

Design a new intelligence expert decision making using game theory and fuzzy AHP to risk management in design, construction, and operation of tunnel projects (case studies: Resalat tunnel)

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Received: 7 June 2009 / Accepted: 20 July 2010 / Published online: 4 August 2010
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Abstract One of the traditional methods on managing risk is taken using engineering decisions taken during the project development. In this paper, we propose a new method for risk assessment of a tunnel project where there are three main parameters called taskmaster, adviser, and contractor. The proposed model of this paper is built based on interactive framework of a game theory where, in making decision, each player considers other possible risks choices. We implement three-person cooperative game theory combined with an interactive decision structural model of fuzzy analytical hierarchy process to perform a balance between actions and suitable cooperative strategy for each player. The results reveal that collaboration strategies give the highest outcome for the three players. It also recommends owner managers, design managers, and contractor managers to make collaboration in undertaking innovation while the operator managers need to let an independent organization clearly identify the appropriate risk mitigation measures to be implemented in a timely manner.

Keywords Risk management · Tunnel project · Cooperative game theory · Fuzzy AHP

1 Introduction

Most of the real-world decision problems occur in a complex environment where conflicting systems of logic, uncertain, and imprecise knowledge need to be considered. To face such complexity, preference modeling needs the use of specific tools, techniques, and concepts to reveal the available information with the appropriate granularity [1, 2]. There are many cases such as choice of alignment or selection of construction methods where the risk management becomes vital in the early stages of a project [3]. The purpose of this paper is to present guidelines for managers to prepare and implement a comprehensive tunnel risk management system. There are four managers for our system called owner managers, designer managers, contractor managers, and operator managers. For the purpose of this paper, “risk management” is the overall term which includes risk identification, risk assessment, risk analysis, risk elimination, and risk mitigation and control. Tunneling and underground construction works impose risks on all parties involved as well as on those not directly involved in the project. The nature of tunnel projects normally involves significant amount risks such as large-scale accidents which create catastrophic incidents. Due to the inherent uncertainties, including ground and groundwater conditions, there might be significant cost overrun and delay risks as well as environmental risks. Furthermore, for tunnels in urban areas there is a risk of damage to people and their properties or even historical buildings. Finally, there is a social risk that the tunneling project may give rise to public protests affecting the course of the project [4].

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