Evaluating the factors that influence public sector involvement in Ghanaian public-private partnership (PPP) power projects

Augustine Senanu Komla Kukah, De-Graft Owusu-Manu and Edward Badu
Department of Construction Technology and Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

David John Edwards
Department of the Built Environment, Birmingham City University, Birmingham, UK and Faculty of Engineering and the Built Environment, University of Johannesburg – Doornfontein Campus, Doornfontein, South Africa

Eric Asamoah
Department of Statistics and Actuarial Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Andrew Anafo
Department of Building Technology, Bolgatanga Technical University, Bolgatanga, Ghana

Dominic Kuutiero
Directorate of Works and Physical Development, University of Education Winneba, Winneba, Ghana, and

Richmond Makafui Kofi Kukah
Department of Computer Science, University of Ghana, Accra, Ghana

Received 5 September 2022
Revised 29 November 2022
Accepted 24 April 2023

Abstract

Purpose – In comparison to other countries, power generation in Sub-Sahara Africa is poor. Public–private partnership (PPP) model has become increasingly popular for addressing infrastructural challenges, especially in the power sector. The purpose of this study is to evaluate and classify the factors that influence public sector involvement in Ghanaian PPP power projects.

Design/methodology/approach – Using purposive and snowball sampling techniques, questionnaires were used to gather responses from experts in the PPP power sector in a two round Delphi survey. Analytical tools adopted were descriptive statistics, mean score ranking, Cronbach's alpha and factor analysis.

Findings – The most significant factors that influence public sector involvement in PPP power projects were: achieving improved value for money; access to additional capital; increased certainty of projects; greater efficiency of project delivery services; and improved ability to deliver new infrastructure. From factor analysis, the four components were: value for money and efficiency; capital and skills; innovation and technology; and project delivery.

Journal of Facilities Management
© Emerald Publishing Limited
1472-5967
DOI 10.1108/JFM-09-2022-0100

Originality/value – Government bodies in the power sector will benefit from the findings, as it would aid them develop policies that would strengthen regulatory structures as well as institutions.

Keywords Factors, Influence, Public sector, PPP, Power projects, Ghana

Paper type Research paper

1. Introduction

In contrast with other economies, power generation in Sub-Sahara Africa is poor (Kemausuor and Ackom, 2017; Seidu *et al.*, 2022). For their respective populations of 260 million and 33 million people, the USA and Canada produce 500,000 and 111,000 MW (Oriakhi and Okoh, 2007). Similarly, the UK, South Africa and Argentina, with populations of 60 million, 45 million and 32 million people, produce 43,000, 23,000 and 9,500 MW, respectively (Oriakhi and Okoh, 2007). Ghana, on the other hand, produces 3,877.4 MW (peak generation) and 3,160.9 MW (off-peak generation) for a population of approximately 25 million people (Boateng, 2014).

Industrial development, petroleum upstream and midstream operations, mining, energy conservation and improvement initiatives, as well as the current electrification scheme, are all potential drivers of electricity consumption, according to Ghana's Energy Commission (Energy Commission, 2018). The rapid growth of Accra, Tema, Takoradi and Kumasi, the four major cities in Ghana, has also fuelled residential electricity demand (Eduful, 2019). The population of Ghana is expected to grow from 25 million people in 2010 to about 40 million people by 2030 (Eduful, 2019). As of 2010, the electricity demand of Ghana surpassed 2 million residential customers and 1150 industrial customers. The peak demand for electricity in 2014 rose from 1,943 MW in 2012 to 2,061 MW in 2014. Ghana needs a generation capacity of between 16,398 and 17,350 GWh, depending on the rate of increase in peak power demand. To meet the current demand, an increase in capacity of 4,000–4,200 MW is needed.

In the past few years, the public–private partnership (PPP) model has become increasingly popular in the infrastructure projects of developing countries, especially in the power sector (Ameyaw and Alfen, 2017; Akomea-Frimpong *et al.*, 2021). PPPs are partnerships in which the public and private sectors each contribute complementary capabilities to a project, with varying degrees of responsibilities and accountability, to deliver public services or projects (Efficiency Unit, 2008). Ghana's PPP sector for infrastructure construction and operation has increased in recent years (Owusu-Manu *et al.*, 2018a).

The influencing factors for engaging in PPPs are varied within different nations. Predominantly in developed countries, there is a tendency to reduce public and increase private expenditure. Developing countries, on the other hand, centre less on upgrading policies (Vining and Boardman, 2008). More significant is the production of necessary facilities for financial enhancement, particularly in countries which have exceeding population expansion. There are considerable infrastructure spending needs, especially in Africa (Dewatripont and Legros, 2005). Nonetheless, because of the rigid budget limitations which several developing countries have faced in recent years, the greater part of these nations are not able to have the funds for the needed capital for infrastructure (Vining and Boardman, 2008).

There have been some past studies on the influencing factors for engaging in PPP projects. A study by Owusu-Manu and Kukah (2017) evaluated the motivation factors of public and private sectors engaging in PPP construction projects. Furthermore, a study by Debela (2021) researched the driving factors for adopting PPP in Ethiopia. In addition,

Chan *et al.* (2009) investigated the privileges and attractions for private sector involvement in PPP projects. However, very little research currently exists in the power sector. In Ghanaian setting too, there is currently no study that explores the influencing factors for public sector being involved in PPP power projects. This study seeks to fill this gap. Based on this premise, the aim of this study is to evaluate the factors that influence public sector involvement in Ghanaian PPP power projects. This research has significant implications. Academia would be a beneficiary, as the findings would serve as a major contribution to knowledge. Practically, the influencing factors can be incorporated by the government when PPP policy guidelines and laws are reviewed.

2. Literature review

2.1 Public–private partnerships

PPPs are not a recent happening, in view of the fact that there are examples dating back several years ago (Wettenhall, 2010; Liu *et al.*, 2020; Owusu-Manu *et al.*, 2020). The contemporary inclination of governments signing agreements with private bodies to make available services, nonetheless, officially started around the year 1992 in the UK once the government had the desire of using private financial support as an alternative for state-owned investment.

2.1.1 Contracting-out. This is a contract between the government and a private company in which the private company is in charge of delivering products and services on behalf of the government and the government or individual consumers are in charge of paying for the services (user charges). The facility's ownership remains public in most contracting-out situations, but administration or management, or both, is outsourced to a private firm (Kukah *et al.*, 2022e). In a management contract, the contracted firm's duty becomes that of managing the facility's daily operations and making strategic decisions to accomplish the organisation's goals (Owusu-Manu *et al.*, 2020). A collaboration between the government-owned water service and Aqua Vitens Rand Limited in Ghana is one example. In 2005, the Ghana Water Company Limited hired Aqua Vitens Rand Limited to run its operations for a five-year period, with the goal of enhancing the company's performance, particularly in the area of efficient water supply. The Ghana Water Company Limited delegated essential managerial responsibilities to Aqua Vitens Rand Limited while maintaining its employees. However, because the contractual company's performance was deemed inadequate, the contract was not extended beyond the five-year period, and operations were returned to the Ghana Water Company Limited (Abubakari *et al.*, 2013).

2.1.2 Privatisation. "A transfer of possession and control from the public to the private sector, with a concentration on asset sale", according to the definition of Owusu-Manu *et al.* (2018a). When a company gets privatised, it receives ownership of the company as well as responsibility for providing market-based services. Because of their perceived socio-economic relevance, regulatory agencies are frequently established to regulate the operations of private enterprises providing such services.

2.2 Factors that influence public sector involvement in public–private partnership power projects

From past literature, the lack of public funds is the most significant factor that influences involvement in PPPs. Conversely, the preliminary arrangements are very diverse. In developed countries, the intent is to increase the pool of current advanced infrastructure (Dewatripont and Legros, 2005; Akomea-Frimpong *et al.*, 2022). PPP model has drawn a lot of people's attention on how to effectively fix the problem of public utility funding shortages in urban growth, as well as increase the pace at which these industries have developed

(Osei-Kyei and Chan, 2017; Ahenkan, 2019; Akomea-Frimpong *et al.*, 2021). PPPs, according to Sen (2014), are entered in the power sector so as to minimise budget commitments, attract foreign investment, build new infrastructure and provide high-quality public services when well-planned (Kukah, 2017; Odonkor and Adom, 2020).

Risk-reduction is another influencing factor for government partaking in a PPP. The public sector partners no longer put up with the monetary risk associated with handling costs of construction, costs of maintenance and revenues (Owusu-Manu and Kukah, 2017; Adinyira *et al.*, 2020). There is the likelihood of the private stakeholder possessing much knowledge with compound monetary arrangements and improved availability to markets which offer effective allocation of risk. A further factor is the fact that private partners encounter reduced political risk as compared to governments. Nevertheless, as PPPs do not decrease the actual risk, but rather spreads and transfers risk more generally, Vining and Boardman (2008) explain this rationalisation for partaking in PPPs as not being convincing enough.

According to a recent McKinsey analysis, by 2040, more than $490bn in new power generating capacity will be required to meet projected demand (Castellano *et al.*, 2015). As a result, existing investment levels are essentially below what is required, requiring expanded private sector engagement (Eberhard and Shkaratan, 2012). Africa's primary source of private investment in the electrical industry is independent power plants or independent power producers (Eberhard and Gratwick, 2013).

Vining and Boardman (2008) explain the reasons why PPP is the most cost-effective way to deliver services and infrastructure. Firstly, private partners have more specialties and are experienced in building and managing of several trades and, consequently, better savings attained (Kukah *et al.*, 2022a). Private partners may be universal functioning ventures, whereas public sector usually has lesser experience and proficiency needed to undertake an infrastructural job (Owusu-Manu and Kukah, 2017). A further rationale for the private sector's cost effectiveness is because the private stakeholder possesses more incentive to reduce the costs (Kukah *et al.*, 2022c). These enticements and incentives are prone to turn out to be most obvious in much enthusiasm to modify job specifications and to use modern technologies so as to lower costs (Dewatripont and Legros, 2005).

A further motivation for the public sector to engage in PPP power projects is the control for corruption and degree of political competition (Kukah *et al.*, 2022e; Kukah *et al.*, 2022f). These factors largely influence investors' intentions to enter various power sector markets, not their eventual levels of investment, implying that investors are sufficiently safeguarded against risks (contract design is important) (Eberhard and Shkaratan, 2012).

Risk mitigation is another influencing factor for public sector involvement in Ghanaian PPP power projects. The financial viability of the off-taker – in this case, the national utility – as well as the consistency of income flows are central to the investment problem (Asumadu *et al.*, 2022). Many utilities in Africa are inefficient and have poor credit ratings (Eberhard and Shkaratan, 2012; Babon-Ayeng *et al.*, 2022). In Sub-Saharan Africa, average distribution losses are 23%, compared to a generally accepted norm of 10% or less in wealthy countries. In addition, average collection rates are only 88.4%, compared to 100% in the best practice. The inefficiency of a utility is measured by the cost of distribution losses and uncollected revenue as a percentage of utility turnover. In Africa, on average, this productivity accounts for 50% of total turnover (Eberhard *et al.*, 2011).

3. Methodology

Epistemologically, this study adopted positivist tradition. Positivist allows the possibility of establishing the study relating to the theory and literature. This makes it possible for the

study to be repeated with ease if need be (Bryman, 2004). Ontologically, this research chose realist position. This study adopted the deductive research approach. Deductive approach is made up of developing theories which have been subjected to robust tests. This approach allows phenomena to be anticipated and predicted. Deductive approach was further adopted, as it aids in identifying facts and the causal relationships between variables to test hypotheses and reach conclusions. The research strategy adopted was quantitative. Quantitative strategy involved the use of questionnaires to gather data from stakeholders in the PPP power sector in Ghana. Quantitative approach places emphasis on measurement and quantification. The Likert scale rating approach was adopted for the questionnaires. The scale ranged from 1 to 7. This rendered the results ordinal, thereby making it appropriate for different statistical analyses. The questionnaire was divided into two parts. In section 1, respondents were asked questions on their demographic background, including the category they belong to, their profession, how long they have been employed in their organisation, level of experience in PPP projects and number of PPP projects involved in. In section 2, respondents were asked to rank the factors that influence public sector involvement in PPP power projects. The scale used was: 1 = Not significant at all; 2 = Least significant; 3 = Lowly significant; 4 = Moderately significant; 5 = Significant; 6 = Highly significant; and 7 = Extremely very significant.

Because of the nature of the fragmented nature of the responses, the exact population was undefined. Subsequently, non-probability sampling techniques were used in deriving the sample size. Purposive sampling and snowball sampling were the sampling techniques for this study in terms of its nature, intent and practical inference on this research subject. The population was made up of respondents who are knowledgeable in the power sector and have experience in PPP power projects. The respondents targeted were in senior positions (directors, managing directors and management members) in their respective organisations. Their rich background and expertise guaranteed reliable feedback on this study. Respondents were chosen from Electricity Company of Ghana, the main provider of urban power supply in Ghana; Public Utilities Regulatory Commission, the economic control centre for electricity; Energy Commission, regulator and manager of energy resources; Volta River Authority, main generator of electricity; PPP Consulting Unit, Public Procurement Authority, in charge of public procurement; and the private sector (Independent Power Producing firms). Using purposive sampling, respondents who were knowledgeable in the power sector and had considerable experience in PPP power projects were reached out to. The inclusion criteria for selecting the study respondents were that they should have at least three years of PPP working experience and should have been involved in at least one PPP power project. Using snowball sampling, the respondents were asked to recommend other respondents who are knowledgeable in the subject area. Efforts were made to ensure adequate representation of private and public institutions.

A two-round Delphi approach was adopted in collecting data. Schmidt (1997) explains that having too many rounds would waste the time of panellists. Based on these and looking at past similar studies, a two-round Delphi survey was preferred for this study. A sample size of 60 respondents was obtained. Questionnaires were sent to the email addresses of the study respondents and reminders sent periodically every one week. After a period of four weeks, 48 responses were obtained, representing a response rate of 80% for the first round of Delphi. For the second round of Delphi survey, all 48 respondents agreed to take part. After two weeks, all 48 responses were received from the respondents who partook in the second round of the study. Descriptive statistics and mean score ranking were the main analytical tools adopted using Statistical Package for Social Sciences software. Furthermore,

factor analysis using principal component analysis (PCA) was conducted to group the influencing factors into components.

4. Results and discussion

4.1 Demographic background of study respondents

Study respondents were asked to indicate their profession. Two respondents representing 4.2% are project directors. Nine respondents representing 18.8% are project managers. Six respondents representing 12.5% are staff of Public Procurement Authority. Five respondents representing 10.4% are staff of PPP Advisory unit. Ten respondents representing 20.8% are lecturers. The remaining 16 respondents representing 33.3% have other professions.

Study respondents were further asked to indicate their total number of years in employment. Three respondents representing 6.3% have less than five years of experience. In all, 14 respondents representing 29.2% have less than 5–10 years of experience. Six respondents representing 12.4% have less than 11–15 years of experience. In all, 14 respondents representing 29.2% have 16–20 years of experience. The remaining 11 respondents representing 22.9% have above 20 years of experience.

The next question sought to know from the respondents their number of years working in their current position. Three respondents representing 6.3% have been working for 1–3 years. Seven respondents representing 14.6% have been working for 4–7 years. In all, 21 respondents representing 43.8% have been working for 8–10 years. The remaining 17 respondents representing 35.4% have been working for above 10 years.

The last question sought to know from the respondents their number of years associated with PPP power projects either through practice or academia. This was an open-ended question where the respondents were required to indicate the specific years. Of the 48 respondents, the one with the least number of years indicated 3 years, while the respondent with the greatest number of years indicated 15 years. The mean/average years of PPP experience was 7.432 years. Standard deviation was 3.507. Skewness was 0.007, while kurtosis was −1.408. The data was normally distributed.

4.2 Reliability statistics

Internal consistency analysis of responses received from respondents on the factors that influence public sector involvement in PPP power projects revealed Cronbach's alpha coefficient value of 0.876. According to Tavakol and Dennick (2011), Cronbach's alpha coefficient values that range from 0.800 to 0.900 are ideal for research studies. The implication for this study is that the internal consistency was high. Table 1 below shows the reliability statistics of responses for this study.

4.3 Factors that influence public sector involvement in public–private partnership power projects

This section sought to ascertain from the study respondents the factors that influence public sector involvement in PPP power projects. Respondents were to rank the 17 reasons on a scale of 1–7 with 1 being the least significant and 7 being most significant. From Table 2, *Achieving improved Value for Money (VfM)* ranked first with a mean score of 5.49, standard

Table 1. Reliability statistics

No. of items	Cronbach's alpha
20	0.876

Table 2. Factors that influence public sector involvement in public–private partnership power projects

Variables	Code	Round 1 Mean	SD	SK	KT	Rank	Round 2 Mean	SD	SK	KT	Rank
Achieving improved value for money (VfM)	PSI3	5.31	1.206	−0.668	0.404	3	5.49	1.27	−0.975	1.184	1
Access to additional capital	PSI 7	5.45	1.225	−0.969	0.665	1	5.38	1.367	−1.101	1.468	2
Increased certainty of projects	PSI 9	5.3	1.533	−0.835	0.005	4	5.35	1.452	−0.796	0.067	3
Greater efficiency of project delivery services	PSI 2	5.34	1.17	−0.791	0.718	2	5.28	1.255	−0.916	0.895	4
Improved ability to deliver new infrastructure	PSI 1	5.17	1.285	−0.652	0.037	5	5.25	1.314	−0.966	1.03	5
Faster delivery time of construction projects	PSI 4	5.11	1.179	−0.819	1.296	7	5.18	1.238	−0.427	−0.149	6
Off-balance sheet financing	PSI 11	5.08	1.392	−0.898	0.498	8	5.18	1.266	−0.786	0.845	7
Minimisation of whole life cycle costs	PSI 8	5.12	1.359	−0.822	0.418	6	5.16	1.325	−0.836	0.515	8
Lesser experience and expertise in project	PSI 10	5.07	1.41	−0.783	0.285	9	5.07	1.224	−0.708	0.405	9
Enhances government integrated solution capacity	PSI 15	4.93	1.555	−0.734	−0.226	12	5.05	1.359	−0.511	−0.306	10
Use of innovative materials and technologies	PSI 5	5.05	1.379	−0.713	0.107	10	4.97	1.421	−0.709	0.089	11
Enhances technology transfer	PSI 16	4.74	1.596	−0.651	−0.533	17	4.97	1.471	−0.616	−0.356	12
Improves public infrastructure management and maintenance	PSI 14	4.82	1.462	−0.764	0.11	13	4.95	1.287	−0.577	0.152	13
Reduction of public expenditures	PSI 6	4.95	1.432	−0.904	0.348	11	4.93	1.434	−0.682	−0.02	14
Access to broader base of investors	PSI 12	4.76	1.505	−0.625	−0.333	16	4.92	1.343	−0.79	−0.059	15
Reduction in risks	PSI 13	4.81	1.444	−0.776	−0.052	14	4.89	1.204	−0.82	0.523	16
Reduced public money tied up in capital investment	PSI 17	4.78	1.577	−0.617	−0.342	15	4.82	1.393	−0.43	−0.336	17
Improved operational efficiency	PSI 20	4.75	1.005	−0.598	−0.128	19	4.80	1.069	−0.654	−0.291	18
Consistent delivery of power projects	PSI 19	4.76	1.112	−0.752	−0.342	18	4.77	1.152	−0.995	−0.311	19
Transfer of skills to state enterprises	PSI 18	4.62	1.231	−0.813	−0.291	20	4.68	1.318	−0.763	−0.287	20

Notes: SD = Standard deviation; SK = Skewness; and KT = Kurtosis
Source: Authors' own creation

deviation of 1.27, skewness of −0.975 and kurtosis of 1.184. *Access to additional capital* ranked second with a mean score of 5.38, standard deviation of 1.367, skewness of −1.101 and kurtosis of 1.468. *Increased certainty of projects* ranked third with a mean score of 5.35, standard deviation of 1.452, skewness of −0.796 and kurtosis of 0.067. *Greater efficiency of project delivery services* ranked fourth with a mean score of 5.28, standard deviation of 1.255, skewness of −0.916 and kurtosis of 0.895. *Improved ability to deliver new infrastructure* ranked fifth with a mean score of 5.25, standard deviation of 1.314, skewness of −0.966 and kurtosis of 1.03.

4.4 Factor analysis for factors that influence public sector involvement in public–private partnership power projects

4.4.1 Initial considerations. From Table 3, it is evident the data obtained from the field survey is adequate to proceed with factor analysis. Data had 48 observations per variable with the Kaiser–Meyer–Olkin value being 0.811 which exceeds the cut-off value of 0.500. Bartlett's measure is for testing the null hypothesis that the original correlation matrix represents an identity matrix. For factor analysis to proceed, the relationship between the variables is required, and if R-matrix is identity matrix, then it implies all correlation coefficients will be zero. The target is then to achieve a significant test (with significance value below 0.05). Significant test implies that R-matrix is not an identity matrix, and hence, there exist relationships among the variables which should be present in the analyses.

A closer look at Table 3 shows that Bartlett's test was highly significant and, therefore, recommended for factor analysis to proceed. This matrix determinant is useful in checking for singularity or multicollinearity. Determinant of the R-matrix should ideally be higher than 0.00001. According to Field (2005), if it is lower than the value, then variables which are highly correlating should not be added during the analysis. However, there were no two variables that correlated very highly. Field (2005) further opines that mild collinearity does not pose as a problem for factor analysis, and therefore, it was concluded that the data was adequate for factor analysis to proceed.

After the preliminary tests of survey instrument, reliability, adequacy of survey size and population matrix were adequate, factor analysis on the data set proceeded using the PCA method using varimax rotation. Before the principal component analysis, communalities inherent were first established. Communalities explain how much variance in variables is accounted for in factors that have been extracted. Communalities are important in determining the factors that should be finally extracted (Owusu-Manu *et al.*, 2020). Cattel scree test and Guttman–Kaiser rule are also useful for checking number of factors that have to be extracted. Guttman–Kaiser rule explains that only the factors that have eigenvalue of 1 and above should be retained. Cattel scree test also explains that subsequent components after the one which starts the elbow should not be added. Based on these tests, four components were extracted for this study.

4.4.2 Variance of components. Table 4 explains the total variance of each component. The variances are explained below: the first principal component (Component 1) contributed

Table 3. Kaiser–Meyer–Olkin and Bartlett's test

Kaiser–Meyer–Olkin measure of sampling adequacy	0.811
Bartlett's test of sphericity	
Approximately Chi-Square	205.927
df	198
Significance	0.000

Factors	Component 1	2	3	4
Achieving improved value for money (VfM)	*0.394*	−0.047	−0.067	−0.048
Access to additional capital	0.059	*0.582*	0.216	−0.063
Increased certainty of projects	−0.510	*0.476*	−0.465	0.228
Greater efficiency of project delivery services	−0.062	0.090	0.069	*0.722*
Improved ability to deliver new infrastructure	0.311	−0.096	0.212	*0.534*
Faster delivery time of construction projects	0.201	−0.098	*0.516*	−0.059
Off-balance sheet financing	−0.010	*0.560*	−0.106	0.002
Minimisation of whole life cycle costs	−0.009	−0.071	*0.662*	0.325
Lesser experience and expertise in project	−0.092	*0.562*	0.213	−0.093
Enhances government integrated solution capacity	*0.506*	−0.469	0.512	−0.210
Use of innovative materials and technologies	0.003	0.061	*0.703*	0.089
Enhances technology transfer	−0.027	−0.082	*0.511*	−0.092
Improves public infrastructure management and maintenance	−0.006	*0.729*	−0.058	0.027
Reduction of public expenditures	0.356	0.205	−0.090	*0.723*
Access to broader base of investors	*0.608*	0.159	−0.216	−0.003
Reduction in risks	0.006	−0.213	−0.051	0.021
Reduced public money tied up in capital investment	0.214	−0.021	*0.678*	−0.051
Improved operational efficiency	*0.544*	−0.012	−0.015	−0.036
Consistent delivery of power projects	*0.411*	0.098	0.312	0.008
Transfer of skills to state enterprises	0.002	*0.838*	−0.025	−0.089

Notes: Extraction method: PCA; Rotation method: Varimax with Kaiser normalisation; and [a]Rotation converged in 17 iterations
Source: Authors' own creation

Table 4. Rotated component matrixa

18.217% of the total variance and the next principal component (Component 2) contributed 15.253%. Furthermore, the third principal component (Component 3) accounted for 12.711% of the total variance, while the last component (Component 4) contributed 10.214%. In summation, all the four components extracted had an accumulative contribution of 56.395% of the variation in the data. This fulfils the cumulative proportion of variance criterion that states that extracted components altogether must explain at least 50% in variance.

4.5 Discussion

4.5.1 Component 1 (value for money and efficiency). The first component is made up of the factors: *Achieving improved VfM; Enhances government integrated solution capacity; Access to broader base of investors; Improved operational efficiency*; and *Faster delivery of power projects*. It is remarkable that these influencing factors have been loaded together under the same component. Observing the relationship among these variables in this component, it has been named "Value for money and efficiency" factor. This component extracted contributed 18.217% to the total variance. It is understandable that this component has been weighted highly because the study respondents deemed them to be the most critical influencing factors for public sector participation in PPP power projects.

Achieving improved VFM with eigenvalue of 0.860 was deemed significant. In a study by Owusu-Manu and Kukah (2017), VFM ranked as a significant factor. All the factors which affect procurement process are required to achieve VfM. These include the risks, costs, benefits and ensuring project requirements will be attained (Ismail, 2012; Adinyira *et al.*, 2020; Asumadu *et al.*, 2022).

Enhances government integrated solution capacity had eigenvalue of 0.622 and is also a significant factor. Both the public and private sectors are concerned with projects that are economically realistic and which would bring to bear the right project identification (Yu *et al.*, 2018).

Access to broader base of investors had eigenvalue of 0.819. Private partners may be universal functioning ventures, whereas public sector usually has lesser experience and proficiency needed by the job (Owusu-Manu and Kukah, 2017).

Improved operational efficiency had eigenvalue of 0.422. In addition, average collection rates are only 88.4%, compared to 100% in the best practice. The inefficiency of a utility is measured by the cost of distribution losses and uncollected revenue as a percentage of utility turnover. In Africa, on average, this productivity accounts for 50% of total turnover (Eberhard *et al.*, 2011).

Consistent delivery of power projects had eigenvalue of 0.422. This is essential in ensuring reliable and improved quality in the manner public sector takes decisions regarding the developing, finance, construction and operating of PPPs (Yu *et al.*, 2018; Akomea-Frimpong *et al.*, 2022).

4.5.2 Component 2 (capital and skills). Component 2 is made up of the following factors: *Access to additional capital; Increased certainty of projects; Off-balance sheet financing; Lesser experience and expertise in project; Improves public infrastructure management and maintenance*; and *Transfer of skills to state enterprises*. It has been named as "Capital and skills" factor. This extracted component accounted for 15.253% in total variance.

Access to additional capital had eigenvalue of 0.623. Private partners have more specialties and are experienced in building and managing of several trades and, consequently, better savings attained (Kukah *et al.*, 2022c).

Increased certainty of projects had eigenvalue of 0.591. When a realistic assessment is conducted, private investors anticipate realistic support from the public sector to boost the relationship (Regan, 2012).

Off-balance sheet financing had eigenvalue of 0.468. The financial viability of the off-taker – in this case, the national utility – as well as the consistency of income flows are central to the investment problem decisions in PPP power projects. Many utilities in Africa are inefficient and have poor credit ratings (Eberhard and Shkaratan, 2012). In Sub-Saharan Africa, average distribution losses are 23%, compared to a generally accepted norm of 10% or less in wealthy countries.

Lesser experience and expertise in project had eigenvalue of 0.562. Private partners may be universal functioning ventures, whereas the public sector usually has lesser experience and proficiency needed by the job (Liu *et al.*, 2020). Comparing this with past literature, a study by Eberhard and Gratwick (2013) indicated that most governments in Sub-Saharan Africa lack adequate planning capacity for their power projects and rely on consultants and private bodies to perform this duty. This ultimately serves as an influencing factor for the public sector engaging in PPP.

Improves public infrastructure management and maintenance had eigenvalue of 0.715. Government provides conducive environment by providing guarantee against risks like inflation, foreign exchange, equity participation, exclusive competition, etc. (Adinyira *et al.*, 2020; Ackah *et al.*, 2021).

Transfer of skills to state enterprises had eigenvalue of 0.481. This is attained through right project identification, as it is important in ensuring a project is worth its investment and also checking how doable it is (Kukah *et al.*, 2022b).

4.5.3 Component 3 (innovation and technology). The factors of the third component were: *Faster delivery time of construction projects; Minimisation of whole life cycle costs; Use*

of innovative materials and technologies; Enhances technology transfer; and *Reduced public money tied up in capital investment*. This extracted component made up 12.711% of the total variance. It was named "innovation and technology" factor.

Faster delivery time of construction projects had eigenvalue of 0.622. When the concerns of the various parties entering into the agreement are considered and deliberated upon at the onset of the project, it leads to project success and faster delivery times (Yu *et al.*, 2018).

Minimisation of whole life cycle costs had eigenvalue of 0.531. Profitability analyses must be conducted at the early stages of PPP power projects (Yu *et al.*, 2018). This is important in ascertaining the debt paying ability of the project and attainment of whole life cycle costs.

Use of innovative materials and technologies had eigenvalue of 0.619. Another influencing factor apart from government's source of funding is specific competence owned by the private sector coming into the PPP power project. Vining and Boardman (2008) explain the motives why services and infrastructure could be offered more cost effectively, by way of PPP.

Enhances technology transfer had eigenvalue of 0.538. Trust and communication coupled with technology transfer by both parties leads to more satisfying outcomes, minimised costs, reduced disputes and affordable power tariffs leading to project success and eventual profitability (Abdel Aziz, 2007).

Reduced public money tied up in capital investment had eigenvalue of 0.762. Consumers must be able to afford tariffs that are cost reflective and which would cover for operation and maintenance costs so that debts used to finance the projects can be paid back and the parties still making a good level of profits (Ackah *et al.*, 2021; Kukah *et al.*, 2022d).

4.5.4 Component 4 (project delivery). The fourth and last component had the following factors: *Greater efficiency of project delivery services; Improved ability to deliver new infrastructure;* and *Reduction of public expenditures*. It was named "Project delivery" factors. This extracted component accounted for 10.214% in the total variance.

Greater efficiency of project delivery services had eigenvalue of 0.639. Shared authority and shared risks must be assessed by way of its impact on the parties in the contract as well as the final consumers of power (Abdel Aziz, 2007). This is essential, as construction projects in general are associated with great risks (Agyekum *et al.*, 2021; Agyekum *et al.*, 2022a; Agyekum *et al.*, 2022b).

Improved ability to deliver new infrastructure had eigenvalue of 0.791. Another rationale for the private sector's cost effectiveness is because the private stakeholder possesses more incentive to reduce the costs (Blay *et al.*, 2021). All these serve as motivations for the public sector to engage in PPP power projects.

Reduction of public expenditures had eigenvalue of 0.514. Most PPP power projects are funded by the private sector by way of donors and development partners (Ameyaw and Chan, 2013; Blay *et al.*, 2022). Government's financial contribution has mostly been on the lower side.

5. Conclusions

The most significant factors that influence public sector involvement in PPP power projects were: achieving improved VfM; access to additional capital; increased certainty of projects; greater efficiency of project delivery services; and improved ability to deliver new infrastructure. Factor analysis grouped the influencing factors into four components. These components were: VfM and efficiency; capital and skills; innovation and technology; and project delivery.

The research has a number of all-encompassing implications. Policy wise, the significant influencing factors for the public sector identified can be incorporated when PPP policy guidelines and laws are reviewed. This will aid in the effective implementation of PPP for

power projects in Ghana. The government bodies in the power sector will also benefit from the findings, as it would aid them to develop policies that would strengthen regulatory structures as well as institutions. This study is beneficial to academia, as it increases knowledge on PPP practice especially on the influencing factors for engaging in PPP power projects. Theoretically, this research constitutes a detailed and generic evaluation of the influencing factors for public sector involvement in Ghanaian PPP power projects. Furthermore, from a theoretical lens, this Delphi study contributes to the checklist of factors that influence governments/public sector bodies into engaging in power projects, and this study, therefore, contributes to deepening understanding of PPP practice and research. Though this study was limited to it being undertaken in Ghana, the agreement of the findings with literature lends credence in the findings. The findings can also be generalised for developing countries with similar power sector like Ghana.

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Corresponding author

Augustine Senanu Komla Kukah can be contacted at: ugustinekukah@gmail.com