Assessment of Construction Risks and Mitigation Strategies in Public Private Partnership (PPP) Projects in Abuja, Nigeria

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Abstract:
Mismanagement of risk factors that come into play during the construction phase of a PPP project can result into non-actualisation of the PPP project / non-conformity with the project schedule. The research aims to assess the construction risks associated with PPP projects, as well as to recommend how best such risks can be mitigated. The research employed the use of the quantitative method from which a total of 306 questionnaires were administered from which 213 were retrieved using the simple random sampling technique to construction professionals and private construction developers, who have executed PPP projects in the Federal Capital Territory (FCT), Abuja. The collected data were analysed using the descriptive method (the mean score method, relative importance index and the ranking method). The study revealed that the most important risks factors associated with PPP projects were construction cost overrun, construction time delay, interest rate fluctuation, availability of finance, and excessive variation in project specification. The risk mitigation tool appropriate for the PPP models (Build-Operate-Transfer [BOT], Build-Operate-Own-Transfer [BOOT] and Design-Build-Operate-Transfer [DBOT]) was the Insurance Policy. Based on these findings, it can be concluded that effective management of construction PPP risks would translate into a timely completion of PPP project. It was recommended that, in exploring options for the mitigation of construction risks in PPP projects, clients and developers should consider insurance, contingency plans and contingency sums in descending order of preference.

Keywords:
Construction, Mitigation strategies, PPP, PPP Models, Risks

1 Introduction

Traditionally, government has prevailed infrastructure funding in Nigeria (Obi & Ofonyelu, 2015 and U-Dominic, Ezeabasili, Okoro, Dim & Chikezie, 2015). Until the 1980s, when reclaims were introduced to confront the dwindling oil revenue that challenged state capability for infrastructure provisioning (Annimashaun, 2011). However, due to the increase in the demand for infrastructure; inadequate public resources to meet present and future desires; and acceptance of a better role for the private sector in providing infrastructure, alternative methods of funding public facilities and services have been adopted by the public sector (Nigeria Public Private Partnerships Review [NPPPR], 2012 and U-Dominic *et al.* 2015), Li *et al.* (2001) established that Nigeria eventually develop a foremost measure towards getting at the advantage of PPPs due to enactment of the Infrastructure Concession Regulatory Commission (Establishment) Act ("then ICRC Act") in 2005 which allows for private sector involvement in infrastructure development projects and establishes the ICRC as the regulator of PPPs projects.

The decision to embark on a building project therefore has inherent element of risk (Adelusi, 2009). It was observed by Jagboro (2007) that risks are unwanted negative consequence of an event of which the possible outcome can be identified, predicted and quantified. Dada (2010) and Odimabo and Oduoza (2013) opined that the risk factors in building construction that are not given proper attention in developing countries such as Nigeria lead to poor quality work, cost and time overruns. Thus, Uher (2003) saw risk management as an organised way of looking at areas of risk and finding out how each should be handled. Lots of PPP projects have failed and even deserted causing suffering, not only to the promoter, but also to the lending funding institutions (Ranjan, 2010).

Previous studies in this field included that of Meruyn (2001) who concluded that proper risk management, identification, assessment, allocation and mitigation are essential for achieving success in project. The ability to actively create and develop collaborative relationships is an essential asset for managing PPP project networks (Pauget & Wald, 2013). Grimsey & Lewis (2002) analysed the principles involved in PPP and depicting on practical experience of assessing such projects to present a framework for evaluating the risks. Chohra *et al.* (2008) recommended that risk transfer mechanisms should be develop for mega-construction projects under PPP; the guiding principle should be a balanced risk allocation. In a related development Patrick *et al.* (2008) opined that optimal risk identification, assessment, allocation and management in PPP bring about value for money and protection of the public interests. Nur & Batu (2011) reviewed risk allocation in public-private partnership project and revealed that risk factors are clustered into 10 groups namely: political, construction, legal, economic, operation, market, project selection, project finance, relationship and natural factor; and that the highest score frequency factors are change in law, delay in project approvals and permits and land acquisition. Mohammed *et al*. (2012) examined risk allocation in PPP projects in Nigeria and establish that the public sector choses to retain most political, legal and social risks, and share most micro level risks and force majeure risk; while the majority of micro level risks were preferred to be allocated to the private sector. The cited works did focus specifically on the assessment of general construction risks and their mitigation strategies. However, they did not link these risks to PPP projects in Abuja, Nigeria. This study is thus concerned with studying risk encountered in construction of PPP project and making recommendation on how best such risks can be successfully mitigated.

2 Risk Analysis and Management in PPPs

Risk occurs due to unforeseen result that can have direct consequence on the project (UNESCAP, 2011). Rouse (2010) indicated that risk analysis is the procedure of determining and examining the dangers to individuals, business concern and public authority presented by potential natural and human-caused unfavourable actions. Olugbodi (2012) stressed that, risk management is a most important worry of the government and private agency in setting any PPPs project; hence, risk sharing is one of the main reasons why PPPs exist in the first place. Rostami (2016) opined that risk identification plays a key role in the success of managing risk. KarimiAzar *et al.* (2011) noted that risk analysis can provide avenue for knowing the origins of project risk and enable management to develop directed corrective action. The key tools and techniques in risk identification and analysis according to Rostam (2016) are: brainstorming, interviews, Delphi, check-lists, hazard analysis and critical control points, environmental risk assessment, structure "what if", scenario analysis, business impact analysis, root cause analysis, failure effect mode analysis, event tree analysis, cause and effect analysis and consequence and probability matrix. However, Rouse (2010); and Rot (2008) concluded that risk analysis may either be quantitative or qualitative. In quantitative risk analysis, there is

effort to find out the chances of many unfavourable actions and the probable level of the losses, if certain event happens. While qualitative risk analysis, which is more applicable, involves understanding the different threats, finding the degree of exposed and making counter measures when an attack occurs? (Hillson, 2004). Quantitative and qualitative risk analysis includes the following:

Interviewing: Interviewing techniques are employed to assess probabilities and the impact of attaining a particular goal due to input from stakeholders and expertise in particular field. In the interview, it is always important to mix to obtain the optimistic (low), pessimistic (high) and probable situation for a particular goal (Thaheem, 2012).

Probability distributions: This method describes how chances are spread upon events. Probability distributions are used to graphically demonstrate risk chances, indicating the probability density functions. For each probability distribution, the vertical axis indicates the chances of the risk event and the relative likelihood, and the horizontal axis depicts the impact (time or cost) of the risk event (Thaheem, 2012). Others include, scenario analysis, sensitivity analysis and brainstorming (Hillson, 2004; Thaheem, 2012).

3 Research Methodology

Mixed method of both quantitative and qualitative research was employed. The research population was PPP construction projects within Abuja, Nigeria. The sampling frame for this study constituted government ministries, parastatals that were involved in construction work, construction developers and private firms that were into PPP works within Federal Capital Territory (FCT), Abuja. A total of 306 questionnaires were administered using the simple random sampling method, from which 213 (69.6%) were returned. The rationale for the simple random sampling was that every data source in the population has an equal chance of being included in the sample. The professionals included: 30 Builders, 50 Quantity surveyors, 68 Architects, 62 Civil Engineers, 50 Mechanical/Electrical Engineer, and 46 Estate Surveyors some of whom are private construction developers in PPP work within Abuja.

The questionnaires were developed to capture the key issues in the research (PPP construction project risks and their mitigation strategies). Though, the first part captured the demographic of the respondents. The collected data were analysed using descriptive method which included: the mean score method, relative important index, and ranking method.

The collected data from the questionnaire were analysed using the descriptive statistical methods which included: percentages, charts, mean-score distribution, relative importance index and ranking method. The mean score method involves assigning numerical values to respondents' ratings of importance, for example strongly agree (5 point), agree (4 points) in this order. Relative Frequency Index (RFI) was employed for two purposes: for ranking and determination of significance of different factors of the data collected. The premise of decision for the ranking was that, the factor with the highest Relative Frequency Index (RFI) is ranked 1st and others in such subsequent descending order (Nurudeen, 2002). It was used to analyse the issues relating to management of construction risks in public private partnership infrastructure projects in Abuja. The results of the analyses were presented in Tables and Figures1, 2, 3.

4 Findings and Discussion

This section presents and discusses the results of the descriptive analyses performed on the issues relating to construction related risks and their mitigation strategies in PPP projects

4.1 Various PPP Arrangements in Place

The PPP projects were categorised into six classes as shown in Figure 1, to give as much information as possible. Infrastructure projects made up five of the categories, while housing was the sixth category. Build-Operate-Transfer (BOT) was the most popular model for housing projects; this was also true for road projects, 8 of which were let contracted using the BOT model. Port infrastructure was concessioner through Operate-Maintain-Transfer (OMT) and Rehabilitate-Operate-Transfer (ROT) models. Water supply infrastructure was solely contracted using BOT model, while railways infrastructure contracting was shared equally between BOT and SOM (Supply-Operate-Maintain). Two instances were observed of housing projects being concessioned using Rehabilitate-Lease-Operate-Transfer (RLOT) model.

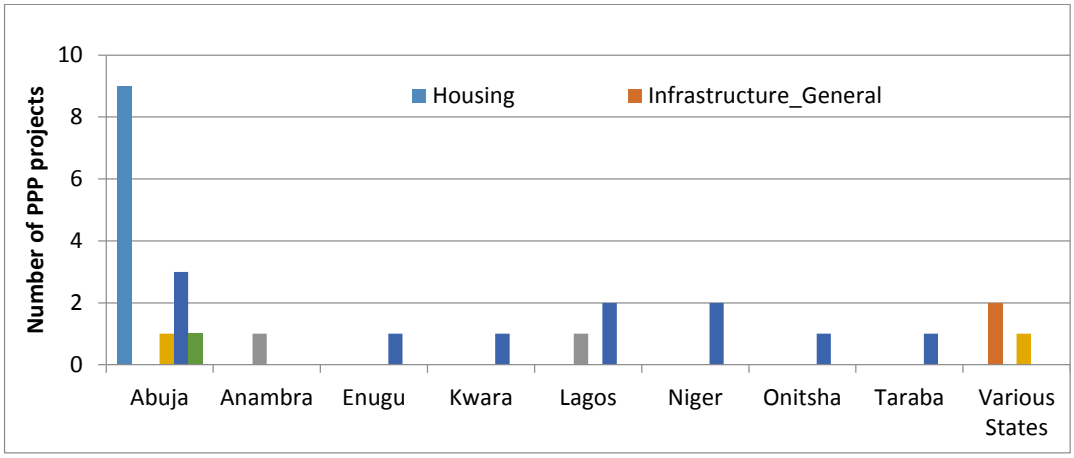

Figure 1: Types of PPP projects sited in different states in Nigeria (source: Researcher)

The bulk of PPP projects covered in the sample obtained in this study were owned by government as shown in Figure 2. Privately owned PPP projects were contracted under BOT and RLOT models only. Public projects appeared to favour the BOT model, under which 12 projects were contracted. DBFT (Design-Build-Finance-Transfer) and ROT (Rehabilitate-Operate-Transfer) were also noticeably popular models.

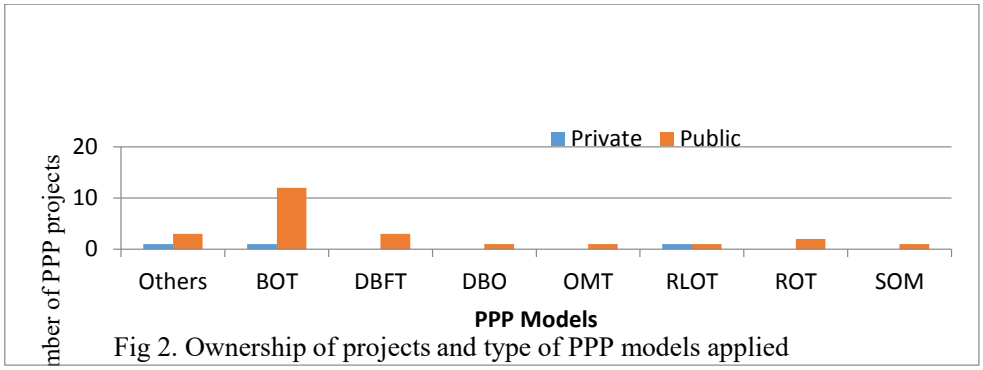

Fig 2. Ownership of projects and type of PPP models applied

Figure 2: PPP Model (Source: Researcher)

The type of PPP projects in terms of ownership was examined in Fig 3. Private PPP projects existed only in the housing subsector. All of the infrastructure PPP projects were under public ownership. Of these, roads were the dominant type of project (numbering 11 projects). Housing was also an important area for publicly-owned PPP projects, with 6 projects currently ongoing. There were 2 projects each for the public sector in the general infrastructure sector, ports, and railways. There was only 1 water supply infrastructure PPP project.

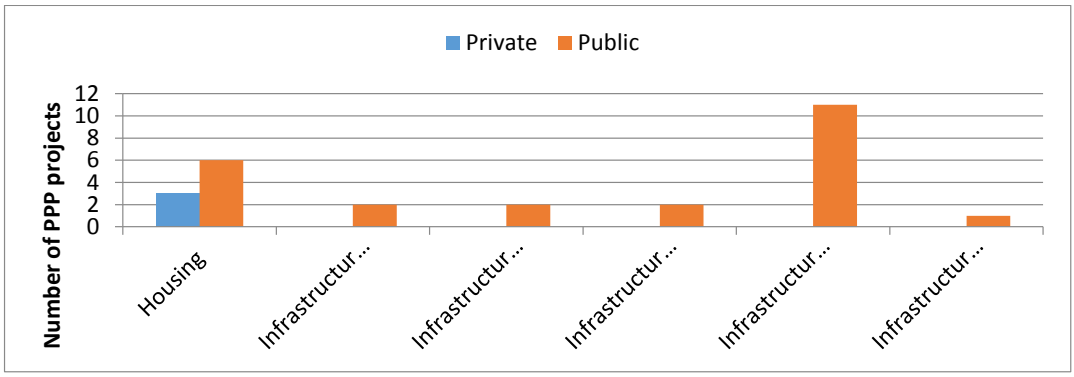

Figure 3: Types of PPP project and Ownership of projects (Source: Researcher)

4.2 Construction Risks Associated with PPP Projects

Construction risks that were associated with PPP projects in Table 1 were identified using two measures of the quantity of responses received from the sample. These were the Mean Score and the Relative Importance Index (RII). While the Mean Score allowed responses to be located in terms of the response option most favoured by respondents, the Relative Importance Index allowed an item to be ranked in terms of the importance accorded it by respondents among its peers.

For instance, in Table 1, the risk variable (Construction Cost Overrun) had a Mean Score of 3.98, which indicated that the weighted average of the responses received was close to the response option coded as '4' on the Likert scale, which represents 'Often'. The risk variable also had an RII of 0.79, which meant, it was the most important risk factor associated with PPP projects, in the opinion of the respondents to the study.

The risk factors that ranked as the five most important risks associated with PPP projects were (i) construction cost overrun, (ii) construction time delay, (iii) interest rate fluctuation, (iv) availability of finance, and (v) excessive variation in project specification. Conversely, the risks that were considered to be of lesser importance to PPP projects were: (a) inconsistency in design, (b) poor quality workmanship, and (c) change in tax regulation. The mean scores of these three risks showed that respondents felt that the risks were rarely associated with PPP projects; the RII of the three risks were also the lowest obtained for the analysis.

Table 1. Construction Risks Associated with PPP Projects

S/No	Risk Variable Codes	Variables	Mean Scores	Relative Importance index (RII)	Ranking
1	Q8	Construction Cost Overrun	3.98	0.79	1
2	Q9	Construction Time Delay	3.76	0.74	2
3	Q30	Interest Rate Fluctuation	3.46	0.69	3
4	Q14	Availability of Finance	3.27	0.65	4

S/No	Risk Variable Codes	Variables	Mean Scores	Relative Importance index (RII)	Ranking
5	Q13	Excessive variation in project Specification	3.29	0.65	4
6	Q29	Material inflation	3.22	0.64	5
7	Q15	Inadequate approved budget	3.18	0.63	6
8	Q19	Late design alteration	3.00	0.60	7
9	Q10	Contractual dispute	3.03	0.60	7
10	Q12	Poor contract management	3.00	0.59	8
11	Q17	Inadequate estimate	2.86	0.57	9
12	Q18	Design ambiguity	2.83	0.56	10
13	Q16	Lack of proper project brief	2.84	0.55	11
14	Q28	Lack of experience	2.78	0.55	11
15	Q22	Lack of communication between sub-contractors, contactors/suppliers	2.75	0.53	12
16	Q20	Geotechnical condition	2.55	0.51	13
17	Q27	Lack of commitment among consultants	2.54	0.51	13
18	Q26	Lack of communication between consultants	2.56	0.50	14
19	Q25	Differences in working method and know-how	2.48	0.50	14
20	Q11	Force majeure	2.73	0.49	15
21	Q23	Shortage of materials and equipment	2.48	0.49	15
22	Q21	Inconsistency in Design	2.54	0.48	16
23	Q24	Poor Quality Workmanship	2.45	0.48	16
24	Q31	Change in Tax Regulation	2.39	0.48	16

Source: Researcher

4.3 Risk Mitigation Strategies in PPP Projects

The responses considered most appropriate to risks that occur in projects carried out under different PPP models were determined using a mean score, which located responses in terms of the response option most favoured by the respondents, and the Relative Importance Index (RII), which ranked items in terms of the importance, accorded them by respondents. The PPP models considered in this section of the study included Build-Operate-Transfer (BOT), Build-Operate-Own-Transfer (BOOT) and Design-Build-Operate-Transfer (DBOT).

4.4 Appropriate Risk Responses for Different Models of PPP Projects

The Table 2 shows that the risk response considered most appropriate for all of the three different PPP models (Build-Operate-Transfer (BOT), Build-Operate-Own-Transfer (BOOT) and Design-Build-Operate-Transfer (DBOT) was the 'risk reduction' with a mean score of 4.06 and relative important of 0.73. The least appropriate response was the 'risk retention', which had both the least mean score and lowest RII value 3.15 and 0.57 respectively.

Table 2. Responses to risk most appropriate to different models of PPP projects

S/No	Risk Response Codes	Response	Mean Scores	Relative Importance index (RII)	Ranking
1	Q101	Risk Reduction	4.06	0.73	1

2	Q100	Risk Transfer	3.92	0.71	2
3	Q102	Risk Avoidance	3.43	0.62	3
4	Q103	Risk Retention	3.15	0.57	4

Source: Researcher

4.5 Appropriate Tools for Risk Mitigation for Different Models of PPP Projects

The Table 3 shows that the risk mitigation tool considered most appropriate for all of the three different PPP models (Build-Operate-Transfer (BOT), Build-Operate-Own-Transfer (BOOT) and Design-Build-Operate-Transfer (DBOT) was the 'insurance policy'. This tool had a mean score of between 4.13 and 4.44. The RII for Insurance Policy also ranged between 0.73 and 0.79.

The least appropriate tool was the 'contingency sum', which had both the least mean score and lowest RII value. Notwithstanding this however, it was obvious that the difference between the most and least appropriate tools for risk mitigation was not very wide; this probably indicates that all of the tools suggested in the study were considered appropriate by respondents, differing only in degree.

Table 3. Tools for Risk Mitigation most appropriate to different models of PPP projects

S/No	Risk Mitigation Tools Codes	Tools	Mean Scores	Relative Importance index (RII)	Ranking
1	Q104	Insurance Policy	4.44	0.79	1
2	Q105	Contingency Plan	4.28	0.76	2
3	Q106	Contingency Sum	4.13	0.73	3

Source: Researcher

4.6 Summary of the Research Findings

- The most popular model for housing, road and water projects was Build-Operate-Transfer (BOT);
- The most important risks associated with PPP projects were: (i) construction cost overrun, (ii) construction time delay, (iii) interest rate fluctuation, (iv) availability of finance, and (v) excessive variation in project specification. However, the risks that were considered to be of lesser importance to PPP projects were (a) Inconsistency in design, (b) Poor quality workmanship, and (c) change in tax regulation.
- "Risk reduction" was the most appropriate risk response for BOT, BOOT and DBOT while "risk retention" was the least appropriate risk response for the models
- "Insurance policy" was considered as the best tool to mitigate identified risks in BOT, BOOT and DBOT projects. Contingency Plan and Contingency Sum were also considered appropriate by respondents, to a lesser degree.

5 Conclusion and Recommendations

Mismanagement of risk factors that come into play during the construction phase of a PPP project can result into non-actualisation of the PPP project / non-conformity with the project schedule. The research aims to assess the construction risks associated with PPP projects, as well as to recommend how best such risks can be mitigated.

This study found that most housing and road projects were contracted using the Build-Operate-Transfer (BOT) model, in which ownership remains with the client, while the developer operates the project to recover investment for a specified period of time. Water supply and railways infrastructure PPP projects have also been executed using BOT model. Other models that have also been applied to currently ongoing projects in Nigeria include Rehabilitate-Lease-Operate-Transfer (RLOT, applied to housing projects), Operate-Maintain-Transfer and Rehabilitate-Operate-Transfer ((OMT, ROT; both were applied to seaport projects) and Supply-Operate-Maintain (SOM, which has been applied to railways infrastructure).

It is concluded that the most important risks associated with PPP projects were: (i) construction cost overrun, (ii) construction time delay, (iii) interest rate fluctuation, (iv) availability of finance, and (v) excessive variation in project specification. By comparison, the risks that were considered to be of lesser importance to PPP projects were: (a) inconsistency in design, (b) poor quality workmanship, and (c) change in tax regulation.

It is also concluded that *'risk reduction'* was the most appropriate risk response for projects carried out under BOT, BOOT and DBOT model, while 'risk retention' was the least appropriate risk response. In order to mitigate the identified risks, 'insurance policy' was considered the best tool for all three PPP models (BOT, BOOT and DBOT). This was in preference to 'contingency plan' and 'contingency sum' as risk mitigation tools. Based on these findings it can be concluded that effective management of PPP Risks would translate into a timely completion of PPP project. Based on the findings and conclusions of this paper, the following recommendations were made:

- The specific circumstances and requirements of each PPP project should be examined in detail, in order to design the most appropriate model for the project. This would forestall situations where the BOT model is applied without discrimination to majority of projects, even where it is apparent that the projects differ widely in almost all respects;
- Clients that might be considering embarking on PPP projects should bear in mind that the following five construction risk factors would require special attention, in order to avoid adverse consequences on the project. The risk factors requiring close scrutiny are (i) Construction Cost Overrun, (ii) Construction Time Delay, (iii) Interest Rate Fluctuation, (iv) Availability of Finance, and (v) Excessive variation in project Specification. The design of the PPP contract should be such that would make adequate provision for the mitigation of these risks, and
- In exploring options for the mitigation of construction risks in PPP projects, clients and developers could consider insurance, contingency plans and contingency sums in descending order of preference.

6 References

Adelusi A.K. (2009). *Assessment of risk and risk management stages in Nigerian Construction Industry.* Unpublished B. Tech degree thesis, Department of Quantity Surveying, Federal University of Technology, Akure, Nigeria.

Annimashaun, A.M. (2011). *Public-Private Partnership as a Policy Strategy of Infrastructure Financing in Nigeria.* Retrieved on 24th Feb, 2013 from *njpg.pactu.edu.np/njpgfiles/4.*

Chohra, M. Shiyu, M. and Hu, C. (2008). PPP Risk Transfer Mechanism in the Specific Project. Case of MAGTAA Desalination Seawater Station in Algeria. Retrieved on January,16, 2012 from *M Chohra, M Shiyu, Cu wbiconpro.com*

Dada, J.O. (2010). Strategies for Mitigating Risk in Construction Projects. *Risk Management in Construction*. *Proceedings of the 40th annual general meeting/conference of the Nigerian Institute of Building*.

Grimsey, D. and Lewis, M.K. (2002). Evaluating the Risks of Public-Private Partnerships for Infrastructure Projects. *International Journal of Project Management,* 20 (2), 107-1

Hillson, D. (2004). *Effective opportunity management for projects–exploiting positive risk*. New York: Marcel Dekker.

Jagboro, G.O. (2007). An evaluation of the impact of risk on project cost overrun in the Nigerian construction industry. *Journal of Financial Management of Property and Construction,* Nigeria, 12, 37 – 44.

KarimiAzar, A, Mousavi, N.S. Farid-Mousavi, S.F., Hosseini, S. (2011). Risk assessment model selection in construction industry. *Journal of Expert Systems with Applications, 38, 9105– 9111*

Meruyn, K.L. (2001). *Risk management in Public Private Partnership*. Discussion paper, Centre for Globalization and Europeanization of the Economy, School of International Business and Enterprise, University of south Austria, Adelaide, South Australia.

Mohammed, I.Y., Bala, K. and Kunya, S.U. (2012). Risk Allocation Preference in Public-Private Partnership Infrastructure Projects in Nigeria, Building Programme. *Journal of Engineering and Applied Science,* Cenresin Publications, Nigeria, 4.

NPPPR (2012). Nigeria Public Private Partnership Review: Where are we? 1(1). Retrieved on April 15, 2012; from www.detailsolicitors.com/media/archive2/.../pppreview.pd

Nur A.A.K. and Batu P.J. (2011). Risk Allocation in Public-Private Partnership (PPP) Project: A review on risk factors. *International Journal of Sustainable Construction Engineering &Technology, 2, (2)*, Retrieved on 13th March, 2013 from http://penerbit.uthm.edu.my/ojs/index.php/IJSCET.

Obi, B. & Ofonyelu, C.C. (2015). Public-Private Partnership (PPP) In Nigeria: A Game Theoretic Conjecture of Low-Level Equilibrium in the Power Industry *Applied Economics and Finance,* 2 (4), Retrieved on 25th September, 2016 from http://aef.redfame.com

Olugbodi, K. (2012). *Assessment of selected public-private partnership projects in the FCT, Abuja*. Unpublished Master of Science Degree thesis. Department of Urban and Regional Planning Faculty of Environmental Design Ahmadu Bello University, Zaria, Nigeria.

Odimabo, O.O. and Oduoza, C.F. (2013). Risk Assessment Framework for Building Construction Projects' in Developing countries. *International Journal of Construction Engineering and Management.* 2(5) 143-154

Patrick, X.W.Z., Shouqing, W. and Dong, F. (2008). A life-cycle risk management framework for PPP infrastructure projects. *Journal of Financial Management of property and Construction.* 13(2), 123-142.

Pauget, B. and Wald, A. (2013). Relational Competence in Complex Temporary Organizations: The Case of a French Hospital Construction Project Network. *International Journal of Project Management,* 31, 200

Ranjan, A. (2010). Successful delivery of public private partnership for infrastructure development. Retrieved on December, 24th 2012; from www.jiit.at.in/upload/Ranjan.

Rostami, A. (2016) Tools and Techniques in Risk Identification: A Research within SMEs in the UK Construction Industry Universal *Journal of Management*, 4(4), 203-210.

Rot, A. (2008) IT Risk Assessment: Quantitative and Qualitative Approach *Proceedings of the World Congress on Engineering and Computer Science* WCECS 2008, October 22 - 24, San Francisco, USA

Rouse, M. (2010). *Essential guide to business continuity and disaster recovery plans. Risk analysis,* Australia: CW Europe.

Thaheem, J. (2012) A review of quantitative analysis techniques for construction project risk management, Creative construction conference, Budapest, Hungary.

Uher, T. (2003). Programming and Scheduling Techniques, Sydney, *UNSW Press.*

UNESCAP (2011). A Guidebook on Public-Private Partnership in Infrastructure. *United Nation Economic and Social Commission for Asia and the Pacific.* Retrieved on 27th December, 2012 from www.unescap.org/ttdw/common/.../PPP/text/ppk.pdf.

U-Dominic, C.M., Ezeabasili A.C.C., Okoro, B.U., Dim, N.U., Chikezie, G.C. (2015). A Review of Public Private Partnership on some Development Projects in Nigeria *International Journal of Application or Innovation in Engineering & Management (IJAIEM),* 4(3), 64-75.