The impact of project risk factors on national competitive tendering procurement method in Ghana

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Abstract: The study determined the extent of occurrence and assessed the impact of project risk factors on the choice of national competitive tendering (NCT), the dominant of the six (6) procurement methods used by public entities, in the procurement of works in Ghana. Data for study were collected by means of a questionnaire survey and analysed statistically through the comparisons of means using one-way analysis of variance. Twenty six (26) project risk factors were evaluated and ranked. Financial and design risk factors were found to have the highest impact on works procured through NCT. A public works risk impact matrix revealed that, financial and design risks factors have the high extent – high impact on projects procured through NCT. Economic related risk factors have low extent – high impact of occurrence. Environmental and construction related risks have low extent – low impact on the risk matrix.

Keywords: contracts; national competitive tendering; NCT; procurement; public; risks; works; Ghana.

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1 Introduction

The procurement of public works through national competitive tendering (NCT) has significantly improved in adherence to the provisions of the Public Procurement Act of Ghana (Act 663) (Ameyaw et al., 2012b). Section 35(1) of Act 663 mandates all public procurement entities to procure works contracts through competitive tendering as "open competition is the basis for efficient public procurement" (African Development Bank, 2012). The choice of a procurement method is a critical decision in the procurement of construction projects due to its potential impact on project risks. The selected method affects risks allocation between the parties during contract implementation (Acquaye, 2011). Selecting the appropriate procurement method, therefore, contributes to obtaining best value for money and eventually, the management of procurement risk.

The purpose of this study is to assess the impact of project risk factors on public works procured through NCT in Ghana. The extent of usage of procurement methods by public entities were assessed initially to identify risk factors that can impact on the choice of NCT as a procurement method. The extents of occurrence of the identified risk factors were then assessed for their impact on NCT procurement method.

A number of researches have been conducted on the Public Procurement Act 663 since its introduction in 2003. The level of compliance to the Act in Ghana (Osei-Tutu et al., 2011) and the impact and challenges of public procurement reforms in Ghana (Ameyaw et al., 2012a; Glavee-Geo, 2008; Anvuur et al., 2006; Dza et al., 2013) have received attention. "Managing risks in construction projects has also been identified as a

very important process in the achievement of project objectives" (Zou et al., 2006). However, construction projects by virtue of their complex nature poses a great deal of risk (Kpodo, 2011) and the choice of a procurement method will ultimately affect how these risks are allocated. As noted by Thai (2001), although public procurement is perceived as a major government's function and numerous reforms and improvements have been carried out in many countries, it has however been an area of neglected academic research and education.

2 Public works procurement in Ghana

Varied definitions and meanings have been given to the term 'procurement' and different organisations have used the term to mean different things. These varied and myriad definitions of the term procurement have resulted in Kwakye (1997) contending that 'procurement is a word only recently encountered in the context of the construction work' with devise meanings to different people. This notwithstanding, "public procurement has a long history, with the earliest procurement dating back from 2400 to 2800 BC written on a red clay tablet found in Syria" (Thai, 2001).

In Ghana, as at 2007, public procurement constituted 17% of Gross Domestic Product (World Bank, 2008) with Public works procurement constituting a major part of government's expenditure (European Network on Debt and Development, 2010) despite a lack of "total aggregate statistical data on the annual volume of public procurement in terms of goods, works and services" (World Bank, 2008). However, there is evidence of a lot of activity on construction (World Bank, 2003) over the last years which therefore suggest that 80% of tax revenue that is spent on public procurement (World Bank, 2008) will go into the procurement of works.

Procurement is noted as a vital tool which must be versatile, encompassing and transparent in order to achieve substantial savings on public sector expenditure (Eadie et al., 2013). There has been a significant increase in ensuring that, public sector procurement is done efficiently in order to address the challenges of corruption and other collateral goals such as environmental concerns in developing countries (Akenroye e t al., 2013).

Ghana's public procurement law largely follows the liberal model put forward by the World Bank and the UNCITRAL model law on procurement and generally opens competition to both local and foreign firms (European Network on Debt and Development, 2010; PPA Annual Report, 2010). Section 35(1) of Act 663, enjoins all procurement entities to procure works, services or goods by competitive tendering as a default method.

Ghana has made many strides in the reformation of its Country Procurement Systems (CPS) over the years (World Bank, 2008). This positive progress has led to a slight increase in the use of CPS from 52% in 2005 to 57% in 2007 (European Networks on Debt and Development, 2010). This indicates increased confidence in using the legislative framework and policies guiding public procurement in Ghana by its development partners (OECD/DAC, 2011).

Public procurement is at the forefront of most reform efforts given that it plays a significant role in promoting accountability and transparency (McCue and Roman, 2012). It is therefore imperative that, public procurement entities acquiring goods, works or services should identify risk factors associated with each stage of the procurement cycle,

analyse the probability of the risk occurring and consider the potential impacts on the final project objective (CIPS and NIGP, 2012).

3 Project risks and procurement

The concept of risk as argued by Ehsan et al. (2010) is multi-dimensional with Hansson (2002) categorising risk definitions into 'technical' and 'non-technical'. The latter contends that, the non-technical definition of risk refers to "the situation in which it is possible but not certain that an undesirable event will occur". However, the technical definition of risk, "the statistical expectation value of unwanted events which may or may not occur", is of interest to this research work. It is relevant because it seeks to define risks and project risks in the context of the product of the extent of occurrence (probability) and degree of severity (impact) of an event or condition occurring (Odeyinka et al., 2008) from the inception, design, production and life cycle stages of works contracts.

The need to diversify and share risk in the delivery of infrastructure projects, the growing complexity of infrastructure projects, the attendant increase in project risks and uncertainties, the effects of the recent financial crisis and the high demand for better and efficient infrastructure has resulted in the change of procurement routes in order to meet infrastructure deficits (Adetola et al., 2013).

The management of risk in the procurement cycle is crucial in the realisation of project objectives. This is reinforced by the works of many researchers in public sector procurements (Akintoye and MacLeod, 1997; Thai, 2007; Barden, 2010; Ameyaw et al., 2012b; Ameyaw and Mensah, 2013; Ogunsanmi, 2013). The procurement cycle is characterised by a lot of risk and Barden (2010) contends that, the slightest error or inconsistency in conducting procurement processes or activities can lead to accusations. The supply chain involved in the delivery of infrastructure projects demands the identification, assessment, management and mitigation of supply chain risks successfully in order to survived and attained competitive advantage (Pradhan and Routroy, 2014). Failure to manage these risks can have significant impact on the final product.

Comparing private and public sector procurement systems, Jaafar and Radzi (2012) concluded that, the traditional procurement system is highly practiced by both sectors in the construction industry. The dominance of this system of procurement is evidenced by the fact that, Eadie et al. (2013) reveals that, 61.56% of procurements used the traditional route in a study of the impact of recession on construction procurement routes in the UK. The work of Noor et al. (2012) in Pakistan, confirms the works of earlier researchers that, two distinct methods are used in the delivery of infrastructure projects in most developing countries. The traditional and the non-traditional methods are used in the delivery of infrastructure projects.

In Ghana, Chileshe and Yirenkyi-Fianko (2011) studied and compiled 25 construction project risk-related factors from both developing and developed economies. The study concluded that financial drivers were the main source of risk that can impact greatly on Ghanaian construction projects. Buertey et al. (2012a) reveals that, 36% of risk impact on Ghanaian construction projects are as a result of specific project risks, and the effect of these project specific risk are beyond the prediction and 'stochastic effort' of the project team. The works of Buertey et al. (2012a) suggests that, project specific risks can be managed through 'collaborative communicative effort' of the project team.

4 Research methodology

Surveys are used to gather data from a relatively large number of respondents within a limited time frame (Naoum, 2007). A self-administered questionnaire was used in the administration of this study. This study was largely done using the postal questionnaire. Hand delivery and collection was also employed to enhance response rate. A five (5) point Likert scale was used to obtain the perception of procurement and construction professionals.

Per the 2010 annual report of the Public Procurement Authority of Ghana (PPA), the total number of procurement entities in Ghana is 1,046. However, there is no comprehensive data on the number of Procurement Officers (PPA, 2007; Ameyaw et al, 2012b) and construction professionals within these entities. The lack of a comprehensive database on the number of procurement officers and construction professionals within these entities (PPA Annual Report, 2007; Ameyaw et al., 2012a) and lack of access to all professionals within this sample space necessitated the use of convenience sampling (or haphazard sampling) to select respondents.

Participants were therefore selected from the list of procurement entities (224 number) that have submitted their procurement plans for 2013 financial year as at 31st October 2012 to the PPA (2012). All respondents were chosen from entities that procured public works mostly through NCT. Consequently, as argued by Bryman (2004), respondents were approached because they are easily available and accessible.

5 Results and discussion

Descriptive statistics, illustrative statistics and inferential statistics using SPSS (version 19.0) and Microsoft excel was used to present the results of the study. The data was analyse under four (4) broad categories namely: Background of respondents, Usage of procurement methods, extent of occurrence of risk factors and Impact of occurrence of risk factors.

5.1 Background of respondents

Ninety eight questionnaires, representing 44% were completed and returned. The rate of response for the study was considered suitable for the construction industry (Akintoye and Fitzgerald, 2000; cited in Odeyinka et al., 2008) as the response rate for postal questionnaires for the industry normally range between 30%–60% (Naoum, 2007; Saunders et al., 2009).

Table 1 indicates that, the sample selected for the study was representative of different types of procurement entities in Ghana. 42% of the respondents were from Metropolitan, Municipal and District Assemblies (MMDAs) of the country. Ministries, Departments and Agencies of government constitute 20% with 17% of the respondents belonging to public universities, schools and colleges. As shown on Table 1, 29% engineers, 27% quantity surveyors, 27% procurement officers indicates that, the data can be relied upon for further analysis as 82% of the respondents (engineers, quantity surveyors and procurement officers) are directly involved in the procurement of infrastructural works. Furthermore, 97% of the respondents possess or have higher education with 69% professionally qualified to practice. Table 1 further suggest that, 66%

of the respondents have over ten (10) years of experience in the procurement of public works contracts.

The questionnaire solicited information regarding the procurement entity's estimated expenditure on works procurement, which enabled their groupings into small, medium and large contract thresholds (Table 2) as per the Standard Tender Documents (STD) for the procurement of works in Ghana (PPA, 2003a, 2003b, 2003c).

This background information with respect to the various respondents affirms the fact that, the responses can be confidently relied upon as respondents are "competent, experienced and capable of exercising sound judgment" in the procurement of public works (Odeyinka et al., 2008). As such, responses provided by them could be used and relied upon for this study as they are "enlightened and informed enough to understand the questions both at surface level and at the technical level" (Braimah, 2011).

Table 1 Background of respondents

Sample representation	*Professional background of respondents*	*Academic and professional qualification*	*Experience in works procurement contracts*
42% MMDAs	82% directly involved in works procurement	97% – higher education	66% – Over ten (10) years' experience in works procurement contracts
20% MDAs	*(29% engineers, 27% quantity surveyors, 27% procurement officers)*	69% – professionally qualified to practice	
17% universities/schools/colleges			

Table 2 Procurement entity's estimated expenditure on works procurement contracts

Estimated procurement contract value (GHS)		*Frequency*	*Percent*	*Valid percent*	*Cumulative percent*
Valid	0.00–50,000.00	13	13.3	13.3	13.3
	50,000.00–1,500,000.00	47	48.0	48.0	61.2
	Above 1,500,000.00	38	38.8	38.8	100.0
	Total	98	100.0	100.0	

Note: $1 = GHS 2.066 (average for 2013)

5.2 Extent of usage of procurement methods

Statistical test using one-way analysis of variance (ANOVA) at 95% confidence interval and 5% level of significance was carried out to compare the means of all the procurement methods and the result is shown on Table 3. It is evident that, based on the sample analysed, NCT and RFQ, are the most extensively used in the procurement of works contracts as they ranked 1st and 2nd respectively in the overall mean ranking. International competitive tendering (ICT) was ranked 3rd as the most extensively used method of procurement with Force Account ranked 4th in the overall mean ranking.

Two stage and single source tendering ranked 5th and 6th respectively in the overall mean score. The ranking of Two Stage Tendering as 4th and 5th respectively for small and high risk works procurements rejects the PPA annual report and the World Bank external review report that, this method of procurement is seldom use in 'works' procurement (PPA Annual Report, 2007; World Bank, 2008).The analysed data saw the usage of Restricted, Procurements under Private Sector Arrangements (BOO/BOT/BOOT etc) and Framework Agreements ranked 7th, 8th and 9th respectively.

Works contracts which are low risk, high risk or minimal risk (PPA, 2003a, 2003b, 2003c) all had NCT ranking 1st as the preferred method of procurement. This perception of respondents on the choice of a procurement method is in line with Act 663 Section 44 which stipulates NCT as the default method of procurement. The use of NCT ranked 1st for both works contract value above GHS 1,500,000.00 and up to GHS 50,000.00. This is quite surprising for works procurement contracts which are considered high risk (PPA, 2003c) and demands the use of ICT as the preferred method of procurement as per Schedule 3 of Act 663. What is even more surprising about this ranking is that, low value contracts which have a threshold up to GHS 50,000.00 also had NCT ranking 1st. Contracts of such nature are considered as low value and low risk (PPA, 2003a) and hence the use of RFQ is required. The results, however, indicates that procurement entities prefer to use NCT which is the default method of procurement. The usage of Force Account ranked 4th in the overall mean ranking, this observation is surprising. Force account as a procurement method is not specifically and explicitly stated within the Public Procurement Act (Act 663) and so therefore cannot be used in the procurement of public works. This observation, however, could be due to the procurement of works contracts using Donor Funds. Some of these works contracts strictly state the use of the donor funding agency's procurement systems (European Networks on Debt and Development, 2010). Because of the specific approval required by an entity before single sourcing and restricted tendering is done, (Act 663, Section 38 & 40), they ranked 6th and 7th overall. Procurements under Framework agreements and private sector arrangements appears alien to the Ghanaian public procurement methods. For small, medium and large contracts, it ranked 9th, 7th and 8th respectively. However, framework agreements and procurements under private sector arrangements (BOO/BOT/BOOT etc) is noted as an antidote for deliberate breaking or splitting of contracts into smaller units (Fordjour, 2013). This observation is reinforced by the works of Ameyaw et al (2012a), where procurement entities were deliberately splitting procurement contracts to avoid the usage of competitive methods. For RFQ to ranked 2nd in both works contracts that are 'high' risk and 'medium' risk and have thresholds above GHS 1,500,000.00 is an amazing feature of the study. It is not surprising however that, in the absence of a procurement method that will satisfy the legislative requirement and procurement need of an entity, the breaking up of procurement contracts into smaller units (bulk breaking) will conveniently help without contravening Act 663 (Fordjour, 2013). The 2007 annual assessment of 515 procurement entities nationwide by the Public Procurement Authority confirms the predominant usage of RFQ (66%) by most entities (PPA Annual Report, 2007). This reinforces the findings of this study, although, most of the entities assessed by the PPA were in the 'low spend' category.

Table 3 Extent of usage of procurement methods

Methods of procurement	*Up to GHS 50,000.00*		*GHS 50,000.00–1,500,000.00*		*Above 1,500,000.00*		*TOTAL*			*F statistic test*		
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Overall mean score*	*Overall rank*	*Standard deviation*	*F stat*	*Level of Sig. (P values)*	*Significant difference (yes/no)*
International competitive tendering (ICT)	3.31	3	3.89	3	3.55	3	3.68	3	1.041	2.153	0.122	No
National competitive tendering (NCT)	4.62	1	4.53	1	4.05	1	4.36	1	0.815	4.717	0.011	Yes
Single source tendering	2.54	6	2.49	5	2.37	4	2.45	6	1.211	0.143	0.867	No
Restricted tendering	2.62	4	2.15	8	1.95	9	2.13	7	1.127	1.736	0.182	No
Two stage tendering	2.62	4	2.49	5	2.37	5	2.46	5	1.211	0.226	0.798	No
Request for quotation	3.77	2	4.17	2	3.79	2	3.97	2	0.947	2.080	0.131	No
Force account	2.54	6	2.64	4	2.34	6	2.51	4	1.262	0.577	0.563	No
Framework agreements	2.00	8	1.77	9	2.11	7	1.93	9	0.997	1.261	0.288	No
Procurement under private sector arrangements (BOO/BOT/BOOT etc.)	1.77	9	2.19	7	2.03	8	2.07	8	1.008	0.955	0.388	No

Note: $1 = GHS 2.066 (average for 2013)

Table 3 indicates that, there is no significant difference in the perception of respondents who procure small, medium and large contracts on the usage of procurement methods. This was tested using the F statistic at significance level of 5% (95% confidence interval). From the table, it is evident that respondents were generally unanimous in their scoring of the procurement methods as opinion pertaining to only one procurement method is shown to have statistical significant difference ($P < 0.05$). This method is NCT and however ranks 1st within small, medium and large contracts.

5.3 Extent of risk occurrence on works procured through NCT

A statistical test using one-way ANOVA at 5% level of significance and 95% confidence interval was carried out to compare the means of all respondents, on the level of extent of occurrence of the identified 26 risk factors on works procurement contracts procured through NCT. Table 4 illustrates the findings of the study. Different categories of risks (low, medium and high) associated with works procurement contracts, as stipulated in the STD for the procurement of works contracts (PPA, 2003a, 2003b, 2003c), does not reflect on the perceptions of respondents on the extent of occurrence of risk factors on works procured through NCT. Construction professionals and procurement officers in Ghana were generally unanimous on the level of extent of occurrence of risk factors on works procured through NCT, regardless of the size of contract (small, medium and large contracts). Only one risk variable, 'clients Insolvency', recorded a statistical significant difference ($P < 0.05$). Whilst this variable ranked 9th in overall mean score, it ranked 9th, 10th and 9th respectively on large, small and medium contracts. This is not surprising, considering that client's insolvency is not a problem on small contracts, but can become substantial and contentious as the size of the project increases.

Table 4 indicates that, based on the data analysed, the top ten (10) risks factors which have the highest possibility of occurrence on infrastructure projects procured through NCT are; 'delay in retention release', 'delay in agreeing variations/day works', 'Delay in payment from client', 'production target slippage', 'variation to works', 'delay in interim certificates', 'delay in settling claims', 'changes to initial design', 'clients insolvency' and 'labour strikes'.

It can be observed that, five (5) of the risk factors having the highest possibility of occurrence can be grouped under 'financial risks'. These are delay in retention release, delay in agreeing variations/day works, delay in payment from client, delay in interim certificates, and delay in settling claims. Delay in retention release ranks 1st among the risk variables. The fact that, respondents ranked 'high financial' risk factors indicates that, irrespective of the value of contracts procured, the probability of occurrence of financial risks on projects is high. This reveals an interesting feature of the study. Public procurement entities deciding to engage in NCT procurement method, would have anticipated, in their annual procurement planning, the estimated value of works procurement contracts. However, for entities to rank high the extent of occurrence of these risk variables, suggests that, procurement entities may not be certain on the yearly release of funds from central government through their quarterly allocations of the national budget. Buertey et al (2013) contends that, the effect of financial risks on construction projects in Ghana cannot be over emphasised, as they have the high propensity to affect the cash flow of projects.

Four (4) of the risk factors, changes to initial design, under valuation, variations to works and production target slippage can be categorised under 'design and construction related risk'. It is surprising that, these factors have a high relative extent of occurrence on projects procured through NCT. National competitive method of procurement, usually allows procurement entities to engage the services of consultants who design and agree with entities the scope and complexity of projects. For respondents to rank variations to works (architect instructions), changes to initial design and production target slippage 5th, 8th and 4th respectively in overall mean score, suggest that, design changes during the construction phase is increasingly becoming rampant with public sector projects. It can be inferred that, if NCT procurement is the default method of acquiring public works and has design risk having a high extent of occurrence, then this can pose a major challenge in the cost management of projects in Ghana (Buertey et al., 2013).

Client's insolvency and labour strikes ranks 9th and 10th respectively in overall mean score. These risk factors are economic and environmental in nature and are generally beyond the control of public procurement entities and contractors. NCT procurement method ensures that public entities estimate and budget for works contracts before inviting tenders from contractors. It is therefore surprising that, respondents will rank high the extent of occurrence of clients insolvency on works procured through NCT. This situation could be as a result of public entities failing to actually commit funds to particular projects before inviting tenders for public works. Increasingly, lack of budgetary allocation or delay in release of funds by central government to public entities is becoming common (severe) as stated earlier (PPA Annual Report, 2010). Agitations within Ghanaian labour front have seen an unprecedented increase over the years (Seniwoliba, 2013). This phenomenon could be responsible for respondents ranking of labour strikes as 10th on the extent of occurrence of risk factors. During post contract execution, contractors and clients do not have control over increases announced for labour wages. Public works procured through NCT are therefore not devoid of strikes that will be embarked upon by construction workers union. Under estimating project complexity ranked 18th in overall mean score and suggest that, despite detailed project scope preparation, contractors do not have enough time to study tender documents prior to submitting tenders. This could be possible if public procurement entities are using minimum lead times allowed for NCT procurement method for complex projects. This is noted in the ranking of the risk factor as 16^{th} in large works contracts (value above GHS 1,500,000.00).

The last 16 risk variables from Table 4 indicate that, respondents were of the opinion that, their extent of occurrence on public works is 'generally low'. Based on the Likert scale that was used, none of the risk variables recorded a mean value greater than 3.0 in overall mean score. Labour shortage, shortage of key materials and shortage of key plant items ranks 14th, 24th, and 21st respectively on overall mean score. The low ranking of these risk variables indicates that, NCT procurement method which usually involves specification of detail project scope and complexity will be included in tender documents before invitation to tender. The volume of materials, labour and plant required to execute public works will be clearly defined in the tender documents, and hence it is not surprising that, respondents ranked these risks low.

Table 4 Respondent's perception on extent of risk occurrence

Risk factors	*Up to GHS 50,000.00*		*GHS 50,000.00–1,500,000.00*		*Above 1,500,000.00*		*TOTAL*			*F statistic test*			
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Overall mean score*	*Overall rank*	*Standard deviation*	*F stat*	*Level of Sig. (P values)*	*Significant difference (yes/no)*
Changes to initial design	4.38	8	4.62	6	4.58	8	4.57	8	0.497	1.121	0.330	No
Inclement weather	1.92	12	2.06	12	2.08	12	2.05	12	0.946	0.137	0.872	No
Variations to works (architect's instructions)	4.62	4	4.66	4	4.66	5	4.65	5	0.539	0.036	0.965	No
Labour shortage	1.69	14	1.89	13	1.50	25	1.71	14	2.192	0.335	0.716	No
Production target slippage	4.92	1	4.66	4	4.66	5	4.69	4	0.485	1.698	0.189	No
Delay in agreeing variations/day works	4.62	4	4.79	1	4.89	3	4.81	2	0.423	2.265	0.109	No
Delay in settling claims	4.54	6	4.53	8	4.66	5	4.58	7	0.772	0.299	0.743	No
Problems with foundations	1.23	26	1.38	26	1.63	22	1.46	26	0.691	2.233	0.113	No
Under estimating Project complexity	1.62	17	1.68	16	1.71	16	1.68	18	0.937	0.049	0.952	No
Estimating error	1.54	24	1.45	25	1.66	18	1.54	25	0.691	0.980	0.379	No
Under valuation	2.23	11	2.62	11	2.50	11	2.52	11	0.933	0.885	0.416	No
Delay in payment from client	4.69	2	4.70	3	4.92	1	4.79	3	0.630	1.447	0.241	No
Shortage of key materials	1.69	14	1.62	21	1.50	25	1.58	24	0.702	0.473	0.625	No

Note: $1 = GHS 2.066 (average for 2013)

Table 4 Respondent's perception on extent of risk occurrence (continued)

Risk factors	*Up to GHS 50,000.00*		*GHS 50,000.00–1,500,000.00*		*Above 1,500,000.00*		*TOTAL*			*F statistic test*		
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Overall mean score*	*Overall rank*	*Standard deviation*	*F stat*	*Level of Sig. (P values)*	*Significant difference (yes/no)*
Delays in interim certificates	4.46	7	4.62	6	4.71	4	4.63	6	0.679	0.670	0.514	No
Delay in retention release	4.69	2	4.77	2	4.92	1	4.82	1	0.544	1.250	0.291	No
Inflation	1.62	17	1.68	16	1.66	18	1.66	19	0.963	0.024	0.976	No
Compliance with new Regulations	1.62	17	1.70	15	1.71	16	1.69	15	0.968	0.049	0.952	No
Subcontractors' insolvency	1.69	14	1.60	23	1.66	18	1.63	21	0.866	0.088	0.916	No
Changes in interest rates	1.62	17	1.68	16	1.74	14	1.69	15	0.957	0.085	0.919	No
Shortage of key plant items	1.62	17	1.64	19	1.63	22	1.63	21	0.901	0.003	0.997	No
Access to funds at reasonable interest rate	1.77	13	1.62	21	1.76	13	1.69	15	0.968	0.281	0.756	No
Archaeological remains	1.62	17	1.64	19	1.66	18	1.64	20	0.888	0.012	0.988	No
Changes in currency exchange rates	1.54	24	1.60	23	1.63	22	1.60	23	0.917	0.051	0.950	No
Civil disturbances	1.62	17	1.74	14	1.74	14	1.72	13	0.961	0.096	0.909	No
Labour strikes	3.77	9	3.45	10	3.68	10	3.58	10	1.093	0.712	0.493	No
Clients insolvency	2.92	10	3.83	9	4.03	9	3.79	9	1.186	4.564	0.013	Yes

Note: $1 = GHS 2.066 (average for 2013)

The extent of occurrence of these risks, based on a well prepared tender document by a procurement entity will result in low probability of occurrence anticipated. The extent of occurrence of 'shortage of labour', 'materials' and 'plant' on works contracts, will be low especially during pre-contract stages as contractors are not certain of wining competitive tenders and cannot predict the consequences of their occurrence.

Based on the data analyse, inclement weather, civil disturbances, inflation, compliance with new regulation, subcontractors insolvency, changes in interest rates, access to funds at reasonable interest rates, archaeological remains and changes in currency exchange rates can be grouped under 'economic and environmental risk factors'. These risk variables rank between 12–23 in overall mean score. Relatively, these factors have low extent of occurrence on works procured through NCT. This situation could be as a result of pre-contract stages planning in projects life cycle. Amendments to the STD's of the PPA are usually done through tender data and contract data sheets. The risks and complexity of a project dictates the use of a particular STD. The duration for project completion, defects liability period, date of commencement of contract, among others will be modified to suit public works contracts and stated prior to tender. It is therefore not surprising that, respondents knowing these details would rank these risk factors low. These risk variables are beyond the control of the contractor and the client. What is amazing however is, the ranking of changes in interest rates, inflation and changes in currency exchange rates as 15th, 19th and 24th respectively. Buertey et al (2012b) and Chileshe and Yirenkyi-Fianko (2011) revealed that these micro and macro-economic indicators are high in developing countries such as Ghana.

Risk factors which are considered 'very low' on extent of occurrence on public works procured through NCT are estimating error and problems with foundations. NCT procurement method, allows public entities to prepare detailed designs and cost estimates of projects before soliciting tenders from contractors. Detailed designs which produce accurate estimates will ensure that contractors do not expect a high occurrence rate for these risk factors.

5.4 Risk impacts on works procured through NCT

This section of the analysis looks at the impact of the 26 risk factors on works procurement contracts that were solicited through NCT. Statistical test using one-way ANOVA within 95% confidence interval and 5% significance level was carried out to compare the means of small, medium and large contract values procured by various procurement entities in Ghana. Table 5 summarises the analysis of the study.

The study reveals ten (10) most significant risk factors that can impact greatly on public works procured through NCT. These are, delay in retention release, changes to initial design, underestimating project complexity, production target slippage, delay in agreeing variations/day works, delay in settling claims, changes in currency exchange rates, variations to works, and access to funds at reasonable interest rates. As discussed previously, changes to initial design, variations to works, delay in agreeing variations/day works, production target slippage, and underestimating project complexity can all be categorised under 'design risks'. These risks are noted to have such a high impact on public works procured through NCT that, they rank 2nd, 8th, 4th, 4th, and 3rd respectively. This trend of analysis could be as a result of the traditional procurement system associated with NCT procurement method where design is separated from construction. Separation of these two phases of a project usually results in

communication gaps between the design team and the construction team. It is therefore not surprising that, 'design risk' ranks high. What is interesting about this ranking is that, medium and large projects are impacted severely when changes to initial design occurs. This is normal because such projects are associated with large and complex scope. From the above, it is justifiable to see that production target slippage was ranked 4th in overall mean score and 1st on very large contracts. This is because frequent changes to initial designs and variations to works as a result of architect's instructions will severely impact the progress of work on site. These factors were studied and grouped under 'systemic risk' factors by Buertey et al. (2012a). They have a 'high-impact' which also has a 'high propensity of cost overrun effect' on Ghanaian construction projects. Consequently, the same researchers add that, to mitigate and managed such risk factors, the project team needs a 'design management effort'.

The impact of 'delay in the release of retention', 'delay in interim certificates', 'delay in payment from client', and 'delay in settling claims' are high as noted in Table 5. These risk variables are categorised under 'financial risks' and their analysis reveals an interesting trend in the procurement of public infrastructure. The high impact associated with 'financial risks' could be as a result of bureaucracy involved in the processing of certificates, invoices and valuations as noted in public entities. It is also possible to infer from the above that, majority of public entities are procuring works which are not found in their annual procurement plans. Hence, there is often lack of funds to pay for such contracts procured on impromptu basis. Buertey et al. (2012b) and Oyewobi et al. (2011) conducted studies in Ghana and Nigeria respectively on risks impacts on construction projects and confirms that, this category of risk factors has the greatest impact on construction.

Another group of risk factors which are noted to have high impact on public works procured through NCT are categorised under 'economic risks'. Economic risks as noted by Buertey et al. (2012a) are micro and macro-economic challenges and are beyond the control of clients and contractors. What is however interesting is, with procurement entities knowing in detail the project durations, estimated value of works contracts, and defects liability period as a result of NCT procurement method, adequate plans and preparations should have been put in place to avoid the high impact of such risk factors. The high ranking of these factors suggest that, they have devastating consequences on public works contracts. The works of Agyakwah-Baah and Fugar (2010) on the causes of delay on Ghanaian construction projects enumerated these factors and revealed them as key in causing projects delay. However, with NCT procurement method all things been equal, should allow for adequate planning and preparation in terms of design, cash flow forecast on projects and hence, these factors should be ranking low on impact of occurrence.

Labour shortage, shortage of key plant items and shortage of key materials for construction, from the analysis impact less on public works procured using NCT. This trend of analysis reveals that prior to tendering for projects, contractors adequately plan for plant, labour and materials. The inclusion of bills of quantities in medium and large contract works as required by NCT procurement method ensures that contractors plan properly to mitigate the impact of these risk factors on public works.

Table 5 Respondent's perception on impact of risk occurrence

Risk factors	*Up to GHS 50,000.00*		*GHS 50,000.00–1,500,000.00*		*Above 1,500,000.00*		*TOTAL*			*F statistic test*		
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Overall mean score*	*Overall rank*	*Standard deviation*	*F stat*	*Level of sig. (P values)*	*Significant difference (yes/no)*
Changes to initial design	4.62	7	4.79	2	4.89	3	4.81	2	0.423	2.265	0.109	No
Inclement weather	1.77	24	1.66	24	1.68	24	1.68	24	0.937	0.068	0.934	No
Variations to works (architect's instructions)	4.62	7	4.66	7	4.66	9	4.65	8	0.539	0.036	0.965	No
Labour shortage	1.54	25	1.53	25	1.45	25	1.50	25	0.561	0.270	0.764	No
Production target slippage	4.69	2	4.68	5	4.92	1	4.78	4	0.547	2.253	0.111	No
Delay in agreeing variations/day works	4.62	7	4.77	4	4.84	5	4.78	4	0.443	1.296	0.279	No
Delay in settling claims	4.62	7	4.66	7	4.68	7	4.66	7	0.517	0.087	0.917	No
Problems with foundations	3.62	17	4.21	16	3.92	17	4.02	17	1.055	1.945	0.149	No
Under estimating project complexity	4.69	2	4.79	2	4.82	6	4.79	3	0.460	0.345	0.709	No
Estimating error	3.15	19	2.94	22	2.68	22	2.87	22	1.289	0.767	0.467	No
Under valuation	1.54	25	1.53	25	1.45	25	1.50	25	0.561	0.270	0.764	No
Delay in payment from client	4.54	14	4.23	15	4.63	12	4.43	15	0.689	3.914	0.023	Yes
Shortage of key materials	4.69	2	4.19	17	3.97	16	4.17	16	1.167	1.882	0.158	No

Note: $1 = GHS 2.066 (average for 2013)

Table 5 Respondent's perception on impact of risk occurrence (continued)

Risk factors	*Up to GHS 50,000.00*		*GHS 50,000.00–1,500,000.00*		*Above 1,500,000.00*		*TOTAL*			*F statistic test*		
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Overall mean score*	*Overall rank*	*Standard deviation*	*F stat*	*Level of sig. (P values)*	*Significant difference (yes/no)*
Delays in interim certificates	4.69	2	4.68	5	4.92	1	4.78	4	0.547	2.253	0.111	No
Delay in retention release	4.69	2	4.83	1	4.89	3	4.84	1	0.372	1.468	0.236	No
Inflation	4.85	1	4.49	14	4.68	7	4.61	14	0.668	1.845	0.164	No
Compliance with new regulations	2.85	21	3.57	19	3.24	18	3.35	19	1.095	2.656	0.075	No
Subcontractors' insolvency	2.54	22	3.47	20	2.74	21	3.06	21	1.512	3.530	0.033	Yes
Changes in interest rates	4.62	7	4.66	7	4.61	14	4.63	11	0.563	0.103	0.902	No
Shortage of key plant items	2.54	22	3.45	21	3.13	19	3.20	20	1.347	2.480	0.089	No
Access to funds at reasonable interest rate	4.54	14	4.66	7	4.66	9	4.64	10	0.542	0.274	0.761	No
Archaeological remains	3.08	20	2.64	23	2.37	23	2.59	23	1.491	1.141	0.324	No
Changes in currency exchange rates	4.62	7	4.66	7	4.66	9	4.65	8	0.539	0.036	0.965	No
Civil disturbances	3.46	18	3.83	18	3.00	20	3.46	18	1.423	3.779	0.026	Yes
Labour strikes	4.54	14	4.66	7	4.61	14	4.62	13	0.566	0.258	0.773	No
Clients insolvency	4.62	7	4.64	13	4.63	12	4.63	11	0.545	0.009	0.991	No

Note: $1 = GHS 2.066 (average for 2013)

The following risk factors; compliance with new regulations, inclement weather and archaeological remains impact less on public works if they are procured using NCT. These factors are environmental risks and usually go beyond the control of clients and contractors. Their low impact on occurrence suggests that, they may not be significant risks factors in terms of NCT procurement method. However, the works of Buertey et al. (2012a) in Ghana rejects the impact of 'inclement weather' as moderate on projects. Furthermore, Buertey et al. (2012a) in their study of estimating cost contingency for construction projects reveals that, 93% of construction industry players rated inclement weather as having the greatest severity of impact on projects.

The analysis from Table 5 indicates that, in Ghana, three (3) risk factors do not have greater magnitude of impact on public works that are procured through NCT. These are; estimating error, under valuation and subcontractors insolvency. These risk variables will impact less on the objectives of public works should they occur. With price been a determining factor in NCT procurement method, it not surprising that estimating error and under valuation is ranked low. The quotations of a contractor in a competitive tender such as NCT will naturally be the true and accurate estimate of the cost involve in executing that project. Little errors will be expected and hence low impact during construction.

The F statistic was used to test the statistical difference in the perceptions of respondents on the impact of risks on public works procured through NCT. The results shown on Table 5 indicated that, with the exception of three (3) risk factors ($P < 0.05$), there was no significant difference in perception of impact of risks factors within a 95% confidence interval. These factors are; delay in payment from client, civil disturbances and subcontractor's insolvency. However, it is worth noting that, 'delay in payment from client', 'civil disturbances and subcontractor's' insolvency ranked 15th, 18th, and 21st respectively in overall mean score. These 'financial and environmental risk factors' had overall mean score greater than 3.0 (moderate) on the five (5) point Likert scale. The high scoring of these risk variables on the average indicates an undivided opinion on the magnitude of impact on public works that are solicited through NCT. Although Chileshe and Yirenkyi-Fianko (2011), had proposed the need to ascertain whether these differences were significant (as a result of $P < 0.05$) through a 'post-hoc comparison using the Turkey HSD test', this exercise was found not relevant for this study. Since the overall mean scores for these risk variables were greater than 3.0 on the 5-point Likert scale, there was a strong relationship of the factors leaning towards 'high' impact. The development and subsequent testing of research hypothesis if done earlier for this study would have necessitated the need for this test.

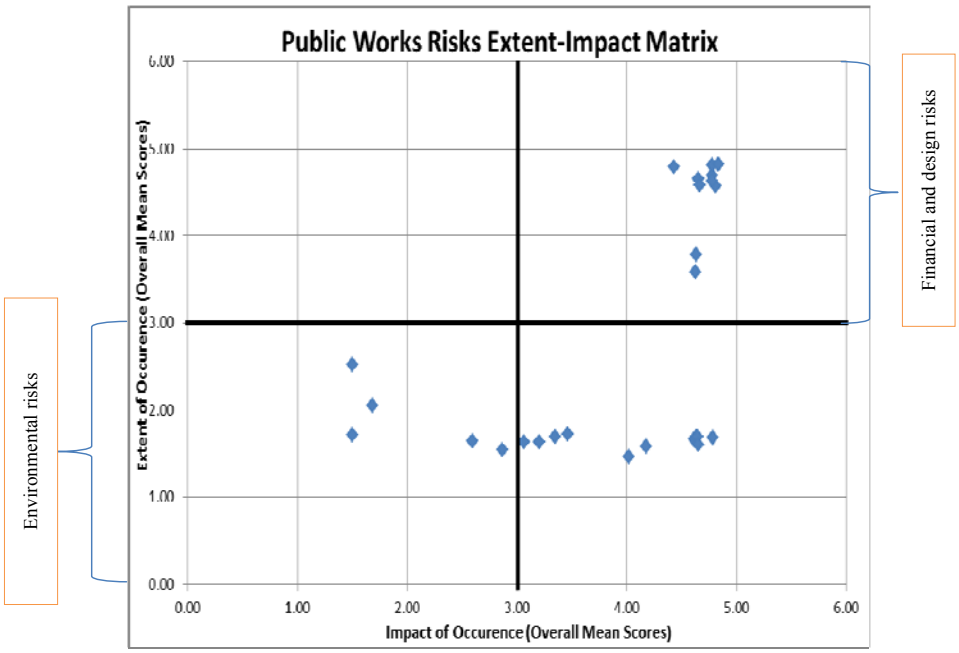
From the above discussion, it can be strongly argued that, respondents were generally unanimous on their perceptions of risks impact on public works procured through NCT in Ghana. Since only three (3) out of the 26 factors showed significant difference in perception of risk impacts, it can be inferred that procurement officers and construction professionals have the same perception on the impact of risk factors on the objectives of public works procured through NCT. This perception did not matter on small, medium or large contract types as stipulated in the STD of the PPA.

5.5 Extent and impact of risk factors

The nature and effect of risk variables on construction projects varies from one factor to the other and though a risk factor may have a high probability of occurrence, its impact

when it occurs may be negligible and vice versa (Buertey et al., 2012a, 2012b). The study reveals that, some factors have both high extent of occurrence and high impact on the objectives of public works procured through NCT. These were generally categorised under 'financial and design risk factors'. Ten (10) risk variables have both high extent of occurrence and high impact of occurrence. Figure 1 plotted on the overall mean scores of extent of occurrence and impact of occurrence reveals a public works risks extent-impact matrix. From Figure 1, 'Delays in agreeing variations/day works' was the risk variable with the highest extent of occurrence and impact on public works that are procured through NCT.

Figure 1 Public works risks impact matrix (see online version for colours)



From Figure 1, it can be analysed that, ten (10) risk factors have low extent of occurrence but high impact on works procured through NCT. These can be classified under economic, environmental and construction related risks. Economic and environmental risks largely are beyond the control of contractors and clients and hence low extent of occurrence will be anticipated for them during tendering. However, their impact on projects during construction will be high considering the total minimum lead time (4.5 months) required before award of contracts and commencement of works on site in NCT procurement method. Four (4) risk factors were classified as low impact-low extent of occurrence on public works solicited through NCT. These are, inclement weather, estimating error, labour shortage and archaeological remains. Proper procurement planning of works contracts, will ensure that projects are slated and acquired during favourable (rain free) weather conditions. The low impact-high extent of occurrence quadrant of the matrix reveals no risk factor. This suggests that, all the risk variables identified during literature review were relevant for the purpose of this study.

6 Conclusions

The three most common methods of procurement used in public sector infrastructure delivery in Ghana were identified as NCT, request for quotations (RFQ) and ICT. NCT was however the most preferred method of procurement and hence the focus of the research.

The extent of risk and impact of occurrence were evaluated on works procured through NCT. The identified risk factors were analysed by ranking the mean score and ANOVA to examine the significant differences of the mean scores between the different categories (types) of works contracts in Ghana.

The study concluded that the top ten (10) project risks factors with the highest possibility of occurrence in works procured through NCT in Ghana are; 'delay in retention release', 'delay in agreeing variations/day works', 'delay in payment from client', 'production target slippage', 'variation to works', 'delay in interim certificates', 'delay in settling claims', 'changes to initial design', 'clients insolvency' and 'labour strikes'. The extent of occurrence of the risk variables, were also found to be independent of the size of contract (small, medium or large contracts).

The study further concluded that the ten (10) most significant risk factors that can impact greatly on public works procured through NCT are; delay in retention release, changes to initial design, underestimating project complexity, production target slippage, delay in agreeing variations/day works, delay in settling claims, changes in currency exchange rates, variations to works, and access to funds at reasonable interest rates. Procurement officers and construction professionals both agreed that irrespective of the size of contracts procured by public entities on the impact of risk factors, should they occur, on the objectives of public works.

The high occurrence and impact of financial and design risk factors is an indication of the gap which exist between the traditional system of procurement where design is separated from construction. This study further demonstrates the vital importance of public sector agencies in Ghana carrying out project design audit before implementation in order to ensure the low occurrence of design risks factors on public sector projects.

The extent of occurrence of financial risks as indicated above is high on projects procured through NCT. The fact that respondents were ranking these risk factors high is a strong indication that, developing economies are confronted with financial risks in terms of project funding. There is therefore the need to explore and introduce alternative procurement methods into the Ghanaian public sector works procurement in order to meet the increasing demand on infrastructure deficits.

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