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Multiple Criteria Decision Analysis for Assessment Project Success

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Abstract: Project success is a foundation to manage and control the current project, plan, and orient the future project. However, project success is a difficult concept because of the project's complexity and dynamic. So it is a challenged decision-making process for any organization to evaluate project success in real practice. This paper provided an innovative, practical list of criteria for project evaluation. It was developed from three sources, which were the literature review (theory), previous documents of completed projects (industrial sources), and experts and respondents (academic and human opinions). Moreover, this research introduces a multi-criteria decision analysis solution for evaluating construction project success by using TOPSIS (The Technique for Order of Preference by Similarity to Ideal Solution) technique. This method is found to be useful when dealing with plenty of assessment criteria and projects.

Keywords: *Decision Analysis, TOPSIS, Project Success, Construction Industry, evaluation criteria*

Introduction:

Project success is a difficult concept because of the project's complexity and dynamic. It is discussed a long time by many researchers. First, it is different in participants, the scope of services, project size, and time-dependent [12]. For example, an architect may consider success regarding aesthetic appearance, but an engineer may view with regard to technical competence [3]. However, according to Parfitt and Sanvido [12], project success definition is different for each participant, but it is based on the core concept of the overall achievement of project goals and expectations. These goals and expectation include technical, financial, educational, social, and professional issues.

So far it is still difficult to get an agreement on the concept of project success, which depends on many factors, especially human perceptions [14, 15]. Until now, there is no accepted universal definition of project success, but no one can disclaim the importance of evaluating project success, especially in construction industry. In order to evaluate project success, a solid list of criteria for evaluating project success should be studied. Moreover, most of the existing project success evaluating models are usually based on subjective opinions of decision makers, resulting in irrational and inappropriate decisions [4]. Also, the models also ignore the factors concerning uncertainty and the importance of assessors [5, 10]. To overcome these disadvantages, we propose a quantitative model for evaluating construction project success using the TOPSIS method.

Construction project evaluation criteria:

The first step to measuring project success is to identify key evaluation criteria. Typically, different organizations have different sets of selection criteria. Based on the information from literature review, twenty-eight projects and sixty-five respondents in Vietnam, we proposed twelve main criteria for evaluating construction project success in Figure 1.

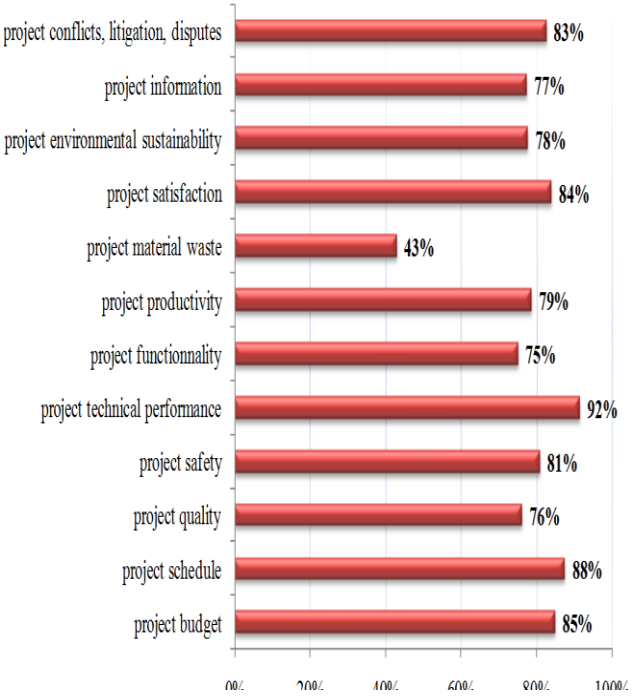

Figure 1. Key construction project evaluation criteria

Multiple Criteria Decision Analysis using TOPSIS method:

From the literature review, there is a broad range of articles focused on the issue of evaluating project success. However, these models and methods contain some problems. Firstly, measuring project success model depends on the perception of evaluators [6]. It cannot avoid bias and sensibility. We need a fair, straightforward, unbiased evaluation project success tool. It is necessary to develop a quantitative assessment project success model than a qualitative approach. Secondly, each model was developed

based on one party's point of view [9, 15]. One project should satisfy the requirements of all parties such as owners, contractors, consultants or project managers, so project success should be evaluated from them to avoid bias [16]. Owners, contractors, and consultants concentrate on the different factors to evaluate the project success. They are also appropriate to provide different information to evaluate project success. Therefore, measuring project success model should let them evaluate the project independently and combine their evaluation to achieve the final project success evaluation [17, 18]. Therefore, a feasible evaluation of project success should be studied to practice in developing countries.

In this study, we applied the TOPSIS method to evaluate construction project success. Yoon and Hwang originally introduced the TOPSIS in 1981 [7]. It orders a set of alternatives having the nearest span to the positive ideal solution and the furthest span to the negative one [8].

The proposed TOPSIS procedure to evaluate construction project success is conducted with the following steps [11, 13]:

Step one. Develop the normalized decision matrix of *n* candidates on *m* criteria by using distributive normalization*:*

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}^2}}$$

where:

r_{ij} stands for the normalized value;

$i = 1,2, 3, \ldots, m$ and $j = 1, 2, 3,\ldots, n$.

Step two. Calculate the weighted normalized decision matrix.

$v_{ij} = w_j * r_{ij}$

where: w_i stands for the weight of the individual criterion; $i = 1, \ldots, m$ and $j = 1, 2, \ldots, n$.

Step three. Identify the positive ideal solution and the negative one.

For the positive ideal solution:

$$V^+ = (v_1^+, ,.., v_j^+ ..., v_n^+)$$

and for the negative ideal solution:

$$V^- = (v_1^-, ..., v_j^-, ..., v_n^-)$$

where $v_j^- = \min_i (v_{ij})$ if C_j is to be minimized.

And $v_j^+ = \max_i (v_{ij})$ if C_j is to be maximized

Step four. Calculate the distance for each alternative to both the positive ideal solution point

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (v_j^+ - v_{ij})^2}$$

and the negative ideal one:

$$d_i^- = \sqrt{\sum_{j=1}^{n} (v_j^- - v_{ij})^2}$$

where $i = 1,2 \ldots, m$; $v_j^+ = \max_i (v_{ij})$ and $v_j^- = \min_i (v_{ij})$

Step five. Calculate each alternative's relative closeness coefficient to the ideal solution:

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-}$$

Step six. Order the alternatives and choose the one with a maximum value of closeness coefficients.

Numerical illustration:

Concerning the proposed criteria, to be simple for illustrative purposes only, the group of decision makers considered only four main criteria with their significant weights as presented in Table 1.

Table 1- Main criteria for evaluating construction project success.

	Main criteria	**Weight**
C_1	Project technical	0.30
C_2	Project schedule	0.20
C_3	Project satisfaction	0.25
C_4	Project health & safety	0.25

Five projects were selected and evaluated for their success with the following scores:

Table 2- The evaluation scores for evaluating construction project success.

Project	**C_1**	**C_2**	**C_3**	**C_4**
P_1	80	70	85	75
P_2	65	85	75	90
P_3	85	70	70	65
P_4	75	90	80	70
P_5	75	70	70	70

From the table 2, we can see that the project P_5 has the evaluation scores dominated by other projects. Therefore, in the screening step, project P_5 were removed out of further calculation. Then evaluators assessed the remaining projects by using TOPSIS procedure. The results show that the project P_1 is the best because it gains the highest relative closeness coefficient score (0.53) among all projects.

Conclusion:

This paper proposes a practical list of criteria for evaluating the success of construction project in developing countries. There are three sources to developing this list of criteria, which are previous research from literature review, information of past projects, and opinion of experts working in construction industry. Also, we proposed a quantitative approach to evaluate project success by using multiple criteria decision-making technique, namely TOPSIS. We believe that this method can provide an even more structured way and reduce the time in the evaluation process. Compared with traditional methods such as scoring technique, TOPSIS technique is very useful when the number of

assessment criteria, as well as the number of projects are large. It helps to overcome the limitations of previous studies in the practical project success evaluation.

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