

# A fuzzy AHP and BSC approach for evaluating performance of IT department in the manufacturing industry in Taiwan

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## Abstract

In this ever-changing world, information technology (IT) is a must for the survival of a company, and the functions of IT department is becoming increasingly important. The assessment of IT department is critical to understand how the department contributes to organizational and strategic goals. Because IT department performs many tasks that cannot simply be measured by monetary units, evaluation methods that solely rely on financial measures are not adequate. The objective of this study is to construct an approach based on the fuzzy analytic hierarchy process (FAHP) and balanced scorecard (BSC) for evaluating an IT department in the manufacturing industry in Taiwan. The BSC concept is applied to define the hierarchy with four major perspectives (i.e. financial, customer, internal business process, and learning and growth), and performance indicators are selected for each perspective. A fuzzy AHP (FAHP) approach is then proposed in order to tolerate vagueness and ambiguity of information. A FAHP information system is finally constructed to facilitate the solving process. The results provide guidance to IT departments in the manufacturing industry in Taiwan regarding strategies for improving department performance. The constructed information system is suggested to be a good tool for solving other multiple-criteria decision-making problems.

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## 1. Introduction

Information technology (IT) involves computers, software and services, but good IT must synthesize these elements to achieve the goal of an organization. As a demand to collect, process, store, and disseminate information grows, the functions of IT department is becoming increasingly important. Although businesses invest huge amount of intellectual and financial capital in a range of communication and information technologies and services, the results of some surveys revealed that some companies have started to freeze IT budgets because there are insufficient evidence of a return from the investments and IT applications seem to be simply a black hole (Martinsons, Davison, & Tse, 1999). The reason behind is that it is dif-

ficult for managers to demonstrate tangible returns on the resources expended to plan, develop, implement and operate computer-based information system (IS). Some frequently asked questions by the organizations are whether the investment in IT/IS is really worthwhile, whether the implemented IT application is a success, and whether the IT department functions productively. The measurement of the value of IT and the evaluation of IS performance, thus, become of great importance to managers.

Many methods and techniques have been suggested over the years to evaluate the investments in IT/IS or the performance of IT departments. However, well-known financial measures such as return on investment (ROI), internal rate of return (IRR), net present value (NPV) and payback period have been demonstrated to be inadequate (Abran & Buglione, 2003). In the assessment of IT/IS investments or departments, it is critical to understand how IT/IS contribute to organizational and strategic goals, and

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evaluation methods that rely on financial measures alone are not suitable for IT applications. The balanced scorecard (BSC), a performance measurement framework that provides an integrated look at the business performance of a company by a set of both financial and non-financial measures, seems to be a good solution. However, conventional BSC does not consolidate these performance measures, and an incorporation of BSC and analytic hierarchy process (AHP) is an improvement. Since fuzziness and vagueness are common characteristics in many decision-making problems, a fuzzy AHP (FAHP) and BSC method should be able to tolerate vagueness or ambiguity, and therefore, is proposed in this research.

The remainder of this paper is organized as follows. Section 2 briefly introduces the BSC and AHP. Section 3 goes over the fuzzy set theory. Section 4 reviews the incorporation of BSC with other methodologies and the application of the BSC in IT/IS field. Section 5 is the proposed model, in which a FAHP and BSC method is proposed, a FAHP information system is constructed, and the performance evaluation for IT department is carried out. Some conclusion remarks are made in the last section.

## 2. The balanced scorecard (BSC) and the analytic hierarchy process (AHP)

Focusing exclusively on traditional financial accounting measures, such as return on investment and payback period, has implications, and has been criticized as the root cause for many problems in industries (Hafeez, Zhang, & Malak, 2002). As managers stress on short-term financial performance metrics, they have a tendency to trade off actions, such as new product development, process improvements, human resource development, information technology and customer and market development that can bring in long-term benefits, for current profitability, and this limits the investments with future growth opportunities (Banker, Chang, Janakiraman, & Konstans, 2004). Such actions of managers are a consequence of poorly designed performance measurement systems that only focus on short-term financial performance. In the attempt to solve the problem by supplementing financial measures with additional measures that can help evaluate the long-term performance of a firm, Kaplan and Norton introduced the BSC, a performance measurement framework that provides an integrated look at the business performance of a company by a set of measures, which includes both financial and non-financial metrics (Kaplan & Norton, 1992; Kaplan & Norton, 1993; Kaplan & Norton, 1996a). The name of BSC is with the intent to keep score of a set of measures that maintain a balance “between short- and long-term objectives, between financial and non-financial measures, between lagging and leading indicators, and between internal and external performance perspectives” (Kaplan & Norton, 1996b). Of the BSC’s four performance perspectives, one is a traditional financial performance group of items, and the other three involve

non-financial performance measurement indexes: customer, internal business process, and learning and growth. The four perspectives are explained briefly as follows (Kaplan & Norton, 1996b):

- **Financial:** This perspective typically contains the traditional financial performance measures, which are usually related to profitability. The measurement criteria are usually profit, cash flow, ROI, return on invested capital (ROIC), and economic value added (EVA).
- **Customer:** Customers are the source of business profits; hence, satisfying customer needs is the objective pursued by companies. In this perspective, management determines the expected target customers and market segments for operational units and monitors the performance of operational units in these target segments. Some examples of the core or genetic measures are customer satisfaction, customer retention, new customer acquisition, market position and market share in targeted segments.
- **Internal business process:** The objective of this perspective is to satisfy shareholders and customers by excelling at some business processes that have the greatest impact. In determining the objectives and measures, the first step should be corporate value-chain analysis. An old operating process should be adjusted to realize the financial and customer dimension objectives. A complete internal business-process value chain that can meet current and future needs should then be constructed. A common enterprise internal value chain consists of three main business processes: innovation, operation and after-sale services.
- **Learning and growth:** The primary objective of this perspective is to provide the infrastructure for achieving the objectives of the other three perspectives and for creating long-term growth and improvement through people, systems and organizational procedures. This perspective stresses employee performance measurement, such as employee satisfaction, continuity, training and skills, since employee growth is an intangible asset to enterprises that will contribute to business growth. In the other three dimensions, there is often a gap between the actual and target human, system and procedure capabilities. Through learning and growth, enterprises can decrease this gap. The criteria include turnover rate of workers, expenditures on new technologies, expenses on training, and lead time for introducing innovation to a market.

The BSC objectives and measures are determined by organizational visions and strategies and are intended to measure organizational performance using the four perspectives. Kaplan and Norton (1996b) stress the importance of adhering to three principles in developing BSC: maintaining cause-and-effect relationships, comprising sufficient performance drivers and keeping a linkage to financial measures. They also emphasize that the BSC is only a template and must be customized for the specific

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