Project Success Evaluation Using TOPSIS Algorithm

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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 its complexity and dynamic. So, it is a challenged decision-making process for any organization to evaluate project success in real practice. This study 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, research introduces a multi-criteria decision making solution for evaluating 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.

Key words: Decision analysis, TOPSIS, project success, construction industry, evaluation criteria

INTRODUCTION

Project success is a difficult concept because of its complexity and dynamic. It has been discussed for a long time by many researchers. It is different in participants, the scope of services, project size and time-dependent (Pirdavani et al., 2010). For example, an architect may consider success regarding aesthetic appearance, but an engineer may refer to technical competence. However, according to Parfitt and Sanvido (1993), project success is defined differently for each participant but it is based on the core concept of the overall achievement of project goals and expectations, including technical, financial, educational, social and professional issues (Chan et al., 2002).

So far, it is still difficult to get an agreement on the concept of project success which depends on many factors, especially human perceptions (Nguyen and Nguyen, 2015). Until now, there is no consent on universal definition of project success but no one can disclaim the importance of evaluating project success, especially in construction industry (Bryde and Robinson, 2005). In order to evaluate project success, a solid list of evaluation criteria should be studied. Moreover, most of the current models are usually based on subjective opinions of decision makers, resulting in irrational and inappropriate decisions (Buyukozkan and Cifci, 2012). Also, these models ignore the factors concerning uncertainty and the importance of assessors (Chan et al.,

2002). To overcome these disadvantages, we propose a quantitative model for evaluating project success using the TOPSIS methodology.

MATERIALS AND METHODS

The first step to measure 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 project success in Fig. 1.

The literature review has shown a broad range of research on evaluating project success. However, some limitations on the models and methods have been found (Tabish and Jha, 2011). Firstly, measuring project success model depends on the perception of evaluators (Ju and Wang, 2012). Therefore, bias and subjectiveness is unavoidable. We need a fair, straightforward, unbiased evaluation project success tool. It is necessary to develop a quantitative assessment project success model rather than a qualitative approach. Secondly, each model was developed based on only one party's point of view (Onut et al., 2010). A 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 (Tabish and Jha, 2011). Owners, contractors and consultants

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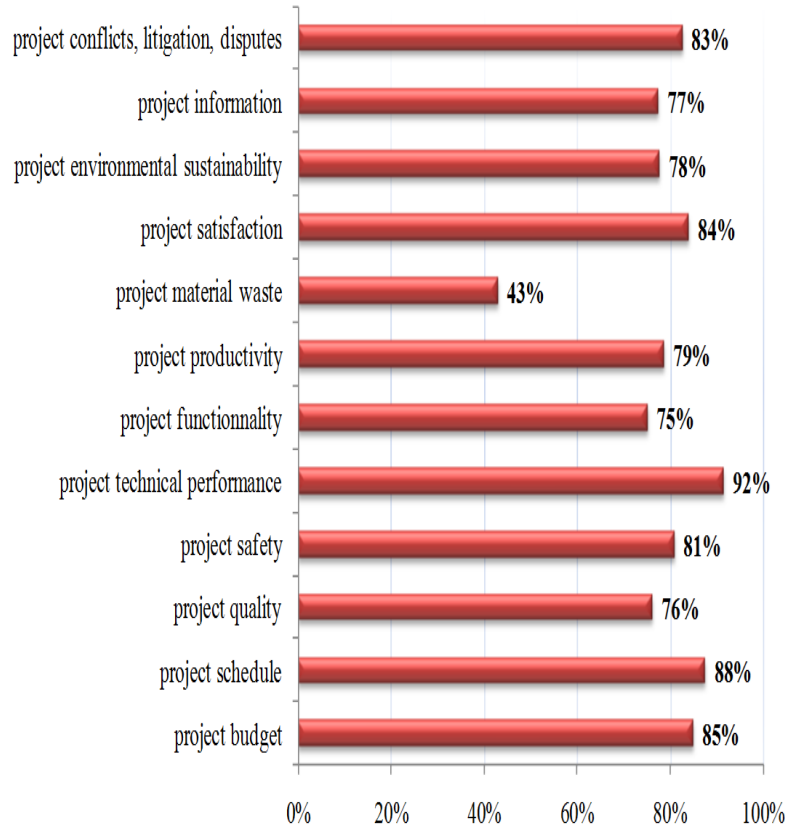Vietnam

Fig. 1: Key project evaluation criteria

concentrate on the different factors to evaluate the project success. They are also appropriate to provide different information to evaluate project success. As a result, an appropriate model of measuring project success should allow them evaluate the project independently and combine their evaluation to achieve the final project success evaluation. 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 project success in construction industry. Yoon and Hwang originally introduced the TOPSIS in 1981 (Mahdavi *et al.*, 2009). It orders a set of alternatives having the nearest span to the positive ideal solution and the furthest span to the negative one (Menches and Hanna, 2006; Wang and Chaudhry, 2014). The proposed TOPSIS procedure to evaluate project success is conducted with the following steps (Pirdavani *et al.*, 2010).

RESULTS AND DISCUSSION

Step one: Develop the normalized decision matrix of n candidates on m criteria by using distributive normalization (Eq. 1):

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

Where:
r_{ij} = Stands for the normalized value
i = 1, 2, 3, ..., m
j = 1, 2, 3, ..., n

Step two: Calculate the weighted normalized decision matrix:

$$v_{ij} = w_j \times r_{ij}$$

Where:
w_i = Stands for the weight of the individual criterion
i = 1, ..., m
j = 1, 2, ..., n

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

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

and for the negative ideal solution:

Table 1: Major criteria for evaluating construction project success

Variables	Main criteria	Weight
C1	Project technical	0.25
C2	Project schedule	0.25
C3	Project satisfaction	0.30
C4	Project health and safety	0.20

Table 2: The evaluation scores for evaluating construction project success

Project	C1	C2	C3	C4
P1	750	720	930	790
P2	800	850	770	900
P3	750	700	730	730
P4	850	870	780	750
P5	690	710	740	730
P6	930	790	750	740

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

Where:

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

$v_j^+ = \min_i (v_{ij})$ = If C_j is to be maximized

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

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

and the negative ideal one:

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

where, i = 1, 2, ..., 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 shown in Table 1.

From the Table 2, we can see that the project P_3 and project P_5 have the evaluation scores dominated by other projects. Therefore, in the screening step, project P_3 and 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 (0.47) among all projects.

CONCLUSION

This study 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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REFERENCES

Bryde, D.J. and L. Robinson, 2005. Client versus contractor perspectives on project success criteria. Int. J. Project Manage., 23: 622-629.

Buyukozkan, G. and G. Cifci, 2012. A combined fuzzy AHP and fuzzy TOPSIS based strategic analysis of electronic service quality in healthcare industry. Expert Syst. Appl., 39: 2341-2354.

Chan, A.P., D. Scott and E.W. Lam, 2002. Framework of success criteria for design build projects. J. Manage. Eng., 18: 120-128.

Ju, Y. and A. Wang, 2012. Emergency alternative evaluation under group decision makers: A method of incorporating DS/AHP with extended TOPSIS. J. Expert Syst. Appl., 39: 1315-1323.

Mahdavi, I., A. Heidarzade, S.B. Gildeh and M.N. Amiri, 2009. A general fuzzy TOPSIS model in multiple criteria decision making. Int. J. Adv. Manuf. Technol., 45: 406-420.

Menches, C.L. and A.S. Hanna, 2006. Quantitative measurement of successful performance from the project manager's perspective. J. Constr. Eng. Manage., 132: 1284-1293.

Nguyen T. and P. Nguyen, 2015. Explaining model for supervisor's behavior on safety action based on their perceptions. J. Eng. Appl. Sci., 10: 9562-9572.

Onut, S., T. Efendigil and S.S. Kara, 2010. A combined fuzzy MCDM approach for selecting shopping center site: An example from Istanbul, Turkey. Expert Syst. Applic., 37: 1973-1980.

Parfitt, M.K. and V.E. Sanvido, 1993. Checklist of critical success factors for building projects. J. Manage. Eng., 9: 243-249.

Pirdavani, A., T. Brijs and G. Wets, 2010. A multiple criteria decision making approach for prioritizing accident hotspots in the absence of crash data. Transp. Rev., 30: 97-113.

Tabish, S.Z.S. and K.N. Jha, 2011. Identification and evaluation of success factors for public construction projects. Constr. Manage. Econ., 29: 809-823.

Wang, Y., W. Ji and S.S. Chaudhry, 2014. A hybrid approach for the evaluation of supermarket food safety. J. Manage. Analytics, 1: 156-167.