



## Fuzzy hierarchy sensitive with Delphi method to evaluate hospital organization performance

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### ABSTRACT

The conventional accreditation policy of Taiwanese hospitals involves helping promote and executing national healthcare quality policies, certifying healthcare quality, supervising the management of health care organizations, pursuing a harmonious relationship between care providers and patients, and enhancing national healthcare quality. However, the quality indicators in use by Department of Health, Executive Yuan, Taiwan (DOH) cannot indicate overall organization performance of each hospital and assess hospital operating crisis. In many cases the preference model of the human decision maker is uncertain, and it is relatively difficult for the decision maker to provide exact numerical values for the comparison ratios. This study proposal fuzzy analytic hierarchy process (FAHP) and fuzzy sensitive analysis-based approach to resolve the uncertainty and imprecision of service evaluations during pre-negotiation stages, where the comparison judgments of a decision maker are represented as fuzzy triangular numbers. A novel fuzzy prioritization method, which derives crisp priorities (criteria weights and scores of alternatives) from consistent and inconsistent fuzzy comparison matrices, is also proposed. Importantly, the proposed model can provide Taiwan's hospital accreditation policy a reference material, making it highly applicable for academic and government purposes.

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### 1. Introduction

To enforce health insurance and enhance medical technology, the Taiwanese government implemented the NHI plan in March 1995. The NHI scheme has resulted in financial unbalance. Therefore, the Bureau of National Health Insurance (BNHI) has sought to prevent further increases in health care expenditures and implemented a Global Budget System (GBS) in July 2002. Under the policy change environment, the hospitals' managers need to change their management strategy, by discarding their past conservative attitudes. Other than fundamental improvement of diagnosis treatment technology and replacement of medical equipment, appropriate assistance and caring for patients should be as well taken into consideration. The conventional accreditation policy of Taiwanese hospitals involves helping promote and executing national healthcare quality policies, certifying healthcare quality, supervising the management of health care organizations, pursuing a harmonious relationship between care providers and patients, and enhancing national healthcare quality. However, the quality indicators in use by DOH cannot indicate overall organiza-

tion performance of each hospital and assess hospital operating crisis. Furthermore, when facing the same operating objects payment standard and medical environment with finite medical resource, competitiveness is naturally to soar. This situation is exacerbated by large reductions of the medical budget by government, which has caused an operating crisis in hospitals. According to report from DOH, the number of hospitals in Taiwan declined by 231 or 29.35%, from 787 in 1989 to 556 in 2004. Additionally, the number of public hospitals declined by 5 or 5.38%, from 93 in 1989 to 88 in 2004; correspondingly, the number of private hospitals declined by 126 or 32.56%, from 694 in 1989 to 468 in 2004 (DOH, 2005). Therefore, administrators or decision makers of the hospitals requires effectively monitoring the organizational performance of the hospitals.

Organizational performance is a perhaps the key issue for top administrator (Finkelstein & Hambrick, 1996). Although the position held by administrator is multifaceted, their most important role is to ensure the long-term success and viability of their organizations (Andrews, 1987). To fulfill this role, administrator must be able to monitor and interpret organizational performance. Such tasks are facilitated through comparisons of performance indicators against referent points. Nevertheless, the organization performance problem is a multi-criteria problem, and evaluating an ideal model requires suitable criteria and strict

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screening. Evans (2004) proposal an effective performance measurement system, which includes the selection of appropriate measures and approaches for analyzing results, is central to aligning an organization's operations with its strategic direction. Kast and Rosenzweig (1974) suggested incorporating efficiency and effectiveness analysis to assess organizational performance. In the existing efficiency and effectiveness analysis studies have utilized data envelopment analysis (DEA) to evaluate performance (e.g., Abagail, Donald, & David, 2005; Butler & Li, 2005; Laine & Linna, 2005). Venkatraman and Ramanujam (1986) contended that organizational performance should include financial performance, business performance and organizational effectiveness. However, the organization performance is a multi-criteria decision-making (MCDM) problem. Among those well-known methods, MCDM is relatively new to be employed to evaluation of performance. MCDM aims at using a set of criteria for a decision problem. Since these criteria may vary in the degree of importance, the analytic hierarchy process (AHP) methodology is employed to prioritize the selection criteria (i.e., assign weights to the criteria). In the existing measurement of performance or studies have utilized AHP to set up a hierarchical skeleton within which multi-attribute decision problems can be structured (Kima, Yang, Yeo, & Kim, 2005; Nieminen & Takala, 2006; Uzoka & Michael, 2005; Wu, Lin, & Chen, 2007; Wu, Lin, & Lin, 2009; Chang, Wu, & Chen, 2008; Chang, Wu, & Lin, 2009; Yurdakul, 2005).

AHP has thus been successfully applied to a diverse array of problems. Despite its popularity, this method cannot adequately resolve the inherent uncertainty and imprecision associated with the mapping of a decision maker's perception to exact numbers. In the traditional formulation of AHP, human judgment is represented as exact numbers. However, in many cases the preference model of the human decision maker is uncertain, and it is relatively difficult for the decision maker to provide exact numerical values for the comparison ratios. The decision makers could be uncertain about their own level of preference, due to incomplete information or knowledge, complexity and uncertainty within the decision environment, or a lack of an appropriate measurement units and scale.

Therefore, this study proposes an evaluation framework through modified Delphi method. Next, the study presents FAHP and fuzzy sensitive analysis-based approach to resolve the uncertainty and imprecision of service evaluations during pre-negotiation stages, where the comparison judgments of a decision maker are represented as fuzzy triangular numbers, followed a case which identifies proposed model capable of choosing an effective monitor to adequately implement an organizational performance model in hospital management practices. Subsequently, the result can provide hospital accreditation policies or hospital administrators in Taiwan with the most effective strategic policy for promoting operating efforts. The fuzzy hierarchy sensitive analysis-based decision-making method for constructing an evaluation method can provide hospital decision makers or administrators with a valuable reference for evaluating the organizational performance. Importantly, the proposed model can provide Taiwan's hospital accreditation policy a reference material, making it highly applicable for academic and government purposes.

## 2. Methodology

The modified Delphi method is adopted here not only to accumulate expert opinions, but also to identify the determinants of the integrated marketing communication-based model. FAHP are then used to determine the weight of each factor weight and rank of importance. A thorough description follows.

### 2.1. Delphi method and modified Delphi technique

The Delphi method accumulates and analyzes the results of anonymous experts that communicate in written, discussion and feedback formats on a particular topic. Anonymous experts share knowledge skills, expertise and opinions until a mutual consensus is achieved (Murry & Hammons, 1995). The Delphi method consists of five procedures: (a) select the anonymous experts; (b) conduct the first round of a survey; (c) conduct the second round of a questionnaire survey; (d) conduct the third round of a questionnaire survey; and (e) integrate expert opinions and to reach a consensus. Steps (c) and (d) are normally repeated until a consensus is reached on a particular topic (Murry & Hammons, 1995). Results of the literature review and expert interviews can be used to identify all common views expressed in the survey. Moreover, step (b) is simplified to replace the conventionally adopted open style survey; doing so is commonly referred to as the modified Delphi method (Murry & Hammons, 1995). Therefore, this study develops a quality evaluation criterion for organization performance by using the modified Delphi method, as well as by conducting interviews with anonymous experts.

Delbecq, Van de Ven, and Gustafson (1975) suggested five to nine as the appropriate number of individuals in a Delphi method group. Therefore, in this study, nine experts participated in the modified Delphi method-based decision group. To ensure non-interference, opinions of the expert group are accumulated, followed by synthesis of those opinions among the medical sector experts to identify the major factors for consideration in the evaluation element of organization performance.

### 2.2. Fuzzy analytic hierarchy process

As a decision method that decomposes a complex multi-criteria decision problem into a hierarchy (Saaty, 1980), AHP is also a measurement theory that prioritizes the hierarchy and consistency of judgmental data provided by a group of decision makers. AHP incorporates the evaluations of all decision makers into a final decision, without having to elicit their utility functions on subjective and objective criteria, by pair-wise comparisons of the alternatives (Saaty, 1990). However, AHP thus is ineffective when applied to ambiguous problem. Since the real world is highly ambiguous, some scholars have combined the fuzzy theory with AHP to develop the mediate this shortfall. Fuzzy multiple attribute decision-making (FMADM) methods have been developed owing to the imprecision in assessing the relative importance of attributes and the performance ratings of alternatives with respect to attributes. Imprecision may arise from a variety of reasons: unquantifiable information, incomplete information, unobtainable information and partial ignorance. Conventional MADM methods cannot effectively handle problems with such imprecise information. To resolve this difficulty, fuzzy set theory, first introduced by Zadeh (1965), has been used and is adopted herein. Fuzzy set theory attempts to select, prioritize or rank a finite number of courses of action by evaluating a group of predetermined criteria. Solving this problem thus requires constructing an evaluation procedure to rate and rank, in order of preference, the set of alternatives. This study adopts the notions of Buckley (1985) and Hus and Yang (2000) to analyze data and reach a consensus among experts. Moreover, the eigenvector method is used to calculate weights.

The AHP of Saaty (1980) only uses the pair-wise comparison matrix to evaluate the ambiguity in multi-criteria decision making problems as in formula (1). Assume that we have  $n$  different and independent criteria ( $C_1, C_2, \dots, C_n$ ) and they have the weights ( $W_1, W_2, \dots, W_n$ ), respectively. The decision-maker does not know in advance the values of  $W_i, i = 1, 2, \dots, n$ , but he is capable of making pair-wise comparison between the different criteria. Also,

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