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An Integrated Multi-Criteria-Decision-Making Tool for Mechanical Designer Selection

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Abstract

In construction projects, many parties, e.g., owner, design team, general contractor, subcontractors, consultants, suppliers, etc., take part and collaborate. The qualifications of those parties directly affect the success of a construction project. Therefore, those parties should be selected in an objective and systematic way to complete the project successfully. The mechanical design group is an important participant of a design team, whose expertise area is very complicated. The design process of the mechanical group requires multi-disciplinary effort. The technical capability, experience, and communication skills of these parties play a critical role. However, in practice, the selection of the mechanical design team is usually made based on the lowest bid criterion, which may result in additional costs due to working with unqualified, incapable, and insufficient companies. The main objective of this study is to propose an integrated approach, which combines two multi-decision criteria decision-making techniques, to select the most appropriate mechanical design team in construction projects. In the proposed approach, Analytical Hierarchy Process (AHP) and Complex Proportional Assessment (COPRAS) methods are used together and various conflicting and compromising criteria are considered simultaneously. In this study, the AHP technique is used to calculate the weights of the criteria and the COPRAS method is used to rank the design team alternatives. In order to demonstrate how this approach can be applied to a real life problem, a case study is presented.

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Keywords: AHP, COPRAS, mechanical designer, multi-decision-making, integrated approach.

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1. Introduction

In construction projects, two key factors play a critical role in the success, which are (1) the quality of design documents and (2) the quality of materials and workmanship. High quality design reduces constructability problems and clashes. Therefore, general contractors should thoroughly select the design team in order to overcome potential delays and cost overruns. However, this selection is not an easy task as it requires long evaluation process. The mechanical design systems are the most challenging and least known phase of the construction design process. The mechanical design process requires multi-disciplinary effort including the deployment of equipment and distribution systems. In most of the construction projects, the coordination of the mechanical systems is very complicated. The design process of the mechanical systems is one of the most complex aspects of construction projects [1]. The proper design process of mechanical systems requires effective communication between all parties of the construction project, such as architectural and structural design teams and other special trades [1]. The mechanical systems can be very complicated depending on the complexity of the required system and the high level of usage. There are several different usage areas of mechanical systems in construction projects and clashes among these systems should be avoided in the design phase. Otherwise, constructability problems can be encountered during the construction stage, which in turn may cause delays, cost overruns and reworks [1]. Generally, the bid price is a key criterion in the selection process of a design team. However, the design process of the mechanical systems necessitates proper technical capability, enough experience, and good communication skills in a design company. Therefore, the technical capability, experience, and communication skills of the mechanical design company will affect the quality of the design served by this company. The evaluation process of a mechanical design team should be made based on multiple criteria. Decision support systems are very helpful and practical tools for selecting the most appropriate company based on knowledge and expertise of experts with saving valuable time [2]. The main objective of this study is to propose an integrated approach to select the most appropriate mechanical design team in construction projects. In the integrated approach, Analytical Hierarchy Process (AHP) and Complex Proportional Assessment (COPRAS) methods are combined to determine the best mechanical design team for a construction project. In the proposed model, the AHP technique is used to determine the weights of the criteria and the COPRAS method is used to rank the alternative mechanical design companies. The proposed approach is applied in a real life project.

2. The Proposed Approach

The proposed integrated approach to select the most appropriate mechanical design team in construction projects consists of eight steps, which can be categorized in two phases. The steps of the proposed approach are presented in Figure 1.

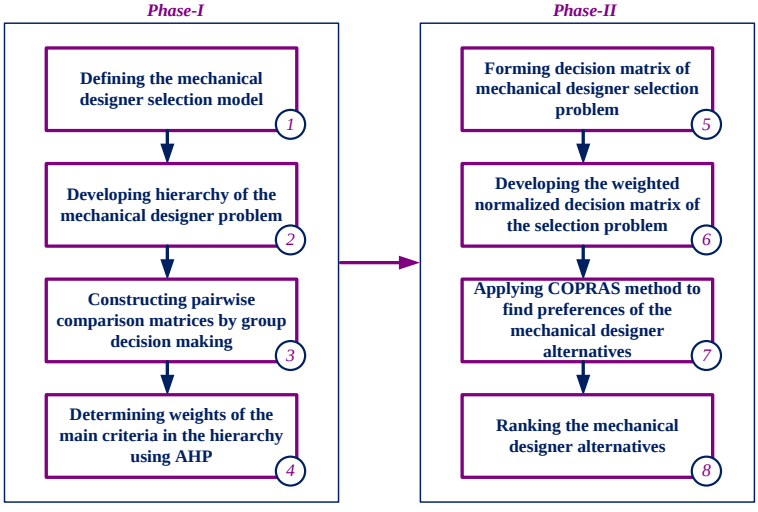

Fig. 1. The steps of the proposed integrated approach.