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Evaluating the Competencies of Built Environment Consultants in Contributing to Sustainable Construction in Ghana

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

There is growing evidence that the earth's ability to sustain life as it has been known for thousands of years has been seriously threatened, and if care is not taken, will result in irreversible degradation of the planet, its ecosystems, and ultimately the quality of life (QOL) of its inhabitants. Sustainable construction is a holistic process aiming to restore and maintain harmony between the natural and built environments and create settlements that affirm human dignity and encourage economic equity. In pursuit of achieving sustainable construction (SC) in the Ghanaian construction industry, the competencies of the built consultants cannot be downplayed. The study aimed to evaluate such competencies which are critically required of the built consultants in achieving SC. The study

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adopted a cross-sectional survey design. Architects, quantity surveyors, project managers, and structural engineers in Ghana were the targeted population. The study adopted a purposive sampling technique to select the survey respondents. The findings of the study revealed fifteen (15) critical competencies required of the built environment consultants in the quest of achieving SC in Ghana. These included; Strategic planning, Quality Management, Time management, Team building, Understanding and interpreting building codes and regulations, and Professional ethics. This study contributes to the state of the art by evaluating the competencies of the built environment consultants concerning the adoption and implementation of sustainable construction in Ghana. This would enable policymakers to be able to develop policies to enhance the environment.

Keywords: Sustainable construction; sustainable development; environmental; competence; built consultants; Ghana.

1. INTRODUCTION

The world is faced with lots of challenges concerning climate change, environmental degradation, poor sanitation issues, floods, etc. coupled with the collapse of buildings, construction cost overrun, delays in completion dates, project abandonment, and demolition of unsafe and unauthorized buildings. These affect the environment, have societal effects, and also affect the country's economy. The WCED [1] said "Many present development trends leave increasing numbers of people poor and vulnerable, while at the same time degrading the environment" and the construction sector is guilty of that. The type of buildings designed and supervised by these consultants contribute significantly to these challenges.

Tampa (1994) defines sustainable construction as "the creation and responsible management of a healthy built environment based on resource efficient and ecological principles" as quoted by [2]. Sustainable construction has been identified as one of the ways of curtailing or reducing the challenges that result from the construction industry and has gained serious discussion over the past three decades. To have thriving and healthy communities, we need to have clean air, natural resources, and a non-toxic environment, and the construction industry can lead the way for greener projects [3]. Sustainable construction is not concerned with only environmental issues, but also economic and social matters. It is impossible to separate economic and social development issues from environmental issues (WCED, 1987)

The built environment is very complex, it is faced with challenges and opportunities across both new construction and the management and maintenance of existing ones. The built environment consultants play a significant role and their competencies in sustainable construction matters cannot be taken for granted. Considering the role each consultant plays in executing construction projects, their knowledge, capabilities, and competencies in sustainable construction are key in protecting the environment from pollution from the construction industry not ignoring the social and economic aspects of sustainable development.

Various studies have been conducted on sustainable construction by different people from the perspective of the architect, quantity surveyor/estimator, and other stakeholders in finding out their contribution to the understanding of sustainable construction. Other studies have been done on the pricing of sustainable materials, and the motivation by the architect in designing sustainable drawings.

Of all these studies little is said about the competencies of the built consultants and their contribution to achieving sustainable construction even though it was seen as a requirement for SC. This research seeks to evaluate the competencies of the built environment consultants concerning the adoption and implementation of sustainable construction in Ghana. This research will address the gap in the key competencies required by built environment consultants to meet industry needs and how they can be applied to the implementation of the concept of sustainable construction in Ghana as a developing country.

2. LITERATURE REVIEW

2.1 Sustainable Development (SD)

There is growing evidence that the earth's ability to sustain life as it has been known for thousands of years has been seriously threatened, and if

care is not taken, will result in irreversible degradation of the planet, its ecosystems, resources, and ultimately the QOL of its inhabitants in the not so distant future [4,5]. “Many present developmental trends leave increasing numbers of people poor and vulnerable, while at the same time degrading the environment” (WCED, 1987). As defined by WCED sustainable development is “the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs’’. Sustainability is a long-term goal in which SD indicates the processes and ways of achieving it through education as an integral part [6].

We need to have the future generation in mind in our quest for development for “we do not inherit the earth from our ancestors; we borrow it from our children’’ (Quote investigator, 2013). The earth is exceedingly burdened with the demand to satisfy human needs resulting in threats to its life-supporting services such as the depletion of non-renewable natural resources and climatic changes. Many present efforts to guard and maintain human progress, to satisfy human needs and ambitions are simply unsustainable in both rich and poor nations. (WCED, 1987)

To guarantee a healthy QOL for the present not compromising the future generation, it is imperative to adopt SD principles that consider the environmental, economic, and social pillars Barbier, (1987) cited by, [7] which are interdependent and mutually reinforcing components for SD, attracting investment, generating employment, contributing to the eradication of poverty and providing revenues for sustainable human settlement development [8] [9] stated that “achieving greater efficiency, equity and reduced poverty in economic systems may still generate unintended environmental and social impacts that undermine ecological and social systems”.

2.2 Sustainable Construction (SC)

According to Chamikara et al. [10], Sustainable construction could be considered as construction that is carried out while ensuring a balance among all aspects related to and affected by construction and saving for the future the available limited resources. Kibert (1994), cited by Uher and Lawson, (1998), said SC is the creation of a healthy built environment using resource-efficient and ecologically based principles. Construction in this context refers to all the activities which start before the on-site works such as designs, bidding, awarding through to the construction of the physical structure, handing over, maintenance, demolition, and waste management [5]. The interpretation of SC is, however, contentious and continues evolving, [11]. The fundamental concept of SC is to produce long-term affordability, quality, efficiency, and value to clients and users, whilst decreasing negative environmental impacts and increasing economic sustainability, [12].

2.3 Sustainable Construction Practices in Ghana

Sustainable concepts and practices have taken a centre-stage in different fields of studies and professions [13]. This is because human activities continue to threaten the carrying capacity of earth resources as well as life's basic needs such as shelter. Ghana, a developing nation, has been characterized by a boom in construction activities. Bediako and Frimpong [13] postulated that the over-dependence of the Ghanaian construction industry on Portland cement has contributed to huge sums of foreign exchange used to import cement ingredients, the high cost of buildings, and annual artificial shortages of cement which leads to the high cost of the product. Adjarko et al. [14] study revealed that minimization of resource consumption, improved indoor air quality, and prevention of environmental health problems were among the key environmental sustainable construction principles applicable in the Ghanaian Construction Industry.

However, most of the building structures in Ghana depend largely on energy, increasing energy waste and reducing occupant comfort [15] postulated that recycled construction materials are not fully used in buildings, and they identified unavailability in the industry, uncompetitive price of the product, and lack of incentives for the use of such materials as the cause.

Atombo et al. [15] argued that the challenge the construction industry is facing today is not only to complete projects within time, cost, and quality but to integrate various constraints such as economic, environmental, and social needs in the act of building.

2.4 Construction Sector and Sustainability

The construction sector is a major consumer of non-renewable resources, a source of waste, a polluter of the air and water, and a contributor to land degradation, Wallbaum & Buerkin (2003) cited by Djokoto et al [16] The construction industry is very important, it holds the built environment and puts in place the physical facilities needed for all sectors of development. The understanding of sustainability in building and construction has changed over the years, the emphasis has moved from limited resources such as energy and the impact of construction on the natural environment to more technical issues such as materials, building components, construction technologies, and energy-related designs, [17]. Investment in sustainability strategies and technologies holds promise for significant cost savings in the construction process, [18]. Construction activities can make a significant contribution to conserving biodiversity by applying environmental management in the execution of project [5]. And this can be achieved only through the competencies of the built environment stakeholders.

2.5 Impact of Construction on the Environment

The construction industry is one of the largest industries in both developing and developed countries concerning employment, investment, and contribution to GDP. The construction industry has a greater impact on the environment in developing countries than in developed countries (Plessis, 2001). The sector is also a big "consumer of energy-intensive manufactured materials such as iron, steel, and cement for various construction components such as structural elements, glass for windows, and synthetic materials for sealing and insulation" (Shen, Ou, & Feng, 2006). The construction industry contributes a considerable load on the environment and impacts severely on practically every environmental issue affecting sustainability (Uher & Lawson, 1998). Ametepey et al. [15] grouped the barriers of sustainability into Financial barriers, Political barriers, Management/ Leadership barriers, Technical barriers, Socio-cultural barriers, and Knowledge/ Awareness barriers. Adjarko et al. [14] identified the challenges as a lack of sustainability measures by stakeholders, inadequate knowledge of the concept, and lack of capacity of construction sectors to implement environmentally sustainable construction principles. Hsia et al. (2015) identified high initial cost and the actual cost of projects, lack of research interest, lack of coordination in policies, risk, and uncertainties were some of the bottlenecks to the progress of sustainable building construction from the Ghanaian contractors.

However, these impacts can be minimized if competent built environment consultants with the SC in mind are managing the construction industry. There should be an attempt by players in the construction industry to reduce waste, conserve energy, adopt effective and efficient methods to improve performance, and offer appropriate responses through sustainability methods to market demands. There is therefore the need to combine traditional construction methods and materials with modern trends of construction such as the use of agricultural waste products and other alternative innovations, [19]. As building technologies advance, the elements of sustainability may change and researchers need to be aware of such developments, (Uher & Lawson, 1998), and develop their competencies to meet the current demands.

2.6 General Competency

Bayatzis (1982) defined competence as "an underlying characteristic of a person, which results in effective and/or superior performance in a job" as quoted by [20]. They also cited Chouhan & Srivastava (2014); and Hanna et al. (2018) summarizing the definition of competencies as a combination of exhibits such as motives, traits, self-concepts, attitudes or values, content knowledge or cognitive behavioral skills, and any individual characteristic that can be reliably measured or counted and that can be shown to differentiate superior from average performers. Ulrich et al (2008), said competencies can be understood as having three (3) components which are knowledge, skills, and abilities (KSA model) used to improve performance as cited by, [21]. Furthermore, competency has been defined as "an individual's fundamental characteristic that is causally related to the impact the performance in a job or situation and job tasks" [22].

Competency development according to Bothma [23] in referring to Raiden et al. (2008) indicated that it is a strategic and planned approach to improving the performance of people and teams

by developing their capabilities in that specific industry. Competence is job-specific; it relates to individual skills that are inherent or taught and are transferable, it combines tasks with skills into one system of effective management. Competence is very relevant to the performance of a built consultant in the execution of his or her work in achieving SC. Built environment consultants are expected to exhibit competence in whatever they do to achieve SC, some major components of competencies include ability, attitude, behavior, knowledge, personality, and skills, [24].

Competencies are in three distinct categories, which are [1] Mandatory - personal, interpersonal, professional practice, and business skills, [9] Technical core - the primary skills of each field [13] Technical optional - selected additional skills required for each field of practice [25]. Furthermore, some mandatory competencies according to RICS across all levels include; Ethics, rules of conduct, and professionalism, Client care, Communication and negation, Health and Safety, Accounting principles and procedures, Business planning, Conflict avoidance, management, and dispute resolution procedures, Data management, Diversity, inclusion, and team working, Inclusive environments, Sustainability Using the Grey correlation method [26].

2.7 The Role of Built Consultants in SC-the Need for Relevant Competencies

The execution of a single construction project brings together several professionals for it to be successful. It is expected that each will contribute a certain level of competence throughout the life cycle of the project. In the formal sector, it also brings together several agencies and departments collaborating to achieve successful execution of the project. Clients/owners, designers/architects, quantity surveyors, engineers, procurement expects, contractors/sub-contractors, project managers, suppliers, inspectors, etc. are some of the members of the construction industry and they all contribute to achieving SC [27]. Valdés et al. [28] identified the most important skills as teamwork in a collaborative way, ethics, creativity and innovation, communication and negotiation skills, and empathy with stakeholders. Departments such as land commission, survey departments, local authority, town, and country planning, etc. also perform various roles creating a lot of bureaucracy in the construction industry, [29]. Achieving sustainable construction requires a collaborative effort with the requisite competencies from these teams of professionals and agencies. The individual competence of each professional is fundamental to the general competencies needed in championing SD/SC.

3. METHODS

A positivist philosophical stance is adopted to explain the competencies needed by the consultants in dealing with sustainability issues. As such, deductive reasoning is used to observe phenomena empirically using a predetermined and highly structured data collection technique and then explain with a logical statistical analysis [30]. Franklin [31] argued that the theoretical formulations effectively precede the data-gathering with the latter functioning as proof or 'falsification' of the original supposition, hypothesis, or general theory. The study was quantitative and adopted a questionnaire survey design to gather the data to elicit the competencies for the analysis. A questionnaire survey is best to garner detailed information to describe a particular population (Franklin, 2013). A total of thirty- five (35) general competencies were identified from the literature review. A pre-survey questionnaire was developed to validate these competencies with a few identified built environment consultants, which enabled the researcher to make the necessary corrections and reduce the competencies to thirty-three (33) before the final one was sent out [32]. A pilot test was done to improve the quality and clarity of the questionnaire and also enabled the researcher to estimate the time needed to complete the questionnaire [33]. The first section of the questionnaire captured the respondent's profile. Saunders et al. (2012) proposed that data related to research questions and objectives must be collected from respondents who have an idea about the information needed. For this reason, purposive and convenient sampling was used to select respondents (architects, project managers, quantity surveyors, structural engineers, and others) to indicate how critical these specific competencies are to them in their specific jobs in achieving sustainable construction in the Ghanaian construction industry using a 5-point Likert scale. Saunders (2012) argued that this technique helps select cases that will best enable you to answer your research question(s) and to meet your objectives. The questionnaire was distributed to the various respondents in two forms, a print (hard copies) and a Google form. In about two months with reminders in between, a total of 143 responses were received and screened

comprising 31 architects, 30 quantity surveyors, 35 structural engineers, 32 project managers, and 15 others who did not belong to any of the groups but participated in the study. The data from the study was analyzed descriptively (mean), [34] and mean-variance (ANOVA) was done using Statistical Package for Social Sciences (SPSS) [35].

3.1 Demographic Information of Respondents

A total of 143 consultants participated in the study, out of which 123 (86%) were males and 20 (14%) were females. 31 (22%) architects, 30 (21%) quantity surveyors, 35 (25%) structural engineers, 32 (22%) project managers, and 15 (11%) others who participated in the study but did not belong to any of the targeted consultants. Of the total number, 33 (23%) consultants have practiced for between 1-5 years, 36 (25%) have worked for between 6-10, 29 (20%) consultants worked for between 11-15 years, those who worked between 16-20 years were 25 (17.5%), whilst 20 (14%) consultants have worked for 20 years and above.

Furthermore, 114 (80%) of the 143 consultants have been involved in SC, and 29 (20%) have not. Of the 114, 36 have been involved in SC for between 1-5 years, 41 consultants for between 6-10 of practice, those who practiced for between 11-15 years were 22, and those with 16-20 years of practice in SC were also 12, with those who practiced for more than 20 years being 3.

Also, the 143 consultants have obtained various certificates with 1 (1%) person having an Advance certificate, 2 (1.4%) having a CTC II certificate with 7 (5%) having a CTC III certificate. Also, 18 (13%) of the consultants had an HND certificate with those having the degree certificate being the majority of 62 (43%). Those with a master's degree were 52 (36%) consultants with 1 (1%) person having a PhD.

4. RESULTS

4.1 Critical Competencies Required of Built Consultants in Achieving Sustainable Construction

4.1.1 Critical competencies required of the architect for the achievement of SC

Boone & Boone (2012) opined that the mean score is used in the Likert Scale survey. Architects who participated in the study were asked to indicate their agreed level of the 33 general competencies identified of how critical they were to the achievement of SC. Sixteen (16) out of the 33 competencies with an average mean (M) of 4.0 were regarded as the most critical competencies required of the architects in achieving SC after the data was analyzed with the help of SPSS and ranked, the result is presented in Table 1.

The most critical competency according to the architects in achieving SC is Leadership skills with a mean of 4.48 ranking 1st with the 2nd most ranked being Quality management with a mean (m) of 4.42. The 3rd, 4th, 5th, 6th, 7th, 8th, 9th, and 10th follows as Understand and interpreting codes and regulation (m=4.42), Professional ethics (m=4.39), Time management (m=4.35), Knowledge in the implementation of BIM (m=4.35), Conversant in sustainability issues (m=4.29), Team building (m=4.26), Good ICT competence (m=4.26), and Knowledgeable in embodied carbon analysis (m =4.22). Additionally, the 11th ranked was Designing to manage energy consumption (m=4.19), 12th Procedural-industrial skills (m=4.06), 13th was Research skills (m=4.06), 15th was Motivation (m=4.00), 16th Expertise in construction economics and quantities (m=4.00).

4.1.2 Critical competencies required of the quantity surveyor for the achievement of SC

Table 2 presents the results of the critical competencies according to QSs in achieving SC. After the analyses and ranking at a mean level of 4.00, they indicated sixteen (16) competencies were the most critical required of the QS in achieving SC with Professional ethics with a mean value of 4.46 being the first. The 2nd competence was Cost management/financing (m=4.43), this was followed by Expertise in construction economics and quantities (m=4.40), the next was Good ICT competence (m=4.33), and Leadership skills (m=4.33). The 6th, 7th, 8th, 9th, and 10th, followed as Procedural-industrial skills (m=4.27), Valuation (m=4.26), Research skills (m=4.23), Team building (m=4.4.20), and Understand and interprets codes and regulation (m=4.20). Additionally, Time management with a mean of 4.13 was the 11th ranked, 12th Conversant in sustainability issues (m=4.13), 13th in Strategic planning (m=4.10), 14th Knowledge in the implementation of BIM (m=4.10), 15th Goal setting (m=4.07), 16th Quality management (m=4.03)

4.1.3 Critical competencies required of the structural engineer for the achievement of SC

The general competencies were presented to site engineers in the built environment, they were also asked to agree to those that are critical to them in achieving SC. Nineteen (19) were considered to be very critical competencies. From the mean score, the highest-ranked competence according to the site engineers was Strategic planning with a mean of 4.51 as indicated in Table 3. Quality management ranked 2nd with a 4.49 mean. 3rd was Team building (m=4.49), 4th Time management (m=4.42), 5th Procedural-industrial skills (m=4.40), 6th Understand and interprets codes and regulation (m=4.34), 7th Motivation (m=4.29), 8th Excellent communication (m=4.26), 9th Professional ethics (m=4.26), and the 10th ranked been Conversant in sustainability issues with 4.23 as the mean. Leadership skills continued at the 11th position with a mean of 4.23. 12th Decision making (m=4.17), 13th Expertise in health and safety (m=4.14), 14th Operational planning (m=4.11), 15th Goal setting (m=4.11), 16th Listening skills (m=4.03), 17th Expertise in construction economics and quantities (m=4.03), 18th Good ICT competence (m=4.03), and 19th Conflict management (m=4.02).

4.1.4 Critical competencies required of the project managers for the achievement of SC

Table 4 also presents the descriptive statistics according to project managers who participated in the study. Twenty-two (22) out of the thirty-three (33) were seen as the most critical competencies required of the project managers. The first critical competence in achieving SC according to project managers was Strategic planning with a mean of 4.72. This was followed by Quality management (m=4.56) with Team building being the third and mean of 4.47. The 4th ranked was Cost management/financing (m=4.41), 5th Time management (m=4.40), 6th Understand and interprets codes and regulation (m=4.38), 7th Operational planning (m=4.34), 8th Motivation (m=4.31), 9th Decision making (m=4.31), 10th Goal setting (m=4.31), 11th Skills in recruitment and hiring (m=4.31), 12th Leadership skills (m=4.31), 13th Skills in recruitment and hiring (m=4.31), 14th Procedural-industrial skills (m=4.16) and 15th Management issues regarding people and the environment with a mean of 4.09. Furthermore, the 16th, 17th, 18th, 19th, 20th, 21st, and 22nd were ranked as Excellent communication (m=4.09), Listening skills (m=4.09), Conversant in sustainability issues (m=4.09), Expertise in construction economics and quantities (m=4.09), and Good ICT competence (m=4.09), Expertise in health and safety (m=4.03), and Power delegation (m=4.00).

4.1.5 Critical Competencies Required Of Others For The Achievement of SC

Apart from the four specified consultants (Architects, QSs, Structural Engineers, and Project Managers), some other consultants who did not belong to any of the specified groups also participated in the study. The analysis from this group is presented in Table 5. The highest-ranked competence in this category of consultants is Good ICT competence with a mean of 4.00 which was also regarded as critical competence.

Table 1. Competencies by architects

Competence	Mean	Standard Deviation	*Rank*
Leadership skills	4.48	0.81	1
Quality management	4.42	0.81	2
Understand and interpret codes and regulation	4.42	0.92	3
Professional ethics	4.39	0.88	4
Time management	4.35	0.88	5
Knowledge of the implementation of BIM	4.35	1.09	6
Conversant in sustainability issues	4.29	1.01	7
Team building	4.26	0.81	8
Good ICT competence	4.26	1.03	9
Knowledgeable in embodied carbon analysis	4.22	1.26	10
Designing to manage energy consumption	4.19	1.25	11
Procedural-industrial skills	4.06	0.68	12
Research skills	4.06	0.98	13
Excellent communication	4.0	1.06	14
Motivation	4.0	1.29	15
Expertise in construction economics and quantities	4.0	0.86	16

Competence	Mean	Standard Deviation	*Rank*
Strategic planning	3.97	1.05	17
Expertise in health and safety	3.94	0.99	18
Decision making	3.9	0.91	19
Goal setting	3.9	1.01	20
Management issues regarding people and the environment	3.84	0.89	21
Knowledge of pertinent Law	3.84	1.04	22
Skills in recruitment and hiring	3.74	0,89	23
Power delegation	3.71	1.19	24
Cost management/financing	3.68	1.17	25
Listening skills	3.61	0.92	26
Conflict management	3.55	0.99	27
Operational planning	3.39	1.23	28
Insurance	3.22	1.2	29
Valuation	3.09	1.04	30
Managing insolvency	2.97	1.03	31
Expertise in business performance	2.94	1.18	32
Expertise in investment appraisal	2.67	1.11	33

Source: Field data

Table 2. Competencies by QS

Competence	Mean	Standard Deviation	*Rank*
Professional ethics	4.46	0.51	1
Cost management/financing	4.43	0.77	2
Expertise in construction economics and quantities	4.4	0.56	3
Good ICT competence	4.33	0.8	4
Leadership skills	4.33	0.92	5
Procedural-industrial skills	4.27	0.98	6
Valuation	4.26	1.08	7
Research skills	4.23	0.94	8
Team building	4.2	0.99	9
Understand and interpret codes and regulation	4.2	0.96	10
Time management	4.13	1.04	11
Conversant in sustainability issues	4.13	1.04	12
Strategic planning	4.1	0.84	13
Knowledge of the implementation of BIM	4.1	0.71	14
Goal setting	4.07	0.78	15
Quality management	4.03	0.93	16
Decision making	3.97	0.72	*17*
Knowledge of pertinent Law	3.97	0.96	*18*
Motivation	3.93	0.94	*19*
Skills in recruitment and hiring	3.9	0.92	*20*
Expertise in health and safety	3.77	1.14	*21*
Managing insolvency	3.77	1.04	*22*
Knowledgeable in embodied carbon analysis	3.77	0.82	*23*
Management issues regarding people and the environment	3.73	1.05	*24*
Insurance	3.73	0.98	*25*
Expertise in business performance	3.7	1.09	*26*
Conflict management	3.67	1.21	*27*
Excellent communication	3.67	1.27	*28*
Listening skills	3.63	0.93	*29*
Operational planning	3.47	1.31	*30*
Power delegation	3.43	0.86	*31*
Expertise in investment appraisal	3.33	0.96	*32*
Designing to manage energy consumption	3.27	0.94	*33*

Source: Field Data

Table 3. Competencies by structural engineers

Competence	Mean	Standard Deviation	*Rank*
Strategic planning	4.51	0.71	*1*
Quality management	4.49	0.66	*2*
Team building	4.49	0.85	*3*
Time management	4.42	0.65	*4*
Procedural-industrial skills	4.4	0.74	*5*
Understand and interpret codes and regulation	4.34	1.03	*6*
Motivation	4.29	1.05	*7*
Excellent communication	4.26	1.01	*8*
Professional ethics	4.26	0.85	*9*
Conversant in sustainability issues	4.23	0.77	*10*
Leadership skills	4.23	1.09	*11*
Decision making	4.17	0.89	*12*
Expertise in health and safety	4.14	0.81	*13*
Operational planning	4.11	0.83	*14*
Goal setting	4.11	0.93	*15*
Listening skills	4.03	1.18	*16*
Expertise in construction economics and quantities	4.03	0.82	*17*
Good ICT competence	4.03	0.89	*18*
Conflict management	4.02	0,82	*19*
Cost management/financing	3.97	0.89	*20*
Management issues regarding people and the environment	3.91	0.85	*21*
Knowledge of pertinent Law	3.91	1.01	*22*
Knowledge of the implementation of BIM	3.91	0.92	*23*
Research skills	3.8	1.16	*24*
Skills in recruitment and hiring	3.8	0.96	*25*
Knowledgeable in embodied carbon analysis	3.77	1.0	*26*
Power delegation	3.74	1.07	*27*
Insurance	3.54	1.15	*28*
Expertise in business performance	3.51	0.92	*29*
Valuation	3.46	1.07	*30*
Designing to manage energy consumption	3.37	1.11	*31*
Expertise in investment appraisal	3.2	1.05	*32*
Managing insolvency	3.09	1.01	*33*

Source: Field Data

4.1.6 Comparison of means of critical competencies in achieving SC

After considering the specific competencies required of the various consultants in the building industry, the researcher went forward to get the mean score of the different means of these competencies and ranked them and this is contained in Table 6. The study realized that fifteen (15) out of the thirty-three (33) competencies were critical per the mean of means. The first-ranked competence was Strategic planning with the highest mean of 4.38. This was followed by Quality management which had a mean of 4.32, and Time management with a mean of 4.29. The 4th ranked was Team building (m=4.28), 5th was understanding and interpreting codes and regulation (m=4.28), 6th Professional ethics (m=4.27), 7th Leadership skills (m=4.27), 8th Procedural-industrial skill (m=4.16), 9th Good ICT competence (m=4.15), and 10thConversant in sustainability issues (m=4.10). The ranking continued with the 11th being Expertise in construction economics and quantities (m=4.09), 12th Motivation (m=4.08), 13th Goal setting (m=4.07), 14th Cost management/financing (m=4.04), 15th Decision making (m=4.04).

4.1.7 Analysis of variance (ANOVA) of critical competencies required of built environment consultants

The study after analyzing the competencies required by each group of consultants, proceeded to perform the analysis of various to identify if there were statistically significant differences among the participating group of consultants, ANOVA was used because the group of interest was more than 2, (Kim, 2014).

At a significant level of 0.05, it was realized that 15 competencies have a P-value of less than 0.05, indicating that there are statistically significant differences among these built environment consultants for these critical competencies as indicated in Table 7 below. These are Cost management/financing (Sig. 0.000), Strategic planning (Sig. 0.000), Valuation (Sig. 0.000), Operational planning (Sig. 0.001), Expertise in investment appraisal (Sig. 0,001), Quality Management (Sig. 0.003), Managing insolvency (Sig. 0.003), Expertise in business performance (Sig. 0.020), Power delegation (Sig. 0.019), Team building (Sig. 0.023), Designing to manage energy consumption (Sig. 0.011), Knowledge in the implementation of BIM (Sig. 0.014), Conversant in sustainability issues (Sig. 0.021), Professional ethics (Sig. 0.028), and Skills in recruitment and hiring (Sig. 0.035). The rest of the competencies indicated a P-value above 0.05 to suggest that there are no significant differences among the groups

Table 4. Competencies by project managers

Competence	Mean	Standard Deviation	*Rank*
Strategic planning	4.72	0.52	*1*
Quality management	4.56	0.5	*2*
Team building	4.47	0.88	*3*
Cost management/financing	4.41	0.76	*4*
Time management	4.4	0.76	*5*
Understand and interpret codes and regulation	4.38	0.71	*6*
Operational planning	4.34	0.94	*7*
Motivation	4.31	0.93	*8*
Decision making	4.31	0.78	*9*
Goal setting	4.31	1.06	*10*
Skills in recruitment and hiring	4.31	0.93	*11*
Leadership skills	4.31	0.78	*12*
Professional ethics	4.25	0.72	*13*
Procedural-industrial skills	4.16	1.39	*14*
Management issues regarding people and the environment	4.09	0.99	*15*
Excellent communication	4.09	0.96	*16*
Listening skills	4.09	0.93	*17*
Conversant in sustainability issues	4.09	0.93	*18*
Expertise in construction economics and quantities	4.09	0.99	*19*
Good ICT competence	4.09	0.93	*20*
Expertise in health and safety	4.03	1.06	*21*
Power delegation	4	0.98	*22*
Insurance	3.97	1.2	*23*
Knowledgeable in embodied carbon analysis	3.97	1.15	*24*
Conflict management	3.93	1.08	*25*
Knowledge of pertinent Law	3.9	0.99	*26*
Expertise in investment appraisal	3.84	1.08	*27*
Expertise in business performance	3.81	1.12	*28*
Research skills	3.81	0.78	*29*
Knowledge of the implementation of BIM	3.81	1.09	*30*
Managing insolvency	3.78	1.07	*31*
Valuation	3.72	0.85	*32*
Designing to manage energy consumption	3.41	1.1	*33*

Source: Field Data

Table 5. Competencies by other consultants

Competence	Mean	Standard Deviation	*Rank*
Good ICT competence	**4**	0.85	***1***
Time management	3.93	1.09	*2*
Management issues regarding people and the environment	3.87	1.13	*3*
Quality management	3.8	0.94	*4*
Strategic planning	3.8	1.21	*5*

Competence	Mean	Standard Deviation	*Rank*
Excellent communication	3.8	1.08	*6*
Goal setting	3.8	1.32	*7*
Understand and interpret codes and regulation	3.8	1.21	*8*
Expertise in construction economics and quantities	3.8	1.01	*9*
Conflict management	3.73	1.22	*10*
Expertise in investment appraisal	3.73	1.28	*11*
Leadership skills	3.73	1.16	*12*
Professional ethics	3.67	1.05	*13*
Expertise in health and safety	3.6	1.24	*14*
Decision making	3.6	1.12	*15*
Team building	3.6	1.12	*16*
Procedural-industrial skills	3.6	0.82	*17*
Managing insolvency	3.6	1.18	*18*
Knowledgeable in embodied carbon analysis	3.6	1.4	*19*
Operational planning	3.53	1.06	*20*
Motivation	3.53	1.3	*21*
Research skills	3.53	1.13	*22*
Listening skills	3.47	1.25	*23*
Designing to manage energy consumption	3.47	1.25	*24*
Expertise in business performance	3.4	1.18	*25*
Knowledge of pertinent Law	3.4	1.35	*26*
Insurance	3.4	1.18	*27*
Skills in recruitment and hiring	3.4	1.35	*28*
Cost management/financing	3.33	1.11	*29*
Conversant in sustainability issues	3.33	0.98	*30*
Valuation	3.27	1.22	*31*
Knowledge of the implementation of BIM	3.27	1.39	*32*
Power delegation	2.93	1.16	*33*

Source: Field data

4.1.8 Discussion of critical competencies required of the built consultants in achieving sustainable construction

The discussion of the critical competencies required of the built environment consultants centered competencies of the average of means of the study. These competencies apart from helping to achieve SC will go a long way to improving the various pillars of Sustainable Development (Environmental, Economical, and Social pillars). The success of SC will have a direct benefit to SD because the fundamental concept of SC is to produce long-term affordability, quality, efficiency, and value to clients and users, whilst decreasing negative environmental impacts and increasing economic sustainability, (Bal et al., 2013). SC balances the three main dimensions of SD; economic sustainability by making more efficient use of construction resources; environmental sustainability by minimizing or preventing harmful impacts on the environment; and social sustainability by taking appropriate responses to the needs of people at all levels in the construction process and providing satisfaction not only for clients and suppliers but to employees and communities,

Table 6. Comparison of means of competencies

Competence	Architects	QSs	Structural Engineers	Project Managers	Others	Mean	Rank
Strategic planning	3.97	4.1	4.51	4.72	3.8	4.38	1
Quality management	4.42	4.03	4.49	4.56	3.8	4.32	2
Time management	4.35	4.13	4.42	4.401	3.93	4.29	3
Team building	4.26	4.2	4.49	4.47	3.6	4.28	4
Understand and interpret codes and regulation	4.42	4.2	4.34	4.38	3.8	4.28	5
Professional ethics	4.39	4.46	4.26	4.25	3.67	4.27	6
Leadership skills	4.48	4.33	4.23	4.31	3.73	4.27	7
Procedural-industrial skills	4.06	4.27	4.4	4.16	3.6	4.16	8
Good ICT competence	4.26	4.33	4.03	4.09	4	4.15	9
Conversant in sustainability issues	4.29	4.13	4.23	4.09	3.33	4.1	10

Competence	Architects	QSs	Structural Engineers	Project Managers	Others	Mean	Rank
Expertise in construction economics and quantities	4	4.4	4.03	4.09	3.8	4.09	11
Motivation	4	3.93	4.29	4.31	3.53	4.08	12
Goal setting	3.9	4.07	4.11	4.31	3.8	4.07	13
Cost management/financing	3.68	4.43	3.97	4.41	3.33	4.04	14
Decision making	3.9	3.97	4.17	4.31	3.6	4.04	15
Excellent communication	4	3.67	4.26	4.09	3.8	3.99	16
Knowledge of the implementation of BIM	4.35	4.1	3.91	3.81	3.27	3.95	17
Expertise in health and safety	3.94	3.77	4.14	4.03	3.6	3.94	18
Research skills	4.06	4.23	3.8	3.81	3.53	3.92	19
Management issues regarding people and the environment	3.84	3.73	3.91	4.09	3.87	3.89	20
Knowledgeable in embodied carbon analysis	4.22	3.77	3.77	3.97	3.6	3.89	21
Skills in recruitment and hiring	3.74	3.9	3.8	4.31	3.4	3.88	22
Knowledge of pertinent Law	3.84	3.97	3.91	3.9	3.4	3.85	23
Operational planning	3.39	3.47	4.11	4.34	3.53	3.81	24
Listening skills	3.61	3.63	4.03	4.09	3.47	3.81	25
Conflict management	3.55	3.67	4.02	3.93	3.73	3.79	26
Power delegation	3.71	3.43	3.74	4	2.93	3.64	27
Insurance	3.22	3.73	3.54	3.97	3.4	3.59	28
Valuation	3.09	4.26	3.46	3.72	3.27	3.58	29
Designing to manage energy consumption	4.19	3.27	3.37	3.41	3.47	3.54	30
Expertise in business performance	2.94	3.7	3.51	3.81	3.4	3.48	31
Managing insolvency	2.97	3.77	3.09	3.78	3.6	3.41	*32*
Expertise in investment appraisal	2.67	3.33	3.2	3.84	3.73	3.31	*33*

Source: Field data

Table 7. ANOVA of competencies

Competence	F	Sig
Cost management/financing	5.932	**0.0**
Strategic planning	5.397	**0.0**
Valuation	5.568	**0.0**
Operational planning	4.83	**0.001**
Expertise in investment appraisal	5.308	**0.001**
Quality management	4.195	**0.003**
Managing insolvency	4.143	**0.003**
Designing to manage energy consumption	3.389	**0.011**
Knowledge of the implementation of BIM	3.248	**0.014**
Power delegation	3.063	**0.019**
Expertise in business performance	3.023	**0.02**
Conversant in sustainability issues	2.982	**0.021**
Team building	2.928	**0.023**
Professional ethics	2.805	**0.028**
Skills in recruitment and hiring	2.669	**0.035**
Procedural-industrial skills	2.391	0.054
Decision making	2.217	0.07
Listening skills	1.931	0.109
Insurance	1.899	0.114
Motivation	1.8	0.132
Research skills	1.709	0.152
Listening skills	1.684	0.157
Expertise in construction economics and quantities	1.573	0.185
Excellent communication	1.402	0.236

Competence	F	Sig
Understand and interpret codes and regulation	1.3	0.273
Time management	1.289	0.277
Knowledgeable in embodied carbon analysis	1.201	0.313
Conflict management	1.133	0.344
Expertise in health and safety	1.025	0.397
Goal setting	0.981	0.42
Knowledge of pertinent Law	0.848	0.497
Good ICT competence	0.701	0.592
Management issues regarding people and the environment	0.58	0.678

Source: Field Data

4.2 Strategic Planning Competence

Strategic planning is the process of defining a strategy or direction, allocating resources, and making decisions to achieve strategic goals. This includes establishing the sequence in which these goals could be realized to achieve the stated vision or goal. Strategic planning is imperative. To achieve SC, built environment consultants should take deliberate action through strategic planning. Strategic planning is a competence required of all consultants in the building and construction industry, as it is critical to the achievement of SC. The demand for SC in this era to execute building projects with minimum raw material or renewable material while meeting quality and maximum life span demand is that built consultants come out with strategies that can assist their clients in achieving this objective. The importance and critical nature of this competence have been emphasized in literature, (Edum-Fotwe & McCafer, 2000; [36] Zulkiffi & Latiffi, 2019; [37] Chamikara et al. 2018). It is therefore important that built consultants develop this competence to the highest to enable them to achieve the goal of SC.

4.3 Quality Management Competence

Quality management competence is crucial for the achievement of SC as this competence helps the built consultants to ensure that the built industry consistently functions. This competence enables the built consultant to oversee all the activities of maintaining a desirable level of excellence. With this competence, all the various consultants ensure that they are working together to improve processes, products, and services to improve SC. The significance of this competence is seen in various literature and this has been confirmed as it was ranked second in the rankings by the consultants [38-40].

4.4 Time Management Competence

Time is of the essence in improving effectiveness, efficiency, and productivity. It is a competence that helps the consultant to plan and take control of the specific activities at their times to achieve better results in less amount of time. Time management competence would enable the built consultant to make the best use of time in the pre-construction, during the construction, and after the construction stages as each stage has a targeted time of accomplishment. The success of every construction project is largely dependent on its construction time management. Each of the consultants is expected to work towards achieving the time target, in this regard, each consultant in the industry needs to acquire this competence toward the achievement of SC Ghana.

4.5 Team Building Competence

The construction industry involves teamwork, the execution of any building project involves the coming together of several professionals who should and must tolerate and work with one another. These different professionals work together toward a common goal most effectively and efficiently. Collaborative teamwork improves the morale of the team members, encourages growth, improves job satisfaction, and reduces the likelihood of committing mistakes. The importance of this competence cannot be taken for granted, hence, the need for built consultants to confirm the need for it if the built environment can succeed in SC. Built consultants are expected to exhibit this competence in the way they relate with one another and their clients. Several studies have emphasized the significance of this competence and expect built consultants not to take it for granted as this boosts the achievement of SC, (Chamikara et al. 2018; Dada and Jagboro, 2012; [41] Ismail et al. 2018; Kwofie et al. 2015; Zulkiffi & Latiffi, 2019).

4.6 Understand and Interpret code and Regulation Competence

In the construction industry, various codes regulations, and standards are issued governing the execution of the project which the built consultant is expected to understand, interpret, and follow. These serve as models or rules and

are expected to be followed by built consultants because they ensure that the construction works well and is safe to use lasting for the expected period. This competence is very critical in achieving SC since the sustainability of a building is largely measured against these codes and standards. Dada and Jagboro, (2012); Ismail et al. (2018); Kwofie et al. (2015); and Ogunsanmi, (2016) have emphasized the significance and the need for built consultants to possess this competence to thrive in the construction industry leading to the achievement of SC [42-45].

4.7 Professional Ethics Competence

These are the behaviors expected of the built consultants working in their specific fields by their professional bodies or organizations [46-49]. The ability to live up to the expectations of these professional bodies will push the consultants to work according to the standards set because their integrity will be at risk in the event of any disaster such as an unsustainable construction questioning their credibility and competence. Built environment consultants are not working in isolation, they are responsible for the good and bad happenings in the construction site, owing an explanation to their professional groups in the case of an accident. In this regard, they are expected to develop this competence in tune with the expectations of these professional bodies who also have an interest in achieving SC. Chamikara et al. (2018); and Ismail et al. (2018) have indicated that professional ethics is a key competence for the constants in achieving SC [50-53].

4.8 Leadership Skills

Each of the built consultants is a leader in a specific area of the construction industry and is expected to live a life that will build relationships with his or her subordinates and among the team members. These consultants do not carry out the manual work by themselves most at times, they rely on the people they recruit, both skilled and unskilled. They are therefore expected to offer direction for the success of the work entrusted under their care through varying creativity, innovation, and negotiation. SC can be successful if the consultants can offer quality leadership skills which is seen in their strengths and abilities to oversee and steer their workers towards the successful completion of the project on time and according to specification. Chamikara et al. (2018) in their study has emphases the need for built consultants to show this kind of competence in the construction industry [54].

4.9 Procedural-Industrial Skills

Procedures are critical in the achievement of sustainable construction and therefore built consultants should have the ability to know how to carry out specific construction works at the site without having to consciously recall any information. The building industry is very cumbersome which requires built consultants to be on top of their duties in offering accurate leadership and procedures to the people working under them. They have the responsibility to detail the construction processes, and the needed steps to be taken to complete any construction project. Procedural-industrial competence will help improve efficiency at the site and create a competitive advantage for the construction company. Studies by Ogunsanmi, (2016); Dada and Jagboro, (2012); and Ismail et al. (2018) have supported the need for built consultants to acquire this competence in pushing forward SC.

4.10 Good ICT Competence

The need for built consultants to show competence in ICT cannot be overemphasized. From the conception of any project to the completion and handing over and through to usage and maintenance in this era are communicated through the use of ICT. ICT has reduced the printing of voluminous documents such as drawings, BOQs, schedules, etc., and has become the means of communication among the players in the building industry. The knowledge in ICT will assist the consultant in using hardware and software in diverse ways during the construction processes, such as in collecting, processing, controlling, sharing, storing, monitoring, and retrieving construction project information. Several studies done in the construction industry have pointed to the fact that this competence is very crucial in SC which has been confirmed by this study, (Dada & Jagboro, 2012; Ismail et al. 2018; Chamikara et al. 2018).

4.10.1 Conversant in sustainability issues competence

There are new studies now and then on sustainable construction matters, this implies that built consultants should be up to date with issues of SC. Built consultants should be acquainted with matters of SC and the trends in the industry. This implies that the built consultant should constantly be interested in matters of SC such as Green construction, Lean construction, and Modular Integrated construction. Ogunsanmi, (2016) said knowledge of sustainability issues is

paramount for the built consultant as this influences the choices made at the construction site.

5. CONCLUSION AND RECOMMENDATION

This study sought to evaluate the competencies required of the built environment consultant in the achievement of SC in Ghanaian construction the objective was met. In answering the research question; What key competencies are required of the built environment consultants in the achievement of sustainable construction? 15 critical competencies identified in the study were; Strategic planning, Quality Management, Time management, Team building, Understanding and interpreting code and regulation, Professional ethics, Leadership skills, Procedural-industrial skills, Good ICT, Conversant in sustainable issues, Expertise in construction economics and quantities, Motivation, Goal setting, Cost management/financing, and Decision making. This study has contributed to the need for sustainable construction in Ghana adding to the various works done by various researchers. The study has elicited the needed competencies required of the players in the construction sector to achieve SC. It has been able to identify the individual specific competencies in addition to the general competencies of architects, quantity surveyors, structural engineers, and project managers in the quest of achieving SC. The study recommends that Built consultants should make it a point to constantly upgrade their competencies in line with the era of civilization as with SC. Employers of these consultants should offer them the opportunity for further studies. Further study could be done to generate a policy framework to assist in assessing the competencies of the built environment consultant which could also serve as a training manual for conducting CPD workshops for the consultants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. WCED. World commission on environment and development: Our common future. Gro Harlem Brundtland; 1987. Available:http://www.un-documents.net/wced-ocf.htm
2. Yin R, Cheng V. Policy option for sustainable construction. the 2005 World Sustainable Building Conference. Tokyo: ove Arup & Partners Hong Kong limited; 2005.
3. Zitman L. sustainable construction: Methods and Benefits; 2020. Available:www.bigrentz.com/blog/sustainable-construction.
4. Uher ET, Lawson W. Sustainable development in construction; 1998.
5. Shen Ly, Ou X, Feng Cc. (). Sustainable construction. Hong Kong: SDP Research Group, dept of building & real estate. Retrieved from ira.lib.polyu.edu.hk
6. UNESCO. Sustainable Development. 2021;17(11). Available:WWW.UNESCO.ORG: en.unesco.org/themes/education.sustaianble-development
7. Du Plessis C. A strategic framework for sustainable construction in developing countries. Construction Management and Economics. 2007;67-76.
8. Habitat Agenda. The Habitat Agenda Goals and Principles, Commitments, and the Global Plan of Action; 2003. Available:http://www.unhabitat.org/declarations/habitat_agenda.htm
9. Barbier EB, Burgess JC. The Sustainable Development Goals and the Systems. Economics. 2017;11:2017-2028. DOI:http://dx.doi.org/10.5018/economics-ejournal.ja.2017-28
10. Chamikara PB, Perera BA, Rodrigo MN. Competencies of the quantity surveyor in performing sustainable construction. International Journal of Construction Management; 2018.
11. Goh SC, Rowlinson S. Dimensions of sustainable construction: perspectives of the construction stakeholders. Sustainability and Development in Built Environment. Colombo, Sri Lanka; 2015.
12. Bal M, Bryde D, Fearon D, Ochieng E. stakeholder engagement: Achieving Sustainability in the Construction Sector. Sustainabilty. 2013;695-710. Available:www.mdpi.com/journal/sustainability
13. Bediako M, Frimpong AO. Alternative binders for increased sustainable construction in Ghana—A Guide for Building Professionals. Materials Sciences and Applications. 2013;04(12):20–28. Available:https://doi.org/10.4236/msa.2013.412a004
14. Adjarko H, Agyekum K, Ayarkwa J, Amoah P. Implementation of Environmental Sustainable Construction Principles

(ESCPs) in the Ghanaian Construction Industry. Engineering and Management Research. 2016;6(2):585–593.
15. Atombo C, Cudjoe J, Dzantor K, Agbo AA. Integration of Sustainable Construction in Project Management: A Case Study in Ghana. International Journal of Construction Engineering and Management. 2015;4(1):13–25. Available:https://doi.org/10.5923/j.ijcem.20150401.02
16. Djokoto SD, Dadzie J, Ababio EO. Barriers to sustainable construction in the Ghanaian construction industry: consultants perspective. Sustainable Development. 2014;7:134-143.
17. CIB Agenda 21. Sustainable Construction. Rotterdam, The Netherlands: CIB General Secretariat; 1999.
18. Pearce AR, Bernhardt KL, Garvin MJ. Sustainability and socio-enviro-technical system: Modeling total cost of ownership in capital facilities. Winter Simulation IEEE. .2017;3157-3169). DOI: 10.1109/WSC.2019.5679008
19. Plessis Cd. Agenda 21 for Sustainable Construction in Developing Countries. Rotterdam: CSIR, Pretoria and CIB; 2001.
20. Tiruneh GG, Fayek RA. Competency and Performance Measures for Organizations in the Construction Industry. Canadian Journal of Civil Engineering; 2020
21. Ahsan K, Ho M, Khan S. Recruiting Project Managers: A Comparative Analysis of Competencies and Recruitment Signals from Job Advertisements. Project Management Journal. 2013;36-54.
22. Ismail H, Akasah AZ, Nagapan S, Khamis, A. Expert perspective on success factors of civil engineers in improving project competencies in construction. International Conference on Biodiversity. IOP Publishing Ltd; 2018. DOI:10.1088/1755-1315/269/1/01202
23. Bothma SF. Developing project management competencies in graduate engineers in the construction industry. University of Pretoria; 2012.
24. Limsila K, Ogunlana O. Linking Personal Competencies with Transformational Leadership Style; Evidence from the Construction Industry in Thailand. Journal of Construction in Developing Countries. 2008;13(1).
25. RICS. RICS requirements and competencies guide. London: RICS, Parliament Square; 2022
26. Fu Y, Bi Y, Wang S. Research on Core Competence of Construction Consultant Enterprises Based on the Grey Correlation method. Applied Mechanics and Materials, 2014;2686-2690.
27. Ametepey O, Aigbavboa C, Ansah K. Barriers to Successful Implementation of Sustainable Construction in the Ghanaian Construction Industry. Procedia Manufacturing. 2015;3(Ahfe):1682–1689. Available:https://doi.org/10.1016/j.promfg.2015.07.988
28. Valdés H, Correa C, Mellado F. Proposed model of sustainable construction skills for engineers in Chile. Sustainability (Switzerland).2018;10(9). Available:https://doi.org/10.3390/su10093093
29. Enyiah AK. Regulation and small contractor development, a case in Ghana. centre on Regulation and competition, working paper. Manchester: Centre on regulation and competition, University of Manchester; 2004
30. Saunders M, Lewis P, Thornhill A. Research methods for business students. Italy: Pearson Education Limited; 2012.
31. Franklin MI. Understanding research : coping with the quantitative-qualitative divide; 2013
32. Agyedu GO, Donkor F, Obeng S. Teach yourself research methods. Kumasi; 2013
33. Taherdoost H. Data collection methods tools and tools for research; A step-by-step guide to choosing a data collection technique for academic and business research projects. International Journal of Academic Research in Management (IJARM) Helvetic Editions2021;10(1), 10-38.
34. Boone HN, Boone DA. Analyzing Likert Data. Journal of Extension. 2012;50(2). Available:www.joe.org
35. Kim HY. Analysis of Variance (ANOVA) comparing means of more than two groups. RDE, Restorative Dentistry & Endodontics; 2014
36. Edum-Fotwe FT, McCafer R. Developing project management competency; perspective from the construction industry. International Journal of Project Management. 2000;111-124.
37. Zulkiffi AN, Latiffi AA. Review of project manager's leadership skills in the pre-construction phase of sustainable construction projects. MATEC Web of Conferences. 2019;266. Malaysia.

Available:https://doi.org/10.1051/matecconf/201926601011
38. Ofori-Kuragu KJ, Baiden BK, Badu E. Key Performance Indicators for Project Success in Ghanaian Contractors. international Journal of Construction Engieering and management. 2016;5(1):1-10.
DOI:10.5923/j.ijcem.20160501.01
39. Ogunsanmi OE. Determining the essential skill requirements for construction managers' practice in Nigeria. International Journal of Construction Supply Chain Management. 2016;6(2):48-63.
DOI:10.14424/ijcscm602016-48-63
40. Kwofie ET, Adinyira E, Botchway AE. Identification of the critical project management competencies of architects in the Ghanaian construction industry. International Journal of Construction Management; 2015.
DOI:10.1080/15623599.2015.1067347
41. Dada JO, Jagboro GO. Core skills requirement and competencies expected of quantity surveyors: Perspectives from quantity surveyors, allied professionals and clients in Nigeria. Australasian Journal of Construction Economics and Building. 2012;78=90.
42. Ayarkwa J, Acheampong A, Wiafe F, Boateng BE. Factors affecting the implementation of sustainable construction in Ghana; the architect's perspective. Conference on infrastructure Development in Africa, Kumansi, Ghaa. 2017;377-386.
43. Adjarko H, Agyekum K, Ayarkwa J, Amoah P. Implementation of Environmental Sustainable Construction Principles (ESCPs) in the Ghanaian Construction Industry. Engineering and Management Research. 2016;6(2):585–593.
44. Crafford GJ. Clients view on construction and design team competencies. Doctoral Thesis; University of Port Elizabeth; 2007
45. GLOPP. (n.d.). The three dimensions of sustainable development.
Available:11 17, 2021, from www.glopp.ch: glopp.ch/A2/en/html/resear_area_present_1_3.html
46. IFC. Green Building Market Intelligence, Ghana Country Profile. International Finance Corporation, World Bank Group; 2017.
Available:www.edgebuildings.com
47. Kissi E, Sadick MA, Agyemang DY. Drivers militating against the pricing of sustainable construction materials: The Ghanaian quantity surveyors perspective. Case Studies in Construction Materials. 2018;507-516.
48. Mark Saunders, Philip Lewis Thornhill, A. Research Methods For Business Students; 2012.
49. Ogunde AO, Olaolu O, Afolabi A, Owolabi J, Ojelabi R. Challenges confronting construction project management system for sustainable construction in developing countries: professionals perspectives (A Case Study in Nigeria). Building Performance; 2017
50. Quote Investigator. 2013;1)(22). Available:11 4, 2021, quoteinvestigator.com: https://quoteinvestigator.com/home
51. Sagoo A, Rahmani F, Alshanbri NM, Maqsood T, Noor MA, Khalfan M. Perceptions towards Sustainable Construction amongst Construction Contractors in the state of Victoria, Australia. Journal of Economics, Business and Management. 2015;940-947.
52. Social watch. (20062011). 2021;11(4). Available: socialwatch.org/node/12477: www.socialwatch.or
53. VanderStoep WS, Johnston DD. Research Methods for Everyday Life; Blending Qualitative and Quantitative Approaches. San Francisco: Jossey-Bass; 2009
54. Yin BC, Laing R, Leon M, Mabon L. An Evaluation of Sustainable Construction Perceptions and Practices in Singapore. 2018;613-620.
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