Critical Skills for Infrastructure Procurement: Insights from Developing Country Contexts

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**CRITICAL SKILLS FOR INFRASTRUCTURE PROCUREMENT: INSIGHTS FROM
DEVELOPING COUNTRY CONTEXTS**

Richard Ohene Asiedu¹, Patrick Manu^{2*}, Abdul-Majeed Mahamadu³, Colin Booth³, Paul Olomolaiye⁴, Kofi Agyekum⁵, and Mohamed Abadi²

¹ Department of Building Technology, Koforidua Technical University, Koforidua, Ghana.

² Department of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Manchester, United Kingdom.

³ Department of Architecture and the Built Environment, University of the West of England, Bristol, United Kingdom.

⁴ Vice-Chancellor's Office, University of the West of England, Bristol, United Kingdom.

⁵ Department of Construction Technology and Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

* Corresponding author

Email: Patrick.Manu@manchester.ac.uk

Telephone: 0044 1613067572

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Abstract

Purpose: Effective procurement of infrastructure is partly dependent on infrastructure procurement personnel having the skills that are important for the discharge of their role. Addressing the infrastructure deficits in developing countries, therefore, calls for an understanding of the skills that are important for the discharge of the roles of public personnel that are involved in infrastructure procurement. This study investigates these skills from the perspective of public infrastructure procurement personnel in the sub-Saharan African region.

Design/methodology/approach: A questionnaire survey of procurement personnel yielded 590 useable responses, which were analysed using t-tests and exploratory factor analysis (EFA).

Findings: EFA established eight key components of important infrastructure procurement skills to include skills related to: project success factors; social and environmental sustainability; marketing and e-procurement; project phase management, the application of procurement laws and procedures; soft skills, ICT and communication; and data analysis and team building.

Originality/value: The findings are crucial in developing infrastructure procurement capacity building programmes that would be appropriate for infrastructure procurement personnel in developing country contexts. Infrastructure procurement personnel ought to engage more in capacity development training that is aligned to enhancing skills within the eight components.

Keywords: Developing countries, infrastructure, procurement, skills, survey.

1.0 Introduction

Infrastructure refers to “a system of basic physical structures, facilities and services that are provided to address energy demand, water and food shortages, unemployment, poverty and general improvement in the quality of life” (Asuquo et al., 2021, p. 1-2). Governments worldwide are responsible for the provision of infrastructure (Dithebe et al., 2019; Asuquo et al., 2021). As an important element of modern society, infrastructure is considered as the backbone of various economic activities (Organisation for Economic Cooperation and Development (OECD), 2015). This implies that the absence of a functional infrastructure system can significantly impact the economy of every country. Currently, this assertion has been confirmed by Asuquo et al. (2021) who iterated that in developing countries, the provision of infrastructure projects is central to economic development. Most governments (both developing and developed) across the globe invest a large share of their resources into infrastructure development such as schools, hospitals, roads, railway, power, and telecommunication (Manu et al., 2021). This is besides the fact that these infrastructure are key drivers towards the attainment of the United Nation’s Sustainable Development Goals (SDGs). This intervention is yielding the expected outcomes in most countries across the world (United Nations Economic and Social Council, 2016).

The Global Construction Perspectives and Oxford Economics (2013) predicts a 70 percent rise in global construction output by the year 2025. While deliberate investment contributions are made to bridge the infrastructure gap between low and

high-income economies, the expectation is that a larger proportion of the expected infrastructure growth would be realized in developing and emerging economies (Mahamadu et al., 2018). Public procurement is an important conduit for delivering public infrastructure. Public procurement comprises of all activities beginning with planning and forecasting, identification of needs, sourcing, and solicitation of offers, evaluation of offers, review, and award of contracts, contracting and all phases of contract administration until delivery of the goods, the end of a contract, or the useful life of an asset (United Nations Office for Project Services, 2010). For any organisation to function effectively, it is important to re-emphasise the need for essential competencies and skills for managing these organisational functions. Several authors have investigated the challenges confronting procurement organisations within the public service (Araujo et al., 2005; Ameyaw et al., 2012; Amemba et al., 2013). The findings of most of the investigations highlight procurement personnel capacity challenges (World Bank, 2013). The existence of a functionally robust procurement system, therefore, depends to a large extent, on the availability of a competent team equipped with the requisite skills and knowledge for any specific procurement activities (Thai, 2008).

The lack of capacity and knowledge to steer procurement processes has resulted in poor project governance with ramifications on project cost, time, and quality (Asiedu et al., 2016). Cost and time overruns and poor project quality have the potential to negatively impact project viability and reduce the volume of infrastructure that can be realised from a given funding amount. Humpherson (2011) describes procurement skill as the ability to interact on equal and professional terms with contractual counterparties in the procurement and management of programmes and projects. Skills may be imparted or trained and have a multi-layered concept extending through education, training, learning, practice, educational attainment, and involvement (Elias and McKnight, 2001; Esposto, 2008), directed by code of ethics and conduct. Skill is complex and dynamic and therefore necessitates consistent updates to keep up with current technological trends and market revolution for organizational competitiveness and productivity (Tassabehji and Moorhouse, 2008).

In the Sub-Saharan Africa (e.g., Nigeria and Ghana), a deficit in the quantity and quality of infrastructure is reported (Mahamadu et al., 2018). This deficit is partly attributed to the procurement of such countries which are riddled with an array of challenges, typical of which is the lack of requisite skills of the public procuring entities of such nations (World Bank, 2013). Though an important issue that merits attention, research conducted in this area is scanty. For instance, Mahamadu et al. (2018) conducted a study into ascertaining the infrastructure procurement skills gap amongst procurement personnel in Nigeria's public sector. The findings from their study revealed that out of the 45 procurement skills areas operationalised, there existed significant gaps in 38 of them. Among the key areas that exhibited such gaps were computing/ICT, problem solving, communication, decision making, and health and safety. Though their study is significant, it only concentrated on identifying the gaps that exist among procurement personnel with not emphasis laid on the critical skills needed by these professionals to bridge the skills gap. In an alternative study in Ghana, a strong link was drawn between the reliance on untrained procurement staff and the misapplication of the procurement procedures which affects infrastructure procurement activities (Addo-Duah et al., 2014). Furthermore, in Ghana, a study has shown that attention has been given to the formulation of a legal and regulatory framework and anti-corruption measures to secure economic transparency and accountability to the detriment of developing the skills of procurement professionals

(Addo-Duah et al., 2014). Effective procurement of infrastructure is partly dependent on infrastructure procurement personnel having the skills that are important for the discharge of their role. Addressing the infrastructure deficits in developing countries, therefore, calls for an understanding of the skills that are important for the discharge of the roles of public personnel that are involved in infrastructure procurement. This study, therefore, sought to provide this insight from the perspective of public infrastructure procurement personnel in developing countries (i.e., Ghana and Nigeria). The next section of this paper discusses the status of infrastructure and the skills gap of procurement personnel in developing countries. Subsequently, the research methodology, findings, discussion, and concluding remarks are presented.

2.0 Literature Review

2.1 Status of infrastructure in developing countries

The literature on the role of infrastructure to output, productivity and welfare abound (e.g. Asuquo et al., 2021). A substantial portion of the empirical studies on the effects of infrastructure has focused on its long-run contribution to the level or growth rate of aggregate income or productivity. Most of the studies conducted reveal a positive long-run effect of infrastructure on output, productivity, or growth rate (e.g. Bivens, 2017). Other studies have examined the effects of infrastructure on income inequality (e.g. Calderón and Servén, 2014). The rationale according to the African Development Report (2015) is that infrastructure provision may have an uneven effect on the income and welfare of the poor by raising the value of the assets they hold (such as land or human capital), or by lowering the transaction costs (e.g. transport and logistic costs) they incur to access the markets for their inputs and outputs (see Bivens, 2017). Other related studies have also examined poverty effects of specific infrastructure projects using matching techniques that combine samples of beneficiaries with samples drawn from regular household surveys (e.g. Gebregziabher et al., 2009; Yasuyuki, 2015).

Notwithstanding, infrastructure deficit remains a worldwide phenomenon although its effects are greatly felt in developing countries (Holtz and Heitzig, 2021). Comparatively, the African continent remains at the forefront of infrastructure development needs. Challenges confronting infrastructure in developing countries differ according to the type of country with the most fragile states faced with impossibilities while resource-rich countries lag despite their wealth. Indeed, nowhere is the dearth of infrastructure more critical than Sub-Saharan Africa. The huge gap manifest in the form of congested and deteriorated roads, the absence of recreational facilities, unstable power supply, and lack of or poor public infrastructure assets (UNECF, 2008).

Infrastructure development accounts for more than fifty percent of Africa's value-added growth performance with the possibility of contributing more to the future. Countries in the region trail their counterparts in other developing countries almost by every measure of infrastructure coverage (World Bank Group, 2017). For instance, countries in Africa were at par with their counterparts in South and East Asia with regards to their stocks in roads in the 1960s, telecommunication in the 1970s, and power generation in the 1980s (Foster and Briceño-Garmendia, 2009). Additionally, the power generating capacity in Sub-Saharan Africa was three times more than South Asia in 1970 (*ibid*). By the year 2000, the tables had turned with South Asia producing twice as much power per million people. Likewise, Sub-Saharan Africa had two times

more telecommunication lines as South Asia in 1970, but by the year 2000, the two regions were at par. The challenging nature of Africa's economic geography poses a difficulty for the region's quest for infrastructure development. The continent is characterised by a relatively low population density, low rates of urbanization, and a high number of landlocked countries with several small economies (*ibid*).

A greater share of infrastructure projects in developing countries is publicly procured with the main driver for investment being the central government budget. The infrastructure deficit in developing countries, especially in Sub-Saharan Africa, implies the need for governments in the region to invest heavily in infrastructure procurement. This makes the effectiveness of public procurement and consequently the capacity of procurement personnel paramount.

2.2 Critical skills requirement among procurement officials

The rapid increase in the extent of procurement requirements and activities demands procurement personnel with the requisite skills and knowledge regarding contemporary technologies for managing procurement. Tassabehji and Moorhouse (2008) have identified a correlation between individual skills and organisational performance. According to the authors, while technical skills are seen as a predictor of firm performance, skills which consider non-behavioural skills such as communication and time management predict strategic purchasing while behavioural skills (soft skills) predict supplier responsiveness. Tremblay and Boyle (2018) also opines that irrespective of the robustness and availability of procurement laws, its effective implementation largely depends on the competencies of the workforce. In a study by Cousins et al. (2006), it was established that purchasers who have rather high level of skills tend to have more impact on financial and operational performance. Hence, the central issues therefore regarding the procurement capacity of individuals relate to the availability of the required competencies towards the management of procurement.

There have been several attempts to enhance the skill set of procurement professions within the public sector (Addo-Duah et al., 2014), although according to Giunipero and Percy (2000) there is currently no central reference point for the required procurement skills to allow for uniform capacity development. Nonetheless, Cousins et al. (2006) highlight the relevance of procurement skills and its effects on organisational performance and further recommends more generic management skills and improvement of procurement specific skills. Furthermore, several procurement capacity areas have been suggested to address the evolving roles of procurement to meet strategic objectives. Schapper et al. (2006) differentiated between the traditional and contemporary roles of procurement as indicated in Table 1.

[Insert Table 1 approximately here]

As a result of the changing roles in procurement, the required skills according to Tassabehji and Moorhouse (2008) are gradually becoming multidimensional that spans across interpersonal, strategic, technical, and managerial skills. Additionally, contemporary procurement requires expertise related to value derivation, total life

cycle analysis, and application of information and communication technology (Addo-Duah et al., 2014). The extant literature offers several skills which are required for modern procurement (see Table 2). In line with Tassabehji and Moorhouse (2008), the skills, shown in Table 2, span across interpersonal, strategic, technical, and managerial skills.

[Insert Table 2 approximately here]

3.0 Research Methodology

This study adopted a positivist deductive research paradigm using a quantitative (survey) research strategy for investigating the important skills required by procurement personnel for infrastructure delivery in developing countries. The quantitative approach was selected over the qualitative strategy due to its suitability for capturing and exploring relationships between factors and for ascertaining a generic view of a phenomenon being studied (Yin, 2009; Creswell, 2009). Additionally, other researchers (e.g. Basheka, 2010, Addo-Duah et al., 2014, Mahamadu et al., 2018; Manu et al., 2018, 2019; Agyekum et al., 2021) have also adopted the survey strategy to investigate procurement capacity issues. According to Fellows and Liu (2008), the qualitative approaches are best suited for investigating subjective reality which runs at variance with the aim of this study. The adoption of the quantitative survey approach, therefore, ensured that the experience and views of the procurement personnel were adequately captured.

3.1 Survey Design

The survey focused on practitioners involved in infrastructure procurement within the public sector in Ghana, and those within the local government authorities and state government agencies in Nigeria. . Ghana is made up of sixteen regions and operates a single unified procurement act. Nigeria on the other hand has 36 states and a Federal Capital Territory. Majority of these states operate different procurement laws except for federal government projects (Manu et al., 2017). Although the two countries operate parallel procurement acts, evidence in the literature suggests that issues of procurement relating to Ghana are similar to the situation in many African countries (e.g., Nigeria) and some Asian countries (Ameyaw et al., 2012). In addition to this, the skills needed for any procurement activity (see Table 1) are generic, hence, one may expect that procurement professionals, despite the laws they are operating with, within the two countries under investigation would need similar skills.

A questionnaire was administered to the procurement personnel. The questionnaire covered the background information of the respondents and an assessment of the importance of a list of procurement skills for the procurement of infrastructure. The first section of the questionnaire captured data on: the respondents' role; education; the number of years worked within their current role; the number of years worked as an infrastructure procurement personnel; the type of infrastructure respondents are involved in their procurement; and the phase of infrastructure procurement respondents are involved in. The second section of the questionnaire captured data on the respondents' perception regarding the importance of a list of procurement skills to the discharge of their role in the procurement of infrastructure. Forty five (45)

procurement skills obtained from the literature (Table 2) were assessed. The respondents were asked to rate the extent to which they agreed that the skills are important for the discharge of their role on a five-point Likert scale (i.e. 5 = strongly agree; 4 = agree; 3 = neutral; 2 = disagree and 1 = strongly disagree).

Prior to distribution of the questionnaire, ethics approval was provided by the relevant university faculty ethics review committee. As an ethics requirement a participant information sheet was included with the questionnaire and informed consent was also sought from respondents.

To ensure the achievement of adequate responses amidst the unreliable nature of obtaining responses via a postal survey in Ghana and Nigeria, in both countries, the questionnaires were administered by hand delivery and collection to procurement personnel in public agencies. The sample frame was made up of personnel involved in procuring infrastructure in public institutions in the two countries. Procurement personnel within the Ashanti, Greater Accra and Easter Regions were contacted in Ghana because of the geopolitical significance of the regions (Manu et al., 2021). In Nigeria, the professionals contacted were within the Kaduna and Oyo states. It is acknowledged that Lagos and Abuja have more Federal Government Agencies involved in procurement activities than Kaduna and Oyo states combined. However, government reports have identified Kaduna and Oyo states to be key locations in Nigeria, with serious infrastructure shortfalls (Oyo State Government, 2010; Kaduna State Government, 2018)). As a result, the professionals within those states were well placed to provide the research with the needed information for the study. The purposive sampling approach was used to locate the respondents. . Table 3 shows a summary of questionnaires distributed in each country and their respective response rate. In all, 853 questionnaires were administered comprising 480 (56%) in Ghana and 373 (43%) in Nigeria. Out of this, a total of 590 useable questionnaires (i.e. 69.17%) were retrieved in Ghana (n = 302; response rate = 62.92%) and Nigeria (n = 288; response rate = 77.21%).

[Insert Table 3 approximately here]

3.2 Data analyses

Data from the questionnaire were coded and inputted into Statistical Software for Social Science (SPSS) version 23 for analysis. The analyses were conducted using statistical techniques such as descriptive statistics (i.e. mean, standard deviation, and frequency) and inferential statistics. The inferential statistical analyses comprised: one-sample t-test to identify the most important/critical infrastructure procurement skills; independent samples t-test to explore associations between important procurement skills and procurement role and endeavours (i.e. type of infrastructure in which personnel is involved in their procurement, and the phase of infrastructure procurement involvement by personnel), and exploratory factor analysis to extract the underlying components of the most important/critical infrastructure procurement skills. Regarding the one-sample t-test, a test value of 3.5 (which approximates to the scale point of 4, meaning “agree” was used (see Ahadzie et al., 2008; Mahamadu et al., 2018). Thus, if a skill obtains a mean score which is significantly greater than 3.5 (p (1-tailed) ≤ 0.05), then it implies that the procurement personnel generally agree that

that skill is important for the procurement of infrastructure. The t-test was used because it helped in determining if there was a significant difference between the means of two groups (i.e., the professionals from Ghana and Nigeria), which may be related in certain features (i.e., procurement skills).

4.0 Findings

4.1 Respondents' Background Information

Table 4 shows the demographic information of the respondents. It shows that procurement officers constituted the majority of the respondents, followed by engineers, quantity surveyors, administrators, other roles, purchasing officers, architects, estate surveyors, builders, urban planners and land surveyors, in that sequence. The other roles comprised engineering technologists, accountants, geologists, hydrologists, and environmental health officers. The average years of experience of the respondents in their professional role is 9.12 (standard deviation = 7.29). The average years of experience of the respondents in infrastructure procurement is 6.62 (standard deviation = 5.70). The majority of the respondents are involved in the procurement of housing infrastructure, followed by education, transport, power, water and sanitation, and health infrastructure, in that sequence. The distribution of the phase of infrastructure procurement involvement by the respondents shows that the majority are involved in tendering/sourcing stage. This is followed by execution stage, initiation/planning stage, closure and review stage, and disposal stage. Overall, the demographic information shows that the respondents have adequate professional background and experience in the procurement of infrastructure and thus their responses regarding the second section of the questionnaire can be deemed credible.

[Insert Table 4 approximately here]

4.2 Important Skills for Infrastructure Procurement - One Sample t-test

The one-sample t-test (with test value = 3.5) results of the important/critical skills needed for infrastructure procurement are shown in Table 5. The test revealed that all the 45 skills examined are generally perceived to be important to the procurement of infrastructure. A ranking of the 45 skills based on mean scores revealed the topmost quarter include: *communication (oral/written); procurement planning; quality management; project monitoring and auditing/evaluation; time management; leadership; value engineering; health and safety management; tendering; decision making; computing/ICT; and problem solving*. The least important skills according to the respondents include: *entrepreneurship; application of corporate social responsibility procedures; business case development; stress management; and cross cultural awareness*.

4.3 Components of Important Infrastructure Procurement Skills - Exploratory Factor Analysis

Exploratory factor analysis (EFA) was adopted to uncover the correlation amongst the procurement skill variables to find out which variables could be measuring aspects of the same phenomenon that were thought of as contributing to procurement competencies. It, therefore, presents the choice of gaining a clear interpretation of the variables by explaining the variance in the observed variables in terms of underlying latent factors. The EFA results are shown in Table 6. The Kaiser-Meyer-Olkin measure of sampling adequacy (i.e. 0.946), which is greater than the minimum criterion of 0.5, confirms the suitability of the sample for factor analysis (Field, 2013). The Bartlett's Test of Sphericity being significant (Chi-Square = 10754.381 (df =946), $p < 0.001$) also confirmed the suitability of factor analysis for the data (Field, 2013). Principal component analysis (being the method of extraction) and varimax rotation (being the method of rotation) were adopted for the factor analysis. Based on the eigenvalue of 1.0 and factor loading set at 0.5, eight components were extracted. The variances explained by each of the components is as follows: Component 1 = 32.46%; Component 2 = 5.21%; Component 3 = 4.04%; Component 4 = 3.64%; Component 5 = 2.84%; Component 6 = 2.80%; Component 7 = 2.57%; and Component 8 = 2.40%. The total variance explained by the eight components is approximately 55.80%. Based on an examination of the composing variables with the highest factor loadings, the components can be described as 1 = skills related to project success factors; 2 = skills related to social and environmental sustainability; 3 = skills related to marketing and e-procurement; 4 = skills related to project phase management; 5 = skills related to the application of procurement laws and procedures; 6 = soft skills; 7 = ICT and communication skills; and 8 = Data analysis and team building skills.

[Insert Table 5 approximately here]

[Insert Table 6 approximately here]

5.0 Discussion

The study has revealed skills that are important for public personnel involved in infrastructure procurement within the Sub-Saharan African context. The extent of the importance of the skills for infrastructure procurement could vary depending on the procurement role, type of infrastructure procured, and the phase of infrastructure procurement involvement by procurement personnel. While all the 45 examined skills were deemed important by the procurement personnel for the discharge of their infrastructure procurement role, the study established that the important skills could condense into eight key components.

The major component comprises 7 variables (*strategic planning, quality management, green procurement, risk management, relationship management, time management, and proposal evaluation*). These 7 variables, which together explain 32.46% of the variability in the important competencies for infrastructure procurement by public personnel, were observed to describe “*project success factors*” (see Gunathilaka et al., 2013). Like any function, procurement supports many different kinds of projects. As a matter of fact, a competent procurement personnel must possess various skills

to be able to engage with various stakeholders and suppliers in order to hit their mark. Key among these required skills as revealed in this study are strategic planning skills, quality management skills, green procurement skills, risk management skills, relationship management skills, time management skills, and proposal evaluation skills. These skills as revealed in this study are core project management skills. According to Bartolini (2014), project management is an inherent part of procurement; hence, solid project management skills must be able to assist procurement departments to build and maintain influence. This implies that attaching great importance to expanding the influence of procurement means having a strong belief in acquiring strong project management skills (Bartolini, 2014). According to Williams et al. (2018), the responsibilities of procurement professionals have changed from sheer buyers to managers of physical and intellectual assets, who require expertise in business skills, interpersonal skills, technical skills, transactional skills, strategic skills, and ethical leadership skills (Giunipero et al., 2006; Prier et al., 2010). These skills are required to ensure multifaceted project success. Conventionally, project success has been associated with adherence to cost, time, and scope. However, Shenhar and Dvir (2007) opine that project success can be deployed into more strategic dimensions such as project efficiency and planning. Meanwhile, the success of a project is largely affected by the standards that are set to assess the tenders. For example, several studies have discussed the significant challenges associated with the adoption of the least price as the only criteria for assessing the suitability of tenders (see Bruno et al., 2018; Doloi 2013; Witjes and Lozano, 2016) which highlights the important problem associated with the use of the lowest price as the sole evaluation criterion to reach sustainability goals (Agyekum et al., 2021). Including additional relevant criteria helps to ensure that the economic, technical, and professional capabilities of the tenderer meet the project and client goals. Besides, infrastructure procurement defines the global organisation and framework of tasks and authorities for personnel within the building process which is a crucial factor that leads to overall project success and client satisfaction. Saher and Khan (2018) have established that project risk has a substantial moderation effect on the correlation between strategic project planning and project success. A well-prepared project management plan, therefore, is positively influenced by institutional efficiency in organisations that include risk management and planning while implementing management practices. Hwang and Ng (2013) contend that one of the difficulties confronting the implementation of green procurement is the attendant challenges in selecting subcontractors that offer green construction services, associated with the insecurities and high cost of adopting green equipment and materials. Concerning buyer-supplier association, contractual relationship is portrayed as a continuum between arms-length contractual relations and obligational contractual relations. According to Rahmani et al. (2017), while relationship-based procurement suggests a major advantage to all project participants, decision-makers are cynical. This is attributed to the lack of robust concepts which makes it difficult to validate value for money for public projects, which may result in their dismissal in the future. According to Deep et al. (2018), the absence of an efficient supply chain risk management framework results in adversarial relationships which have the potential to pollute the project environment.

Secondly, the five variables; *cross cultural awareness, stress management, application of corporate social responsibility procedures, environmental management,*

and health and safety management together describe skills related to “*social and environmental sustainability*”. Public procurement organisations worldwide have designed sustainable public procurement (SPP) policies, which oblige suppliers to contribute to the attainment of policy objectives (Grandia and Voncken, 2019). The uptake and implementation of sustainable public procurement policies has received a growing attention in academia (Ongaro, 2017). The uptake and implementation of the SPP is reported to vary greatly across countries, organisations and projects (Grandia, 2016). This is because within public organisations, changes have to be made and barriers removed to achieve the SPP. Sustainable public procurement is considered an umbrella concept that encompasses concerns for social, economic and environmental aspects of procurement decisions (Grandia and Voncken, 2019). According to the Department of Health (2007), it is through the consideration of the balance of social, environmental, and economic factors that we recognise that what we purchase and how we purchase has such a significant role to play. Though the three dimensions must go together to achieve an inclusive and sustainable economic growth, of late the research community has paid attention to issues related to the social and environmental aspects of procurement (Gidigah et al., 2021). This is the case because firms that adhere to the Human-Centred Business Model (HCBM), which complies with a broad set of environmental and social sustainability principles seem perfectly suited already to meet the requirements and specifications of preferred and more specifically sustainable procurement policies (OECD, 2019). Within the context of this study, this assertion by OECD (2019) is the case because the findings revealed the social issues related to procurement to include cross cultural awareness, stress management, and application of corporate social responsibility procedures. The environmental issues were identified to include environmental management, and health and safety management. Sustainable procurement aligns with the principles of sustainable development which includes living within environmental limits (Zhao et al., 2006). According to Bygeth and Hochschorn (2006), environmentally desirable procurement has been progressively growing in both public and private organisations in recent years. There is, therefore, the need for public institutions to appreciate and understand regulations and policies to manage the environmental impacts of their products (Committee for Environmental Cooperation, 1999). The advancement of corporate social responsibility has extended the forms of policies that are now frequently related to public procurement in mitigating environmental issues and social conditions. This according to Rimmington (2006) accounts for why issues about fair trade, reduction in child labour, and environmental sustainability have been brought to the forefront of public procurement discussions.

The four variables; *marketing*, *e-procurement*, *research and development*, and *sustainable design* collectively explain 4.04% of the variance in the important skills for infrastructure procurement. These four variables reveal the need for skills related to “*marketing and e-procurement*”. Expectations to cross-train procurement officers in aspects of marketing, e-procurement, and sustainable design are increasing (Williams, 2018; Abdullahi et al., 2020). Modern procurement officers require expertise in marketing and e-procurement due to their management functions (Oke et al., 2018). According to Nkado (2000), the knowledge base of procurement professionals is key in meeting the changing demands and growth of their market share. Oke et al. (2018) suggest it is therefore required that quantity surveyors and allied procurement professionals within the built environment develop expertise in both curriculum and

professional practice regulations to help sustain and win clients to ensure continuous existence. E-procurement is crucial in enhancing transparency, lowering administrative costs, and improving the economic outcome in a dynamic and competitive environment (Gascó, et al., 2018). The possible effect of public procurement on sustainability is obvious bearing in mind the size and impact of the infrastructure sector as a percentage of the GDP of a country (Preuss, 2009). However, the adoption of e-procurement is dependent on having adequate ICT/computing skills.

The four variables; *tendering, project monitoring and auditing/evaluation, project scope definition, and project strategy development/organisational governance*, explain 3.46% of the variance in the important skills for infrastructure procurement. The four variables describe skills related to key “*project stage/phase management*” along the lifecycle of an infrastructure project. Procurement outcomes in infrastructure projects are considered sensitive to decision making during the planning, design and execution phases of such projects. A procurement strategy will involve choices which are made to determine what must be delivered through a particular contract, the contracting arrangement, promotion of secondary procurement objectives among other things (Watermeyer, 2018). Procurement tactics will also involve the selection of the other party to a contract who is most likely to deliver best value or a cost-effective solution through the performance of the contract (Watermeyer, 2018). This means that for a procurement professional to be strategically and tactically sound, that person must possess certain key skills. The findings from this study revealed that a procurement professional must possess the appropriate tendering skills, project monitoring and evaluation skills, scope definition skills and organizational governance skills. These skills are crucial for managing various phases of projects. Public procurement practice, stretching from contractor selection to post-contract administrative evaluation, have become commonplace across the world as more governments attempt to reform their procurement function (Dimitri, 2013; Kaufmann et al., 2017). Past studies conducted in some advanced countries suggest that some tenderers find procurement regulations somewhat complex which tend to hinder innovation (Aschhoff and Sofka, 2009; Schapper et al., 2006). Choosing a competent contractor through an efficient tendering process is fundamental in ensuring successful project execution. Proper administration of procurement regulations and ethics ensures the tendering process runs smoothly. Sustainable infrastructure must develop technical and engineering skills as well as systems for data collection, monitoring, and evaluation. Monitoring and evaluation are crucial for the provision of a consolidated source of information that displays project progress and allows officials to learn from past experiences. However, according to Adjei-Bamfo and Maloreh-Nyamekye (2019), there is currently no formalised monitoring and evaluation systems in Ghana regarding sustainable public procurement while the needed personnel is lacking. This suggests the absence of the needed capacity to monitor activities of contractors to ensure compliance and guide procurement officials towards the administration of sustainability. The absence of proper monitoring and evaluation also results in opportunistic ventures (Adjei-Bamfo and Malori-Nyamekye, 2019).

Three variables; *application of international procurement law and procedures, application of national procurement law and procedures, and application of modern integrated procurement procedures* collectively describe skills related to the “*application of procurement laws and procedures*”. Procurement has become a politically delicate issue especially because it constitutes a large share of public expenditure. Coupled with this is the extensive misinterpretations and ignorance

among public officers regarding what procurement involves. The findings from this study have revealed that procurement professionals must develop skills in the application of international laws and procedures, application of natural procurement law and procedures, and application of modern integrated procurement procedures. There is often a lack of understanding regarding which skill is needed which poses a huge risk to good governance. Public procurement has ceased to be just a means to an end to being a policy tool that is used to realise expected outcomes. Outcomes that deliver wider public benefit demand assessment beyond financial metrics and require a longer-term measurement of impact (Grandia and Meehan, 2017). These measures may be new and inventive involving iterative network relationships between suppliers, service providers, public bodies, and communities. Hence, if public procurement lacks these capabilities, then its ability to reach desired outcomes in society is limited.

Additionally, the component “*soft skills*” clusters four variables; *creative thinking, problem solving, entrepreneurship, and decision making*. Soft skills are the skills required to have successful interactions with others (Lewis and Boucher, 2012). When accompanied by traditional technical skills, soft skills help to create a more well-rounded skills set. The right balance of soft and technical skills is critical to the success of any procurement department. They are those qualities that enable a person to interact, collaborate, and lead effectively. Soft skills are vital to any management position because they affect both external and internal relationships. According to Bag (2016), most of the procurement officers lack vital soft skills which are needed to complement the technical skills. However, as a procurement professional, especially, in a leadership position, one is expected to be able to effectively motivate the people who work for them, show leadership and bring out the best in employees (Fournier, 2020). From the findings of this study, it is evident that the respondents perceived creative thinking, problem solving, entrepreneurship and decision making to be critical soft skills required by procurement practitioners to be able to function appropriately. Literature reports on other equally important soft skills required by procurement professionals to include the ability to communicate with people at all levels of an organisation, liaise between departments, drive value into other areas of the business, and lead innovation and change (Lewis and Boucher, 2012; James, 2016; Fournier, 2020). It is expected that human resource managers will develop the required training manuals for procurement officers to enhance the essential soft skills. Relationship management/stakeholder engagement skills are very important so that candidates can engage with people and build rapport quickly. So too are supplier management skills and excellent negotiation skills (James, 2016). Soft skills help to enhance personal development and professional ethics. Decision making skills are considered amongst the most significant skills as it encapsulates skills such as flexibility, planning, and problem solving. Jordan and Bak (2016) hold the view that although problem solving skills, for instance, may be imparted in the classroom, professional experience is the most effective way of enhancing the skill.

Three variables; *computing/ information communication and technology (ICT), communication (oral/ written), and conflict resolution and management* were observed to collectively describe skills about “*communication and use of ICT*”. Strong communication skills are necessary for procurement management. The wisdom of teams is hidden in the means of communication among professionals (Lewinson, 2010). Members of effective procurement teams cooperate with each other and clearly and consistently communicate with people within and outside the team regarding issues like vendor management and teamwork (Lewinson, 2010). Effective internal communications ensures that the right decisions are made, conflicts are constructively

handled, and valuable feedbacks are received (Lewinson, 2010). In addition to the normal communication among team members, ICT is seen to play a significant role in innovation processes within the public sector while ICT driven innovations seem to depend on the general ICT infrastructure in a specific policy sector and/or in a particular country (Bekkers & Homburg, 2007; Korteland & Bekkers, 2008). Cooperation amongst project participants is enhanced through effective communication based on trust (Sarker et al. 1998), which is crucial to interface management (Shokri et al. 2012). Cross-functional communication helps to identify and track interface conflicts on time. When interface problems occur, effective and direct communication can help project participants analyse the causes and jointly seek solutions (Dettman and Bayer, 2012). Effective information flow, and relying on high communication quality between project stakeholders, can play a mediating role in the relationship.

Two variables; *data (quantitative and qualitative) analysis* and *team building* were observed to collectively explain skills related to “*data analysis and team building*”. As the procurement team shifts from being a tactical function to strategic function within the supply chain, the skills required of procurement top performers shift as well. Data analysis and team building are two of such critical skills which the procurement team must possess at this stage. Data is a powerful and valuable tool for decision making when in the right hands; however, in the wrong hands it can be meaningless or even damaging to an organisation (ProcureAbility, 2020). As a procurement professional, one would be required to analyse large sets of data like category market data and internal historical procurement data. From this, such professionals are required to act as strategic advisors where they assist a business to develop category strategies, negotiation plans, and pricing models (ProcureAbility, 2020). According to Paulraj et al. (2006), assessing the effect of strategic procurement on supplier integration and performance demands an appreciation of the role procurement could play in integrating supplier-buyer relationships. On a construction project, procurement is responsible for purchasing design services, construction works, goods, etc. Performing this function goes with the formation of an effective procurement team. Team building thus, plays an important role in procurement in the construction sector. The procurement manager who leads the procurement team must possess special team building skills because of his broad roles in developing a clear procurement strategy for the purchasing of goods and services. Thus, skill types targeting global management, such as team building is becoming popular in relation to procurement specific skills.

6.0 Conclusion and Recommendations

Public procurement of infrastructure that is adequate and fit for purpose is partly contingent on the competencies of procurement personnel. The pressing need to bridge the growing infrastructure gap, therefore, requires an appreciation of the various skillset that is useful for procuring infrastructure. Developing countries, especially those in Sub-Saharan Africa remains deficient in both infrastructure (quality and quantity) and the right personnel within the various procurement entities. Literature is, however, unclear on the right mix of critical skills the various procurement personnel require to deliver the needed infrastructure effectively and efficiently.

This study has investigated the important skills needed by public procurement personnel for the discharge of their role in terms of procurement of infrastructure. The study revealed 45 procurement skills that are important to public procurement personnel for the procurement of infrastructure. The study further established that these skills can be consolidated into eight key components of infrastructure procurement skills, namely: *skills related to project success factors; skills related to social and environmental sustainability; skills related to marketing and e-procurement; skills related to project phase management; skills related to the application of procurement laws and procedures; soft skills; ICT and communication skills; and data analysis and team building skills.*

The main implications of the study are two-fold:

- (1) infrastructure procurement personnel should engage more in capacity development activities that are aligned to enhancing the skills that make up the eight key components of infrastructure procurement skills. In connection with this, the staff capacity building plans, programmes and initiatives of infrastructure procurement agencies also need to have greater alignment with the skills that make up the eight components;
- (2) public infrastructure procurement agencies and relevant government agencies (e.g. public procurement governing authorities) in conjunction with other stakeholders (e.g. professional bodies, and educational institutions) need to offer a variety of skills development avenues/opportunities to enable procurement personnel to develop capacity within the key components of infrastructure procurement skill.

Though the findings of this study provide some useful inferences, key limitations are acknowledged. To begin with, the study adopted a quantitative survey of procurement personnel from various public institutions in both Nigeria and Ghana. The underlying explanations regarding the effects of the observed skills on the attainment of procurement objectives could, therefore, not be explored deeper. Qualitative studies could be conducted in the future to unearth further empirical realities regarding the critical skills identified. Also, taking into consideration the fact that the two countries operate parallel procurement acts, it would be good for future studies to consider how the acts of the individual countries impact the critical skills required for infrastructure procurement in the two countries. Again, it must be noted that though Ghana has 16 regions that operate a unified procurement act, Nigeria has 36 states and a Federal Capital Territory with each state having their own procurement laws slightly different from the national public procurement act operated in Nigeria. This implies that though the critical skills identified could be generic, the extent of generalisability of the insights may be limited given that the data was obtained from procurement professionals within specific states and regions in Nigeria and Ghana, respectively. To assist in better generalization, future studies could consider the procurement professionals within other states in Nigeria as well as other developing countries.

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Table 1: Evolution in Procurement and Skills Requirements (adapted from Schapper et al. (2006))

	Traditional Procurement	Modern Procurement
Characteristics	Simple Processes Large goods and products Low value, low risk Back office function Warehousing	Complex Contracts and Relationships Complete service solutions High value, high risk Central to strategic management Just-in-time
Skill requirements	Simple and Basic	Complex and multidisciplinary

Table 2: Procurement skills (adapted from Mahamadu et al., 2018)

Skills	Example of sources
Business case development	Carr and Smeltzer (2000), Giunipero et al. (2006), Tassabehji and Moorhouse (2008)
Conflict resolution and management	Dainty et al. (2004), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Contract management and enforcement	Giunipero and Percy (2000), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Cost management and accounting compliance	Carr and Smeltzer (2000), Ahadzie et al. (2009), Addo-Duah et al. (2014)
Creative thinking	Carr and Smeltzer (2000), Dainty et al. (2004), Tassabehji and Moorhouse (2008)
Application of diversity and equal opportunities procedures	Mahamadu et al. (2018)
Cross cultural awareness	Giunipero and Percy (2000), Moorhouse (2008)
Data (quantitative and qualitative) analysis	Giunipero and Percy (2000), Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008)
Communication	Giunipero and Percy (2000), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Decision making	Dainty et al. (2004), Giunipero et al. (2006), Tassabehji and Moorhouse (2008)
Entrepreneurship	Giunipero and Percy (2000), Mahamadu et al. (2018)
Environmental management	Ahadzie et al. (2009), Mahamadu et al. (2018)
Application of ethics guidelines in procurement	Mahamadu et al. (2018)
E-procurement	Tassabehji and Moorhouse (2008), Mahamadu et al. (2018)
Health and safety management	Ahadzie et al. (2009), Mahamadu et al. (2018)
Leadership	Giunipero and Percy (2000), Giunipero et al. (2006), Addo-Duah et al. (2014)
Market analysis and forecasting	Giunipero and Percy (2000), Tassabehji and Moorhouse (2008), Addo-Duah et al. (2014)
Application of international procurement law and procedures	Mahamadu et al. (2018)
Marketing	Mahamadu et al. (2018)
Negotiation	Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Computing/ICT	Carr and Smeltzer (2000), Giunipero et al. (2006), Addo-Duah et al. (2014)
Problem solving	Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Procurement planning	Tassabehji and Moorhouse (2008), Kwofie et al. (2016), Mahamadu et al. (2018)
Project monitoring and auditing/evaluation	Carr and Smeltzer (2000), Addo-Duah et al. (2014), Kwofie et al. (2016)
Project scope definition	Giunipero et al. (2006), Tassabehji and Moorhouse (2008), Addo-Duah et al. (2014)

Project strategy development/organisational governance	Giunipero et al. (2006), Tassabehji and Moorhouse (2008), Mahamadu et al. (2018)
Proposal evaluation	Giunipero and Percy (2000), Giunipero et al. (2006), Addo-Duah et al. (2014)
Quality management	Dainty et al. (2004), Tassabehji and Moorhouse (2008), Addo-Duah et al. (2014)
Application of corporate social responsibility procedures	Mahamadu et al. (2018)
Relationship management	Giunipero and Percy (2000), Ahadzie et al. (2009), Addo-Duah et al. (2014)
Research and development	Giunipero and Percy (2000), Giunipero et al. (2006), Kwofie et al. (2016)
Responsible sourcing/Green purchasing/Green procurement	Kwofie et al. (2016), Mahamadu et al. (2018)
Risk management	Giunipero and Percy (2000), Tassabehji and Moorhouse (2008), Kwofie et al. (2016)
Stakeholder management	Tassabehji and Moorhouse (2008), Mahamadu et al. (2018)
Strategic planning	Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008), Addo-Duah et al. (2014)
Application of modern integrated procurement procedures	Addo-Duah et al. (2014), Mahamadu et al. (2018)
Stress management	Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008)
Sustainable design	Kwofie et al. (2016), Mahamadu et al. (2018)
Team building	Carr and Smeltzer (2000), Giunipero et al. (2006), Tassabehji and Moorhouse (2008)
Application of national procurement law and procedures	Giunipero and Percy (2000), Addo-Duah et al. (2014), Kwofie et al. (2016)
Tendering	Mahamadu et al. (2018)
Time management	Carr and Smeltzer (2000), Tassabehji and Moorhouse (2008), Ahadzie et al. (2009)
Value engineering	Ahadzie et al. (2009), Mahamadu et al. (2018)
Variation/Change management	Giunipero and Percy (2000), Tassabehji and Moorhouse (2008), Addo-Duah et al. (2014)
Whole life costing and financial analysis	Dainty et al. (2004), Mahamadu et al. (2018)

Table 3: Summary Questionnaire Response Rate

Country	Questionnaire administered	Useable questionnaire received	Response rate
Ghana	480	302	62.92%
Nigeria	373	288	77.21%
Total	853	590	69.17%

Table 4: Background information for the survey participants

Item	Frequency	Percent
<i>Role</i>		
Procurement officer/personnel	139	23.6
Engineer	146	24.7
Quantity surveyor	63	10.7
Purchasing officer/personnel	35	5.9
Architect	32	5.4
Land surveyor	8	1.4
Administrator	56	9.5
Urban/Town planner	23	3.9
Estate surveyor	25	4.2
Builder	24	4.1
Other role	39	6.6
<i>Experience in role (years)</i>		
0-5	248	42.0
6-10	133	22.5
11-15	77	13.1
16-20	59	10.0
Over 20	46	7.8
Non-response	27	4.6
Mean score = 9.12; Standard deviation = 7.29		
<i>Experience in the procurement of infrastructure(years)</i>		
0-5	281	47.6
6-10	128	21.7
11-15	39	6.6
Over 15	40	6.8
Non-response	102	17.3
Mean score = 6.62; Standard deviation = 5.70		
<i>^aType of infrastructure</i>		
Education	151	25.6
Transport	94	15.9
Power generation/Electricity	86	14.6
Water and sanitation	76	12.9
Health	64	10.8
Housing	189	32.0
<i>^aPhase of infrastructure procurement</i>		
Initiation/Planning stage	195	33.1
Tendering/Sourcing stage	238	40.3
Execution stage	196	33.2
Closure and Review stage	35	5.9
Disposal stage	20	3.4

Notes: ^aDue to multiple involvement in infrastructure type and procurement phase by some respondents, total percentage is greater than 100.

Table 5: One sample t-test for the importance of procurement skills for infrastructure procurement

Procurement skills	N	Mean	Rank by Mean	Std. Deviation	Std. Error Mean	Test Value = 3.5						
						t	df	Sig. (2-tailed)	Sig. (1-tailed)	Mean Difference	95% Confidence Interval of the Difference	
											Lower	Upper
Communication (oral/written)	590	4.329	1	0.857	0.035	23.501	589	0.000	0.000	0.829	0.76	0.90
Procurement planning	588	4.241	2	1.889	0.078	9.520	587	0.000	0.000	0.741	0.59	0.89
Quality management	590	4.190	3	0.806	0.033	20.786	589	0.000	0.000	0.690	0.62	0.76
Project monitoring and auditing/evaluation	588	4.172	4	0.817	0.034	19.942	587	0.000	0.000	0.672	0.61	0.74
Time management	589	4.166	5	0.808	0.033	20.021	588	0.000	0.000	0.666	0.60	0.73
Leadership	587	4.162	6	0.796	0.033	20.136	586	0.000	0.000	0.662	0.60	0.73
Value engineering	589	4.146	7	0.861	0.035	18.219	588	0.000	0.000	0.646	0.58	0.72
Health and safety management	588	4.139	8	0.820	0.034	18.913	587	0.000	0.000	0.639	0.57	0.71
Tendering	589	4.134	9	0.781	0.032	19.712	588	0.000	0.000	0.634	0.57	0.70
Decision making	588	4.128	10	0.817	0.034	18.635	587	0.000	0.000	0.628	0.56	0.69
Computing/ICT	588	4.126	11	0.845	0.035	17.969	587	0.000	0.000	0.626	0.56	0.69
Problem solving	588	4.116	12	0.805	0.033	18.551	587	0.000	0.000	0.616	0.55	0.68
Team building	589	4.102	13	0.751	0.031	19.442	588	0.000	0.000	0.602	0.54	0.66
Strategic planning	589	4.100	14	0.852	0.035	17.091	588	0.000	0.000	0.600	0.53	0.67
Proposal evaluation	587	4.094	15	0.826	0.034	17.413	586	0.000	0.000	0.594	0.53	0.66
Relationship management	586	4.063	16	0.836	0.035	16.310	585	0.000	0.000	0.563	0.50	0.63
Application of national procurement law and procedures	589	4.059	17	0.883	0.036	15.368	588	0.000	0.000	0.559	0.49	0.63
Cost management and accounting compliance	588	4.053	18	0.841	0.035	15.933	587	0.000	0.000	0.553	0.48	0.62
Negotiation	588	4.049	19	0.873	0.036	15.255	587	0.000	0.000	0.549	0.48	0.62
Creative thinking	585	4.041	20	0.881	0.036	14.857	584	0.000	0.000	0.541	0.47	0.61

Application of ethics guidelines in procurement	587	4.041	21	0.937	0.039	13.979	586	0.000	0.000	0.541	0.46	0.62
Contract management and enforcement	587	4.027	22	0.846	0.035	15.097	586	0.000	0.000	0.527	0.46	0.60
Data (quantitative and qualitative) analysis	589	4.020	23	0.799	0.033	15.798	588	0.000	0.000	0.520	0.46	0.59
Environmental management	590	3.993	24	0.856	0.035	13.989	589	0.000	0.000	0.493	0.42	0.56
Project strategy development/organisational governance	586	3.993	25	0.812	0.034	14.698	585	0.000	0.000	0.493	0.43	0.56
Sustainable design	587	3.983	26	0.860	0.036	13.600	586	0.000	0.000	0.483	0.41	0.55
Project scope definition	585	3.979	27	0.821	0.034	14.124	584	0.000	0.000	0.479	0.41	0.55
Application of modern integrated procurement procedures	588	3.974	28	0.893	0.037	12.877	587	0.000	0.000	0.474	0.40	0.55
Variation/Change management	586	3.969	29	0.835	0.034	13.612	585	0.000	0.000	0.469	0.40	0.54
Market analysis and forecasting	588	3.963	30	0.831	0.034	13.501	587	0.000	0.000	0.463	0.40	0.53
Stakeholder management	588	3.952	31	0.899	0.037	12.199	587	0.000	0.000	0.452	0.38	0.53
Risk management	587	3.922	32	0.951	0.039	10.738	586	0.000	0.000	0.422	0.34	0.50
Conflict resolution and management	588	3.920	33	0.919	0.038	11.090	587	0.000	0.000	0.420	0.35	0.49
Whole life costing and financial analysis	587	3.913	34	0.857	0.035	11.677	586	0.000	0.000	0.413	0.34	0.48
Application of diversity and equal opportunities procedures	585	3.908	35	0.875	0.036	11.271	584	0.000	0.000	0.408	0.34	0.48
Application of international procurement law and procedures	589	3.905	36	0.936	0.039	10.504	588	0.000	0.000	0.405	0.33	0.48
Research and development	589	3.903	37	0.878	0.036	11.143	588	0.000	0.000	0.403	0.33	0.47
E-procurement	588	3.869	38	0.949	0.039	9.427	587	0.000	0.000	0.369	0.29	0.45

Responsible sourcing/Green purchasing/Green procurement	588	3.838	39	0.962	0.040	8.528	587	0.000	0.000	0.338	0.26	0.42
Marketing	586	3.834	40	0.852	0.035	9.500	585	0.000	0.000	0.334	0.27	0.40
Entrepreneurship	587	3.816	41	0.940	0.039	8.142	586	0.000	0.000	0.316	0.24	0.39
Application of corporate social responsibility procedures	587	3.802	42	0.919	0.038	7.971	586	0.000	0.000	0.302	0.23	0.38
Business case development	586	3.797	43	0.882	0.036	8.152	585	0.000	0.000	0.297	0.23	0.37
Stress management	587	3.775	44	0.931	0.038	7.157	586	0.000	0.000	0.275	0.20	0.35
Cross cultural awareness	587	3.702	45	0.932	0.038	5.249	586	0.000	0.000	0.202	0.13	0.28

Notes: Scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree

Table 6: Exploratory factor analysis results

Infrastructure Procurement Skills	Communalities after extraction	Components of Important Infrastructure Procurement Skills							
		1	2	3	4	5	6	7	8
Strategic planning	0.564	0.660							
Quality management	0.546	0.628							
Responsible sourcing/Green purchasing/Green procurement	0.615	0.612							
Risk management	0.536	0.604							
Relationship management	0.525	0.597							
Time management	0.424	0.534							
Proposal evaluation	0.492	0.531							
Cross cultural awareness	0.695		0.734						
Stress management	0.639		0.729						
Application of corporate social responsibility procedures	0.639		0.659						
Environmental management	0.629		0.642						
Health and safety management	0.617		0.587						
Marketing	0.558			0.669					
E-procurement	0.575			0.619					
Research and development	0.524			0.565					
Sustainable design	0.610			0.550					
Tendering	0.628				0.722				
Project monitoring and auditing/evaluation	0.587				0.630				
Project scope definition	0.574				0.600				
Project strategy development/organizational governance	0.572				0.599				
Application of international procurement law and procedures	0.713					0.785			
Application of national procurement law and procedures	0.696					0.744			
Application of modern integrated procurement procedures	0.630					0.698			

Creative thinking	0.655						0.661		
Problem solving	0.649						0.616		
Entrepreneurship	0.580						0.574		
Decision making	0.531						0.554		
Computing/ICT	0.634							0.744	
Communication (oral/written)	0.625							0.698	
Conflict resolution and management	0.539							0.606	
Data (quantitative and qualitative) analysis	0.582								0.589
Team building	0.546								0.553
Eigen value		14.284	2.294	1.779	1.524	1.250	1.233	1.132	1.054
Variance explained		32.464	5.213	4.044	3.464	2.841	2.802	2.573	2.396
Scale's Cronbach alpha		0.832	0.837	0.749	0.759	0.797	0.748	0.705	0.649

Notes: The Method of Extraction: Principal Component Analysis. Method of Rotation: Varimax.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.946.

Variance explained by 8 factors = 55.796%.

Bartlett's Test of Sphericity: Chi-Square = 10754.381 (df =946), $p < 0.001$.

Factor loadings below 0.5 have been suppressed.