



Identifying risk factors of IT outsourcing using interdependent information: An extended DEMATEL method

Zhi-Ping Fan^a, Wei-Lan Suo^{a,b,*}, Bo Feng^c

^a Department of Management Science and Engineering, School of Business Administration, Northeastern University, Shenyang 110819, China

^b Institute of Policy and Management, Chinese Academy of Sciences, Beijing 100190, China

^c Department of Decision Sciences, School of Business Administration, South China University of Technology, Guangzhou 510641, China

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ABSTRACT

Risk factor identification of IT outsourcing is significant to capture the source of IT outsourcing risk. Risk factors of IT outsourcing are often interdependent, and consequently the interrelationships among factors affect risk factor identification, whereas this fact is neglected in the existing studies. The purpose of this paper is to investigate a method for identifying risk factors of IT outsourcing, in which the interrelationships among risk factors are considered. Firstly, the risk factors of IT outsourcing are figured out through literature review and expert interview. Then, the interrelationships among risk factors and relative analysis are given. Furthermore, based on the 2-tuple fuzzy linguistic representation model and the classical Decision Making Trial and Evaluation Laboratory (DEMATEL) method, an extended DEMATEL method is developed to identify the importance together with the classification of risk factors. Finally, the potential of the proposed method is shown through an illustrative example of a Chinese resource company.

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1. Introduction

In facing an ever-increasingly competitive and changeable environment, organizations are required constantly managing their resources and focusing on core business so as to maintain competitive advantages (Porter, 1985). To meet this requirement, more and more organizations resort to information technology (IT) as a solution for achieving the informationization management of resource and business (Dewett & Jones, 2001; Heim & Peng, 2010). In recent years, IT outsourcing has been extensively accepted by various organizations (Antelo & Bru, 2010; Ferreira & Laurindo, 2009; Gonzalez, Gasco, & Llopis, 2006; Lee, Huynh, Kwok, & Pi, 2003; Paisittanand & Olson, 2006; Wang & Yang, 2007). This is because IT outsourcing has many potential benefits: cost saving (Lacity & Hirschheim, 1993; Lacity, Willcocks, & Feeny, 1996; Loh & Venkatraman, 1992), improved efficiency (Barthélemy, 2001; Chen & Wang, 2009; Samaddar & Kadiyala, 2006), increased flexibility (Offodile & Abdel-Malek, 2002; Rao, Nam, & Chaudhury, 1996; Wu, Li, Chu, & Sculli, 2005) and so on. However, IT outsourcing also entails risk that may lead to undesirable consequences, e.g., costly contractual amendments (Earl, 1996), shirking and opportunistic bargaining (Ngwenyama & Bryson, 1999), disclosure of commercial secrets

and fraud (Mojsilović, Ray, Lawrence, & Takriti, 2007). Thus, a significant risk management effort is required to adeptly steer IT outsourcing operation (Aubert, Dussault, Patry, & Rivard, 1999; Osei-Bryson & Ngwenyama, 2006; Shi, Tsuji, & Zhang, 2010). Especially, risk factor identification is the base of whole risk management (Li & Liao, 2007; Maytorena, Winch, Freeman, & Kiely, 2007). By risk factor identification, various risk factors that may influence IT outsourcing operation are uncovered to help decision makers capture the source of IT outsourcing risk.

In real world, risk factors of IT outsourcing are often interdependent (Bahli & Rivard, 2005; Lacity & Hirschheim, 1993; Ramachandran & Gopal, 2010). In some situations, the interrelationships among risk factors can induce the transmission effect from one risk to another. For example, in IT outsourcing operation, *requirements instability* and *technological complexity* are two interdependent risk factors (see: Ramachandran & Gopal, 2010). *Requirements instability* can increase the cognitive uncertainty of technology, which is accompanied with the complexity of technology. On the other hand, *technological complexity* can make organizations confused with their requirements so as to lead to the instability of requirements. Furthermore, the interrelationship between the two risk factors can induce the transmission effect from *market risk* to *operation risk*. Therefore, it is necessary to consider the interrelationships among risk factors in risk factor identification of IT outsourcing. Furthermore, the importance and classification of risk factors are also needed to be identified to support the decision makers' judgments on risk factors. The importance of a risk factor means the role of this factor and what extent this risk factor should be watched. The

* Corresponding author. Address: Department of Management Science and Engineering, School of Business Administration, Northeastern University, Shenyang 110819, China. Tel.: +86 24 83687753; fax: +86 24 23891569.

E-mail addresses: zpfan@mail.neu.edu.cn (Z.-P. Fan), suoweilan_neu@yahoo.com.cn (W.-L. Suo).

classification of risk factors figures out the controllability or uncontrollability of each risk factor, which avails to select the targeted measures for risk control.

Some studies on risk factor identification of IT outsourcing have been found. For example, Aubert, Patry, and Rivard (1998) listed risk factors of IT outsourcing by reviewing the existing literature and propose a framework for categorizing the listed risk factors. Further, Aubert, Patry, Rivard, and Smith (2001, 2005) revised and updated the list of risk factors that they presented previously. Following the work of Aubert et al. (1998, 2001, 2005), Bahli and Rivard (2005) gave the analysis of risk factors. Also, Earl (1996) listed risk factors of IT outsourcing by discussing with both vendors and clients in the IT outsourcing marketplace, while Willcocks, Lacity, and Kern (1999) elicited risk factors of IT outsourcing by a case study.

On the other hand, studies on risk assessment (Bahli & Rivard, 2001, 2005) and risk control (Aubert et al., 2005; Bahli & Rivard, 2003; Willcocks et al., 1999) based on the work of risk factor identification can be found. For example, Bahli and Rivard (2001) proposed a model for defining and measuring IT outsourcing risk based on transaction cost and agency theory. Willcocks et al. (1999) conducted a longitudinal case research on risk mitigation in IT outsourcing operation.

Prior studies have significantly advanced risk factor identification of IT outsourcing. However, in the existing studies, the major limitation is that the interrelationships among risk factors are not involved. This incurs the inaccuracy in the process of determining the importance and classification of risk factors, together with the low-performance implementation of risk control. Hence, it is necessary to develop a routine method for solving the problem of risk factor identification considering the interrelationships among risk factors. This is the motivation of our study.

The purpose of this paper is to develop a method for identifying risk factors of IT outsourcing, in which the interrelationships among risk factors are considered. Firstly, based on the literature review and interviews with experts in IT industry, risk factors of IT outsourcing are figured out. Then, the description and analysis of the interrelationships among risk factors are given. Furthermore, based on the 2-tuple fuzzy linguistic representation model (Herrera & Martínez, 2000, 2001) and the classical Decision Making Trial and Evaluation Laboratory (DEMATEL) method (Fontela & Gabus, 1976; Gabus & Fontela, 1972, 1973), an extended DEMATEL method is developed to identify the importance and classification of risk factors.

This paper is organized as follows. Section 2 lists the risk factors of IT outsourcing. Section 3 analyzes the interrelationships among risk factors. Section 4 introduces the 2-tuple fuzzy linguistic representation model. Section 5 presents an extended DEMATEL method to identify the importance and classification of risk factors. Section 6 illustrates the potential of the proposed method through a case study. Finally, Section 7 summarizes and highlights the main features of the method proposed in this paper.

2. Risk factors of IT outsourcing

To analyze and list risk factors of IT outsourcing, the following procedures are implemented. Firstly, literature review is conducted, which includes the literature on risk factor identification of IT outsourcing and IT outsourcing decision. Secondly, various risk factors of IT outsourcing mentioned in the existing literature are filtrated and a reference set of risk factors is formed. Additionally, interviews with 23 experts in IT industry are conducted to select risk factors from the reference set.

By these procedures, eight risk factors of IT outsourcing are finally listed, and the descriptions of these risk factors are shown in Table 1. Particularly, with a specific scenario of risk factor identification, the risk factors shown in Table 1 can be eliminated and added.

3. Interrelationships among risk factors of IT outsourcing

In real world, there often exist interrelationships among risk factors of IT outsourcing, which can be judged through subjective judgments of experts. The interrelationships among risk factors of IT outsourcing can be characterized by a graph, for instance, Fig. 1 shows the interrelationships among six risk factors (F_1, F_2, \dots, F_6). In Fig. 1, the arrowed line linked two risk factors represents that there exists interrelationship between them, and the width of the line represents the intensity of interrelationship. The wider the line is, the higher the intensity is. Especially, the direction of the arrowed line shows the influence relationship. For example, the line between factors F_2 and F_3 means that F_2 affects F_3 . We can see from Fig. 1 that there does not exist the direct interrelationships among some factors while exist indirect interrelationships among them due to the transmission effect of interrelationships among other factors, e.g., F_1 and F_3 . We highlight the interrelationships among F_1, F_2 and F_3 by Fig. 2, where the dashed line means the indirect interrelationship. It implies F_1 indirectly affects F_3 since F_1 affects F_2 and F_2 affects F_3 .

Moreover, existences and intensities of interrelationships among risk factors can be judged by experts. For doing so, linguistic terms (e.g., low and high) are used to express experts' opinions. In the process of risk factor identification, experts' judgments that are in the form of linguistic terms should be processed and aggregated. The available approaches for dealing with linguistic terms can be classified into three categories (Herrera & Martínez, 2000). The first one is based on the *extension principle* (Bonissone & Decker, 1986; Degani & Bortolan, 1988). It makes operations on the fuzzy numbers that support the semantics of the linguistic terms. The second one is the *symbolic method* (Delgado, Verdegay, & Vila, 1993). It makes computations on the indexes of the linguistic terms. The third one is based on the

Table 1
The risk factors of IT outsourcing.

Risk factors	Descriptions
Technological indivisibility	Since much of information technology is not divisible, trying to divide it into parts for different vendors can be problematical
Possibility of weak management	New type of IT outsourcing management may be more difficult. Weak management could increase costs and lead to conflict and dissatisfaction
Cultural fit	Poor cultural fit may damage the outsourcing relationships between client and vendor and lead to the conflict between them
Requirements instability	Future direction and requirements of the client may change in the process of IT outsourcing operation
Coordination between client and vendor	Effective coordination between client and vendor could facilitate the favorable cooperation in the process of IT outsourcing operation
Reliability of selected vendor(s)	Unreliable vendor(s) may influence the schedule and quality of IT outsourcing operation
Uncertainty about the legal environment	Legal environment is the external condition for IT outsourcing. Uncertain legal environment could influence IT outsourcing operation
Technological complexity	Technological complexity may influence the schedule of IT outsourcing operation and the quality of task accomplishment

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