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Generating project risk response strategies based on CBR: A case study

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ABSTRACT

Risk response is an important work in project risk management (PRM). To generate project risk response strategies, retrieving and reusing information and knowledge of the similar historical cases is important, while research concerning this issue is still relatively scarce. Taking the risk response of the subway project in S city, China as a case problem, this paper proposes a pragmatic method for generating project risk response strategies based on the case-based reasoning (CBR). The procedure of the method include the five parts: first, representing the target case and the historical cases; second, retrieving the available historical cases by judging whether the risks involved in each historical case cover or are the same as those in the target case; third, retrieving the similar historical cases by measuring the similarity between each available historical case and the target case; fourth, revising the inapplicable risk response strategies involved in the similar historical cases by analyzing the response relation between each strategy and each risk of the current project; and generating the desirable risk response strategies by evaluating each candidate risk response strategy set. To illustrate the use of the proposed method, an empirical analysis of generating the risk response strategies for the subway station project is given. The proposed method can support project managers to make the better decision in PRM.

1. Introduction

Project execution is always accompanied by risks. For example, there may exist some risks during the execution of an engineering project, such as management risk, cost risk and so on. Therefore, it is necessary to conduct project risk management (PRM). In general, PRM includes three phases: risk identification, risk assessment and risk response (Fan, Lin, & Sheu, 2008). Risk identification refers to recognizing and documenting associated risks. Risk assessment refers to examining the identified risks, refining the description of the risks, and estimating the value of the risks. Risk response refers to generating and implementing proper strategies to prevent and control the risks. Once risks of the project have been identified and assessed, proper risk response strategies must be generated and adopted (Zou, Zhang, & Wang, 2007). So far, many studies on risk identification and assessment have been found, whereas risk response has seldom been addressed in the existing studies (Seyedhoseini, Noori, & AliHatefi, 2008). Hence, an in-depth study on risk response is necessary.

In the existing studies, the methods for generating project risk response strategies can be mainly classified into four types (Zhang & Fan, 2014): the zonal-based method (Elkjaer & Felding, 1999; Flanagan & Norman, 1993; Jordan, Jørgensen, & Mitterhofer, 2013; Marcelino-Sádaba, Pérez-Ezcurdia, Echeverría Lazcano, & Villanueva, 2014; Miller & Lessard, 2001; Piney, 2002; Sumit, 2001), the trade-off method (Chapman & Ward, 1996; Kujawski, 2002; Pipattanapiwong & Watanabe, 2000), the work breakdown structure (WBS)-based method (Chapman, 1979; Klein, Powell, & Chapman, 1994; Seyedhoseini, Noori, & Hatefi, 2009) and the optimization-model method (Ben-David & Raz, 2001; Fan et al., 2008; Hu, Zhang, Ngai, Cai, & Liu, 2013; Hu et al., 2013; Kayis, Arndt, Zhou, & Amornsawadwatana, 2007). The detailed elaborations of the above four types of methods can been seen from Zhang and Fan (2014). The four types of methods have made significant contributions to generating project risk response strategies from different perspectives. However, it can be seen that the existing methods have some limitations in practical applications. For example, the key of using the zonal-based method is to form a two-axis graph composed of multiple zones for the risks. If more than two criteria concerning the risks are

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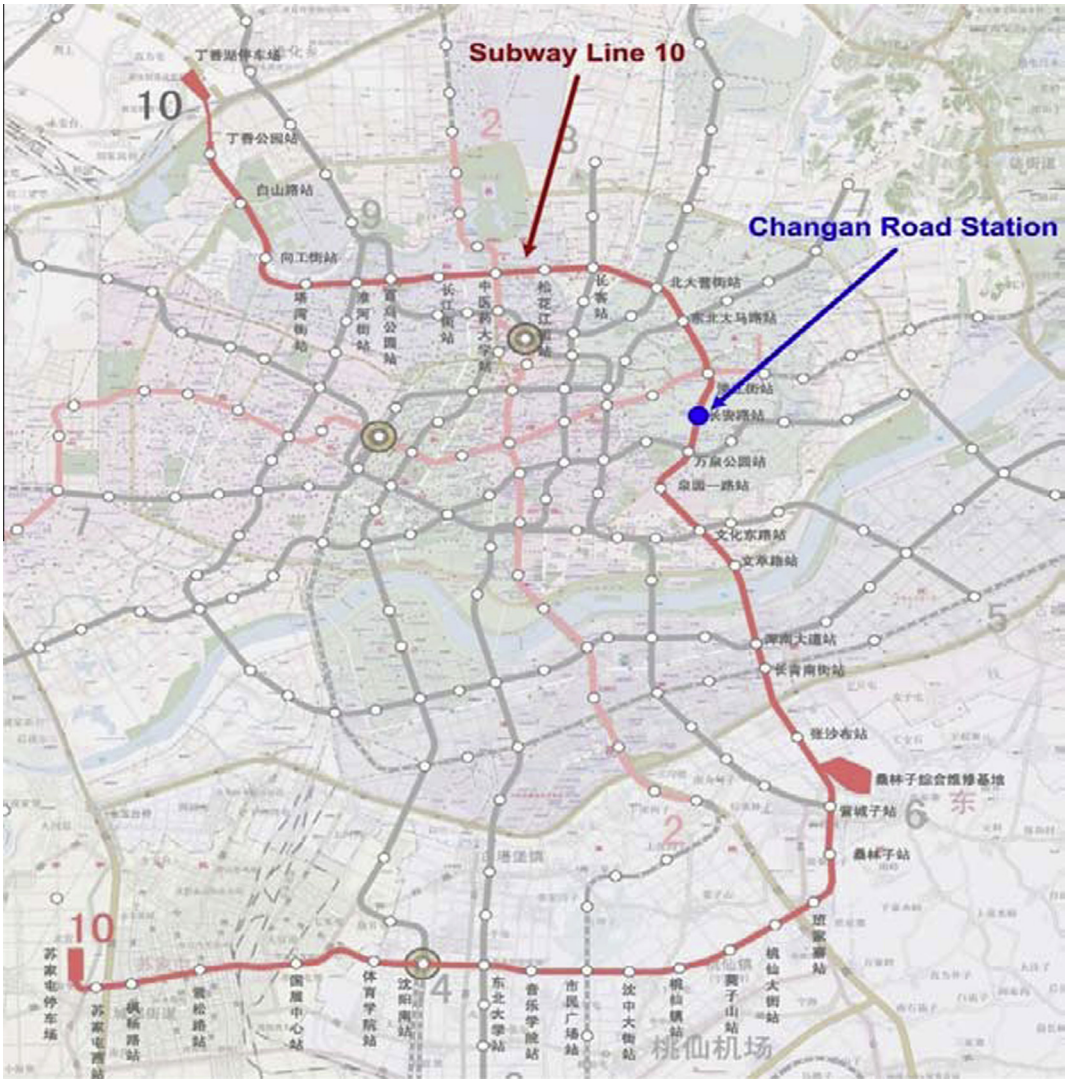

Fig. 1. The subway line 10 of S city.

considered, it will be difficult to form the graph. Likewise, the trade-off method only applies to the situation of two criteria considered. In addition, there are some limitations in the use of the optimization-model method because it is difficult to quantify some project features (e.g., project size or technical complexity) in the process of risk analysis and modeling. Moreover, it is no easy task to determine the WBS for some projects with complicated characteristics. Thus, it will be difficult to generate risk response strategies for the projects using the WBS-based method. Besides, using the WBS-based method, it is unlikely to know whether the obtained strategies are the desirable ones for risk response.

Given the limitations of the exiting methods, it is necessary to conduct further research on how to tackle project risk response problems from a new perspective. Some studies in recent years show that it is feasible to solve the decision-making problems using the case-base decision analysis methods (Amailef & Lu, 2013; Chen, Kilgour, & Hipel, 2008; Ma, 2012; Pla, López, Gay, & Pous, 2013). Thus, to solve the project risk response problem, a way of case-base decision analysis may be considered. That is, the project manager can retrieve the available information and knowledge on risk response from case base. Then appropriate risk response strategy or strategies for the current project can be generated by analyzing and reusing the retrieved information and knowledge. As is known to all, the case-based reasoning (CBR) technique is good at solving problems by retrieving and reusing information and knowledge of the similar historical cases (Aamodt & Plaza, 1994; Abelson & Schank, 1977; Hansen, Meservy, & Wood, 1994). Over the decades, CBR was widely applied in various areas such as medicine (El-Fakdi, Gamero, Meléndez, Auffret, & Haigron, 2014; Guessoum, Laskri, & Lieber, 2014; Ting, Wang, Kwok, Tsang, & Lee, 2010; Zhuang, Churilov, Burstein, & Sikaris, 2009), manufacturing industry (Kuo, 2010; Wu, Lo, & Hsu, 2008) and business (Carmona, Barbancho, Larios, & León, 2013; Li, Adeli, Sun, & Han, 2011), etc. It can been found that there are some studies on risk management based on CBR (Aarts, 1998; Bajo, Borrajo, De Paz, Corchado, & Pellicer, 2012; Chang, Ma, Song, & Gao, 2010; Dingwei & Xinping, 2011; Goh & Chua, 2009; Jung, Han, & Suh, 1999; Kumar & Viswanadham, 2007; Li, Yu, Zhou, & Cai, 2013; Lu, Li, & Xiao, 2013; Yao, Chen, & Yang, 2014). For example, Kumar and Viswanadham (2007) develop a CBR-based framework of the decision support system to support the risk management of construction supply chains. Dingwei and Xinping (2011) develop an audit decision aid system based on analytical hierarchy process and CBR to assess the management fraud risk. Bajo et al. (2012) develop a CBR-based multi-agent system for web-based risk management in small and