.61	14	3.71	16	13.39	0.60	13
Operational revenues below expectation	3.60	15	3.71	16	13.36	0.59	14
Unstable government	3.47	19	3.81	11	13.22	0.58	15
Bankruptcy of Concessionaire	3.54	18	3.71	16	13.13	0.58	15
Poor financial market	3.57	16	3.65	19	13.03	0.57	17
Availability in finance	3.68	12	3.53	22	12.99	0.57	17
Insolvency/default of sub-contractors or suppliers	3.43	21	3.76	14	12.90	0.56	19
Force majeure	3.40	22	3.72	15	12.64	0.55	20
Inadequate distribution of responsibilities and risks	3.68	12	3.35	37	12.33	0.52	21

Inflation rate volatility (4.49) has the highest index of probability, followed by geo-technical conditions (4.40) and exchange rate fluctuations (4.07). Corruption and lack of respect for rule of law (4.01) is the fourth but on the probability indices but sixth in the overall ranking. For the severity index, there is consistency for the first three risk factors. Inflation rate volatility (4.54) has the highest index of severity, followed by geo-technical conditions (4.49) and exchange rate fluctuations (4.32). However, there is variability in the ranking of the other risk factors (See Table 2). The reason might be attributed to the perception of the different stakeholders on the risk factors. A risk may have very high probability to the consultants but moderate to concessionaire and low to contractors. 21 significant risk factors were established from a total of 70 risk factors that were used in the study.

IMPLICATIONS FOR PRACTICE

The implication of this study is in two parts. Firstly, the identification of 70 risk factors that are peculiar to the BOT highway sector is a starting point for the practitioners. It will serve as a guide for them. The need to start from the scratch is no longer needed.

Secondly, the study has established 21 significant risk factors in the BOT highway sector in Nigeria. This will serve as a guide for the stakeholders in the industry. They are better informed now on the areas to channel their efforts and resources to ensure that the objectives of the projects are achieved. Contrary to the erroneous believe that corruption is the number one problem in the construction sector, this study has shown clearly that the assertion is wrong in Nigeria context. Corruption is perpetrated under any of the projects' conditions.

CONCLUSION

In carrying out research on risk allocation, the first step is proper identification of the typical and significant risks. This research addressed these steps in BOT highway projects in the Nigerian construction industry. 21 significant risk factors were established from 70 risk factors used in the study. These significant risk factors have serious impacts on the management of BOT highway projects in Nigeria. Stakeholders need to put all resources together to manage these risks as failure to do so can lead to failure at the different phases of the project.

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