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Evaluation of Strategic Knowledge Areas Required in Mechanical and Electrical Services Cost Management

Victor Adetunji Arowoiya[1], Olusola Festus Akinradewo[2], and Onaopepo Adeniyi[3]

[1]Assistant Lecturer, Department of Quantity Surveying, Federal University of Technology Akure, P.M.B 704 Akure, Nigeria.
[2]Senior Lecturer, Department of Quantity Surveying, Federal University of Technology Akure, P.M.B 704, Akure, Nigeria (corresponding author).

[3]Senior Lecturer, Department of Architecture and Built Environment, Northumbria University, Newcastle United Kingdom.

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Abstract: Mechanical and Electrical (M&E) services account for 10-70% of the total cost of projects, depending on the project type. Sadly, the complex nature of the design of M&E services among other peculiar attributes has led to an enormous challenge in the cost management of M&E services in the construction industry. This study examined the knowledge areas required to effectively cost-manage M&E services in construction projects. Data for the study were collected by administering copies of a carefully designed questionnaire among experts in M&E services after a pilot study with a team of experts. The variables outlined in the questionnaire were extracted from relevant literature. In selecting the M&E services experts that participated in the survey, purposive and snowballing sampling techniques were used. The professionals involved include electrical, mechanical engineers, and quantity surveyors. Data analysis was done using mean item score, gap analysis, Spearman rank correlation, and Kendall coefficient of concordance. Findings revealed that knowledge in Bill of Quantities (BOQ) preparation, valuation, measurement of M&E works, estimating, and quality management were ranked as the most important knowledge areas and a statistically significant agreement among the experts was recorded. Gap analysis revealed that the ability of cost managers/QSs in the knowledge areas is currently below expectation while a moderate relationship was observed between the importance and performance of QSs/cost managers in the knowledge areas. The study concludes that there is a need for cost managers/quantity surveyors to enhance their knowledge in the identified knowledge areas and strive hard to close the gap between importance and performance in the knowledge areas.

Keywords: Cost management, knowledge, M&E projects, performance, skills

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1. Introduction

Mechanical and Electrical (M&E) services are an intricate element of a building, which constitute an important component of construction costs (Yusuf and Mohammed, 2015). M&E services can account for up to 10 to 70% of the construction cost of any project (McCaffrey, 2011). Nowadays, the design and construction of the building have been greatly improved due to the quality and improved standard of living of people. Consequently, the design of M&E services in building projects is becoming more complex thereby creating an enormous cost management gap in pricing (Babalola and Adesanya, 2007). According to Yismalet and Patel (2018), cost management is the process of controlling the expenditure on a construction project from inception to completion stage, within the approved budget and this is an important tool to control and improve the cost performance of construction projects. These cost management roles are majorly performed by quantity surveyors in the construction industry.

Quantity Surveyors (QSs) are described as cost accountants in the construction industry and are sometimes referred to as construction economists or cost engineers (Nnadi and Alintah-Abel, 2016). Basically, QSs are trained as construction cost managers, they are professionally responsible for the financial probity of a construction work. According to Ashworth et al. (2013), the traditional roles of QS on a typical construction project include single rate approximate estimating; cost planning; procurement advice; measurement and quantification; contract document preparation among others. Recently, quantity surveying evolved roles to include whole life costing, value management, sustainability, and facilities management (Wao and Flood, 2016).

QSs acquire training through workplace and formal university education which enhances their competency

level (Perera et al., 2011). The quantity surveying program at the undergraduate level is to give education and training at the degree level with aim of preparing the students to meet the challenges involved in the management of construction projects from the initial to final stages, especially in M&E services (Oke and Ogunsemi, 2017). The problem now lies in the level of knowledge acquired by QSs and how adequate it is to face the challenges out there in the industry. According to Perera et al. (2011), quantity surveying education has failed to identify and understand the multi-dimensional needs of clients to give satisfaction in the cost management of M&E services. Suhaila (2013) affirmed the barriers that hinder QS to manage the cost of M&E services include the omission of M&E services in the scope of work of QS which leads to the work being passed to the M&E engineers. The study also stated that QS faced difficulty in understanding and interpreting M&E components during the measurement of M&E services. This suggests that some knowledge areas are missing from the capability of QSs.

QSs are involved in the procurement of M&E services but most of the services performed are on the downstream side of the supply chain not upstream in Malaysia. In another relevant study, Babalola (2009) only examined the core competencies of QSs in electrical services, this was only on electrical services, and the study was conducted over a decade ago and due to time factors, it is necessary to revalidate the areas of competencies. Oke and Ogunsemi (2017) examined areas of competencies of QSs and their relevance to value management. The study found that the identified areas of competencies are important and relevant to value management with construction economics and professional practice being very relevant.

Basically, it appears that the present education/training of QSs has not led to adequate qualitative competence of the QSs due to the evolving nature of the discipline (Dada and Jagboro, 2012) and the emerging complexities of the construction industry. Other studies that work on skills and competencies of QS have been conducted mainly in the construction industry generally, value management, procurement management, and civil engineering works (Opawole et al., 2010; Dada and Jagboro, 2012; Oke and Ogunsemi, 2009; Oke et al., 2017). A review of the literature available revealed that limited empirical research has actually been done on the knowledge areas needed by QSs in the cost management of mechanical and electrical services. Therefore, there is a need to assess the knowledge areas needed in the cost management of M&E services with the view to enhancing the performance level of QSs. The objectives are; to examine the importance of the knowledge areas required for the cost management of M&E services, examined the performance of QSs on the respective knowledge areas, and presented a gap analysis as well as a relationship between the importance of the knowledge areas and the performance of QSs on each of the areas. Also, Kendall's coefficients were used to validate the findings by determining the level of agreement among professionals.

Research hypothesis

1. Ho1: There is no significant relationship between the importance and performance of QSs in knowledge areas for cost management of M&E services
2. Ho1: There is no agreement between the professionals' perceived performance of QSs on knowledge areas needed for cost management of M&E services

2. Knowledge Areas Relevant to Cost Management of M&E Services

Jack et al. (2006) and the Design Buildings (2020) explain some knowledge areas required for the cost management of M&E services. These knowledge areas include:

Knowledge in measurement: This refers to the understanding of design and being able to quantify each component. It is very important to understand the measurement, design, and construction process which helps in the costing of M&E services (Design Buildings, 2020)

Knowledge in alternative design: This refers to the ability of a cost manager to interpret an alternative design. Knowledge and skills in the area of M&E services component help the cost expert to advise the clients on different options/alternatives and cost implications. This will assist help the client in selecting the best option (Ashworth et al., 2013).

Knowledge in estimating: This refers to the understanding of the estimating procedure and the likely cost to be incurred on the acquisition, installation, and associated administrative costs of the M&E project. This simply refers to when appropriate estimating techniques are used to get the cost of the M&E project (Oforeh and Alufohai, 1998).

Knowledge in feasibility and viability studies: This, when a QS/Cost expert has the knowledge to ascertain whether a project, is realistic and economically viable. The outcome of this study helps the client to go ahead or not (Perera et al., 2010).

Knowledge of the installation process: Knowledge of the installation of M&E components is very vital in the costing of M&E services. The installation process applies to both mechanical and electrical equipment designed to fulfill specific purposes. This will help cost experts in accurately costing M&E works, especially the labor cost (Oforeh, 2008).

Knowledge in financial control: This is the ability of a quantity surveyor to know how to monitor and control the financial resources of M&E services. Financial control is the act of adopting control measures that are necessary to ensure that cost is not exceeded (Jack et al., 2006). This can be done by preparing final statements, final accounts, and cash flows of the M&E project.

Knowledge in valuation: The knowledge of valuation preparation is crucial in monitoring cash flows. This is prepared so that the accurate value of work done by the contractor is being paid (Ashworth et al., 2013).

*Knowledge in the bill of quantity preparation***:** Cost experts must know about preparing a detailed bill of quantity for M&E services with the specification. The knowledge of those scheduled items of work to be carried out under the contract with quantities entered against each item. This bill of quantity provides project-specific measured quantities of the items of work identified by the drawings and specifications in the tender documentation (Design Buildings, 2020).

Knowledge in risk management: QS/Cost experts must understand the possible risks that can affect a M&E project. This is very important for the successful completion of the project at targeted cost, standard quality, and at a fixed time. Risk assessment is used to know the uncertainty concerning costing decisions (Wao and Flood, 2016).

Knowledge in procurement management: This refers to the knowledge required for procuring M&E components. For a professional to cost manage a M&E project, aware of the prices of M&E components is germane to have high bargaining power. It is a process of identifying and obtaining goods, works, and services. It also includes sourcing, purchasing, and covers all activities from identifying potential suppliers through to delivery from supplier to the users or beneficiary. The procurement process is the entire procurement cycle starting from the identification of need, through to the completion of the contract (Sukulpat, 2007).

Knowledge in quality management: The quantity surveyor must know about the quality management of M&E services. This refers to the possession of the skills required to oversee activities and ensure that they are done to the specific standard stated in the bill of quantity or specification. Cost experts should ensure that quality policies and objectives are achieved (RICS, 2006)

Knowledge in value management: A quantity surveyor should have knowledge of value management. Value management can be defined as a systematic process of technical appraisal of a developing project, product, or process to eliminate unnecessary costs and add value while maintaining or enhancing quality, scope, and performance (Jack et al., 2006). It is a process of identifying components that have the best function at a minimal cost. QSs must be versatile about different components that can be used for M&E projects and advice the best component to be used

Knowledge in whole life cycle costing: This includes the initial cost, installation cost, operation and maintenance, and disposal cost. To know the viability of the M&E project, it is, therefore, necessary to understand the life cycle cost (CIPFA, 2011).

Knowledge in cost-benefit analysis: The knowledge of cost-benefit analysis is required to compare the cost with the benefit derived from a purported investment. Cost experts must be able to advise on which M&E components to procure by examining the cost to benefits derived. Potential cost and revenue or intangible benefits are being examined which can be enjoyed from the product (Will Kenton, 2019).

Knowledge in understanding, interpreting M&E components and specifications: The knowledge and understanding of M&E components are important. The symbol that each M&E component represents in the drawing is essential for an expert to know so that the cost of those components can be easily done. The specification of those M&E components is very important in pricing for those components (Oforeh, 2008)

3. Research Methodology

The study commenced with a literature review targeted at identifying the knowledge areas relevant to the management of M&E services. This was followed by a pilot study conducted with five (5) carefully selected experts. These experts include one (1) mechanical engineer, two (2) QSs, and two (2) electrical engineers. The pilot study was conducted to ensure that all relevant variables were included in the research instrument, ambiguous words were not expressed, and appropriate technical terms were used. Pretesting a research instrument helps to check whether the raised questions are appropriate or they are in rhetorics (Dada, 2012). In this study, snowballing and purposive sampling techniques were used in selecting professional experts. The snowballing techniques were used because the sampling frame is difficult to establish. The sampling techniques are premised on the fact that unknown respondents can be known through known respondents. Snowballing is an answer to hidden/concealed respondents. After the pilot survey, the known specialized professionals nominated the unknown professionals, the professionals who work in M&E engineering firms, and some consultancy firms in the study area.

Each identified professional identifies another professional (snow-balling) and other respondents were selected based on researchers' knowledge of the area of practice of the professionals. Eventually, 168 professionals were identified and given questionnaires, 144 copies of the questionnaire were retrieved but 122 questionnaires were suitable for analysis. This connotes a response rate of 73 percent which makes more than the normal response rate of 20-30 percent for questionnaire surveys. The respondents were 68 QSs, 24 mechanical engineers, and 30 electrical engineers. M&E engineers were included because they work together with QSs in those M&E firms and also to prevent a biased view of QSs performance. Most of the un-retrieved questionnaires fall among the mechanical and electrical engineers. The questionnaire administered was designed with different sections, respondents' demographic information such as years of experience, profession, the number of projects engaged, academic qualification, and a number of M&E projects handled was retrieved in the first section. The other part is about the knowledge areas needed in the cost management of M&E services. Five-point Likert Scale was used as the basis for ranking the level of significance and the level of performance in the knowledge areas, 5 represents Very high, 4 indicates High, 3 indicates Average, 2 connotes Low and 1 represents Very low**.** The data collection was conducted within three months via self-administration to respondents and electronic channels. mean item score, bar chart, standard deviation, gap analysis, Spearman correlation, and Kendall's coefficient of Concordance were used in analyzing the retrieved data. The Background information of professionals was presented with a Bar chart, and an average of the responses of professionals were analyzed by mean item score (MIS). Variability or disparity in the responses of professionals was revealed by the standard deviation. A gap analysis was used to compare the current or actual state and the expected or desired state. Spearman correlation test was used to examine the relationship between the importance and performance of these knowledge areas while Kendall's coefficient of Concordance was used to examine the level of agreement between the professionals.

4. Findings and Discussion of Result

Figure 1 shows that 32 respondents work in a consulting firm which represents 26.2% while 90 respondents discharge their duties in an M&E contracting firm which connotes 73.8 percent. The QSs were 68 respondents'

representing more than half of the population while mechanical engineers represent 19.7% of the population and electrical engineers represent 24.6% of the respondents. Ninety-two (92) respondents, i.e., 75.4% of the population were male while the rest were females.

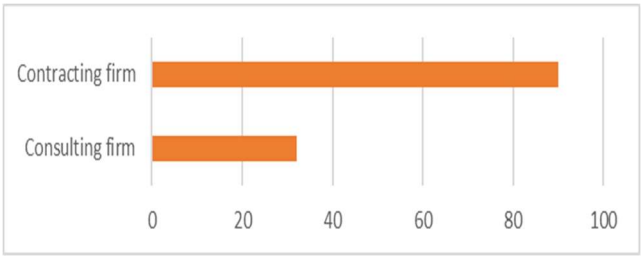

Figure 1. Types of organization

Also, figure 2 shows that higher national diploma holders were 21.3% i.e., 26 respondents, 70 professionals hold Bachelor of Science/Technology degree (B.Sc/B. Tech) i.e., 57.4% of the population while the remaining respondents hold a Master of Science/Technology (M.Sc/M.Tech) degree in their respective professions. For the year of experience, those with a range of 1-5 years were 46 respondents which denotes 37.7% of the population, 54.1% represent 6-10 years which was 66 respondents, 4 respondents fall in the range of 11-15 years which represent 6.6% and those above 20 represent 1.6%. Furthermore, 44 people are a member of their various affiliations which represents 72.1%, 12 respondents belong to a corporate member which represents 19.7 percent and 5 professionals belong to an associate member which represents 8.2%. The last part concerns the number of M&E projects handled by each profession; 13 respondents noted that they have handled 1-5 number of M&E projects which connotes 21.3%. 27.9% have handled 6-10 M&E projects which were 17 respondents, 6.6% of the population belongs to 11-15 numbers executed projects, 3 respondents have handled 16-20 projects while those projects handled above 20 are 24 respondents which represent 39.3%. Based on the findings above this can be affirmed that the data provided by the respondents are reliable

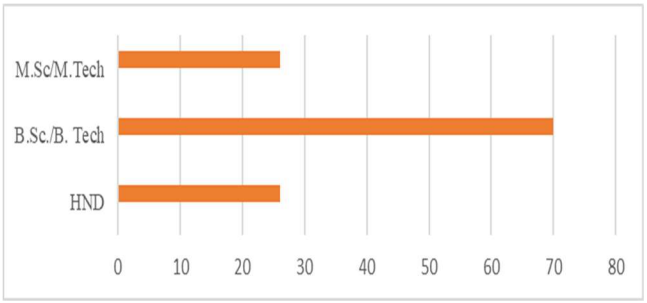

Figure 2. Academic qualifications

Table 1 shows the ranking of the importance of the knowledge areas for cost management of M&E services. The table shows the fifteen variables are important to the cost management of M&E services because their overall mean values are all above 4.00. This ranking revealed the mean item score and the standard deviation of each variable. The largest ranked importance was knowledge in preparing bill of quantity for M&E services of 4.82 to mean value with SD of 0.388 followed by knowledge in valuation of M&E works of 4.77 means value with SD of 0.424. The third-ranked importance was knowledge in the measurement of M&E services and the next was knowledge of estimating techniques. The fifth and sixth-ranked have the same mean with different standard deviations. Lowest SD was ranked first which makes Quality management to be ranked fifth. The least ranked variable was Knowledge in the installation of M&E services having a mean value of 4.03 and SD of 0.8.

Table 2 shows the ranking of the performance of QS in knowledge areas for the cost management of mechanical and electrical services. This ranking reveals the mean item score and the standard deviation of each variable. The largest ranked performance of QS was knowledge in preparing bill of quantity for M&E services of 3.90 mean value with SD of 0.851 followed by knowledge in valuation of M&E works of 3.90 to mean value with SD of 0.978. The third-ranked performance of QS was knowledge in financial control having a mean value of 3.82 and SD of 0.719 the next was knowledge in feasibility study/viability studies of M&E services with 3.72 and 0.777 standard deviations. The least ranked variable is knowledge in the installation of M&E services having a mean value of 3.18 and SD of 1.057. The least ranked has a standard deviation above 1.0 because there is a high disparity between the professionals' opinions. The performance means were fixed at 3.5 and the performance level was set at 95 percent following the conventional risk levels. On this basis, the factors are said to be considered when QSs is performing at 3.5 and above (Ahadzie et al., 2008). Performing areas are knowledge in preparing BOQ, valuation, financial control, feasibility/viability study, measurement, estimating techniques, understanding and interpreting M&E services, risk management strategies, and value management. Non-performing areas are procurement management, the cost for alternative designs, cost-benefit analysis, whole life cycle costing, quality management, and installation of M&E services.

Table 3 shows the gap between the importance and the performance of QS in the knowledge areas required for the cost management of mechanical and electrical services. Ideally, the performance of a QS/cost manager in a knowledge area should match or surpass the importance of the knowledge area. This will imply that the professional can effectively meet up with the knowledge demands of cost management. However, the findings of this study revealed that in terms of the gap between importance and performance, quality management/assurance knowledge ranked first having a gap value of 1.03, this is followed by knowledge in preparing the bill of quantity of M&E services with a gap value of 0.92. The third-ranked gap value is knowledge in cost for alternative designs of M&E services of 0.90 next to knowledge in valuation of M&E services having a gap value of 0.87. The fifth-ranked variable was knowledge of the installation of M&E services. The least ranked is understanding and interpreting M&E components with a gap value of 0.47 which means QSs are not performing to expectation in the knowledge area for cost management of M&E services. There is a need for QSs to improve themselves in the knowledge areas to meet up or bridge the gap between the possessed and expected levels.

The level of relationship between the importance of knowledge areas and the performance of QSs in those knowledge areas for cost management of M&E services

was determined by carrying out a correlation test. From the result below, it can be observed the correlation coefficient (Rs) was 0.654. This means there is a moderate positive relationship between the importance of knowledge areas and the performance of QSs. The positive values mean that the increase of one brings an increase in others to a moderate degree (Laerd Statistics, 2017). Although, based on the result of the gap analysis (Table 3), performances are not matching up with the importance of the knowledge areas. The *p-value* was 0.008 at a significance level of 0.01 which revealed the *p-value* is lesser than the significance level. This means there is a significant relationship between the importance of knowledge areas and the performance of QSs. Therefore, we accept H1 and reject Ho.

Ho1: There is no significant relationship between the importance and performance of QSs in knowledge areas for cost management of M&E services

Kendall's coefficient of concordance (*W*) was computed to further determine the degree of agreement between the professionals on the knowledge areas needed in the cost management of M&E services. Kendall's coefficient of concordance (*W*) takes note of the variation between the ranks that constitute the mean score of each factor. Kendall's coefficient of concordance (*W*) of the components was based on the rating of professionals' experts which was 0.153. Kendall's coefficient is statistically significant at the 0.000 significant level. It is therefore concluded that there is statistically significant agreement among the professional experts. To further buttress the statistical output of Kendall's coefficient, a chi-square (χ^2) test was conducted. The chi-square value (χ^2) of the knowledge area for cost management of M&E services was 130.344. The χ^2 critical value from the chi-square table revealed 23.685 (for p=0.05) and 29.141 (p=0.01) at the degree of freedom (df) of 14. The computed chi-square values (χ^2) were higher than the critical values obtained from the statistical table at a significant level of 0.000 which implied a robust consensus among professionals. Therefore, we reject the null hypothesis (Ho) and accept the research hypothesis (Ha).

Ho1: There is no agreement between the professionals' perceived performance of QSs on knowledge areas needed for cost management of M&E services

Table 1. Importance of the knowledge areas for cost management of M&E

Knowledge areas	QS	Elect.	Mech.	O/R mean	Std. deviation	Rank
Knowledge in preparing bill of quantity for m&e services	4.85	4.80	4.75	4.82	0.388	1
Knowledge of valuation of M&E works	4.85	4.60	4.75	4.77	0.424	2
Knowledge in measurement of m & e services engineering works	4.76	4.20	4.25	4.52	0.648	3
Knowledge in estimating techniques	4.50	4.53	4.42	4.49	0.595	4
Quality management/assurance knowledge	4.32	4.53	4.25	4.36	0.578	5
Knowledge of financial control	4.38	4.27	4.42	4.36	0.633	6
Knowledge of cost for alternative designs of M&E services	4.59	3.93	4.17	4.34	0.574	7
Knowledge in value management/analysis of M&E works	4.53	3.93	4.08	4.30	0.558	8
Procurement management studies knowledge	4.12	4.53	4.33	4.26	0.656	9
Knowledge in feasibility study/viability studies of M&E services	4.35	3.93	4.25	4.23	0.864	10
Understanding and interpreting M&E components and specification	4.29	3.80	4.25	4.16	0.734	11
Knowledge in cost benefit analysis of M&E components	4.09	4.00	4.42	4.13	0.741	12
Whole life cycle costing of M&E services knowledge	4.21	4.07	3.83	4.10	0.746	13
Risk management strategies knowledge	3.97	4.27	4.08	4.07	0.834	14
Knowledge of the installation of M&E services	4.44	3.67	3.33	4.03	0.856	15

Table 2. Performance of QSs in knowledge areas for cost management of M&E

Knowledge areas	QS	Elect.	Mech.	O/R mean	Std. deviation	Rank
Knowledge in preparing bill of quantity for M&E services	4.29	3.47	3.33	3.90	0.851	1
Knowledge of valuation of M&E works	4.38	3.27	3.33	3.90	0.978	2
Knowledge of financial control	4.24	3.40	3.17	3.82	0.719	3
Knowledge in feasibility study/viability studies of M&E services	4.03	3.40	3.25	3.72	0.777	4
Knowledge in measurement of M & E services engineering works	4.05	3.60	2.83	3.70	0.955	5
Knowledge of estimating techniques	4.06	3.20	3.33	3.70	0.955	5
Understanding and interpreting M&E components and specification	4.03	3.40	3.08	3.69	0.886	7
Risk management strategies knowledge	3.88	3.07	3.17	3.54	0.828	8
Knowledge in value management/analysis of M&E works	4.09	3.13	2.33	3.51	0.960	9
Procurement management studies knowledge	3.76	3.00	3.33	3.49	0.674	10
Knowledge of cost for alternative designs of M&E services	3.91	2.87	2.83	3.44	0.992	11
Knowledge in cost benefit analysis of M&E components	3.85	2.87	2.75	3.39	0.988	12
Whole life cycle costing of M&E services knowledge	3.85	2.93	2.58	3.38	0.756	13
Quality management/assurance knowledge	3.79	2.73	2.75	3.33	0.944	14
Knowledge of the installation of M&E services	3.76	2.40	2.50	3.18	1.057	15

Table 3. Comparison of means of knowledge areas needed by QSs

Knowledge areas	Importance mean	Performance mean	Gap	
			Mean	Rank
Quality management/assurance knowledge	4.36	3.33	1.03	1
Knowledge in preparing bill of quantity for M&E services	4.82	3.90	0.92	2
Knowledge of cost for alternative designs of M&E services	4.34	3.44	0.90	3
Knowledge of valuation of M&E works	4.77	3.90	0.87	4
Knowledge of the installation of M&E services	4.03	3.18	0.85	5
Knowledge in measurement of M&E services engineering works	4.52	3.70	0.82	6
Knowledge of estimating techniques	4.49	3.70	0.79	7
Knowledge in value management/analysis of M&E works	4.30	3.51	0.79	7
Procurement management studies knowledge	4.26	3.49	0.77	9
Knowledge of cost-benefit analysis of M&E components	4.13	3.39	0.74	10
Whole life cycle costing of M&E services knowledge	4.10	3.38	0.72	11
Knowledge of financial control	4.36	3.82	0.54	12
Risk management strategies knowledge	4.07	3.54	0.53	13
Knowledge in feasibility study/viability studies of M&E services	4.23	3.72	0.51	14
Understanding and interpreting M&E components and specification	4.16	3.69	0.47	15

Table 4. Test on relationship between means on knowledge areas needed by QSs

			Importance mean	Performance mean
Spearman's rho	Importance mean	Correlation coefficient	1.000	0.654**
		Sig. (2-tailed)	.	0.008
		N	15	15
	Performance mean	Correlation coefficient	0.654**	1.000
		Sig. (2-tailed)	0.008	.
		N	15	15

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

Table 5. Test on the performance of QSs in knowledge areas needed

Knowledge areas	**Mean**	**Std. deviation**	**Rank**
Knowledge in preparing bill of quantity for M&E services	3.90	0.851	1
Knowledge of valuation of M&E works	3.90	0.978	2
Knowledge of financial control	3.82	0.719	3
Knowledge in feasibility study/viability studies of M&E services	3.72	0.777	4
Knowledge in measurement of M&E services engineering works	3.70	0.955	5
Knowledge of estimating techniques	3.70	0.955	5
Understanding and interpreting M&E components and specification	3.69	0.886	7
Risk management strategies knowledge	3.54	0.828	8
Knowledge in value management/analysis of M&E works	3.51	0.960	9
Procurement management studies knowledge	3.49	0.674	10
Knowledge of cost for alternative designs of M&E services	3.44	0.992	11
Knowledge in cost benefit analysis of M&E components	3.39	0.988	12
Whole life cycle costing of m&e services knowledge	3.38	0.756	13
Quality management/assurance knowledge	3.33	0.944	14
Knowledge of the installation of M&E services	3.18	1.057	15
Number of respondents	**122**		
Kendall's coefficient of concordance	**0.153**		
Chi-square	**130.344**		
Degree of freedom (Df)	**14**		
Sig.	**0.000**		

The findings revealed the importance of the knowledge areas to the cost management of M&E services. It was revealed that knowledge of preparation of bill of quantities (BOQ), knowledge of valuation, knowledge of measurement of M&E services, knowledge of estimating techniques, quality analysis, management knowledge, and knowledge of financial control was rated high. This reason is that for QSs to manage M&E services these knowledge areas are very important. For effective management, there is a need to have versed and experienced knowledge in preparing the bill of quantity, valuation, and controlling finances so that resources will be monitored and ensure their cost is not exceeded. This is in line with Mohd Shafiei and Said (2008) who stated that quantification/measurement is one of the most important knowledge areas in the construction of QSs. The findings also partly corroborate Yogeshwaran et. al (2018) where cost estimation was rated the most important area of knowledge area for QSs while delivering construction industry-related services. This implies that estimating knowledge is a vital area in getting the cost of executing M&E services

In terms of performance, it is evident that other professionals rated the performance of QSs low compared to QSs themselves in the cost management of M&E services. There were none of the knowledge areas where the possessed level of QSs is up to the expected level or more. This was shown in the gap analysis results in table 3; this finding does not agree with Yogeshwaran et. al

(2018) where it was revealed that QSs perform more than the expected level in risk management, value management, and life cost analysis. This implies that academia needs to improve and equip upcoming professionals with the right knowledge to meet up with the industry demands and standards. This means there is a gap to bridge the level of knowledge possessed to the level expected by the industry. Furthermore, Wao and Flood (2016) noted that professionals should go beyond conventional duties and acquire knowledge in value management, whole life cycle costing, sustainability, and facilities management. This statement is in support of my findings where QSs were ranked among the least in whole life costing and averagely in value management of M&E services. Perera (2010); Dada and Jagboro (2012) opined that the knowledge of building construction is critical in the knowledge of measurement for building components. This means that knowledge of building construction includes practical aspects of site exposure and how construction processes are done. This is also applicable to M&E services but against my findings where knowledge of installation of M&E services has the least performance for QSs. It implies that QSs are not well exposed to the construction and installation process of M&E works which allows for cost overrun in most projects. It was also affirmed by Unit (2015) who stated that new strategies must be developed to influence the students with intellectual performance and capacity to manage projects

5. Conclusions and Recommendations

Industry practitioners and educational institutions have important roles in passing knowledge to upcoming professionals and graduates. The industry should ensure additional knowledge is given to graduates that are beyond the confining of the curriculum in their degree program. The study revealed knowledge in preparing bill of quantity for M&E services, knowledge in valuation of M&E works, knowledge in measurement of M&E services engineering works, knowledge in estimating techniques, quality management/assurance knowledge, and knowledge in financial control as the most important knowledge areas of QSs in cost management of mechanical and electrical services. Even though QSs performs better in knowledge in preparing bill of quantity for M&E services, knowledge in valuation of M&E works, knowledge in financial control, knowledge in feasibility study/viability studies of M&E services. There are still large gap values between the actual and the expected performance in preparation of BOQ and valuation of M&E services. The QSs are expected to increase their level of knowledge by updating themselves on the current practices. The least performed areas are Quality Management/Assurance knowledge and Knowledge in the installation of M&E services. Those skills and knowledge areas that QSs performed least require urgent attention so that it would be improved in the curriculum used in the training of QSs.

Quantity surveying education must be able to equip them with the knowledge needed for the upcoming professionals to face the challenges and threats in the M&E industry. The spearman correlation conducted revealed that there is a moderate relationship between the importance and performance mean. Kendall's coefficient of concordance was used to show that there is significant agreement among the professionals/expert which means robust consensus among professionals' opinions. It is recommended that there is a need for QSs to develop themselves personally, especially in the areas of the installation process, quality management, and preparing the bill of quantity for M&E services. These require immediate attention because they were rated high in terms of importance but rated low in terms of performance by Nigerian QSs. The curriculum of the educational system for quantity surveying should be reviewed to meet the industry expectations. This can be done by meeting industry practitioners and academia to review the curriculum regularly. Low performance of QSs in those areas listed above can be improved by visiting the site where M&E projects are being executed to give them exposure and experience, attending the symposium, workshops, seminars, etc., conducted by the Nigerian Institute of QSs or relevant professional institutions. Further research can be conducted in other developing countries to ascertain this study for general acceptability.

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Victor A. Arowoiya is an Assistant lecturer in the Department of QuantitySurveying, School of Environmental Technology, Federal University of Technology, Akure, Nigeria. He is also a Master's graduate student from the same institution. Victor is a probationer member of the Nigeria Institute of Quantity Surveyors (NIQS). He is a budding researcher that is passionate about novel research. His research interest includes Cost Management, Green building, Digital technologies, and sustainable construction.

Dr. Olusola F. Akinradewo is a senior lecturer in the Department of Quantity Surveying, School of Environmental Technology, Federal University of Technology, Akure, Nigeria. Olusola does research in Quantitative and Qualitative Social Research. He lectures Pre and Post Contract Administration, Building and Civil Engineering Measurement, Law of Contract, and Arbitration

Dr. Onaopepo Adeniyi holds a Ph.D. in Built Environment with commendable research outputs and university teaching experience in the United Kingdom and Nigeria. His research interest includes quantity surveying practice/education, procurement, disaster/climate resilience, construction project management, and infrastructure development economics. He is highly interested in discussing research collaborations, engagements, and other forms of opportunities in his research area. Onaopepo is a member of the Nigerian Institute of Quantity Surveyors (NIQS), the Quantity Surveyors Registration Board of Nigeria (QSRBN), and a Fellow of the Higher Education Academy (FHEA).