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# EFFICIENCY ANALYSIS USING THE ANALYTIC HIERARCHY PROCESS

**Gang Hao and K.K. Lai**
Department of Management Science
Faculty of Business
City University of Hong Kong, Kowloon, Hong Kong
arghao@cityu.edu.hk / arkklai@cityu.edu.hk

**Kaoru Tone**
Graduate School of Policy Science
Saitama University, Urawa, Saitama 338, Japan

**Abstract:** The assessment and analysis of operational efficiency across a set of Decision Making Units (DMU) under a central governed organization is crucial for its overall improvement in productivity and competitiveness. Establishing the methodology that is effective in providing a more detailed and accurate insight about a DMU's performance has attracted growing interests from both academic and industrial communities in recent years. The most common methods in use today include Ratio Analysis, Multiple Regression, Multi-factor Productivity Index and the Data Envelopment Analysis (DEA), among which there have been a large amount of research done in the DEA context. As well as many successful applications, some difficulties or limitations have also been recognized from using these conventional methods. One main concern is their common requirement of all the input and output components under consideration to be quantitatively measurable. In assessing the true state of a DMU's production efficiency or performance level, additional considerations of many intangible factors, such as product/service quality and environmental conditions, etc. are necessary. The existing methods have not been successful in dealing with the qualitative elements together with the regular quantifiable attributes. To overcome these difficulties, we propose the AHP as a means for efficiency assessment and analysis. Although the AHP has been used for performance evaluation in a number of cases from the literature, it has neither been theoretically confirmed nor commonly accepted as a formal methodology in the efficiency analysis field. This research aims at a systematic study of the AHP approach in comparison with the existing conventional methods, so that the role of the AHP in the area of efficiency analysis can be identified.

Our study involves following five phases. First, we have identified a set of criteria that are essential to efficiency analysis tools, including the ability of scaling performance levels, identifying the areas for efficiency improvements, accounting of variation of site characteristics and quality factors, etc. Secondly, a close examination of the conventional methods with respect to these criteria is conducted. As a result, the weaknesses of the conventional methods have been identified and the need of introducing a more comprehensive methodology became apparent. In the third phase, we have proposed alternate AHP-based models for efficiency analysis and the characteristics of the AHP method is discussed in comparison with conventional techniques. In the forth phase, we implemented our models in a gas company which operates a number of maintenance fleets that are not homogeneous with respect to operating conditions. We typically select the service sector for the study, unlike a manufacturing unit, it usually involves a number of subjective factors that affect its productivity and service quality. In the test cases, we examined the consistency of the AHP with conventional methods under the same setting of the assessment framework. We then explore the advantages of the AHP by including additional intangible elements. In the last phase, we proposed several hybrid models which combine the AHP with some of the conventional methods to gain extra benefit from the use of the AHP, which also lead to potential areas for further research.