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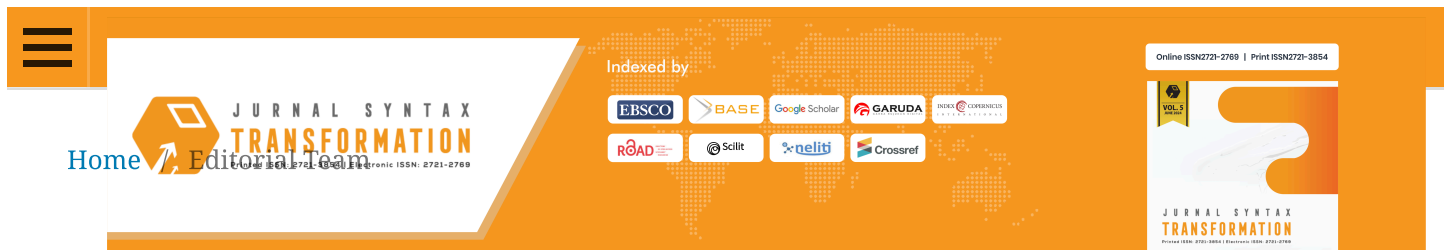
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Construction Supplier Selection Criteria: A Systematic Literature Review

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ABSTRACT

This research proposes a new model for further research on how to choose criteria in supplier selection for construction sector, through a literature review and analysis of the advantages and disadvantages of previously used methods. The methods used to select criteria in construction supplier selection were extracted from various scopus databases. The weaknesses and advantages of these methods were then analyzed. Based on these findings, several opportunities for improvement are proposed for further research. Finally, criteria methods for the selection of suppliers are proposed using statistical Multi-Criteria Decision Making (MCDM) methods. Direction and guidance for subsequent research to select the criteria used in supplier selection, based on the advantages and disadvantages of the decision methods used. Limitations of this study are that it is focused on the methods of criteria design in the supplier selection. This study can provide a research direction on the design of criteria for supplier selection. This study provides ongoing guidance and avenues for further research. Use method / value for working out the developmental strategy for criteria selection are provided by statistical MCDM methods in the construction supplier selection.

Keywords: criteria selection, supplier selection, criteria, method, construction

INTRODUCTION

The main goal of supplier selection processes is to get the best supplier for procurement in construction sector. Which supplier is “best” depends on several factors, all of which must be assessed, checked and weighed. Generally, the supplier selection process involves three basic stages (Demiralay & Paksoy, 2022; Safa et al., 2014; Taherdoost & Brard, 2019; Tay & Aw, 2021; Woschank et al., 2022; Zhao et al., 2019). The first stage is identification and selection of criteria that will be considered in the construction selection supplier sector. The second stage is the determination of methods for the assessment of suppliers based on criteria. The last stage is the selection of suppliers based on the assessment results. Most of the research papers in the field of supplier selection construction sector, although they do explain how their decision criteria were determined, most always focus on the second stage in the process of selecting suppliers. Therefore, there are also many literature reviews related to supplier selection methods that also focus on the second stage as well.

Jianwei Ma, Milind Siddhpura, Assed Haddad, Ana Evangelista, Arti Siddhpura (2024) review in this article that Multi-Criteria Decision Making (MCDM) methods have been implemented to improve the selection regulation and this alternatives including an innovative and two traditional structural systems have been selected and compared in terms of three criteria like economic, social, and environmental impacts.

Alptekin Ulutas, Figen Balo, Katarina Mirkovic, Zeljko Stevic, Mohamed M. H. Mostafa (2023) review this article that MCDM Model can use for assess the primary energy consumption and the environmental effects of the fabrication of building and thermal isolation materials. C Chama, K. Harding, J. Mulopo, P. Chego (2021) this paper addressed about MCDM Model can use for analysis approach to pallet selection with development of a material of construction evaluation model. Vu Hong Son Pham, Thuy Dung Dau, Le Anh Tran (2024) explain about application of multi criteria analysis in the selection of formwork material for high-rise building construction projects. In this paper, explained that each MCDM approach involves a series of steps or components, including defining objectives, choosing criteria to measure these objectives, specifying alternatives, assigning weights to the criteria, applying the appropriate mathematical algorithm for ranking alternatives, and finally, selecting the most suitable option (Ananda & Herath, 2009; Gamini & Prato, 2006; Mosadeghi et al., 2009).

The development of these models is dependent on the designer's perspective and can be differentiated into direct or indirect approaches. In the direct approach, the prioritization or weighting is directly influenced by inputs from beneficiaries, societal stakeholders, or acquaintances collected through surveys. Conversely, the indirect approach involves separating all the possible criteria into components, with weightings assigned as similar problems encountered previously, judgment of decision maker based on experience, etc (Polatidis et al., 2006). A taxonomical delineation of such models is presented in Figure 1. MCDM issues are inherently complex, encompassing a range of factors such as technical, institutional, standards-related, social, economic, and stakeholder dimensions. Consequently, these issues necessitate analyses at both the engineering and managerial levels. Additionally, the process is often controversial

because the objectives may result in divergent solutions at different times, depending on the priorities established by decision-makers or individuals engaged in the process. Furthermore, specific problems may be addressed using various methods contingent upon the defined functions. Each method or model carries its own set of limitations and constraints (Jato-Espino et al., 2014). An overall framework for MCDM techniques is depicted in Figure 2.

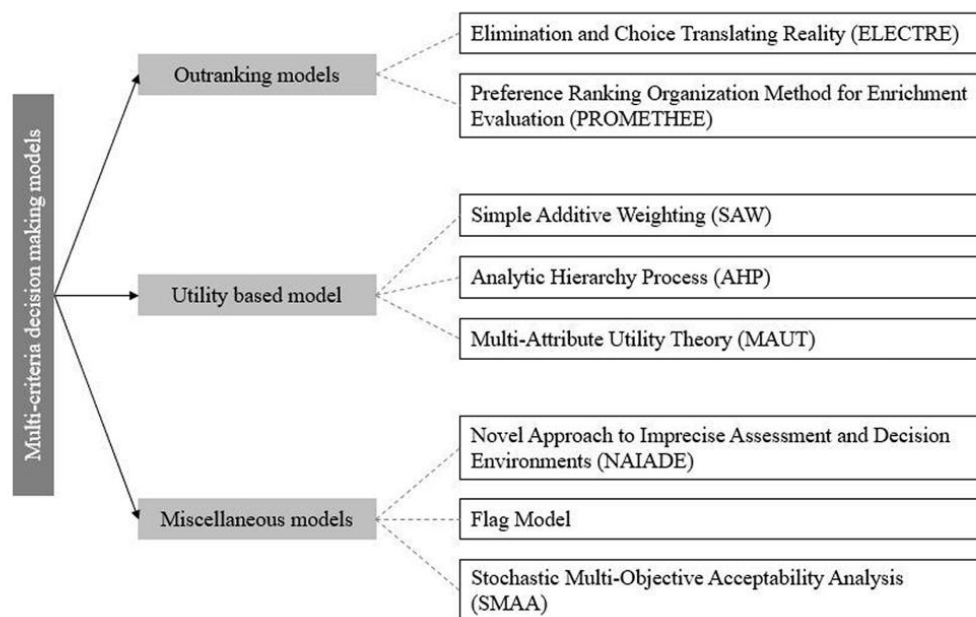


Figure 1. Multi-Criteria Decision Making models

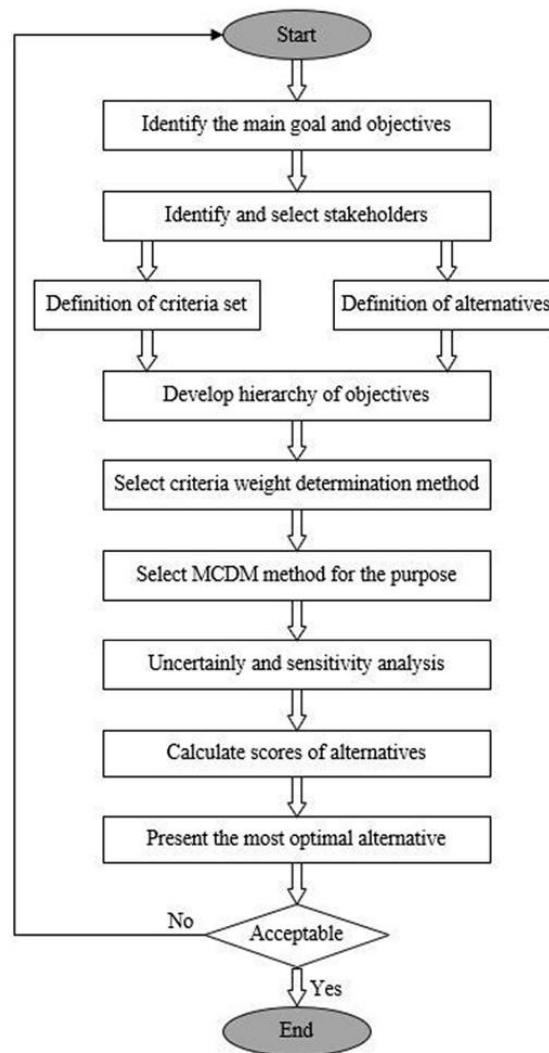


Figure 2. The overall framework of MCDM models

RESEARCH METHOD

The research employs a Systematic Literature Review (SLR) methodology, which is a comprehensive and structured approach to reviewing and synthesizing existing research on a specific topic. In this study, the focus is on the selection of criteria in supplier selection within the construction sector. The primary aim is to evaluate the various supplier selection methods used in previous studies, critically assess their advantages and disadvantages, and propose a new model for future research. The SLR process involves a well-defined search strategy to ensure that all relevant studies are included. The literature search was conducted using the Scopus database, with the keywords “supplier and selection and material and construction.” The review focused on research published between 2015 and 2025, leading to the initial identification of 1,549 articles. The search was further refined by narrowing down the subject area to engineering, resulting in 481 articles, and filtering for journal articles in English, ultimately yielding 230 articles.

The second phase of the SLR methodology involved further refinement and selection to ensure that the articles were relevant to the research topic. After eliminating studies based on citation relevance and compatibility with the research objectives, the final selection included 21 articles that directly contributed to the topic of supplier selection in the construction sector. This process ensured that the study exclusively reviewed the most pertinent and high-quality research. The SLR approach thus enabled a thorough evaluation of the literature, ensuring that the proposed model is grounded in current and relevant studies within the field.

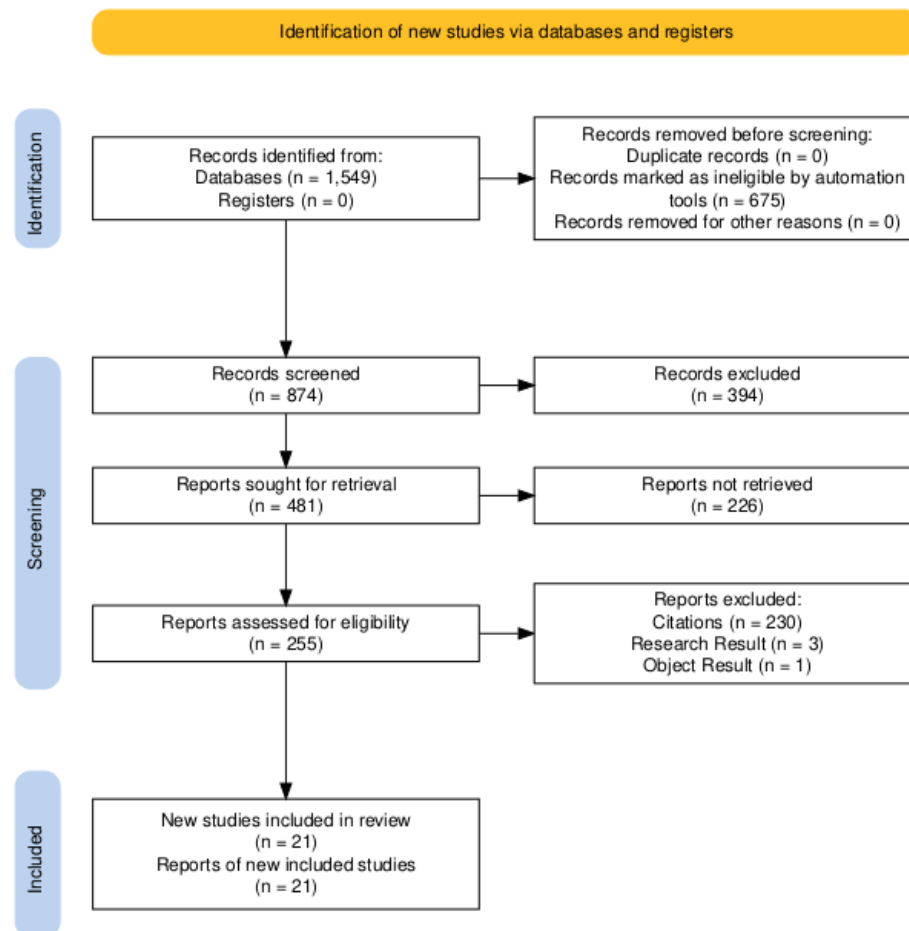


Figure 3. Flowchart of PRISMA methodology
Source: PRISMA Statement 2020

RESULTS AND DISCUSSION

A. Review Categories of Criteria Selection

A total of 21 international journal articles published from 2015 to 2025 were included in our sample. After the analysis of methodological decisions of all the articles collected, the distribution of the methods used in selection criteria for supplier selection is shown in Figure 4. There were four methods are the first rank: Analytical Hierarchy Process (AHP), Interpretative Structural Model (ISM), Decision Making Trial and Evaluation Laboratory (DEMATEL), Principal Component Analysis (PCA)/Analysis Factor, then followed by Analysis of variance (ANOVA). Based on our investigation, we summarized the seventeen methods that have been used for

selection of criteria. We classify these methods into four categories, namely: Delphi, Statistical, multi criteria decision making (MCDM), and mixed methods.

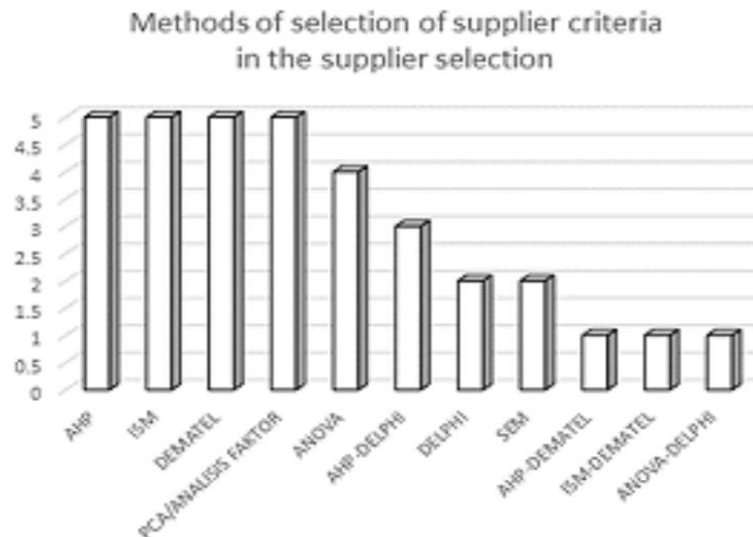


Figure 4. Methods of Selection of Supplier Criteria

B. Future Research is Based on Advantages and Weakness of the Methods

Delphi has some disadvantages. Delphi results are highly dependent on the expertise of the panellists. Therefore, the accuracy of the results depends on the selection of appropriate experts in the field. In addition, it is not easy to unify the perceptions of many experts. Although Kar and Pani (2014) attempt to fix this deficiency using a geometric mean, it can only be done for quantitative data only. For the Delphi method, panellists are experts in their field. However, they are human beings who have many limitations, leading the results to be ambiguous and inconsistent. As a result, Delphi is often done in several rounds. A proposal to overcome this weakness was made by Mahamadu, Mahdjoubi and Booth (2017). They proposed statistical tests to maintain stability between rounds, to end the process when there is no significant change in the panellist opinion between the rounds. One of the major drawbacks of Delphi is that it is expensive and takes a long time. It is not easy to gather many experts in one place and at one time. They are not necessarily willing to do so, even if paid. Many methods can overcome this deficiency by not using Delphi, but still using a few experts, such as ISM, DEMATEL, AHP, SEM, etc. Another weakness of Delphi is a qualitative one, in determining the weight and priority of each criteria. To overcome this weakness, Luzon and El-Sayegh (2016), Kar (2015), and Banaeian (2015) proposed adding stages using AHP in the weighting of the criteria. However, the disadvantage is that if the consistency ratio is not consistent, then the Delphi process must be repeated until the pairwise comparison matrix becomes consistent. Therefore, it is necessary to improve Delphi so that it can yield a consistent pairwise comparison matrix. DEMATEL is applied to find out the diagram of interrelation between criteria and sub criteria in supplier selection (Orji & Wei, 2014). The data input obtained from the questionnaire. This questionnaire should be filled in by an expert in supplier selection, who determines the intensity of the relationship between the criteria in supplier selection. Therefore, the magnitude of the influence between the criteria is identified in this method. The result obtained from DEMATEL is an impact-relation map (IRM) (Orji & Wei, 2014).

This result is very relevant if used as a basis to develop the structural self-interaction matrix in the first step of ISM. So, the results of DEMATEL are suitable for input of ISM. This combination method in the supplier selection is introduced by Mehregan et al. (2014). However, the ISM's end result is to identify the driving force of each criteria only. Thus, it can be concluded that both methods (ISM and DEMATEL) are very suitable methods in the selection of criteria but cannot rank the selected criteria. Merging both methods is inefficient, because they have almost the same goal. The other weakness of both methods (ISM and DEMATEL) is the result does not include the weight of criteria and takes a long time to calculate. Raut et al. (2011) proposed a new combination method of DEMATEL and AHP, but output of DEMATEL was not processed using AHP to obtain the weight of criteria. A better model than ISM and DEMATEL is SEM. SEM is able to estimate the relationship between criteria that are multiply related (Sukwadi & Yang, 2014). This relationship is formed in a structural model (the relationship between dependent and independent constructs). SEM is able to illustrate the pattern of relationships between latent constructs and manifest criteria or indicator criteria (Sukwadi & Yang, 2014). SEM can perform three activities simultaneously, namely the validity and reliability of the instrument (equivalent to confirmatory factor analysis), testing the relationship model between latent criteria (equivalent to path analysis), and obtaining a useful model for prediction (equivalent to structural model or regression analysis) (Sukwadi & Yang, 2014). So, SEM is actually a hybrid technique that includes confirmatory aspects of factor analysis, path analysis, and regression. Although SEM has many advantages, there is little research on supplier selection using SEM. The weakness of SEM is to focus more on affirming the relationships between criteria rather than focus on explaining their relationships. In this method, confirmatory analysis is used more than exploratory analysis. Another weakness is dependent on theoretical justification in the constructing of structural models and measurement models in the form of path diagrams. Justification of this theory is obtained from previous research. However, sometimes a field of research has not been studied before. Therefore, it is necessary to establish the justification of the theory from other models. ISM or DEMATEL is appropriate to build the justification of the theory in a particular field of research. So, the combination model of DEMATEL-SEM and ISM-SEM are suitable in determining the criteria for choosing a supplier.

C. Framework of Criteria Selection in the Supplier Selection

Based on the reviews of the methods in the previous section, we propose a direction guide for selection of criteria. The direction guide can be summarized as shown in Figure 10. In the first stage, we suggest modifying the Delphi model. The purpose of this modification is to save costs. The modification is to summarize the Delphi step so that it becomes one round only. It uses a new method in one round, so it can produce the same solution as using two rounds. ANOVA is required in testing the solution resulting from that one round. Another suggestion is that the questionnaire given once to each expert. Therefore, the expert is not collected in one place and one time, but visited by the surveyor. In the second stage, a model can be developed of the related criteria using DEMATEL or ISM. This model is used to display how multiple criteria are related. Then, SEM is used to test the validity of those related by evaluating the linear relationships between a set of observed and unobserved criteria (Panuwatwanich, Stewart & Mohamed, 2008). ANOVA or multiple regressions cannot be performed on unobserved criteria (Lei & Wu, 2007). Therefore, the third stage uses SEM method to evaluate the correlation of between criteria in the supplier selection. Some criteria should be taken into consideration in the supplier selection, but sometimes there are overlaps of information between criteria. The PCA method can reduce the number of

these criteria without a loss of information. It can be displayed by new linear combinations that reflect the original information. Meanwhile, it still keeps most of the information of the original criteria. Therefore, the third stage uses PCA method to evaluate the criteria in the supplier selection comprehensively. In the last stage, there are several methods of multi criteria decision making (MCDM) that can be used, discussed below. These methods are capable to calculate the weighting of criteria and have been successfully applied in solving the problem of supplier selection. Analytical Network Process (ANP) is a special form of AHP that includes the dependence of criteria and can be used to solve more complicated decision problems than AHP (Pang & Bai, 2013). In ANP, a network of criteria and subcriteria is created that controls the interaction between them (Bayazit, 2006). The general stages of the ANP are: (1) determine the network for each control criteria and combine the relevant criteria, (2) for each control criteria, create clusters versus a cluster matrix with zero or one as entries depending on whether the cluster on the left side affects or does not affect the clusters represented at the top of this matrix, (3) repeat the similar process for criteria versus criteria matrix, (4) derive eigenvectors and to form a supermatrix, (5) construct the supermatrix and rank the order of criteria (Bayazit, 2006).

The Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) takes into account the distance of each criteria assessment of the positive ideal and negative ideal, with a relative closeness index (RC) used for ranking based on maximizing of the distance from the negative ideal (Wood, 2016). The general stages of the TOPSIS are (1) construct a preference matrix, (2) determine the ideal and anti-ideal criteria, (3) calculate the distances of each criterion to ideal reference point and anti ideal reference point, (4) obtain the closeness coefficient and rank the criteria (Igoulalene, Benyoucef & Tiwari, 2015). The fundamental idea of Grey Relational Analysis (GRA) is that relationship closeness is judged based on the level of similarity using limited amounts of data (Bali, Kose & Gumus, 2013). GRA is capable in the problem solving with complicated of the interrelationships between multiple criteria with discrete data and incomplete information (Li, Yamaguchi & Nagai, 2007). The general stages of the GRA are (1) the assessment of criteria of the decision maker, (2) the making of grey decision matrix, (3) normalize grey decision matrix, (4) making the ideal criteria as a referential criterion, (5) calculate the gray possibility degree between compare criteria, (6) rank the order of criteria (Li et al., 2007). complex proportional assessment of alternatives (COPRAS) is a decision evaluation method based on variability of the data of each criterion. The steps of COPRAS are (1) select data (smallest and biggest value) from each criterion, (2) construct the matrix of decision making using data (column) and criteria (row), (3) normalize the decision matrix; (4) calculate P_j (larger value are more preferable) using Equation (4) where i is index of data, j is index of criteria, \max_j is maximum value of the data i of criteria j , and \min_j is minimum value of the data i of criteria j , (5) Calculate the utility degree of each criterion (Q_j)(Equation (5)) and rank the criteria based on the utility degree (Zavadskas, Turskis, Tamošaitiene & Marina, 2008).

CONCLUSION

This paper provides a systematic literature review of articles published between 2015 and 2025 on selection techniques in supplier criteria. A total of 21 journal articles were carefully selected and reviewed in detail. We systematically summarized four techniques of selection criteria that have been applied: the Delphi method, statistical method, MCDM (Multi-Criteria Decision Making), and mixed methods. Despite their advantages, the shortcomings of these methods highlight the potential for further development and improvement. The paper contributes valuable accumulated knowledge on current research and offers recommendations for future studies. Some

methods in MCDM are still rarely used in the selection of supplier criteria. However, expert discussion should continue to be a core aspect of future research.

For future research, we recommend expanding the exploration of underutilized MCDM methods, as they could offer more robust and versatile frameworks for supplier selection, especially in complex decision-making scenarios. Additionally, the incorporation of emerging technologies such as artificial intelligence and machine learning into these methods could significantly improve decision accuracy and efficiency. Future studies should also address the inclusion of articles published beyond 2025, considering that the evolving nature of supplier selection criteria might introduce new methodologies and insights that have not yet been captured in the current literature.

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