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Public-Private Partnership (PPP), A Veritable Tool for a Sustainable Energy Mix in Subnational and Municipal Public Infrastructure Projects

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Abstract

The aim of this study is to comprehensively investigate the public-private partnership (PPP) model that can be used to fund subnational and municipal public infrastructure projects as well as using it as a veritable tool for a sustainable energy mix in the contemporary socio-political era. Concurrent Triangulation Design (CTD) was used to gather data, analyze and merge final results. The model had phase 1 and 2 comprising of the quantitative and qualitative phases respectively. The four PPP models: Design, Build Finance Operator and Transfer (DBFOT), Operate Maintain and Transfer (OMT), Build Lease Operate and Transfer (BLOT) and Build Operate and Transfer (BOT) selected were analyzed using regression coefficient. A Standard deviation of 0.19508 shows that the Standard Deviation is less than 1, Coefficient of Variation < 1. The low variance recorded showed that DBFOT recorded the highest response showing that DBFOT model as the chosen in the model can be used as a veritable tool for a sustainable energy mix in municipal public private infrastructure project. DBFOT recorded 83.92% of respondents, BLOT had 8.93%,OMT had 5.36% and BOT had 1.79%, of respondents. The established funding model DBFOT in this study will be adequate in constructions of industrial waste facility, operate, maintain and provide a sound financial mechanism for industrial waste project.

1.0.Introduction

Public-private partnership model is a funding model that finances projects. Financing waste to-energy projects with service provided by the private sector entity using the facility for a long term with operations standards [1]. In terms of energy mix, circular economy and energy recycling in Europe looked into municipal solid-waste management and waste to energy issues in terms of public-private partnership. Waste facilities were constructed, and a good financing mechanism was structured [2]. Public-private partnership has revolutionized the world through provision of infrastructure and project management [3]. The development of the urban environment using land property or facilities controlled by public sector and provision of funding by the private sector, have developed the urban environment and improved infrastructures. Public-private partnerships in urban waste water management was investigated using Adelaide experience and lessons for developing countries [4]. A research was done on PPP relationship building and how the romance of public – private partnership can be kept alive to improve infrastructural development and funding mechanisms of industrial projects [5]. China has done a lot in the area of Public – Private Partnership for improving the waste-to-energy incineration industry. The status of waste-to-

energy, the opportunities from waste-to-energy as it impacts the Chinese economy and the challenges of waste-to-energy incineration were critically looked into [6]. The reason for public private partnership, viewing the policy perspective and the prospects of PPP were critically examined by looking into the 'what' and 'why' of PPP policy perspective. Issues of operating services, operating standards and pricing were resolved [7].

1.2. Municipal Public Infrastructural Projects: Public infrastructure procurement practice and challenges as studied by [8], revealed that public infrastructure play a pivotal role in eradicating poverty and development of human capacity, owners were advised to release contract finds early enough for proper execution of projects. The law No. 73/7 of 7th December, 1973 on the preferential claim of the treasury to safeguard public funds by municipal councils should be effectively implemented.

1.3. Gaps of Present Research: Some study examined the matrices of performance for the existing energy resource in terms of a sustainable energy solution for an envisaged energy market. A side from funding, energy is a vital agent in public-private partnership as power drives the industrial sector. This study seeks to investigate the public-private partnership (PPP) model that can be used to fund subnational and municipal public infrastructure projects as well as using it as a veritable tool for a sustainable energy mix in the contemporary socio-political era.

1.4. Energy mix

Energy mix is all direct use of energy in housing, use of energy in industrialization, energy sources from coal, oil, gas, nuclear, hydropower, solar etc. Energy mix of Nigeria is the specific combination of the different sources of energy used to meet her energy consumption needs especially for industrial purposes. Energy consumption needs: Energy used for industry purposes as PPP is a partnership before the public and private sector.

The present energy scenario and future energy mix of Bangladesh and her indigenous fuels, played a major role in electricity generation which led to the diversifiable of existing primary energy mix for ensuring long-term energy security. Bangladesh utilized renewable energy (solar energy) and imports large hydropower from neigbhouring countries through grids in the regions [11].

The study examined the matrices of performance for the existing energy resource. A long term sustainable energy solution in Bangladesh's energy market was envisaged. A side from funding, energy is a vital agent in public-private partnership power drives the industrial sector. Fossil fuels are the main source of energy for generating electricity. Industrial projects need sustainable energy (power) to function effectively. Sustainable energy mix is all renewable energy-hydroelectricity-wind biomass– wave/tidal that are of different energy sources used to meet energy needs in a region (generating power) to generate electricity supply to industries that can be replenished within a lifetime with no damage on the long run, to the planet.

1.5. Public private partnership models

Public-private partnership modes are models of funding public infrastructure project. The main principles of PPP are investing in projects, using main power, materials, budget and knowledge [9]. The private and public partners contribute to the society and do soon a commercial note. PPP are beneficial in a number of usage which are: Risk sharing, completing projects on a timely basis, funding some of the demerits are: limited influence by public sector, models adopted and investigated in this research are: Build Lease Operate Transfer (BLOT)., Design Build, Finance, Lease, Operate and Transfer (DBFLOT) and Operate Maintain and Transfer (OMT) and Build Operate and Transfer (BOT).

1.6. Build Lease Operate and Transfer (BLOT): A public private partnership model Build Lease Operate and Transfer (BLOT) is a model where a private contractor builds, handle the industrial municipal infrastructure project on a leaded public land and operates the facility for the duration of the lease once the lease is complete, and ownership is transferred to the public entity or client. A private organization designs the finance and builds a facility on a leased public land for the duration of the lease and then transfer ownership to the public organization.
BLOT model is transparent in operations and focus on core business of the cheat BLOT is a strategic partnership where a multi-disciplinary team with skill sets come together to operate and transfer. One may transfer the team to one's location and place the workforce on one payroll at the end of the project option 1 for option 2, one may continue with some contract and option 3. The team may be transferred to one's payroll and continue to lease the facility the BLOT model.

1.7. Design Build Finance, Operate and Transfer Model (**DBFOT**) Project delivery scheme involving designing building an infrastructure, operating this structure for a specific time frame and transferring the ownership of the project to the government after specific time frame. It involves a private sector awarded a contract to design, construct, finance, and operate a major project with conditions of agreement with considerations as: The private sector may be paid by the government agency from fees collected from the projects. End users while government retains ownership of the projects. It transfer procurement route is a PPP which involves private finance initiative (PFI). For design, a public body enters into a single contract, construction and full/partial private financing of a public-private facility over a contractual defined term. The main contractor is appointed to design and construct the works as opposed to a traditional contract, where the client appoints consultants to design, and the contractor assigned to construct the works.

1.8. Operate Maintain and Transfer (OMT): Operate maintain and transfer (OMT) model uses a tender process, toll contractors are appointed on an annual basis.
BLOT Build Lease Operate and transfer is a PPP model where a private contractor finances the building of an industrial waste management project on behalf of a public sector partner and thereafter, lease out the project to the client for a predetermined period or lease period.
The client occupies the project and pays rent to the contractor for a minimum term under a lease hold agreement. The level of the rent is generally a function of the total development costs including acquisition of the land, design, constructing and operating cost of the project. The contract transfers the ownership of the project to the client for a price that was agreed on previously. During the lease period, the client handles operations while the contract handles maintenance at the end of the agreement, maintain reverts back to the client.

1.9. Build operate and Transfer (BOT): Build operate transfer is a method of delivering a project for an infrastructure project of a large scale. The public sector gives concession to a private entity to construct, design, finance, own and operate the project as stated in the concession contract.

2.0. Methodology

This survey adopted a survey research design sorted to examine four PPP models namely DBFOT, BLOT, OMT and BOT, and how an established PPP model can be used as a veritable tool for sustainable energy mix in sub-national and municipal public infrastructure project. It made use of both qualitative and quantitative methods using primary data from a three (3) months extensive field investigation through administering of questionnaires, in-depth interviews on focus groups, and use of secondary data from journal articles, books, and internet to explore the research findings.

2.1. Concurrent Triangulation Design

The concurrent triangulation design (CTD) was used to analyze data in this study where both quantitative analysis using closed ended questions structured in a questionnaire survey and qualitative analysis using in-depth interview method with a thematic analysis.

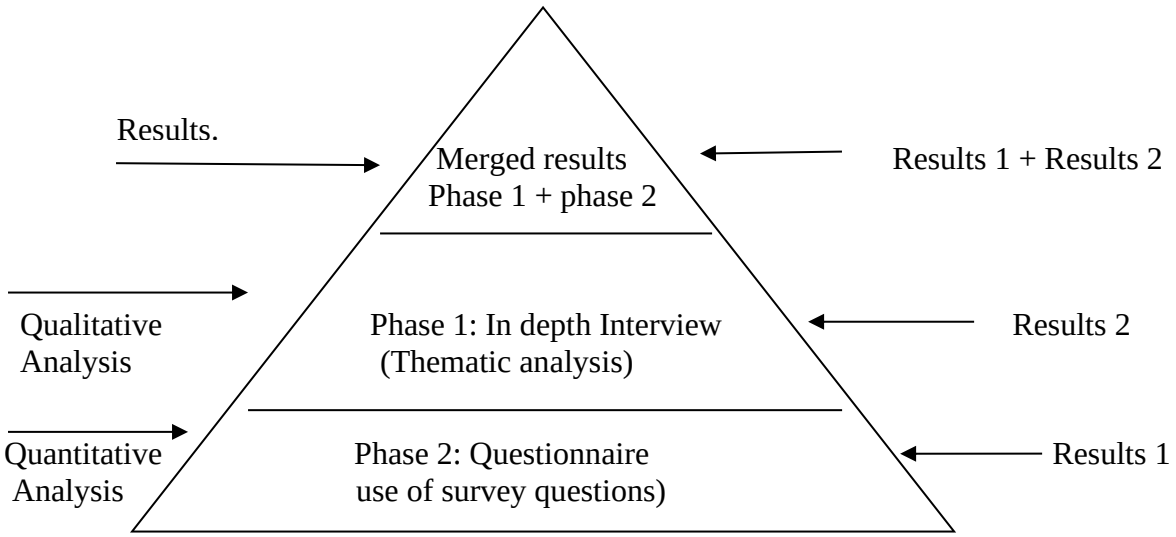

Figure 1: Concurrent Triangulation Design (CTD) source: [7]

A dedicated e-mail address was uploaded with a list of 3000 recipients imported from a CSV file closed ended questions in a questionnaire was distributed.

Phase 1: Quantitative analysis was carried out for a population of 300 respondents. 300 questionnaires were administered; only 260 questionnaires were answered and returned with 40 questionnaires unanswered.

Phase 2: For the qualitative analyses, in-depth interviews were conducted for a sample size of 30 respondents. Only 20 in-depth interviews were recorded and analyzed.

A total of 280 responses were merged, analyzed and recorded. A five point likert scale of strongly Agreed (1), Agreed (2), disagreed (3), strongly disagreed (4) and Undecided (5) were used to check for consistency of respondents on subject matter and validation was carried out. The data collected was in two sections. Section A contained socio-demographic characteristics of the respondents and section B examined the industries in Benin metropolis of Edo State, Nigeria.

3.0 Results

Table 1: Table of questionnaires and in-depth interviews found useable for PPP models. Concurrent triangulation design (CTD) (merged results (R_1 + R_2)

S/N	PPP models	Respondents	%
1.	BLOT	25	8.93
2.	DBFLOT	235	83.92
3.	OMT	15	1.79
4.	BOT	5	1.79

	Total	280	100%

Table 2: Questionnaires (R_1)

S/N	PPP models	Respondents	%
1.	BLOT	24	9.23
2.	DBFLOT	208	80.00
3.	OMT	13	5.00
4.	BOT	5	1.92
	Total	260	100%

Table 3: In-depth Interview (R_2)

S/N	PPP models	Respondents	%
1.	BLOT	1	5
2.	DBFOT	17	85
3.	OMT	2	10
4.	BOT	0	0
	Total	20	100%

Table 4: Section A: Socio-demographic Characteristics of respondents (280 persons)

	Response	Frequency	Percentage
Age as at last birthday	28 – 37	05	1.786%
	38 – 47	166	59.285%
	48 – 57	70	25.000%
	58 – 67	20	7.143%
	Above 68 years	19	6.786
		280	100%
Educational Qualification	OND	10	3.571%
	HND	40	14.285%
	B.SC	200	71.428%
	Masters	10	3.571%
	Ph.D.	20	7.145%
		280	100%
Religious affiliation	Christianity	210	75.00%
	Islam	65	23.210%
	Traditional religion	5	1.790
		280	100%

Field work, 2021

Objective 1: To examine the perceptions of engineers on public – private partnership models in the area of municipal public infrastructure projects.
Objective 2: To determine the PPP model that can be used to achieve a sustainable energy mix for municipal projects.
Section B: Selecting the most appropriate PPP model that will be a veritable tool for sustainable energy mix for municipal public infrastructure project.

Table 5: Perceptions of Engineers on the public – private partnership models

	Responses	Frequency	Percentage
Have you heard of public – private partnership (PPP)	Yes	274	97.86
	No	6	2.14
If yes, what is PPP	A partnership plan for infrastructure development, using private funding	201	71.8

	A partnership plan that encourages innovations utilizes assets and contributes to societal development	40	14.3
	A partnership that involves government and private person working together to deliver infrastructural projects and developing human capacity.	39	13.9
		280	**100%**
PPP models. DBFOT – Design Build Finance, Lease Operate and Transfer BLOT – Build Lease Operate and Transfer BOT – Build Operate Transfer OMT – Operate maintain and transfer	Yes No - -	277 3 - -	98.93 1.07 - -
Have you heard of these models? Which of these models is ideal for industrial development	DBFOT BLOT OMT BOT	225 35 15 5	
		280	**100%**
The DBFOT uses the private finance initiative (PFI). The private sector is highly involved.	Yes No	280 0	100 0
		280	**100%**

In support of the result in Table1, a participant gave her opinion thus: The Design Build Finance, Lease Operate and Transfer PPP model deals strictly with the private sector initiative. It has a time frame, and transfers the ownership of the infrastructure to the government after specific time frame. The main contractor, designs, builds and constructs the project. (In depth Interview word in Florson PVC Industries 20/6/2021).

Another respondent said: consultants do not design the projects and the clients do not appoint consultants to design the project and the private sector involved in the project may be paid by the government agency from monies collected from the project. (In depth interview from worker in Mouka Foam Manufacture Industries, 20/6/2021).

Objective 3: Impact of energy mix on the four PPP to examine the models DBFOT, BLOT, OMT, BOT and on municipal public infrastructure projects.

Table 6: Responses

	Response	Frequency	Percentage
What is energy mix?	Energy mix is all direct use of energy. Combination of different sources of energy to meet energy consumption needs for industrial purposes.	80 200	28.57 71.43
		280	**100%**
Energy mix has impact on the PPP models that later impacts on industrial projects?	Yes No	271 9	96.79 3.21
		280	**100%**
If yes, what are the impact	Industrial projects need sustainable energy to function effectively	11	3.92

	A sustainable energy mix using all renewable energy from different energy sources like solar, wind, tidal etc that can be replenished within a lifetime, has an impact on the function ability of the PPP models and the municipal public infrastructure project.	269	96.07
		280	**100%**

Field work 2021.

Table 7: Types of PPP models available to be used as a veritable tool for a sustainable energy mix in municipal public infrastructure projects.

	Response	Frequency	Percentage
How many types of PPP model do you know?	5 types	56	20
	4 types	96	34
	7 types	100	35
		280	**100%**
What is the type of PPP model that is common in PPP practices in Nigerian infrastructure projects sponsored using PPP?	DBFLOT BLOT OMT BOT	248 12 10 10	88.57 42.9 3.57 3.57
		280	**100%**
Which of these PPP model have been executed and seen to be most function for Nigerian government as regards PPP?	DBFLOT BLOT OMT BOT	199 31 10 10	71.07 11.07 3.57 14.29
		280	**100%**
Do you think that DBFLOT has worked, for all PPP contracts executed in Nigeria for infrastructure development?	Yes No	272 08	97.14 2.86
		280	**100%**
Have you seen project that were executed using the DBFLOT	Yes No	276 04	98.57 1.43
		280	**100%**

Field work 2021.

Table 8: Socio-economic and political impact of PPP models used for infrastructure development

	Response	Frequency	Percentage
The issue of contractors not being paid is a political issue.	Yes	274	97.86
	No	06	2.14
		280	**100%**
	Yes No	211 19 50	75.36 6.79 17.85
		280	**100%**
	Yes No	249 31	88.93 11.07
		280	**100%**
Do you think the government and private sector can always do a lot in the area of PPP?	Yes No	251 29	89.64 10.36
		280	**100%**
What can be done to improve on industrial development as regards building more infrastructures? Which of these PPP	-1. DBFLOT -2. BLOT	110 77	39.29 27.50

model is most preferred?	-3. OMT -4. BOT	93 0	33.21 0
		280	**100%**
Does private partnership impact on government projects?	Yes No	271 19	96.70 3.21
Do you think the private sector should passively invest on government projects?	Yes No	261 19	93.21 6.70
		280	**100%**
Should the private sector initiative transfers ownership of infrastructure to government after time frame?	Yes No	219 61	78.21 21.79
		280	**100%**
Do you think consultants should design project?	Yes No	270 10	96.43 3.57
		280	**100%**
Government should provide a sound financing mechanism for government projects and build sustainability.	Yes No	269 11	96.07 3.93
		280	**100%**

Field work, 2021

3.1. Hypothesis Testing:

Objective 1:

To examine the perception of engineers in the area of municipal public infrastructure projects on public – private partnership model: Design Build Finance Operate and Transfer.

With regards to PPP projects financing, assets, utilization, construction, operations and maintenance of public infrastructure projects. It looked into the area if the model selected helping to attract technical expertise for industrial development. Engineers from their perspectives, showed that PPP models are important parameters and majority of them agreed that PPP models was ideal with positive perceptions.

Objective 2:

To determine the PPP model that can be used to achieve a sustainable energy mix for municipal public infrastructure projects. From results, advocacy have been provided for makers of policy in the area of PPP models selecting and DBFOT model was the PPP model selected by most respondents as the appropriate model to faster sustainable energy mix, boost private finance initiative, government owning projects after executing of projects, the funding will provide.

Objective 3

To examine the impact of energy, mix on the four PPP models: BLOT, DBFOT, OMT, BOT and how each model impacts on municipal public infrastructure projects.

Objective 4

To identify mechanism to ensure that the four PPP models: BLOT, DBFOT, OMT and BOT are used as prompt intervention for assist. Energy mix in sub-national and municipal public infrastructure projects.

3.2 Findings

1. This study has comprehensively enlightened engineers on the subject Public Private Partnership (PPP) Models: BLOT, DBFOT, OMT and BOT, with regards to financing, assets utilization, operations and maintenance of public infrastructures.
2. Examinations of the perception of engineers in the area of municipal public infrastructure projects on public – private partnership model: Design Build Finance Operate and Transfer were carried out.
3. The PPP model that can be used to achieve a sustainable energy mix for municipal public infrastructure projects was determined. From results, advocacy have been provided for makers of policy in the area of PPP models selection. DBFOT model was the PPP model selected by most respondents as the appropriate model to foster sustainable energy mix and boost private finance initiative.
4. Examination of the impact of energy mix on the four PPP models: BLOT, DBFOT, OMT, BOT and how each model impacts on municipal public infrastructure projects have been carried out. Mechanism to ensure that the four PPP models: BLOT, DBFOT, OMT and BOT are used as prompt intervention for energy mix in sub-national and municipal public infrastructure projects have been identified.

4.0 Conclusion

The perceptions of engineers on public – private partnership models in the area of municipal public infrastructure projects were examined. The PPP model that can be used to achieve a sustainable energy mix for municipal projects have been determined. The impact of energy mix on the four PPP models: BLOT, DBFOT, OMT, BOT and how each model impacts on municipal public infrastructure projects has been examined. The mechanism to ensure that DBFOT, BLOT, OMT and BOT are used as prompt interventions for a sustainable energy mix in a sub-national and municipal public infrastructure project has been identified. The mechanisms are: Planning, outlining the business case, publication of tender notice, prequalification of bidders, shortlisting bidders, negotiation, receipt of bid, issue of bid as regards best offer and final offer and invitation to tender. The most appropriate PPP model that will be a veritable tool for sustainable energy mix for municipal public infrastructure project has been selected to be the Design, Build, Finance, Operate and Transfer (DBFOT) Model as it impacts on energy positively. This model will be able to deliver improved services and produce better value for money by encouraging innovation, greatest asset utilization and integrated white whole-of-life management.

Conflict of interest

There is no conflict of interest.

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