



## Integrating DANP and modified grey relation theory for the selection of an outsourcing provider

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### ABSTRACT

Globalization has inevitably forced firms to pursue outsourcing as a strategy to reduce operating costs and improve their competitiveness in the global marketplace. However, a successful outsourcing activity depends on the selection of the appropriate provider. Unlike previous multiple criteria decision-making (MCDM) methods that assume the criteria are independent, we propose a novel hybrid model, combining a Decision Making Trial and Evaluation Laboratory (DEMATEL) and Analytical Network Process (ANP) method called DANP, which addresses the dependent relationships between the various criteria to better reflect the real-world situation. At the same time, instead of ranking the alternatives, we apply a modified grey relation method to select and improve the criterion-gaps to the aspiration levels. To demonstrate the usefulness and effectiveness of the proposed model, we use data from a Taiwanese company.

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### 1. Introduction

Outsourcing is motivated by a combination of environmental pressure, efficiency, and competitive pressure. This occurs when one company hands over a part of their existing internal activity to another company by contract (McCarthy & Anagroustou, 2004). Outsourcing is becoming the next critical business process that firms are addressing. Firms can either embark on internal off-shoring (by setting up their own centres or subsidiaries in foreign countries while maintaining full ownership and control) or external off-shoring (by handing over business functions to independent foreign providers). Interest is growing among strategy and international business scholars to better understand how outsourcing can be used as a strategic device, or as a strategy itself, in order to create value (Kedia & Mukherjee, 2009). The concept of outsourcing is not new. External service providers in areas such as facilities operations, finance, accounting, logistics, legal services, marketing, and customer care have existed for a long time. However, new elements such as modern technologies, delivery models, globalization, and more demanding end-users have acted provide impetus for outsourcing activities (Yang, Kim, Nam, & Min, 2007). The result – firms have increased efficiencies and abilities to focus on core competencies – which has produced real profits and increased customer satisfaction. However, ineffective outsourcing activities, derived from improper strategies or methods,

can lead to a loss of core competencies and capabilities, exposure to unexpected risk, and even business failures (Wang & Yang, 2007). A rational, systematic and scientific decision process for choosing outsourcing providers is very important to increasing the success rate of outsourcing.

Transaction cost theory could be the most popular method used by early researchers. However, in recent years, aspects of strategy such as core competency, risk analysis, and organizational flexibility have been growing in importance. This trend has led researchers and practitioners to become more interested in the multi-criteria decision model for outsourcing. The goal of the multiple criteria decision-making (MCDM) method is to aid decision-makers in integrating objective measurements with value judgments which are not based on individual opinions, but rather on collective group ideas (Belton & Stewart, 2002). Some (Yang et al., 2007; Wang & Yang, 2007) have applied the MCDM method to different outsourcing issues, but have assumed that the criteria were independent. The analytic hierarchical process (AHP) has been used to construct a model of outsourcing problems. In the real world, criteria are seldom independent but always have a degree of interactive relationships, sometimes with dependence and feedback effects (Tzeng, Chiang, & Li, 2007; Tsai & Chou, 2009). Liou and Chuang (2010) did consider the dependent effects but assume the dimensions are equal weights which are true in the real-world situation.

In this study, we improve previous methods and apply a new model which considers multiple criteria and uses the Decision Making Trial and Evaluation Laboratory (DEMATEL)-based ANP (called DANP) to construct the relationship and weights of the

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criteria. Then a modified grey relation method is used to select and improve the alternatives. The DEMATEL technique maps out the relationship between various perspectives, enhancing our understanding of the complex issues related to the performance of outsourcing providers. An influential network-relationship map (INRM) is utilized to plot the performance of the outsourcing provider, which, combined with the DANP can help to measure the mutual importance of each factor. The ANP method currently deals with normalization in the supermatrix by assuming that each cluster has equal weight. Although the supermatrix normalization method is easy, the assumption of equal weight seems to be irrational, because different criteria have different degrees of influence (Ou Yang, Shieh, Leu, & Tzeng, 2008). Therefore, this study utilizes a hybrid MCDM model that combines DANP to solve the dependence and feedback problems, thus more accurately reflecting real world situations. For selection of the best alternative, the traditional grey relation method use a referential alternative which is usually obtained from a set of existing alternatives, but these do not necessarily satisfy firm needs. A modified grey relation method is thus proposed to solve the problem. We further develop a new ranking index that considers both the aspired and worst alternatives. The new index should be more reliable than the original model, which is based on referential alternatives only.

With this in mind, we provide a framework which considers interdependence between the criteria. This DANP method combining with the modified grey relation method fixes some of the problems encountered in the original model. This hybrid model offers a more useful way to solve the performance evaluation problems of outsourcing providers. Therefore, the contribution of this work is that it offers a quantitative decision model that can help practitioners with the selection of outsourcing provider and reap the most benefits from outsourcing. We use data from a Taiwanese airline to demonstrate this model.

## 2. Literature review

Over the last decade or so, the question of whether to outsource key activities or keep them in-house has become an increasingly urgent one for companies (Rieple & Helm, 2008). Against a background of globalization, many companies are going through a process of de-integration as they contract-out large parts of their business to suppliers in the search for greater efficiency and competitiveness. Outsourcing non-core activities also increases flexibility, for example, through better use of international resources. It enables quick responsiveness to customer needs and decreases financial risk by reducing capital investment demands (Ellram, Tate, & Billington, 2008). However, the advantages of outsourcing are not always clear; contracting-out key elements of a business can be risky, difficult to implement and manage. Managers need to carefully consider shortcomings related to outsourcing along with its benefits. The generally recognized disadvantages include: information security, loss of management control, morale problems, and labour union issues. Furthermore, many companies have found that outsourcing activities have introduced unexpected complexities, added costs and friction to the value chain, and can require more senior management attention and deeper management skills than initially anticipated (Howell, 1999).

Although many theoretical frameworks have been developed to examine the benefits of outsourcing, transaction cost economic (TCE) theory has been largely used in many prior studies to explain outsourcing decisions (Ellram et al., 2008; Bustinza, Arias-Aranda, & Gutierrez-Gutierrez, 2010; Ngwenyama & Bryson, 1999). There are five principal dimensions of TCE theory. *Opportunism* is the po-

tential risk of sequestration of key assets by outside suppliers. *Asset-specificity* refers to the degree to which an asset is valuable in the context of a specific transaction. *Frequency* of use implies that transactions carried out only very infrequently do not need to be undertaken within an organization's hierarchy. *Bounded rationality* refers to the degree of difficulty in forming transactional contracts because of the limitations of managers' knowledge and perceptions.

*Environmental uncertainty* increases the problems arising from bounded rationality. Although TCE uses the term assets mainly in the sense of physical things, it can also refer to intangibles like brands and proprietary technologies as well as core competences and capabilities – things that an organization does exceptionally well (Rieple & Helm, 2008).

Except the TCE theory used by many researchers, Lee and Kim (2005) analyzed the structural relationship among the determinants of an outsourcing partnership and identified the relationship between partnership-related variables and outsourcing success. They identified the six key factors of a successful partnership in areas of outsourcing, working partnerships in marketing, and strategic alliances in management. Their proposed six key inter-related factors: shared knowledge, organizational linkage, mutual dependency, benefits, commitment, and predisposition. Some other researchers (Yang et al., 2007; Wang & Yang, 2007; Hafeez, Malak, & Zhang, 2007; Saaty & Shang, 2011) have used different MCDM models to investigate information system outsourcing. However, these studies did not consider the inter-relationship between criteria. Jharkharia and Shankar (2007) applied the ANP method to help firms select logistics service providers but did not clarify how to generate the relationship between criteria. Our new approach, a hybrid model combining the DANP and modified grey relation methods, accounts for the more complex relationships among relative criteria/factors and feedback effects, and can be utilized as an outsourcing decision model.

## 3. Integrating DANP and modified grey relation methods

In this section, we simply introduce the concepts of the DANP (to establish the relations-structure model problem evaluation and to determine the criteria weights with dependence and feedback) and modified grey relation (to prioritize and improve alternatives) methods.

### 3.1. DEMATEL method

The DEMATEL method is used to construct the interrelations between criteria and to build an INRM. The method can be summarized as follows:

*Step 1: Calculate the direct relation average matrix.*

Assuming that the scales 0, 1, 2, 3 and 4 represent the range from “no influence” to “very high influence”, respondents are asked to propose the degree of direct influence each criterion  $i$  exerts on each criterion  $j$ , which is denoted by  $d_{ij}$ , using the assumed scales. A direct relation matrix is produced for each respondent, and an average matrix  $\mathbf{D}$  is then derived from the mean of the same criteria in the various direct matrices for all respondents. The average matrix  $\mathbf{D}$  is:

$$\mathbf{D} = \begin{bmatrix} d_{11} & \cdots & d_{1j} & \cdots & d_{1n} \\ \vdots & & \vdots & & \vdots \\ d_{i1} & \cdots & d_{ij} & \cdots & d_{in} \\ \vdots & & \vdots & & \vdots \\ d_{n1} & \cdots & d_{nj} & \cdots & d_{nn} \end{bmatrix}. \quad (1)$$

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