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Evaluating the Competency Gaps Among Ghanaian Quantity Surveyors in Mechanical and Electrical Services Cost Estimation

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ABSTRACT

Mechanical and Electrical (M&E) services contribute a significant proportion (30% -70%) to a building's total and future costs. Unfortunately, for most quantity surveyors, getting involved in the M&E services cost estimation is an unknown territory. This study was carried out to identify the competency gaps of quantity surveyors that often inhibit their involvement in the cost estimation of M&E services. The study employed a quantitative approach comprising a questionnaire survey to collect data from quantity surveyors. A five-point Likert scale ranging from 1-very low to 5-very high was used. The data collected were analysed using means, standard deviations, bar charts, coefficient of variation, and quadrant analysis. The importance of competency areas was compared with the performance in the respective areas, and the gaps were determined using the coefficient of variation. The study showed that quantity surveyors were less active in M&E services cost estimation. From the initial 22 variables considered in the study, 7 competency areas were identified as gaps. These gaps were specifically associated with M&E services systems, which led to the conclusion that quantity surveyors were deficient in their understanding of M&E services technology. Quadrant analysis of the data revealed 3 competency gap areas that demanded immediate attention. These consisted of competency in industry standards & code of M&E services, competency in materials & equipment components of M&E services, and competency in the installation process of M&E services. To tackle these competency gaps, the study recommended that targeted education and training in the field of M&E services cost estimation be developed for quantity surveyors through collaboration with industry and academia to improve their competencies in M&E services cost estimation, as well as the accuracy of the cost estimates in this crucial aspect of building projects.

Keywords: Competency gaps, Cost estimation, Quantity surveyors, Mechanical and Electrical (M&E) services, Competencies

INTRODUCTION

Mechanical and electrical (M&E) services elements constitute an integral and indispensable component of the modern building construction industry. There is hardly a modern building infrastructure without a component of M&E services element incorporated into it. Generally, M&E services represent the totality of all amenities, facilities, and utilities provided as part of the building to provide for human comfort and convenience (Akinwole, 1992). M&E services installations, therefore, are crucial to the smooth running

of building construction projects (Aibinu *et al.*, 2015). Apart from providing comfortable and healthy conditions in a building (Swaffield and Pasquire, 2000), M&E services also contribute between 10% – 70% to the total building cost. (Aibinu *et al.*, 2015; Olanrewaju and Anahve, 2015; McCaffrey, 2011). Effective cost estimation and management of M&E services in buildings is therefore highly desirable by industry stakeholders (Langdon, 2010), because of the significance of M&E services and their relative cost to the total cost of building projects (Kumar, 2009; CIDB, 2009; Yong *et al.*, 2004).

Cost estimation tasks are mostly performed by quantity surveyors in the building construction industry (Arowoiya et al 2022; Cunningham, 2014; AIQS, 1998; RICS,1998). The Royal Institute of Chartered Surveyors (RICS) broadly defines the quantity surveyor as a professional who has the expertise in administering the cost-related aspects of a construction project across all its stages (RICS,2015). Quantity surveyors are considered to be the cost managers of the construction industry (RICS,2018), and are sometimes referred to as construction economists or cost engineers (Nnadi and Alintah-Abel, 2016). According to Ashworth et al. (2013), the traditional roles of quantity surveyors on a typical construction project include single-rate approximate estimating; cost planning; procurement advice; measurement and quantification; and contract document preparation among others. Quantity surveyors are therefore anticipated to advise clients on cost–quality criteria of the various aspects of the building works, including M&E services systems, as part of their competencies (Ashworth et al., 2013). Although quantity surveyors might not be expected to design and construct M&E services infrastructure, they must demonstrate an adequate understanding of M&E services elements and cost estimation. To the client and the consulting team, the competencies of quantity surveyors are a required deliverable to ensure the success of building projects (Cunningham, 2014).

The competencies of the quantity surveyor are expected to impact every stage of the building construction project, from the early stage, right through to the completion of the project if the client is to achieve value for his/her investment. Notwithstanding these competencies of quantity surveyors, and the cost significance of M&E services, providing reliable cost estimates for M&E services elements has always been a challenging task to perform by the quantity surveying profession (Aibinu *et al.*, 2015). Meanwhile, the belief is that the competencies of quantity surveyors should allow them to provide cost estimates for M&E services just as they do for other building fabrics and finishes (Mitchell, 2016). Unfortunately, for most quantity surveyors, getting involved in the M&E services system and cost estimation is an unknown territory.

As indicated in existing literature, the active involvement of quantity surveyors in preparing cost estimates for M&E services is limited. This is also the case in the Ghanaian Building Construction Industry (GBCI). In Ghana, there seems to be a notable lack of proactive efforts by quantity surveyors in assuming responsibility for this crucial aspect of M&E services cost estimation. This lack of engagement suggests that there are gaps in the competencies among quantity surveyors related to the estimation of costs for M&E services. Consequently, there is a need to identify these competency gaps that hinder quantity surveyors from fulfilling their expected role of providing cost estimates for M&E services. It is worth noting that empirical studies on M&E services cost estimation are scarce in general. Furthermore, no such study had been conducted within the context of the Ghanaian building construction industry at the time of this study.

This dearth of empirical study emphasizes the significance of undertaking the current study in identifying the competency gaps among quantity surveyors in M&E services cost estimation. To achieve this goal, specific competency areas relevant to M&E services cost estimation were identified. The study proceeded to assess the performance of quantity surveyors in each of these areas using the coefficient of variation (CoV) to identify gaps. The extent of participation of quantity surveyors in M&E services cost estimation was also determined. Subsequently, quadrant analysis was conducted to highlight competency gap areas demanding immediate attention.

LITERATURE

Mechanical and Electrical Services in Buildings

M&E services constitute essential facilities that make buildings more than shelters (Swaffield and Pasquire, 2000). There is hardly a modern building infrastructure without a component of M&E services element incorporated into it. Generally, M&E services represent the totality of all amenities, facilities, and utilities provided as part of the building to provide for human comfort and convenience or to meet specialized electromechanical functions of the building as required (Akinwole, 1992). M&E services installations, therefore, are crucial to the smooth running of building construction projects (Aibinu *et al.*, 2015). The M&E services technology is a generic term that is used to comprise many different systems, such as heating, ventilation, and air-conditioning (HVAC) systems, electrical installation, and power distribution, plumbing installation and sprinklers, transportation systems (e.g., lifts and escalators), ductworks, communication, and security systems, firefighting, etc. (Aibinu *et al.*, 2015; Olanrewaju and Anahve, 2015). According to Hall and Greeno (2009), the nature of M&E services makes them specialist work, discrete and complex. This complexity of M&E services stems from its design, technical capability, initial capital involved, contract documentation, and administration (Akinpelu, 2009). However, the complexity of M&E services is too often ignored at the inception of building projects (Churcher, 2009). M&E services are also known by the following names: building services (Olanrewaju and Anahve, 2015; Ashworth, 2010), engineering services (Aibinu et al. 2015), and mechanical, electrical, and plumbing or MEP (Kwon *et. al.*, 2019; Hanna *et al.*, 2005).

Importance of M&E Services in Buildings

M&E services contribute a significant proportion to a building's capital and future costs (Aibinu *et al.*, 2015). A typical M&E services cost could represent between 10% to 70% of the total cost of a building. (Olanrewaju and Anahve, 2015; McCaffrey, 2011). This cost is expected to rise depending on the sophistication of the M&E services and the purpose of the building (Yusuf *et al*, 2013). For instance, in highly serviced buildings like hospitals, laboratories, mega shopping complexes, and hotels, M&E services cost alone can account for approximately 60% or even more of the capital costs (Olanrewaju and Anahve, 2015; Yusuf *et al.*, 2013). As buildings grow in size and complexity, so is the complexity and cost of the M&E services (Aibinu *et al.*, 2015; Olanrewaju and Anahve, 2015). Further, Olanrewaju and Anahve (2015) state that, the greater the increase in the size of M&E services in capital cost, the higher the operation cost and the maintenance of the building while in operation. Ashworth (2010) alleges that close to 80% of the operating costs of buildings can be attributed to M&E services. According to Rawlinson and Dedman (2010), M&E services can take up 15% of the total volume of a building. Hall and Greeno (2007) also posit that building services cannot be ignored, and architects have to learn to accept and accommodate the increased need for M&E services components like pipes, ducts,

and cabling encroaching onto their designs. Effective cost estimation and management of M&E services in buildings is therefore highly desirable by industry stakeholders (Langdon, 2010), because of the significance of M&E services and their relative cost to the total cost of building projects (Kumar, 2009; CIDB, 2009; Yong *et al.*, 2004). However, the design of M&E services in building projects is becoming more complex, thereby creating an enormous cost estimation and management gap in pricing (Babalola and Adesanya, 2007).

The Quantity Surveyor and M&E Services Cost Estimation

In the building construction industry, the quantity surveyor is responsible for cost advice and cost estimation services on construction projects, as a member of the consulting team. However, the M&E services engineers have traditionally been providing cost estimates for M&E services rather than quantity surveyors (McCaffrey, 2010; Swaffield and Pasquire,1999). Meanwhile, McCaffrey (2010) contends that M&E services cost estimation should not be left in the grips of M&E services engineers, because they are generally not trained to manage costs as effectively as the quantity surveying profession. Leaving M&E services cost estimation in the care of M&E services engineers constitutes a long-existing failure in the quantity surveying profession (Mitchell 2016; McCaffrey, 2010). According to Olanrewaju and Anahve (2015), most building clients have become increasingly frustrated with quantity surveyors' inability to prepare proper cost estimates for M&E services, leading to the inclusion of M&E services in the bills of quantities as a lump sum. Accurate cost estimates of M&E services prepared by quantity surveyors are required to improve both the client's confidence and the reliability of the M&E services cost estimates (Ashworth, *et al.*, 2013; Babalola, 2012). According to Mitchell (2016), the Interim Measure 1 of the Public Works Contract (PWC) of the Republic of Ireland, requires the quantity surveyor to measure and provide cost estimates for M&E services. There is nothing like the M&E services engineer being responsible for M&E services cost estimation like in other jurisdictions, unless having a dual qualification as a quantity surveyor. Thus, for the quantity surveyors to provide value-added services to the client, they must have the competencies to prepare reliable cost estimates of M&E services (Yusuf *et al.*, 2013).

Challenges and Barriers to M&E Services Cost Estimation

Several authors (Aibinu *et al.*, 2015; OGP, 2015; Yusuf and Mohamad 2015) attribute the enormous gap in quantity surveyors' competencies in cost estimation of M&E services to the lack of sufficient skillset and competency in understanding the technology of M&E services design and installation. Mitchell (2015) believes that the specialization and ever-changing technology of M&E services are to be blamed for the current state of affairs. Arowoiya and Akinradewo (2021) observe that some quantity surveyors do not possess enough training to effectively manage the M&E services costs in the construction industry. Buys and Matthew (2005) posit that, historically, the traditional roles of quantity surveyors have been limited to building fabrics and finishes and are not used for M&E services because of their complex nature. Murray (1997) states that, due to the detailed nature of more complicated M&E services installations and the fact that a detailed design is generally not sufficiently complete for pricing at the tender stage, the quantity surveying profession has failed to embrace the role of cost estimation for M&E services. Further, Murray comments that some service engineers are "hostile" and protective in the essence of their work.

METHODOLOGY

A quantitative research approach was employed to collect data for this study. Secondary data were sourced from a review of relevant extant literature on the topic. Based on the literature review (Arowoiya et al., 2022; Mitchel, 2016; Aibinu et al.,2016; and Swaffield, 1999) a list of some competency gap factors or variables was compiled for the study. In addition, informal discussions were held on the subject area with some selected experienced professionals comprising two (2) M&E engineers and two (2) quantity surveyors prior to the actual survey. The idea here was to avoid biases associated with using a single approach to gathering information and to include as many relevant variables in the subsequent survey instrument as possible.

Close-ended questionnaires were prepared based on the variables identified in the literature and the informal discussions to address the research objective. The questionnaire for this study had two parts: Part A was devoted to the demographic data of the respondents, such as years of experience, position in the firm, academic qualification, membership of a professional body, and extent of involvement in M&E services cost estimation. Part B of the questionnaire focused mainly on the objective of the study, which is identifying the competency gaps of quantity surveyors in the cost estimation of M&E services. The responses of each respondent were measured using a five-point Likert scale, ranging from 1 - very low to 5 - very high.

In this study, purposive sampling techniques were employed. The population was limited to quantity surveyors. The Ghana Institution of Surveyors (GhIS) membership list was accessed and used to select respondents for the study. According to the GhIS, there were about 106 registered quantity surveying firms and individual members as of March 2013. Since the number was not that large, a decision was made to include all 106 firms and individuals in the survey. Consequently, 106 questionnaires were distributed, of which 6 were used for pre-testing the questions, whilst the remaining 100 were used for the actual survey. Pretesting a research instrument is an important exercise toward good instrument design because it does not only ensure that all relevant variables are included, but also helps to check whether the raised questions are appropriate, or rhetorical (Dada, 2017; Campanelli, 2008). The final questionnaires were both delivered and returned online.

Prior to data analysis, Cronbach's alpha coefficient test was performed on the data. Cronbach's Alpha is an index commonly employed to measure the reliability of a scale (Tavakol and Dennick, 2011). For scales to be reliable, Cronbach's alpha should exceed 0.700. (Nunnally, 2007). The Statistical Packages for Social Science (SPSS) Version 25 was used for the analysis.

RESULTS AND DISCUSSION

Characteristics of Respondents

Out of the 100 questionnaires administered to quantity surveyors, 92 valid questionnaires, representing 92% of the total were returned. This percentage was considered more than the normal response rate of 30% to 40% (Antwi-Afari et al., 2018).

Descriptive statistics of the demographic revealed that a large percentage (67.39%) of quantity surveyors occupied top management positions in their respective firms, with a whopping 95.65% of them having worked in the industry for more than 10 years, indicating extensive experience in the industry. Almost

all respondents included in this study had the relevant university degree with a minimum of a bachelor's degree (46.74%), and the highest being a PhD (2.17%). The remaining 51.09% of respondents held master's degrees. Furthermore, 88.4% of respondents belonged to a professional body (GhIS), indicating their competency and adherence to best practices in the industry. Based on the respondents' profiles, it can be deduced that the data provided by them can be relied upon and considered sufficiently good enough to report the findings of this study. Respondents' profile is depicted in Table 1.

Table 1: Demographics of Respondents (N=92)

	Frequency (N)	Valid Percentage (%)	Cumulative Percentage (%)
POSITION IN FIRM			
Managing Director	38	41.30	41.30
Director	13	14.13	55.43
Project Manager	11	11.96	67.39
Cost Consultants	24	26.09	93.48
Others	6	6.52	100
EXPERIENCE IN INDUSTRY			
6-10yrs	4	4.35	4.35
11-15yrs	4	4.35	8.70
Above 15yrs	84	91.30	100
LEVEL OF EDUCATION			
Bachelor's Degree	43	46.74	46.74
Master's Degree	47	51.09	97.83
PhD	2	2.17	100
PROFESSIONAL AFFILIATION (GhIS)			
Yes	88	95.65	95.65
No	4	4.35	100

Sources: Field Survey (2023)

Validity of the Questionnaire

The values of the Cronbach Alpha obtained for the dataset of this study were 0.950 and 0.915 respectively for the importance of competency areas and performance in competency areas, justifying the reliability of the scale (Table 2). This meant that the questions measured exactly what they were intended to measure and gave a consistent result.

Table 2. Cronbach's Alpha Reliability Test for the Main Survey Questions

S/N	Reliability Statistics	Cronbach's Alpha	Number of Items
1	Important Competency Areas for M&E Services Cost Estimate	0.950	22
2	Performance in Important Competency Areas	0.9I5	22

Extent of Participation of Quantity Surveyors in M&E Services Cost Estimation

Quantity surveyors were asked to indicate how often they were involved in direct M&E services cost estimation. The results are depicted in Figure 1. Analysis of the results revealed that only a fraction (7.6%) of quantity surveyors were active in M&E services cost estimation. The majority of them (65.22%), however, were not significantly engaged in the cost estimation of M&E services. This represents a compromise on the quality of services provided by quantity surveyors to the construction industry, justifying the need to investigate the competency gaps among quantity surveyors in this domain. The findings agree with those of several authors (Olanrewaju and Anahve, 2015; Yusuf et al., 2013; McCaffrey, 2010) that quantity surveyors are not involved in M&E services cost estimation, leaving that responsibility to the M&E services engineers.

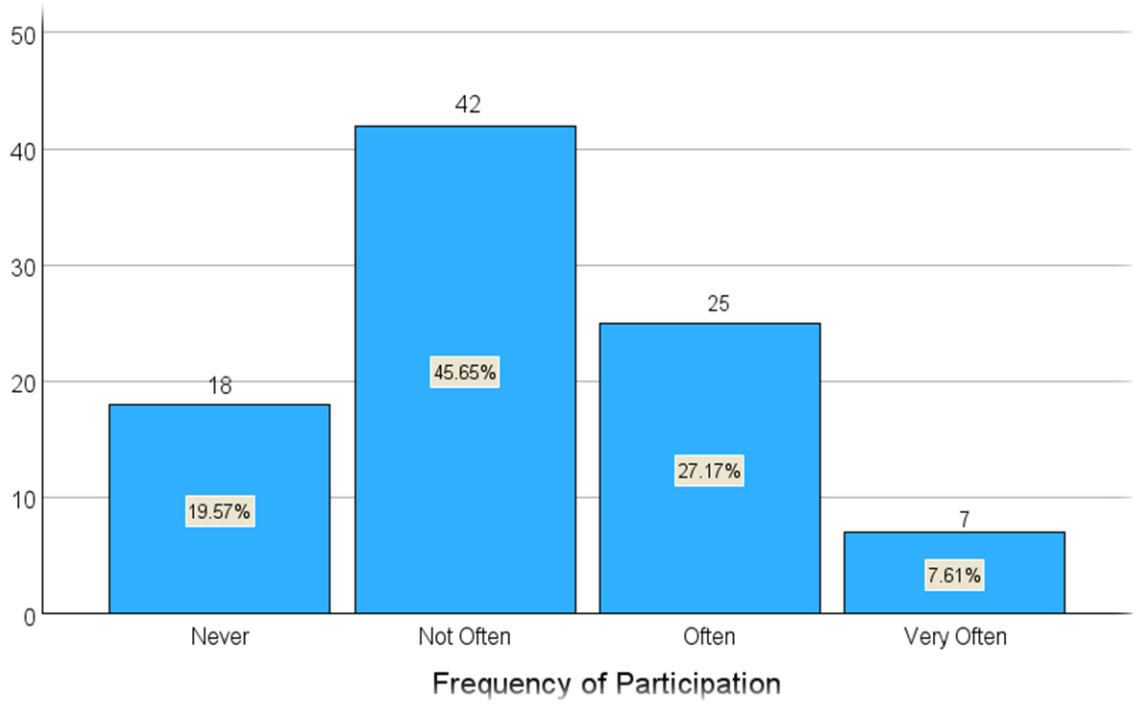

Figure 1: Extent of QSs Participation in Cost Estimation of M&E Services

Competency Gap Areas in M&E Services Cost Estimation

Based on the five-point Likert scale rating, a success criterion was deemed significant if it had a mean of 3.5 or more (Ahadzie, 2007). Considering the 'competency importance' means and 'performance' means in Table 3, the majority of the identified variables had a mean greater than 3.5, signifying the importance of the variables as competency areas for M&E services cost estimation. Moreover, most variables had standard deviations of less than 1.000, indicating a high level of consistency between respondents, depicting a good representation of respondents. The coefficient of variation (CoV) was used to determine the competency gap areas. CoV is a statistical measure that expresses the relative variability (SD) of a dataset as a percentage of the mean. It is often used to compare the degree of variation or relative risk between different datasets (Adinyira et al., 2014).

In an ideal scenario, the performance of quantity surveyors in any specific competency area should, at the very least, match, if not surpass, the importance of that competency area. This implies that quantity surveyors can effectively meet the competency demands of cost estimation.

Table 3 depicts the analysis of the competency gaps for the study which indicated significant competency gaps (IP1 to IP18) of quantity surveyors ranging from -9.12% to 15.81%. The actual gap areas consisted of 7 competency areas (IP1 to IP7). The largest gap was observed with 'competencies in industry standards & code of M&E services' (IP1 = -9.12%), followed by 'competencies in measurement & quantification of M&E services' (IP4 = -6.04%), and 'competencies in the installation process of M&E services' (IP3 = -5.74%). The rest are competencies in materials & equipment components of M&E services (IP = -4.94), competencies in alternative design of M&E services (IP6 = -4.35), competencies in understanding & interpreting M&E services drawings (IP5 = -3.94), with 'competencies in bills of quantities preparation of M&E services' recording the lowest gap (IP7 = -0.25%). Quantity surveyors performed badly in these competency areas. Competency requirement areas with codes IP8 through IP22 did not represent competency gaps as quantity surveyors performed well in these areas.

The findings of the study indicated that quantity surveyors' competency gaps in M&E services cost estimation were predominantly associated with M&E services systems. This suggests that quantity surveyors were particularly deficient in the competency of M&E services technology. These significant gaps may have impeded their capacity to understand the intricacies of the M&E services and standards, impacting the accuracy of their cost estimates. This finding aligns with those of several authors (Arowioya., 2022; Mitchell, 2016; Aibinu et al., 2015; Swaffield and Pasquire, 1999) who contend that a lack of knowledge in the understanding of the technology of M&E services systems inhibits the competency of quantity surveyors to prepare realistic M&E services cost estimates.

On the contrary, quantity surveyors performed well in competency areas coded IP8 through IP22. This finding was not unexpected as these areas are considered fundamental to the quantity surveying profession by authoritative bodies like the Royal Institute of Chartered Surveyors (RICS) and the Australia Institute of Quantity Surveyors (AIQS). Quantity surveyors' competence in these areas demonstrated that they had a strong grasp of essential competency aspects relevant to the general practice of their profession.

Table 3: Competency Gap Areas in M&E Services Cost Estimation

Code	Competency Requirement Areas	Importance of Competency Areas (I)		Performance (P)		CoV – $\left(\frac{Std.Dev}{Mean}\right)x100$		Gaps in %
		Mean	Std. Dev.	Mean	Std. Dev.	I	P	(I-P)
IP1	Competencies in industry standards & code of M&E services	4.39	.889	3.48	1.022	20.25	29.37	-9.12
IP2	Competencies in materials & equipment components of M&E services	4.59	.800	3.89	.870	17.43	22.37	-4.94

IP3	Competencies in the installation process of M&E services	4.53	.791	3.88	.900	17.46	23.20	-5.74
IP4	Competencies in measurement & quantification of M&E services	4.57	.803	4.02	.949	17.57	23.61	-6.04
IP5	Competencies in understanding & interpreting M&E services drawings	4.62	.782	4.16	.868	16.93	20.87	-3.94
IP6	Competencies in alternative design of M&E services	3.86	1.012	3.48	1.064	26.22	30.57	-4.35
IP7	Competencies in bills of quantities preparation of M&E services	4.47	.943	4.14	.884	21.10	21.35	-0.25
IP8	Competencies in construction cost estimating	4.51	.858	4.36	.750	19.02	17.20	1.82
IP9	Competencies in procurement of M&E services	4.07	.981	4.21	.749	24.10	17.79	6.31
IP10	Competencies in whole life-cycle costing	3.85	.901	4.00	.877	23.40	21.93	1.47
IP11	Competencies in valuation	4.01	1.022	4.20	.815	25.49	19.40	6.09
IP12	Competencies in cost-benefit analysis	3.85	.971	4.09	.807	25.22	19.73	5.49
IP13	Competencies in computer skills	3.96	.937	4.21	.833	23.66	19.79	3.87
IP14	Competencies in quality management	3.76	.999	4.03	.805	26.57	19.98	6.59
IP15	Competencies in risk management	3.71	1.000	3.99	.819	26.95	20.53	6.42
IP16	Competencies in financial management	3.68	.960	4.09	.765	26.09	18.70	7.39
IP17	Competencies in project management	3.82	1.026	4.25	.750	26.86	17.65	9.21
IP18	Competencies in critical & analytical skills	3.79	.978	4.24	.803	25.80	18.94	6.86
IP19	Competencies in team-	3.72	1.083	4.25	.721	29.11	16.96	12.15

	working							
IP20	Competencies in Mathematics/ numeric skills	3.83	1.075	4.40	.771	28.07	17.52	10.55
IP21	Competency /skills in negotiation	3.59	1.039	4.33	.827	28.94	19.10	9.84
IP22	Competencies in interpersonal & communication skills	3.47	1.104	4.26	.709	31.82	16.64	15.18

Source: Field Survey (2023)

To integrate the ratings of the current competency levels and current performance levels, a quadrant analysis was performed for the competency gap areas. From Figure 2, competencies gap areas coded IP1, IP2, and IP3 constituted significant gaps requiring immediate attention (see quadrant QII). They consisted of 'competencies in industry standards & code of M&E services', 'competencies in materials & equipment components of M&E services', and 'competencies in the installation process of M&E services' respectively. This means that competencies in M&E services technology and standards are a crucial requirement and a must for M&E services cost estimation. The quadrant analysis also revealed that high-performance competency areas were unfortunately not necessarily high-priority areas required for M&E services cost estimation (quadrant QIV). This suggests that the fundamental skills and competencies of quantity surveyors alone were not enough for M&E services cost estimation.

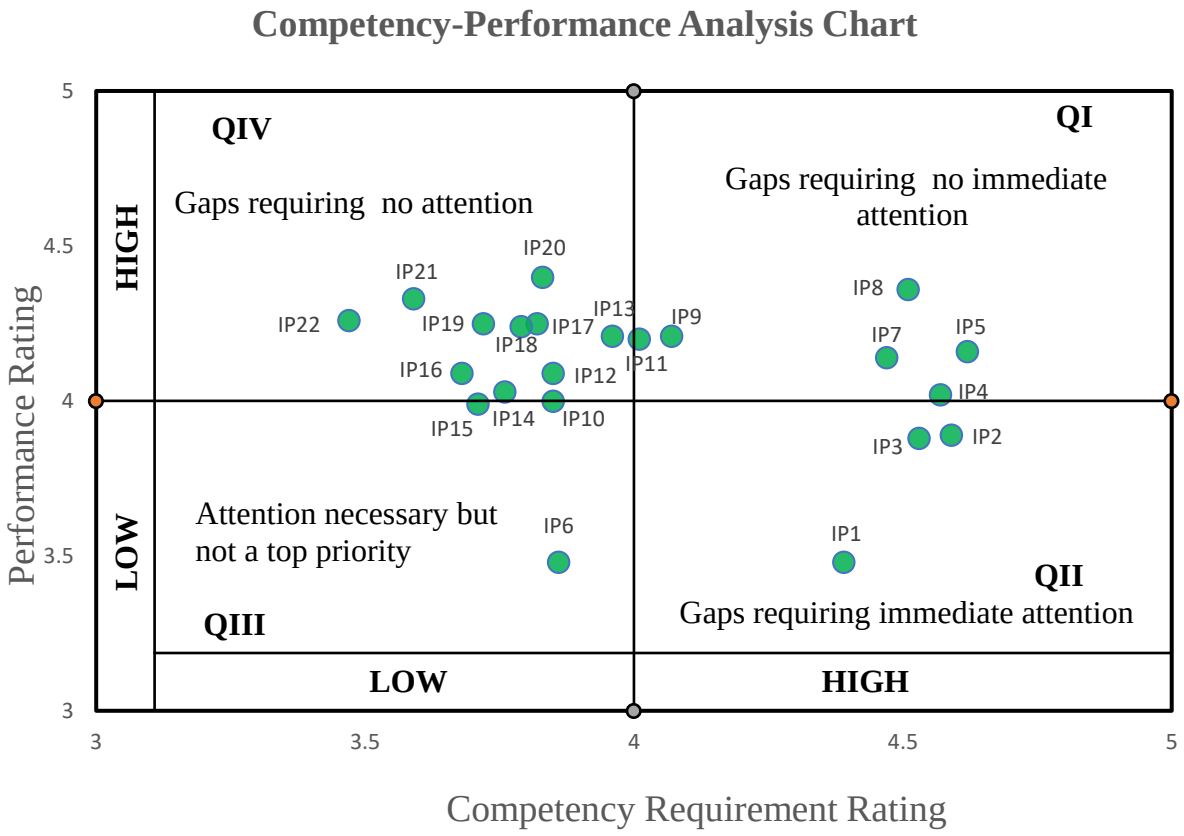

Figure 2: Competency–Performance Quadrant for M&E Services Cost Estimation

Relationship Between Importance and Performance in Competency Areas

The level of relationship between the importance of competency areas and the performance of quantity surveyors in those competency areas for cost estimation of M&E services was determined by conducting a Spearman Rank correlation test. From the result in Table 4, the correlation coefficient of 0.400, indicates a moderate positive relationship between the importance of competency areas and the performance by Quantity Surveyors. The positive values mean that the increase in one construct brings about an increase in another to a moderate degree (Laerd Statistics, 2017), although, the result of the gap analysis (Table 3), indicated that performances were not matching up with the competency areas. The p-value of 0.000 at a significance level of 0.01 meant that there was a significant relationship between competency requirement areas and performance.

Table 4: Correlations Between the Importance of Competency and Performance

			Performance	Importance
Spearman's rho	Performance	Correlation Coefficient	1.000	.455**
		Sig. (2-tailed)	.	<.001
		N	92	92
	Importance	Correlation Coefficient	.455**	1.000
		Sig. (2-tailed)	<.001	.
		N	92	92

**. Correlation is significant at the 0.01 level (2-tailed).

CONCLUSIONS AND RECOMMENDATIONS

The study focused on the competency gaps of quantity surveyors in M&E services cost estimation. It established that quantity surveyors exhibited competency gaps in M&E services technology, which impacted their ability to engage in effective cost estimation of M&E services. Seven competency gaps, related to M&E services technology and systems out of a total of 22 competency variables were identified and used in the analysis. Three competency gap areas emerged as critical, demanding immediate attention. These consisted of competencies in industry standards & code of M&E services, competencies in materials & equipment components of M&E services, and competencies in the installation process of M&E services. Quantity surveyors, however, performed well in those relevant competency areas considered basic to their profession. Unfortunately, these fundamental competencies alone were not sufficient for M&E services cost estimation.

The study adds to the body of knowledge in the field of cost estimation by identifying competency gaps specific to M&E services cost estimation. The findings of the study underscore the importance of targeted education and training in M&E services cost estimation for quantity surveyors to bridge the identified competency gaps, particularly in areas related to industry standards, measurement, quantification, and the installation process of M&E services. Strengthening competencies in these specific areas, and M&E services technology in general, is crucial for enhancing the accuracy and reliability of M&E services cost estimation within the quantity surveying profession. Further studies on the subject area are recommended to validate the findings of this study for generalisation.

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