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Integrated Delivery of Quality, Safety and Environment through Road Sector Procurement: The Case of Public Sector Agencies in Ghana

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Abstract: Poor quality, safety and environmental (QSE) performance within Ghana's road sector has been cited as a major challenge in the procurement of infrastructure. This study evaluates the applicability and level of integrated consideration of QSE in the delivery of roads through procurement by public sector agencies in Ghana. Integrated delivery is explored on the basis of theoretical and empirical evidence of an existing synergistic relationship among QSE in the management and delivery of projects. A mixed methodological design was adopted to investigate two public road agencies through a questionnaire survey and interviews of technical staff with procurement responsibilities. This was done concurrently with soliciting professional perspectives on the subject. Procurement is widely regarded as paramount to the delivery of better QSE in the Ghana road sector. However, the level of synergistic consideration is low, which is attributable to an over-reliance on traditional procurement arrangements as a result of non-supportive local procurement regulatory frameworks. It is further established that a general lack of know-how and experience in the use of modern and integrated procurement arrangements prevent effective management and realisation of QSE beyond the current focus on time and cost through procurement processes within public road sector agencies.

Keywords: Procurement, Developing countries, Quality, Safety, Environment

INTRODUCTION

Increased expectation from the construction industry on delivery of "value for money" has resulted in customers placing emphasis on the delivery of quality products in a safe and environmentally friendly manner (Kumaraswamy et al., 2004). Procurement and its strategic use by clients is regarded as one of the most critical functions capable of influencing project delivery outcomes (Eriksson and Westerberg, 2011). This is particularly important in a developing country context where wider regulatory environments are often weak and lack effectiveness (Agaba and Shipman, 2007; Wells and Hawkins, 2011). According to Anvuur, Kumaraswamy and Male (2006), however, legislative reforms in the Ghanaian public procurement process over the past decade have not achieved significant objectives beyond fiscal and legal regulation. The overall attainment of value through procurement has still not been achieved because of lack of strategy and innovation in the use of procurement systems. Kumaraswamy et al. (2004) suggests that the development of procurement strategies should be effectively "synergised" within other operational project systems such as quality, safety and environment in order to leverage the improved delivery of value, transcending the traditional focus on cost and timely delivery.

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Integrated management of quality, safety and environment (QSE) has received tremendous attention in academic discourse as a result of the recognition of similarities in their respective management systems as well as operational requirements (Bhutto, Griffith and Stephenson, 2004; Griffith, 2011). Few studies have, however, explored the role of procurement as a framework for achieving such integrated delivery of QSE (Shen and Walker, 2001). This necessitates systematic research, particularly in the Ghanaian road sector, where delivery of quality, safety and environment is greatly challenged (Netherlands Economic Institute, 2000; World Bank, 2008). The road subsector is a major constituent of the Ghanaian construction industry. Making any improvement in road construction would be a significant achievement in Ghana's quest for attainment of enhanced value within an industry greatly challenged in the efficient procurement of projects, as well as delivery of quality, safety and better environmental performance.

Integrated delivery is explored to establish the applicability of synergistic approaches to QSE management in a procurement, client and developing country context. The extent of the use of procurement and organisational capabilities are subsequently assessed based on road sector expert opinion with a view toward ascertaining its role in improving delivery of QSE in a developing country context.

Ghana Road Sector Procurement and the Delivery of QSE

The road sector is regarded as central to socioeconomic development in developing countries. Ghana spends up to 1.5% of Gross Domestic Product (GDP) on road construction and maintenance, one of the highest in West Africa (Foster and Pushak, 2011). It has, over the years, been the highest beneficiary of international investment from various donor partners, including the World Bank, the European Union, and the African Development Bank (Netherlands Economic Institute, 2000). Roads in Ghana facilitate up to 90% of passenger and freight movement (Netherlands Economic Institute, 2000). The road mix condition is remarkable for a developing country but still falls short of requirements of a middle income country. This underscores the need for more efficient delivery of road infrastructure considering the levels of investment within the sector (Foster and Pushak, 2011). Various programmes, including the Road Sector Development Programme (RSDP) and the Transport Sector Programme (TSP) continue to deliver roads to cover Ghana's road deficit (Netherlands Economic Institute, 2000; Government of Ghana, 2007). Delivery is, however, still characterised by poor quality and a lack of effective incorporation of measures to improve safety and environmental performance (Government of Ghana, 2007). This has been partly attributed to a general lack of compete and capacity (technical and human resource) within both client and contractor organisations (Westring, 1997; Government of Ghana, 2007; World Bank, 2008).

The road sector has undergone institutional reforms that have resulted in the creation of public agencies specifically for the delivery and maintenance of roads (World Bank, 1999). The Ministry of Roads and Highways (MRH) has the overall responsibility for the road subsector and delivers this through implementing agencies: the Ghana Highway Authority (GHA); the Department of Feeder Roads (DFR); and the Department of Urban Roads (DUR). The GHA operates as an

autonomous state institution, while the DUR and DFR are functional departments under the MRH (Acquah and Acquah, 2004). These agencies are responsible for the procurement of road infrastructure right from identification of need, through construction to operation and maintenance (Netherlands Economic Institute, 2000). They are tasked to provide comprehensive delivery and maintenance to required international standards, which makes QSE a key part of their delivery objectives (Acquah and Acquah, 2004). These include option appraisals and financial feasibility studies to decide on issues including prioritisation of routes; financial and economic appraisals; environmental appraisals; design; tendering and selection; supervision; operation and maintenance; and decommissioning (Acquah and Acquah, 2004). Technical duties within the stages of procurement are performed either by in-house staff or by consultants, who are competitively selected (Acquah and Acquah, 2004). Decisions and systems in all these key processes influence project delivery outcomes and are considered very important in the Ghana Road Sector, where poor management of some of these processes has led to poor road quality, safety and environment issues (Netherlands Economic Institute, 2000; Office of Auditor General, 2010).

While fiscal management, accountability and stakeholder engagement have generally been adhered to (Acquah and Acquah, 2004), quality, safety and environment issues are less often incorporated within the procurement as critical criteria due to overemphasis on lowest tender and other cost considerations (World Bank, 2008). According to Chileshe and Berko (2010), best practice developments within the industry, notably partnering, risk management, value engineering and total quality management (TQM), are neither practiced nor effectively implemented within the road sector agencies. These, however, remain key ingredients in modern project delivery strategies as well as in QSE management (Shen and Walker, 2001; Kumaraswamy et al., 2004).

Quality and Ghana road sector procurement

The delivery of poor quality has been a serious challenge in Ghanaian construction (Westring, 1997). World Bank and the Government of Ghana evaluations of the RSDP revealed that poor quality of workmanship and delivery had characterised most road projects inspected by the MRH monitoring teams (Government of Ghana, 2007; World Bank, 2008), citing issues such as technical incapacity and poor materials as contributory factors. According to Ahiaga-Dagbui et al. (2011), challenges in funding affect contractors' cash flow and equipment capacity, which subsequently result in poor quality of work within Ghanaian construction. It, however, remains unclear what role procurement can play in mitigating these challenges in the road sector.

Safety and Ghana road sector procurement

The industrial fatality rate in Ghana is estimated at 18.2 per 100,000 persons (Hämäläinen, Saarela and Takala, 2009) compared to the rate in the UK at 0.6 per 100,000 persons (Health and Safety Executive [HSE], 2011). Labour-intensive methods of production dominate Ghanaian construction and pose serious occupational health challenges (Kheni, 2008; Ofori, 2012). Occupational health and safety in Ghana has worsened over the years with statistics indicating

increases in accidents as high as 250% between 2004 and 2009 (Akomah, Nimo-Boakye and Fugar, 2010). For the purposes of this study, safety is broadened to include road user safety, which remains an important aspect of the road sector, especially in Ghana, where an estimated 1.6% of GDP is lost due to road-related accident fatalities (1600 fatalities per annum) (Office of Auditor General, 2010). Technical factors, such as design, maintenance and quality of building, have been cited as major contributory factors to the Ghanaian road safety situation (World Bank, 1999; Office of Auditor General, 2010). Ghana lacks a strong institutional regulator like the UK's Health and Safety Executive and mainly relies on disjointed regulation of both road user and occupational safety from different under-resourced Government agencies (Laryea and Mensah, 2010; Office of Auditor General, 2010). Despite evidence that procurement has a critical influence on improving safety in developing countries, this has not been explored in the Ghanaian context.

Environment and Ghana road sector procurement

Excessive use of natural resources, such as construction materials, coupled with low technology application poses serious environmental challenges that require attention in overall planning and delivery of infrastructure in Ghana (Ayarkwa, 2010; Ofori, 2012). Destruction of ecosystems, erosion, and pollution are a few of the environmental effects of road construction activities in Ghana (Andoh, 2000). The conduct of Environmental Impact Assessment (EIA) and the overall management of the environmental aspects of road infrastructure delivery is, however, challenging due to inadequate funding and lack of technical know-how and guidance (World Bank, 2008). According to Agyemang (2012), the environmental impact of construction in Ghana is often viewed as an inescapable consequence of an urgent need for infrastructure development. This is similar to the challenges in other developing countries where such development goals take priority over environmental protection (Trethanya and Perera, 2009). This has also resulted in a lack of systematic efforts towards improvement, including incorporation of best practices in relation to management through the procurement processes within public agencies.

BACKGROUND DEVELOPMENTS IN ROAD SECTOR PROCUREMENT

Procurement has been transformed. Lowest-cost consideration has given way to greater demand for value, including increased customer satisfaction and sustainability (Fewings, 2013). The highway sector has been dominated by traditional (separated) procurement arrangements across the world, both in developed and developing countries (Pakkala, 2002). These rely on separate organisations for design, construction and supervision, where tendering is usually based on unit pricing of predetermined quantities by the client (Altaminaro, 2010). More "innovative" or "progressive" methods are gaining popularity (Pakkala, 2002: 45), mainly consisting of integrated, management oriented, partnering or discretionary methods, as categorised by Masterman (1992) in his assessment of modern procurement delivery methods. The integrated arrangements include design-build (DB) and its variants that allow integration of design, construction and

sometimes operation (Build-Operate-Transfer [BOT]; Build-Own-Operate-Transfer [BOOT], and Build-Own-Operate [BOO]). Other arrangements that involve public and private sector collaboration in delivery and finance options, generally referred to as public private partnerships (PPP), include Design-Build-Finance-Operate (DBFO) and Private Finance Initiative (PFI) (Altaminaro, 2010). Currently, these new forms (innovative) of procurement are being extensively used in the road sector with experts arguing for their efficacy in overall attainment of value and invariably better performance in terms of issues including quality, safety and environment (Pakkala, 2002). Contemporary expectations of the construction procurement require procurement frameworks, which seek to develop trust- and relationship-based interaction with contractors on a long-term basis (McDermott, Khalfan and Swan, 2004). It is highly recommended that more innovative supplier selection be adopted to encourage mechanisms that promote multi-parameter considerations in procurement strategies, where issues such as QSE can be considered to be as important as other objectives, such as cost (Pakkala, 2002; Cui et al., 2004; Stankevich, Qureshi and Queiroz, 2005). In addition to incorporating the best practice principles in sustainability, TQM and value engineering, many leading highway agencies have reported better delivery of QSE through adoption of the above considerations (Cui et al., 2004).

EFFECT OF PROCUREMENT ON PROJECT DELIVERY OUTCOMES

It is widely accepted that procurement type or management is an influencing factor in delivering QSE on projects (Masterman, 1992; Eriksson and Westerberg, 2011). Variables including level of interaction between teams, communication, collaboration, leadership and trust are increasingly being recognised as determinants of project performance and similarly found to be stimulated to varying degrees by various forms or features of procurement (Kumaraswamy, 1999; McDermott, Khalfan and Swan, 2004; Fewings, 2013). According to Eriksson and Westerberg (2011), the delivery of better performance (cost, time, quality, environmental impact, safety, and innovation) is highly dependent on procurement type and the extent to which it engenders co-operation (joint specification, soft parameters in bid evaluation, joint subcontractor selection, incentive-based payment and collaborative tools). Table 1 shows key procurement features that promote project success in terms of QSE. The table is presented with support from the literature.

The above evidence has aroused a general acceptance of the superiority of forms that foster seamless process interfacing, which improves interaction and eliminates fussy project boundaries that in turn create communication and efficiency barriers (Fewings, 2013). This includes consideration of design and construction as an integral whole, which can be mainly achieved through adoption of innovation procurement and the improvement of interaction, collaboration and communication. These provide the necessary atmosphere for successful delivery, including better QSE outcomes (Eriksson and Westerberg, 2011). Fernie, Weller and Green (2004) suggest that these new forms provide a context for the evolution of other managerial practices. Such practices include the management of QSE in the delivery process, either through the structural support it provides for QSE integration (Shen and Walker, 2001; Fewings, 2013) or as

a motivational capability for improved QSE performance (Eriksson and Westerberg, 2011).

Table 1. Procurement Features and Project Success in Terms of QSE (Adapted from Eriksson and Westerberg, 2011)

Procurement Features Which Promote Successful Project Delivery in Terms of:	**Quality**	**Safety**	**Environment**
Design stage: Higher level of integration between client and contractors	Warsame (2011)	Sulaiman (2008); Smallwood (1998)	Arts, Faith-Ell and Chisholm (2007) Faith-Ell (2005)
Tendering: More focus on soft parameters in bid evaluation and selection criteria	Stankevich, Qureshi and Queiroz (2005); Yasamis, Arditi and Mohammadi (2002)	Teo, Ling and Chong (2005); Smallwood (1998)	Eriksson and Westerberg (2011)
Payment: More use of incentive based payment	Stankevich, Qureshi and Queiroz (2005)	Eriksson and Westerberg (2011); Stankevich, Qureshi and Queiroz (2005)	Eriksson and Westerberg (2011)
Collaboration: More use of collaborative tools	Warsame (2011)	Sulaiman (2008)	Arts and Faith-Ell (2010); Arts, Faith-Ell and Chisholm (2007)
Evaluation of performance: Reliance on contractor self-control measures	Stankevich, Qureshi and Queiroz (2005)	Stankevich, Qureshi and Queiroz (2005)	Eriksson and Westerberg (2011)

Quality and Developments in Procurement

Quality within construction is often defined as conformance to requirements (Arditi and Gunaydin, 1997). More recently, quality has been conceptualised as the totality of factors that contribute towards a more holistic satisfaction of the need for a product or service (Battikha, 2003). Resultantly, there is more emphasis on issues such as client satisfaction, sustainability and relational approaches to contracting within quality management (Toakley and Marosszeky, 2003; Warsame, 2011). While quality within the highway sector has generally followed the earlier definition, there is an emerging acceptance of the latter definition, which engenders a more holistic quality management approach (Toakley and Marosszeky, 2003). Traditionally, most quality control requirements are strictly monitored by the owner or his representative in the road sector (Warsame, 2011; Kraft and Molenaar, 2012). Recent project delivery methods, however, lend themselves to different quality control systems that emphasise other subjective issues and more contractor-led quality management (Battikha, 2003; Kraft and Molenaar, 2012). This view, however, requires some form of motivation and incentive to deliver quality as opposed to the traditional focus on compliance and

penal measures (Warsame, 2011). Non-traditional procurement such as relational and collaborative approaches have been identified as providing a good atmosphere for modern quality management (Warsame, 2011; Kraft and Molenaar, 2012). For instance, a contractor who jointly owns a facility being delivered through a PPP has an incentive to produce a better quality product to reduce operational cost and achieve better returns on investment.

Safety and Developments in Procurement

Rwelamila and Smallwood (1999) suggest inappropriate selection of procurement systems adversely affects health and safety on projects. Best value considerations are generally favoured as more capable of delivering on Health and Safety (H&S) within the procurement of roads, as opposed to the traditional focus on lower cost and overreliance on mechanistic adherence to rules and regulations, such as contracts and specifications (Smallwood, 1998). Sulaiman (2008) recommended integrated procurement as a result of its structural support and inclination towards more cooperation and integration between project actors. Early involvement of the supply chain through integrated procurement promotes more holistic risk appraisals that result in eliminating potentially hazardous project features in the early stages and is recommended by UK's HSE (Fewings, 2013). Primary requirements for enhanced safety performance through procurement include client leadership, team integration, collaboration and incentives (Teo, Ling and Chong, 2005; Sulaiman, 2008). According to Wells and Hawkins (2011), procurement is the single most influential tool for improving these requirements for effective safety management in the developing country context where little external regulatory support often exists.

Environment and Developments in Procurement

Construction of roads may appreciably damage ecosystems and environments with adverse effect on the local people and other users of built roads (Faith-Ell, 2005). Environmental Assessment (EA) and EIA have become commonplace in the delivery of road infrastructure, being a prerequisite in some circumstances to gain permission and approvals at various stages of the procurement process (Arts, Faith-Ell and Chisholm, 2007; Trethanya and Perera, 2009). A major challenge, however, has been the effective integration of the processes within the various phases to ensure the effective flow of information required for decision-making, which is often hindered by communication bottlenecks (Faith-Ell, 2005; Varnäs, 2008; Faith-Ell and Arts, 2009). Trethanya and Perera (2009) advocate contextual application of local environmental requirements on project based management systems in a developing country context. Significant provision has been made within procurement strategies, especially within standard forms of contract, specifications and standards (Arts and Faith-Ell, 2010). According to Faith-Ell, Balfors and Folkeson (2006), communication within the supply chain is the key challenge to the effective application of environmental requirements in road projects. Institutions involved in the development of infrastructure are therefore increasingly resorting to procurement as an instrument to improve performance (Faith-Ell and Arts, 2009). Eriksson and Westerberg (2011) assert that environmental performance is enhanced by co-operative procurement strategies that effectively solve such

problems as communication challenges through more integrated approaches to delivery. This is validated by Faith-Ell and Arts (2009), who specifically advocate the use of integrated procurement to enhance more effective applications of tools such as EIA. To this end they recommend PPP's and overall integrated approaches where issues such as quality and safety are leveraged on sound sustainability principles.

THE INTEGRATION OF QSE IN PROJECT DELIVERY

High level synergistic relations have been found between management systems for QSE in construction (Griffith, 2011). The greatest synergy has been at the operational level, where integration of Quality Management Systems (QMS), Environmental Management Systems (EMS) and Safety Management Systems (SMS) have yielded positive results supported by many case studies (Bhutto, Griffith and Stephenson, 2004; Bernardo et al., 2009). Structural similarities and overlaps exist within each QSE domain, including the fact that they revolve around effective planning, monitoring, control through standards (ISO 9000, ISO 14001 and ISO 18001) and practices (Simon and Douglas, 2013). Supported by case study evidence, QSE has successfully been integrated in contractor organisations and yielded noticeable benefits (Shen and Walker, 2001), such integration being within "the organisational structure, resources and procedures used to plan, monitor and control project quality, safety and environment" in an integrated fashion in order to achieve synergy (Griffith, 1999: 233). According to Shen and Walker (2001), EMS and SMS are subsets of an effective QMS and must be integrated as a logical extension of TQM to effectively realise the benefits of their synergistic capabilities.

The following represent the core principles of integrated approaches to QSE delivery and are synonymous with integrated project delivery philosophies such as concurrent engineering and integrated project delivery (IPD) as highlighted by Bhutto, Griffith and Stephenson (2004) and Griffith (2011): (1) team integration and empowerment (use of cross-functional teams, departments and professionals within organisations and projects), (2) process Integration within a process-based philosophy (process improvement through elimination, lean approach to phasing of core processes), (3) leadership and commitment, (4) use of technology to enhance the process of design, processing and production (e.g., Computer Aided Design [CAD], the use of computers systems to aid a more efficient design process; Building Information Modelling [BIM], the use of Information Communication Technology (ICT) for virtual collaboration and information sharing), (5) use of tools for optimisation of outcomes (e.g., Quality Function Deployment [QFD], a tool used to convert stakeholder requirements into technical project features), (6) effective communication and coordination and (7) development of common protocols and standards.

The key benefits of integration of QSE systems on construction projects as presented in Shen and Walker (2001), Griffith (2011) and Simon and Douglas (2013) include the following: (1) avoidance of duplication from multiple individual systems, (2) elimination of the overlap of effort, (3) reduction in the fuzzy management boundaries between individual systems, (4) broadening of the horizon beyond the functional level of any individual system, (5) enhancement of

sharing of information across traditional organisational boundaries and (6) streamlining of paperwork and communications.

From the above, modern expectations on QSE revolve around similar issues as those for procurement, such as the need for early consideration, and better communication and interaction between teams and key project processes. Modern approaches to procurement were confirmed to be most influential in delivery of better outcomes through an integrated approach (Shen and Walker, 2001; Sulaiman, 2008; Faith-Ell and Arts, 2009; Warsame, 2011). There is a high level of overlap in the major and modern tools (and their variants) used in influencing QSE in the project delivery process including: QFD, EIA, Design Quality Indicators (DQI) and Safety Auditing and Engineering which can be used as vehicles for enhanced QSE within the procurement function (Griffith, 2011). Shen and Walker (2001) also demonstrated the feasibility of integrating QSE within modern road procurement project structures where benefits including time performance were noticeable. Other studies have established location as an influencing factor on benefits derived from integrated management delivery (Simon and Douglas, 2013). These studies have, however, been conducted in a developed rather than a developing country context. This study is aimed at assessing and demonstrating if similar benefits, if any, could be realised in the developing country scenario.

METHODOLOGY

Based on pragmatic philosophical assumptions, a mixed method approach was adopted to explore integrated delivery of QSE in the Ghanaian road sector. Pragmatism as an approach works in between the interpretive and positivist paradigms; it is even more appropriate for this study, which is pinned on both interpretive (qualitative) and positivist (quantitative) tenets. A questionnaire survey (quantitative) was used to aid elicitation and quantitative inference from professional opinion on the feasibility, status and level of integration in the approach to delivery of QSE through procurement. Qualitative interviews were used to provide deeper insight and contextualised explanation of the findings across two public organisations.

Sampling and Data Collection

As cited by Denscombe (2007), decisions on sampling can be precise when based on familiarity and good judgment. Consequently, appropriate respondents were chosen based on those who have direct procurement and QSE responsibilities. The determination of an appropriate sample size was through the Kish formula (Kish, 1965), which was adjusted for non-responses on the basis of response rate from similar research within the same institutions (Chileshe and Berko, 2010). Data collection was limited to two out of the three main public road agencies. Structural and organisational similarities between two ministerial departments (DFR and DUR), however, led to selection of one DUR in addition to the other, which is an autonomous state agency (GHA).

A survey instrument was designed to solicit the respondent's individual perspectives on the following: the existence of synergy, level of synergistic consideration, feasibility of an integrated approach through procurement and

preferred approaches to integration. In view of the importance of the professional opinion of staff within the agencies, a questionnaire survey was adopted to aid wide coverage of the sample population. This consisted of professionals with direct procurement responsibilities within the selected road agencies.

Fifty-eight questionnaires were subsequently distributed across the GHA (31) and DUR (27) resulting in 56% and 78% response rates, respectively, and an overall 66% response rate. The minimum qualification held by respondents was a bachelor's degree (approximately 66%) with 34% holding a master's degree. Overall, 39% of the respondents had between 11 to 15 years of experience while 21% had more than 15 years of experience in the road sector. The sample was composed of civil engineers (55%), quantity surveyors (39%) and geodetic engineers (5%). This is indicative of a significantly suitable calibre of respondents, a good indicator of internal validity (Oppenheim, 1992).

Respondents for interviews

Senior management members within the sample population were contacted as part of the questionnaire distribution to ascertain their willingness to grant interviews. This was viewed as critical to aid deeper exploration of emerging issues due to the likelihood of such persons being strategically adept as a result of their occupation of decision making positions in relation to project delivery. Consequently, three management level staffs were interviewed to complement the data and clarify findings from the questionnaire survey. They consisted of a contracts manager (quantity surveyor) with 15 years of experience from the DUR, and a regional director and a maintenance manager, civil engineers with 16 and 11 years of experience, respectively, from the GHA.

Data Analysis

The analysis of data was performed with the aid of IBM SPSS version 19 and Microsoft Excel (2007) data processing software. Frequencies and percentages were used to aid the descriptive presentation of the results in tables, charts and graphs.

Mean Scores (MS) were computed to aid the descriptive presentation of responses from ordinal data as well as to aid the comparison, ranking and further testing for agreement and variations. MS was used based on the formula adopted in Henjewele, Sun and Fewings (2011) in their study on critical parameters influencing value for money variations in PFI projects in the healthcare and transport sectors in the UK. Mean Scores (MS) were computed per the Equation 1:

$$MS = \sum_{1}^{5} (Pi * Ri\%) \qquad \text{Eq. 1}$$

where, P = rating point at i ($1 \leq i \geq 5$) and
$Ri\%$ = percentage response at rating point i.

The Relative Importance Index (RII) was used to convert ordinal data into measurable figures to aid ranking and descriptive presentation. The formula

adopted for computation was based on Babatunde, Opawole and Ujaddughe (2010) and is presented in Equation 2:

$$RII = \sum_{1}^{5} (Ni \times Ki) / (Rh \times N) \quad \text{Eq. 2}$$

where, *Ni* = the number of respondents choosing rating point *Ki*, *i*(1≤,*i*,≥5),
Ki = rating points (1 to 5) on Likert scale,
N = the total number of responses for variable and
Rh = the highest value in ranking order (5).

Friedman's Test has been used in this study to ascertain the existence of similarities in the following: levels of consideration of QSE in the key procurement stages, the methods used in influencing QSE and organisational competence and capacity for delivering QSE during procurement. Spearman's rank correlation coefficient was used to measure agreement between the two organisations (GHA and DUR) on key issues to determine any peculiarities to each particular organisation.

Telephone Interviews lasting an average of 30 minutes were conducted to solicit data based on a protocol consisting of open-ended questions. These were recorded, transcribed and coded manually through identification of themes from the research objectives for effective comparison and analysis.

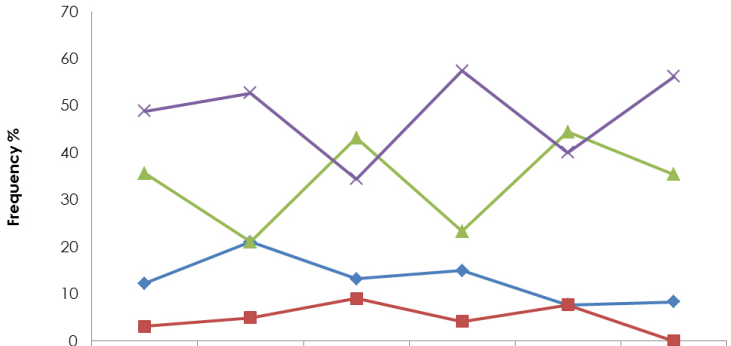
FINDINGS AND DISCUSSION

Questionnaire Survey Findings

Most respondents (71%) were of the opinion that integrated consideration of QSE during procurement will result in better delivery. As indicated in Figure 1, most respondents alluded to the existence of similarities, mostly in organisational structures (58%), procedures adopted (56%), standards and guidance documents used and human resources required (49%) for its delivery during procurement. However, 45% of the respondents cited the existence of significant similarities between safety and environmental aspects only with respect to external legal and regulatory environment, with 43% agreeing to the existence of such similarity in the logistic resource requirements.

Findings indicated a greater focus on the delivery of quality through procurement processes (Table 2). Monitoring during construction was the most used (with MS = 4.42). Specification and standards (with the following MS: Q = 4.32, S = 3.89 and E = 3.45) and conditions of contract (MS: Q = 4.16, S = 3.95 and E = 3.61) were also rated as moderately used. The use of project specific requirements (MS: Q = 3.58, S = 3.24 and E = 2.95) was generally low, indicating that most of the other processes may be fairly standardised across projects (for example, conditions of contract in standard forms of contracts). These findings indicate significant consideration is given to QSE variables at the construction stage as opposed to the front end procurement stages. This is evidenced in slightly lower MS

for the use of brief statements (MS: Q = 3.08, S = 2.61 and E = 2.63) and feasibility and option appraisal (MS: Q = 3.87, S = 3.39 and E = 3.03).



	Human Resources Required for QSE	Standards and Guidance Documents Used (Eg., ISO Standards)	Logistical Resources Used	Organisational Structures Used	Legal and External Regulatory Requirements	Procedures Adopted
QS	12	21	13	15	8	8
QE	3	5	9	4	8	0
ES	36	21	43	23	45	35
QSE	49	53	34	58	40	56

Figure 1. Respondents' Assessment of Areas of Similarity in the Current Delivery of QSE through Procurement

The statistically significant Friedman's test ($p < 0.05$) indicates the existence of significant differences in the extent of use of the outlined processes in delivery of QSE individually. This is indicative of both lack of synergistic consideration currently as well as possible significant variations in the approach and levels of attention paid to QSE through procurement functions.

Respondents were generally of the opinion that their organisations possessed superior capacity in delivery of quality than safety and environment as shown in Table 3. Human resource (MS of 4.21), general know-how (MS = 4.13), clear policies and guidance (MS = 3.95) were rated highest among quality variables. Funding availability (with MS = 3.24) was rated as the least area of capacity in terms of delivering quality. Human resource (MS = 3.32), supporting organisational structures (MS = 3.11) and clear policies and guidance (MS = 3.05) were the highest in the Safety category with legal regulatory environment being the lowest rated variable (MS = 2.24). In the environment category, human resource (MS = 3.05) and general know-how (MS = 2.76) were the highest ratings, with the least being adequate logistics and equipment (MS of 2.26).

A statistically significant Friedman's test (p-values 0.001[$p < 0.05$]) indicates significant distributions of the three scores (QSE) and is indicative of significantly varying levels of competence and capacity in managing QSE within both organisations.

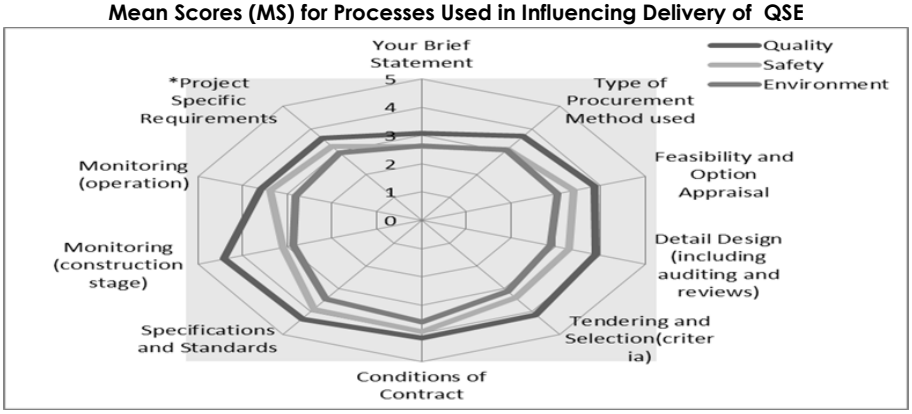
Respondents' views on some key procurement related factors that have been identified as being capable of enhancing delivery of QSE were assessed. Out of 12 factors identified in the literature, four were categorised as the more traditional approach while the other eight factors were categorised as modern and more related to best practice. This was to ascertain overall agreement and

inclination of respondents towards either traditional or modern approaches for effective QSE delivery.

Respondents were generally inclined towards traditional approaches to the delivery of QSE in procurement as presented in Table 4. An average MS of 3.96, interpreted as "Agree", represented traditional approach while MS of 3.35, interpreted as neutral (Neither agree nor disagree), represented modern procurement approaches. "Strict agency or consultant led monitoring of conformance to QSE requirements" was the highest ranking factor (MS = 4.18). "Reliance on contractors self-control" was however the lowest ranking factor (MS = 2.45). Spearman's coefficient (rho = 0.842**) 0.001 ($p < 0.01$**) are statistically significant, which is indicative of a strong positive correlation (agreement) between DUR and GHA respondents on their ratings.

Table 2. Extent of Use of Key Procurement Processes in Influencing QSE

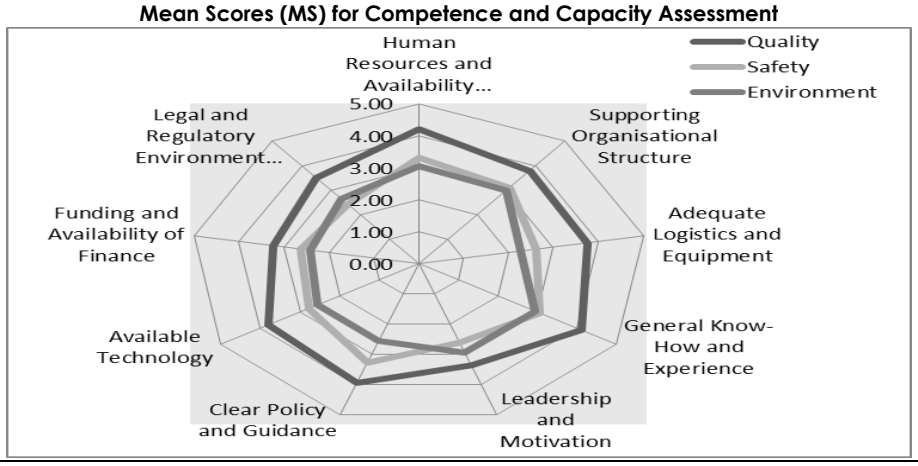
Mean Scores (MS) for Processes Used in Influencing Delivery of QSE



	Q (MS)	S (MS)	E (MS)
Your brief statement	3.08	2.61	2.63
Type of procurement method used	3.68	3.11	3.08
Feasibility and option appraisal	3.87	3.39	3.03
Detail design (including auditing and reviews)	3.89	3.29	2.89
Tendering and selection (criteria)	4.13	3.39	3.11
Conditions of contract	4.16	3.95	3.61
Specifications and standards	4.32	3.89	3.45
Monitoring and evaluation during construction (eg., quality)	4.42	3.11	2.87
Monitoring and evaluation during operation of facility	3.58	3.39	2.82
*Project specific requirements	3.58	3.24	2.95
Friedman's Tests Scores: N = 10; Chi-sq. = 18.200; df = 2; Sig: 0.000			

Notes: *NB requirements used only in specific projects other than generalised and standard requirements used for all projects (where, 1 = Not used; 2 = Slightly extensive; 3 = Somewhat extensive; 4 = Moderately extensive; 5 = Extremely extensive on scale)

Table 3. Respondents Assessment of Organisations Competence and Capacity



	Q (MS)	S (MS)	E (MS)
Human resources and availability of skills	4.21	3.32	3.05
Supporting organisational structure	3.79	3.11	2.68
Adequate logistics and equipment	3.76	2.61	2.26
General know-how and experience	4.13	3.05	2.76
Leadership and motivation	3.37	2.61	2.34
Clear policy and guidance	3.95	3.26	2.55
Available technology	3.82	2.79	2.45
Funding and available finance	3.24	2.63	2.42
Legal environment	3.5	2.42	2.66
Friedman's Tests: N = 9; Chi-sq. = 14.889; df = 2; Sig: 0.001			

Notes: Where, 1 = Poor; 2 = Fair; 3 = Good; 4 = Very good; 5 = Excellent on scale

Table 4. Respondents Agreement on Procurement Related Factors Capable of Delivery of Better QSE

Rank	MS	Procurement Related Factors that Enhance QSE	Individual Organisational Breakdown				
			Factor Category	GHA		DUR	
				MS	Rank	MS	Rank
1	4.18	Strict agency/consultant led monitoring of conformance to QSE requirements	TAF (1)	4.29	1	4.10	2
2	4.16	Greater communication	MAF (1)	3.94	5	4.33	1
3	4.11	Specific guidance and instructions on how to achieve QSE outcome	TAF (2)	4.12	3	4.10	2
4	4.05	Greater teamwork	MAF (2)	4.29	1	3.86	4

(*continued on next page*)

Table 4: (*continued*)

Rank	MS	Procurement Related Factors that Enhance QSE	Individual Organisational Breakdown				
			Factor Category	GHA		DUR	
				MS	Rank	MS	Rank
5	3.95	Strict use of standards and specifications	TAF (3)	4.06	4	3.86	5
6	3.61	Legal binding performance requirements for QSE	TAF (4)	3.94	5	3.33	6
7	3.39	Contractor and supplier selection must not be based on cost but other assessments including the ability to deliver on QSE	MAF (3)	3.76	7	3.10	7
8	3.34	Early contractor and supplier involvement in the procurement process	MAF (4)	3.65	9	3.10	8
9	3.26	Consideration of whole life or long term project /facility performance from onset	MAF (5)	3.76	7	2.86	10
10	3.24	Long term relationships with contractors and suppliers	MAF (6)	3.47	10	3.05	9
11	2.92	Incentive to promote innovative solutions	MAF (7)	3.47	10	2.48	12
12	2.45	Reliance on contractors self-control of QSE performance outcomes	MAF (8)	2.24	12	2.62	11
Average MS for Two Categories of Factors							
1	3.96	All traditional approach related factors	TAF (1 to 4)	4.10	1	3.85	1
2	3.35	All modern approach related factors	MAF (1 to 8)	3.57	2	3.17	2

Notes: Test of Agreement: N = 12; Spearman's rho = 0.842**; Sig: 0.001**. Correlation is significant at the 0.01 level (2-tailed).

Identified methodologies for the integrated delivery of QSE were ranked by respondents in terms of their view on its effectiveness during procurement and are presented in Table 5. The use of integrated teams was ranked highest (RII 0.78), while integrated delivery through integrating key phases such as design and construction (RII 0.62) and merging of departments and teams (RII 0.61) were rated as less effective.

The Spearman Coefficients of (0.321) and 0.483 ($p < 0.05$) are significant and are indicative of disagreement between the two road agencies being surveyed. The most apparent disagreement in Table 5 was on the variable use of tools and procedures to aid optimisation of delivery outcomes, which was ranked 1st and 7th by GHA and DUR respondents, respectively.

Table 5. Respondents Preferred Approach to Integration

Overall		Respondents Preferred Approach to Integration	Individual Organisational Breakdown			
			GHA		DUR	
RII	Rank		RII	Rank	RII	Rank
0.78	1	Use of integrated project teams	0.76	1	0.79	1
0.76	2	Adoption of common protocols and guidance for procedures (eg., ISO Standards)	0.72	3	0.79	1
0.73	3	Enhanced communication through deployment of IT	0.67	4	0.77	3
0.72	4	Use of tools and procedures to aid optimisation of delivery outcomes (eg., QFD and Design Quality Indicators)	0.76	1	0.68	7
0.68	5	Use of technology aided design, construction and simulation methods for integration (eg., CAD)	0.61	5	0.73	4
0.62	6	Integrating planning, design and construction phases of project (eg., using design-build etc.)	0.48	6	0.73	4
0.61	7	Merging departments and teams (using cross functional departments for QSE)	0.47	7	0.71	6

Findings from Interviews

The three interviewees are, respectively, identified as ITW1 (DUR), ITW2 and ITW3 (GHA). All interviews were conducted in confidentiality, and names of interviewees are withheld by mutual agreement. QSE management, in general, is client-led with extensive use of standard specifications and conditions of contract as some of the key tools (ITW1, 2012; ITW2, 2012; ITW3, 2012). Monitoring and supervision during the construction stage is considered the most effective way of monitoring quality (ITW1, 2012; ITW2, 2012). Insufficient capacity (human resource and logistics) in the road agencies, however, hamper effective monitoring and management of QSE issues, a situation made worse by an assertion that safety and environmental issues are often regarded as less important (ITW1, 2012).

Interviewees generally disagreed on procurement or organisational structures that promote process interfacing (such as merging functions or major procurement phases as reiterated in quotes):

> I don't believe design build can improve safety or quality or the environment… (ITW2, 2012)

ITW3 (2012) however, believed that appropriate levels of team interaction have often delivered some efficiencies in their management of QSE during procurement as presented in quote:

> … so when we talk about merging quality control with safety and environment then you are talking about bringing about efficiency … but to merge alone doesn't necessarily bring efficiency … what happens is that when there is procurement, and there is always a coordinating team with experts on all these issues, and they look at issues from an integral point of view, that brings about efficiency… (ITW3, 2012)

Some efforts are being made to increase the uptake of integrated procurement forms, especially through PPP. Interest in these forms of procurement is, however, due to financial imperatives as a solution to acute lack of funding availability for infrastructure development rather than its overall ability to deliver on other strategic and operational delivery objectives such as QSE. Interviewees also assert that the greatest challenge in adoption of integrated and modern procurement forms is non-supportive local procurement laws and legislation (ITW1, 2012; ITW2, 2012; ITW3, 2012).

> There is a lot of interest in private partnerships currently, we have a few projects on the drawing board, which will be PPP, but the focus is more on the finance though … but it will definitely deliver better quality and environment and safety… (ITW2, 2012)

Discussion of Findings

The findings indicate the existence of synergies between QSE's functional and management requirements from a procurement perspective. Hitherto most of the reported synergies have mainly been reported in the construction and contractors' operations aspects of projects (Bhutto, Griffith and Stephenson, 2004; Shen and Walker, 2001; Griffith, 2011). A generally low level of synergistic consideration within the sector is, however, attributable to the extensive reliance on traditional procurement methods, which is regarded as incapable of providing the required atmosphere for an integrated approach to QSE delivery and similarly highlighted by Shen and Walker (2001) in their assessment of an infrastructure project case study. Significantly varying levels of capacity and competence in the respective QSE areas could also be attributed to lack of current synergistic consideration (Bhutto, Griffith and Stephenson, 2004). Perceived higher levels of consideration; use of procurement functions; capacity; and competence in quality, however, validates a general assertion of the lack of importance placed on safety and the environment as key project delivery objectives. This is also in agreement with World Bank (2008) assertions in an evaluation of the Ghana road sector. Furthermore, it reflects observations by Kheni (2008) of poor consideration for safety and Ayarkwa (2010) for environment generally in Ghana. The situation is, however, not different from Trethanya and Perera's (2009) observation that, in developing countries, wider development objectives take precedence over the quest for such issues as environmental stewardship. This, however, represents an opportunity for increasing internal capacity within the public road sector agencies in safety and environment as a result of the general acceptance that principles for their management emanate from quality management (Arditi and Gunaydin, 1997; Rwelamila and Smallwood, 1999; Shen and Walker, 2001; Griffith, 2011).

Theoretical appreciation of the benefits of integration exists; however, a general lack of experience in the use of modern delivery methods limits road sector professionals' recognition of the principal strategic objectives of an integrated approach. Despite an overall acceptance that integration (especially team integration) will deliver, findings indicate a lack of acceptance of process integration and interfacing such as merging construction phases through procurement forms such as DB or merging key organisational departments. However, one of the most important advantages of such process integration is the creation of the necessary interaction and communication between teams, which is invariably consistent with the primary objective of team integration (Fewings, 2013). Contemporary views of requirements for QSE delivery as well as its integration are contingent on such principles as communication, cooperation, interactivity and coupling (Bhutto, Griffith and Stephenson, 2004; Eriksson and Westerberg, 2011). This lack of knowledge on a modern view of procurement and QSE delivery is also evident in the respondents' higher rating of traditional procurement-related factors as better in contributing to enhanced QSE delivery. Knowledge and appreciation of the interrelatedness of both process and people (team) level integration as well as procurement's evolution towards a more strategic function is important, if it is to be used as a lever for innovative incorporation of operational requirements for QSE delivery (Kumaraswamy et al., 2004; Eriksson and Westerberg, 2011).

As similarly noted by previous studies (Ofori, 1992; Kumaraswamy et al., 2004), it is inferred from the findings that QSE is not as highly regarded a project objective as issues such as cost and does not place QSE on the right pedestal to be leveraged through procurement functions. Such awareness and recognition will, however, be vital, especially in view of the road sectors current evolution towards integrated and modern forms (e.g., PPP's). In addition to advocacy for integrated approaches to procurement for enhanced QSE delivery, it is generally recognised as an effective way for the general improvement of construction procurement in developing countries where traditional approaches have been criticised as a cause of underperformance (Kumaraswamy, 2006; Ofori, 2006). A case can also be made for the applicability of procurement as a strategic function for achieving wider project objectives, particularly in other African countries where the state of development in public sector procurement is similar to the Ghanaian situation.

CONCLUSION

This study evaluated the delivery of QSE in the procurement of road infrastructure in Ghana. It examined the use of modern procurement strategies and practices to promote integrated QSE delivery in view of existing synergistic potentials reported in previous studies.

While it is demonstrated that integrated approaches to delivery of QSE are feasible and capable of leveraging procurements' performance-enhancing capabilities, the overall use of integrated procurement to achieve this will be challenging in the developing country context due to funding and inadequacies in legislative frameworks governing procurement. Current levels of synergistic consideration of QSE during procurement are low despite acceptance of the

existence of such synergies. Technical inexperience and knowledge gaps in the use of modern procurement methods is also evidenced as one of the greatest inhibitors towards the road sector's bid to adopt a more integrated approach to delivery of QSE during procurement. While the current ethos for adoption of PPP may be primarily to solve funding problems, it will be vital for a deeper recognition of its capabilities in delivering value and other performance objectives. This will aid strategic incorporation of requisite systems, to aid both technical and managerial competence; conducive project and organisational structures; and motivation and incentives for better QSE delivery for which procurement functions will be used as a leveraging framework.

It is recommended that appropriate technical assistance and technology transfer be sought in the areas of sustainability, TQM and value engineering as part of sourcing for international funding and other forms of assistance for road projects. This should be focused towards the development of in-house procurement delivery strategies or a framework to aid management of procurement. In view of the similarities in the areas of logistics and general resource requirement, it is recommended that an integrated management system approach be devised within public sector agencies specifically for QSE management and monitoring, mainly in the front-end procurement processes.

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