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# Factors Influencing Selection of a Project Manager for Energy Retrofit Projects in Ghana

John Dadzie[1], Brookman Asare-Dadzie[2], Susan Djokoto[3]

[1&3] Department of Building Technology, Kumasi Technical University, Kumasi, Ghana
[2]Managing Director, AMS And Sons Ltd, Kumasi, Ghana

eeedadzie@gmail.com

## Abstract
Project management is a complex process that requires commitment, strong will and teamwork to ensure success in terms of cost, time, quality, safety and client satisfaction. The concept of green renovation is new as actions to reduce $CO_2$ continue to capture the attention of the world. The main aim of the study is to align the concept of green renovation to the selection of competent project managers/consultants. A survey of selected district assemblies in Ghana was undertaken. The nature of green renovation influenced the selection of the district as those with no records of such renovations were not included. District assemblies are motivated to select project managers with adequate working experience and knowledge of sustainable technologies. The results indicate ability to work effectively in a team, evidence of adequate training and green renovation projects managed also influence selection of a project manager. The theory underpinning project management reinforces the results identified as challenges that hinder effective project delivery are addressed. The findings inform government decision to engage project managers for green renovation projects and provides literature for teaching and learning.

## Keywords
Project Management, Project Manager, Green Renovation, Experience, sustainable technology, policy

## 1. Introduction
Green renovation is the process of using sustainable strategies and technologies to improve existing buildings and systems to deliver energy and $CO_2$ savings. Green renovation or sustainable upgrade generally applies to existing buildings, equipment or systems that present poor environmental outlook. The form of upgrade depends on cost of renovation, availability of technologies and technical skills to undertake renovations. The role of a project manager (PM) is critical to the delivery or execution of green renovations. Thus, a project managers' understanding of energy retrofit project contributes to improved project performance. Often, urgency of a project at hand, project duration, variations, political influence from higher authority, untimely decisions on the part of the consulting team and a lack of experience of the design team affect the performance of consultants (Dadzie et al., 2012).

Attitude and general personal characteristics of a project manager and success were linked by Ha and Tran (2018) and the role of project managers by Jazebi and Rashidi (2013). Sharma and Kumar (2018) highlighted enthusiasm, high self-esteem, political sensitivity, ability to delegate and evidence of capacity to mobilise as factors influencing selection of project managers. A successful project manager should be able to delegate, that is, allow subordinates to participate in decision making which is in tandem with effective project delivery. A project manager should be flexible, patient and persistent, with good communication skills, be a good planner with credible capabilities (Horvath, 2019). These factors in one way or the other ensure successful project delivery as the PM provides leadership (Sharma & Kumar, 2018). Kondalkar (2020) discussed the concept of organisational behaviour and relates that to the functions of a project manager. A client expects a project management team to deliver on time and within budget by supporting the functions of a builder. Technical understanding of all forms of construction including green renovation is therefore relevant to the success of a project manager. Clients are always looking for a consultant capable of meeting

project timelines at a reasonable cost. To be successful as a project consultant requires strong commitment, capacity to work with different people and the ability to work effectively in a team (Sankaran et al., 2020).

A methodology for selecting project managers is studied and extensively reported in the literature. Jazebi and Rashidi (2013) developed an automated procedure for selecting project managers in construction firms. The model used 15 field data and fuzzy rules to develop a predictive model. Moradi et al. (2020) presented a competency model for the selection and performance improvement of project managers in collaborative construction projects using behavioural characteristics. Chaghooshi (2016) proposes the joint use of the Fuzzy DEMATEL (FDEMATEL) and Fuzzy VIKOR methods of a decision-making process for selecting the most suitable managers. The FDEMATEL method is used to prioritise the importance of various criteria and the FVIKOR is used to rank the alternatives in a preferred order to select the best project manager from several alternatives. Similarly, Çelikbilek (2018) proposes a Grey Analytic Hierarchy Process (G-AHP) for engineering and managerial problems with grey systems to make objective decisions. The results of the case study concluded with the effectiveness and applicability of the proposed G-AHP method for science, engineering and management. These methods are for the selection of a project manager, not providing detailed information of factors that influence selection, particularly for green renovation. The main aim of the study is to investigate factors influencing the selection of a project manager for green renovation projects. To date, the extent to which project managers are assessed with green related parameters to motivate selection is lacking. Many studies are aligned to the conventional construction approaches as the concept of green renovation is often not addressed. Identifying and investigating these factors, the concept of green renovation is reinforced and tied to reductions in $CO_2$ emissions.

## 2. Settings and Methods

### 2.1 Theoretical framework

PMBOK® defines a project as a temporary endeavor to create a unique product, service, or result. Levy (2018) defines project management as “application of knowledge, skills, tools and techniques to meet project requirements”. Project management is accomplished through the application and integration of concepts such as project initiation, planning, executing, monitoring and controlling and closing. It is the process of planning, directing and controlling resources to ensure high level of project performance which is normally expressed in terms of time, cost, quality and stakeholder satisfaction (Meredith, 2020).

### Factors that influence selection of a project manager

The role of a project manager is distinct from that of a functional manager or operations manager. Typically, a functional manager focuses on providing management oversight for a function or business unit. Operations managers are responsible for ensuring that business operations are efficient. A project manager is a person assigned to lead a team that is responsible for achieving a set of project objectives. The selection of project managers is linked to basic requirements, experience, education, communication, computer and management skills and time management. Other factors include cost, resource, quality and project management skills, planning, interpersonal skills, decision making and team development (Afshari, 2017). A project manager must manage costs, time and resources and be able to plan and develop skills of a project team (Sadatrasool et al., 2016). Also, knowledge, legal skills, communication skills, social awareness, action management, financial management, and ability to identify risk affect decisions to select project managers (Sadatrasool et al., 2016). The authors added that effective human resource management, procurement skills, time management, quality design and control and technical impact selection of a project manager. Sharma and Kumar (2018) discussed factors that influence selection of a project manager to include enthusiasm, high self-esteem and political sensitivity. Although Sharma and Kumar (2018) sought to reinforce findings of earlier studies, ability to delegate, team management good communication skills were identified and included. The position of Sharma and Kumar (2018) is in line with that investigated by Sadatrasool et al. (2016). By proposing the joint use of the Fuzzy DEMATEL (FDEMATEL) and Fuzzy VIKOR methods, Chaghooshi et al. (2016) investigated many variables including site management capacity, technical level, level of leadership and personal qualities. Management capacity include project, program and portfolio orientation, health, security, safety and environment. Earlier studies by Dodangeh et al. (2014) and Sadeghi et al. (2014) applied various selection criterion in developing selection tools and models. They are basic requirement, project management skills, management and interpersonal skills. Sadeghi et al. (2014) relied on the competencies for project managers, records of past performance and behavioural parameters.

Wen et al. (2021) developed a new method that focuses on fuzzy multiple decision-making methods in civil engineering. The outcome of the study addresses the issue of high error in decision making, which is a very common

phenomenon in the construction industry. The models were examined using a case study in a project-based organization for selecting the most suitable project construction manager. Education, planning, controlling, communication skills, experience etc., were used for the second round of a Delphi approach. The third round involves basic requirements, management skills, interpersonal skills and project management skills. Manaan et al. (2014) demonstrated a fuzzy-based method for assessing the performance level of a project manager (PM) at the construction phase of Mass Housing Building Projects (MHBPs). Seven competencies including knowledge of appropriate site layout techniques for repetitive construction works, dedication and knowledge of appropriate technology transfer were applied (Manaan et al. 2014).

Afshari (2018) showed that in small projects, a PM with strong communication skills is needed to maximize performance, whereas negotiation skills in medium projects and project management knowledge in large projects are the most critical. Gharouni and Noorzai (2021) propose a framework to determine the most appropriate project manager (PM) to enhance the performance of occupational groups (POGs) in large, medium and small road construction projects in warm regions. The occupational groups (OGs) in road projects were divided into three categories: workers, technicians, and engineers. Using the Pareto principle, 14 critical project manager competencies (PMCs) were extracted from a 70-item list developed by performing a comprehensive literature review. Two indexes were ranked in each size of road project using the analytic hierarchy process (AHP) technique.

Similarly, leaderships, technical skills, performance level and certification level for each project manager is a critical selection criterion (Keren et al., 2014). Other factors include computer knowledge, experience, age, education depth of the expertise, extent of comprehensive knowledge and management knowledge (Afshari & Kowal, 2017). Leadership, communication, staffing, decision making, character, psychology, physiology influence project manager selection (Afshari & Kowal, 2017). Luţaș et al. (2020) identified the profile of an ideal project manager by presenting an overview of studies regarding the profile of a good project manager. In that regard, the authors analysed the perceptions of organisations' managers and HR specialists. The empirical research provides evidence that persons involved in project managers' selection perceive the value of education, certification, experience or soft skills differently, based on their professional role. Secondly, it shows that project management certifications are relevant for project managers' selection and are much appreciated around the world. Although each project requires specific skills and competencies of a project manager, the research ascertains a preferred profile based on the perception of over one hundred respondents, involved in the selection process. Mohammadi et al. (2014) developed an approach in the form of a hybrid Quality Function Deployment (QFD) and Cybernetic Analytic Network Process (CANP) model for project manager selection. This involves the use of QFD to translate the owner's project management expectations into selection criteria and the CANP to examine the expectations and selection criteria. The research involves the development of 18 selection features in response to the owner's three main expectations of time, cost and quality. Other factors include experience, academic achievement, communication skills, Microsoft Project Software experience and planning skills were the selection criteria adopted and applied to develop the model. The survey of literature shows that planning, project initiation skills, implementation and closeout are important in the selection of a project consultant (Moradi et al, 2021). Sang et al. (2018) studied the effects of project manager competency on green construction performance in China. The study identified the position of a project manager as an important factor determining the success of a project that is complex in nature. The authors argued that with the deterioration of the environment, green buildings present better environmental outlook compared to conventional buildings. Green buildings encounter more complex problems during the construction process thus project managers are faced with greater challenges. A survey questionnaire was used to investigate the understanding of the importance of project manager skills. Structural equation modelling was applied and the results demonstrate leadership skills and emotional intelligence of project managers are important factors that affect green construction performance.

## 2.2 Research methodology

In line with the research questions, a quantitative approach is adopted to explore and discuss factors that influence selection of project managers for green renovation. The study is focused on projects that align to sustainable upgrade

of existing buildings. District assemblies and regional coordinating professionals in Ghana are the main respondents. A five-point Likert scale was used to understand factors that affect selection of PMs for sustainable upgrade projects. The respondents were asked to rate the items in relation to the degree of agreement or importance as 1=strongly disagree; 2=disagree; 3=neutral;4=agree;5=strongly agree. A pilot survey of experts to test the variables for suitability as the concept of green renovation is new to many professionals. A total of 15 professionals were engaged online during the pilot stage of the study. Specific modifications to the variables were proposed that helped to restructure the survey for distribution. Thereafter, potential respondents were identified through personal contacts or referrals from staff of the district assemblies. The survey was sent to 182 professionals at the district and regional assembly level with adequate knowledge and understanding of green renovation. Those with no clear insight of the concept of sustainability and related impact of green renovation on the environment were excluded. Also, poorly answered survey questionnaires were rejected. The survey covered a period of 3 months as attempts to improve the initial response contributed to extension of the survey. The last month served as a mop-up to encourage professionals to participate. Within the first month, 25 professionals had responded, this was improved in the subsequent months. Overall, 55 professionals responded, providing a response rate of 30.2%. The mean and standard deviation as applied in this study are consistent with similar studies related to environment and energy efficiency.

$$Mean = \frac{\sum_{i-1}^{5} W_i . X_i}{\sum_{i-1}^{5} X_i}$$

where: i – responses category of a Likert scale – 1,2, 3, 4, 5. $W_i$ – is the weight assigned to $i^{th}$ response – (5 is Strongly agree, 4 for agree, 3 for neutral, 2 is disagree, 1 for strongly disagree); and $X_i$ – frequency of the $i^{th}$ response. The Chi-squared test for the study is given by:
$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$, Where $X^2$= Chi-squared, $O_i$ = observed value, $E_i$ =expected value

## 3. Results

Calculated means provide the descriptive analysis of the study for detailed and further analysis, based on the maximum and minimum values. The standard deviation estimates become relevant as that forms basis for ranking of similar means.

### 3. 1 Factors influencing selection of project managers for green renovation

Table 1 presents the overall results of the study on the factors that influence selection of PMs for energy retrofit projects. The Table presents the factors, mean, standard deviation, variance, rank, p-value and the hypothesis.

**Table 21.** Factors influencing selection of project managers for green renovation

| S/N | Factors | Mean | SD | variance | Rank | p-value | Decision |
|---|---|---|---|---|---|---|---|
| 1 | Academic Qualification | 4.88 | 0.853 | 0.7276 | 1 | 0.002 | Reject |
| 2 | Working experience | 4.44 | 0.769 | 0.5914 | 4 | 0.001 | Reject |
| 3 | Relationship with clients | 3.94 | 0.667 | 0.4449 | 13 | 0.000 | Reject |
| 4 | Human relations | 3.52 | 0.718 | 0.5155 | 21 | 0.000 | Reject |
| 5 | Conflict management skills | 3.72 | 0.832 | 0.6922 | 17 | 0.000 | Reject |
| 6 | Work effectively in a team | 4.24 | 0.891 | 0.7939 | 8 | 0.000 | Reject |
| 7 | History of delays | 4.18 | 0.946 | 0.8949 | 10 | 0.000 | Reject |
| 8 | History of payment | 3.85 | 0.862 | 0.743 | 14 | 0.063 | Accept |
| 9 | Records of cost overrun | 3.45 | 0.684 | 0.4679 | 22 | 0.000 | Reject |
| 10 | Availability of funds | 3.36 | 0.734 | 0.5388 | 23 | 0.000 | Reject |
| 11 | Safety records | 4.01 | 0.647 | 0.4186 | 12 | 0.144 | Accept |
| 12 | Green renovation projects managed | 4.75 | 0.854 | 0.7293 | 2 | 0.000 | Reject |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13 | Green certified/NABERS | 3.56 | 0.733 | 0.5373 | 20 | 0.000 | Reject |
| 14 | Interest in continuous green training | 3.65 | 0.688 | 0.4733 | 19 | 0.000 | Reject |
| 15 | Energy and Co2 emission savings | 3.70 | 0.721 | 0.5198 | 18 | 0.000 | Reject |
| 16 | Cleaner construction records | 4.23 | 0.869 | 0.7552 | 9 | 0.070 | Accept |
| 17 | Size of green renovation project | 4.56 | 0.987 | 0.9742 | 3 | 0.000 | Reject |
| 18 | Understanding of green renovation | 4.36 | 0.88 | 0.7744 | 6 | 0.000 | Reject |
| 19 | Experience of workers | 3.02 | 0.897 | 0.8046 | 24 | 0.000 | Reject |
| 20 | Type of technologies involved | 3.74 | 0.875 | 0.7656 | 16 | 0.000 | Reject |
| 21 | Quantity of technologies involved | 3.81 | 0.779 | 0.6068 | 15 | 0.311 | Accept |
| 22 | Location of project | 4.25 | 0.722 | 0.5213 | 7 | 0.000 | Reject |
| 23 | Cost of project | 4.09 | 0.86 | 0.7396 | 11 | 0.000 | Reject |
| 24 | Project duration | 4.41 | 0.786 | 0.6178 | 5 | 0.000 | Reject |

In all 24 factors were affirmed after the initial pilot study that identified over 30 variables. The pilot study reinforced the initial data by contributing to the rejection and modification of variables. Table 1 presents the factors that influence the selection of project managers or consultants. Academic qualification (mean = 4.88), green renovation projects managed (mean = 4.75), size of new green renovation project (mean = 4.56), working experience (mean = 4.44), project duration (mean = 4.41), understanding of green renovation (mean = 4.36), project location (mean = 4.25), work effectively in a team (mean = 4.24), cleaner construction records (mean = 4.23) and history of delays (mean = 4.18) ranked from 1st to 10th in that order. Least ranked factors include quantity of technologies involved (mean = 3.81), type of technologies (mean = 3.74), green certification (mean = 3.56), availability of funds (mean = 3.36) and experience of workers (mean = 3.02). Chi-square test results confirm the rejection of the null hypotheses that the factors do not affect selection of project managers for green renovation projects. Table 1 shows that for each of the independent variables $X^2est > X^2\beta$ at $p<0.05$. This implies that the factors do affect selection of project managers hence rejection of the null hypothesis. There is a strong statistical relationship between the variables and selection of project managers.

## 4. Discussion

The academic qualification provides detailed information about the level or expertise of project managers. According to the results the Ministry of Local Government is interested in the training and academic background of experts. To be successful at the expression of interest stage of a tender process, a consultant or project manager should present required and expected qualifications. Project managers without the appropriate qualification tend to perform poorly thereby negatively impacting the project in terms of cost, quality and safety. Critical verification of training and other forms of training in line with construction management ensure that delays and project failures are avoided (Alvarenga et al., 2019). The concept of green renovation makes the issue of academic qualification important as it is a unique area, new and relates closely with $CO_2$ emissions. The results agree with Creasy and Anantatmula (2016) in a study that indicates personal traits have a relationship with project success. The uniqueness of green renovation makes it necessary to have evidence of past projects managed and the level of success achieved. Having the qualification does not guarantee selection, however being able to present details of green renovation managed in the past presents a positive outlook. Clients are interested in the number of green renovation projects managed and the success rate. The local government officers consider a project manager or consultant qualified by looking at the nature of energy retrofit projects undertaken, records of systems adopted and the energy savings obtained. Given the technologies adopted and the volume of works executed, clients are presented with the necessary data to aid decision making processes. The results indicate the size of green renovation as a factor that motivates selection of project managers. Identifying size of projects handled provide basis to connect experience gained to a new project. New projects are complex particularly energy conservation renovation projects, thus the size also relates to experiences and selection decisions (Hadad et al., 2013). For example, a project manager with no experience of pumps, motors, cooling systems, cooling tower systems retrofit may not be able to handle similar projects.

## 5. Conclusions

Past studies on project manager selection are focused on conventional buildings, with little knowledge on the concept of green renovation. Indeed, the literature presents little information on the factors that influence selection of project managers for green renovation. The main aim of the study is to investigate factors influencing selection of project managers for energy conservation refurbishments. The literature review provided secondary data of various factors although there is little information on energy retrofit and selection of project managers. A survey design in the structure of a questionnaire ensured factors that influence selection of consultants are identified and investigated. As presented in Table 1, the main factors include academic qualification, green renovation projects managed, size of green renovation project, working experience, project duration, understanding of green renovation and project location. The study is limited to a developing economy thus future studies can focus on expanding the variables. The findings fill the gap in the literature and provide data for the selection of project managers. Policy makers are provided with a tool to follow in relation to appointment of project managers or consultants for green renovation projects.

## References

Afshari, A. R. (2017). Methods for selection of construction project manager: Case study. *Journal of Construction Engineering and Management*, *143*(12), 06017003.

Afshari, A. R., Yusuff, R., & Derayatifar, A. R. (2012, May). Project manager selection by using Fuzzy Simple Additive Weighting method. In *2012 International Conference on Innovation Management and Technology Research* (pp. 412-416). IEEE.

Afshari, A., & Kowal, J. (2017). Decision making methods for the selection of ICT project manager. *GOSPODARKA RYNEK EDUKACJA= ECONOMY MARKET EDUCATION*, *18*(4), 19-28.

Afshari, A. R., Nikolić, M., & Akbari, Z. (2018). Review on project manager selection criteria and methods. In *8th International Symposium Engineering Management and competitiveness* (pp. 22-23).

Alvarenga, J. C., Branco, R. R., do Valle, A. B., Soares, C. A. P., & e Silva, W. D. S. (2019). The self-perception of project managers compared to other project actors. *Interciencia*, *44*(8), 444-453.

Çelikbilek, Y. (2018). A grey analytic hierarchy process approach to project manager selection. *Journal of Organizational Change Management*.

Chaghooshi, A., Arab, A., & Dehshiri, S. (2016). A fuzzy hybrid approach for project manager selection. *Decision Science Letters*, *5*(3), 447-460.

Chipulu, M., Neoh, J. G., Ojiako, U., & Williams, T. (2012). A multidimensional analysis of project manager competences. *IEEE Transactions on Engineering Management*, *60*(3), 506-517.

Creasy, T., & Carnes, A. (2017). The effects of workplace bullying on team learning, innovation and project success as mediated through virtual and traditional team dynamics. *International Journal of Project Management*, *35*(6), 964-977.

Dadzie, J., Abdul-Aziz, A. R., & Kwame, A. (2012). Performance of consultants on government projects in Ghana: client and contractor perspective. *International Journal of Business and Social Research*, *2*(6), 256-267.

Dodangeh, J., Sorooshian, S., & Afshari, A. R. (2014). Linguistic extension for group multicriteria project manager selection. *Journal of Applied Mathematics*, *2014*.

Gharouni Jafari, K., & Noorzai, E. (2021). Selecting the most appropriate project manager to improve the performance of the occupational groups in road construction projects in warm regions. *Journal of Construction Engineering and Management*, *147*(10), 04021131.

Hadad, Y., Keren, B., & Laslo, Z. (2013). A decision-making support system module for project manager selection according to past performance. *International Journal of Project Management*, *31*(4), 532-541.

Ha, T. P. T., & Tran, M. D. (2018). Review of impacts of leadership competence of project managers on construction project success. *International Journal of Emerging Trends in Social Sciences*, *4*(1), 15-25.

Horváth, V. (2019). Project management competence–definitions, models, standards and practical implications. *Vezetéstudomány-Budapest Management Review*, *50*(11), 2-17.

Jazebi, F., & Rashidi, A. (2013). An automated procedure for selecting project managers in construction firms. *Journal of Civil Engineering and Management*, *19*(1), 97-106.

Kondalkar, V. G. (2020). *Organizational behaviour*. New Age.

Levy, S. M. (2018). *Project management in construction*. McGraw-Hill Education.

Luțaș, M., Nistor, R., Radu, M., & Beleiu, I. (2020). Perceptions regarding the profile of an ideal project manager. *Amfiteatru economic*, *22*(54), 608-622.

Manaan, O. A., Ahadzie, D. K., Panford, J. K., & Proverbs, D. G. (2014). Competency-based evaluation of project managers' performance in mass house building projects in Ghana–the fuzzy set theory approach. *Journal of Science and Technology (Ghana)*, *34*(1), 46-62.

Meredith, J. R., Shafer, S. M., Mantel Jr, S. J., & Sutton, M. M. (2020). *Project management in practice*. John Wiley & Sons.

Mohammadi, F., Sadi, M. K., Nateghi, F., Abdullah, A., & Skitmore, M. (2014). A hybrid quality function deployment and cybernetic analytic network process model for project manager selection. *Journal of Civil Engineering and Management*, *20*(6), 795-809.

Moradi, S., Kähkönen, K., & Aaltonen, K. (2020). Comparison of research and industry views on project managers' competencies. *International Journal of Managing Projects in Business*.

Moradi, S., Kähkönen, K., Klakegg, O. J., & Aaltonen, K. (2021). A competency model for the selection and performance improvement of project managers in collaborative construction projects: Behavioral studies in Norway and Finland. *Buildings*, *11*(1), 4.

Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK®). 6th ed. Project Management Institute; 2017.

Reza Afshari, A. (2015). Selection of construction project manager by using Delphi and fuzzy linguistic decision making. *Journal of Intelligent & Fuzzy Systems*, *28*(6), 2827-2838.

Sadatrasool, M., Bozorgi-Amiri, A., & Yousefi-Babadi, A. (2016). Project manager selection based on project manager competency model: PCA–MCDM Approach. *Journal of Project Management*, *1*(1), 7-20.

Sadeghi, H., Mousakhani, M., Yazdani, M., & Delavari, M. (2014). Evaluating project managers by an interval decision-making method based on a new project manager competency model. *Arabian Journal for Science and Engineering*, *39*(2), 1417-1430.

Sang, P., Liu, J., Zhang, L., Zheng, L., Yao, H., & Wang, Y. (2018). Effects of project manager competency on green construction performance: the Chinese context. *Sustainability*, *10*(10), 3406.

Sankaran, S., Vaagaasar, A. L., & Bekker, M. C. (2020). Assignment of project team members to projects: Project managers' influence strategies in practice. *International Journal of Managing Projects in Business*.

Sharma, K. K., & Kumar, A. (2018). Facilitating quality project manager selection for Indian business environment using analytical hierarchy process. *International Journal of Quality & Reliability Management*.

Wen, Z., Liao, H., Zavadskas, E. K., & Antuchevičienė, J. (2021). Applications of fuzzy multiple criteria decision making methods in civil engineering: A state-of-the-art survey. *Journal of Civil Engineering and Management*, *27*(6), 358-371.

# Proceedings of the 12th International Conference on Construction in the 21st Century (CITC-12)

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**Editors:**
**Syed M. Ahmed, Salman Azhar, Amelia D. Saul, & Kelly L. Mahaffy**

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# Proceedings of the 12th International Conference on Construction in the 21st Century (CITC 12)

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*South Dakota State University*

Dr. Salman Azhar

*Auburn University, Auburn, Alabama, USA*

Dr. Amelia D. Saul

*East Carolina University, Greenville, North Carolina, USA*

Ms. Kelly L. Mahaffy

*East Carolina University, Greenville, North Carolina, USA*

## *Foreword*

While technology and innovation are shrinking, the distance between countries and industries and leadership and collaboration are actively shaping the construction industry, as well as guiding it towards success. Construction in the 21st Century (CITC) is an organization based in the Department of Construction Management at East Carolina University. The CITC-12 conference is being organized by CITC and supported by Auburn University. CITC organizes international conferences to bring together like-minded construction management professionals. The CITC-12 conference seeks to bring together an international group of practitioners, researchers, and educators to promote a novel exchange of ideas in a multidisciplinary fashion.

CITC-12 is a peer-reviewed conference that acts as a dynamic collaboration for the exchange of knowledge. New methods and techniques must be carefully scrutinized and rigorously tested before implementation, and CITC-12 plays an integral role in this process. As the industry moves forward in an ever-complex globaleconomy, multi-national collaboration is crucial. Future growth in the industry will undoubtedly rely on international teamwork and alliance.

This May marks the twelfth CITC conference. Previous conferences include CITC-I in Miami, USA of 2002, CITC-II in Hong Kong, China of 2003, CITC-III in Athens, Greece of 2005, CITC-IV in Gold Coast, Australia of 2007, CITC-V in Istanbul, Turkey of 2009, CITC-VI in Kuala Lumpur, Malaysia of 2011, CITC-VII in Bangkok, Thailand of 2013, CITC-8 in Thessaloniki, Greece of 2015, CITC-9 in Dubai, UAE of 2017, CITC-10 in Colombo, Sri Lanka of 2018, and CITC-11 in London, United Kingdom of 2019. Allconferences were tremendously successful. As with previous conferences, this effort has been greatly supported by our friends and colleagues across the globe. It is our pleasure to now present to you the Twelfth International Conference on Construction in the 21st Century (CITC-12, Amman). This three-day conference is being held in Amman, Jordan at the Inter-Continental Hotel. CITC-12 will bring together adiverse group of academics, professionals, government agencies, and students from all over the world to contribute to the future growth of the industry.

We gratefully appreciate your attendance and hope that you will support the future endeavors of CITC.

Thank you and kind regards,

*Editors:*

Dr. Syed M. Ahmed

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- Furkan UYSAL
- Pavan Meadati
- Yuhan Jiang
- Balkiz Yapicioglu
- Mohsen Garshasby
- Innocent Musonda
- Timson Yeung
- Benedict Amade
- Sanjeev Adhikari
- Thomas Ying
- Wassim AL BALKHY
- Athanasios Chassiakos
- Hamed Hyab Samir
- Iyiola Comfort Olubukola
- Toyin James Olaonipekun
- John Dadzie
- Norma Nusz Chandler
- Albena Yordanova
- Salar Ahmadi
- Rifat Sonmez
- Hakan Karabacak
- İzzet Arı
- Opeoluwa Akinradewo
- Abid Nadeem
- Dubem Ikediashi
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- Scott Kramer
- Arun Garg
- Jackie Yang
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