Computers in Industry 75 (2016) 127–139

Contents lists available at ScienceDirect

Computers in Industry

journal homepage: www.elsevier.com/locate/compind

A study of enterprise resource planning (ERP) system performance measurement using the quantitative balanced scorecard approach

Yung-Chi Shen[a,1], Pih-Shuw Chen[b,*], Chun-Hsien Wang[a,1]

[a] Department of BioBusiness Management, National Chiayi University, No. 580, Sinmin Road, Chiayi 600, Taiwan, ROC
[b] Department of Business Administration, National Chiayi University, No. 580, Sinmin Road, Chiayi 600, Taiwan, ROC

ARTICLE INFO

Article history:
Received 11 September 2014
Received in revised form 11 May 2015
Accepted 29 May 2015
Available online 10 July 2015

Keywords:
Enterprise resource planning
Balanced scorecard
Non-additive fuzzy integral

ABSTRACT

Enterprise resource planning (ERP) systems have been used in integrating information and accelerating its distribution across functions and departments with the aim to increase organizations' operational performance. Thus, it is worth measuring ERP system performance based on its impact to critical performance of an organization: this requires a systematic method that bridges ERP performance measurement and key organizational performance. The hierarchical balanced scorecard (HBSC) model with respect to multiple criteria decision-making is such a systematic approach to ERP performance measurement. An ERP evaluation framework that integrates the balanced scorecard dimensions, linguistic variables, and non-additive fuzzy integral provides an objective approach to measuring both the performance level of the ERP system and its contribution to the strategic objectives of high-tech firms. Taking Taiwan's high-tech firms as an example, this study demonstrates the effectiveness of this integrated approach to measure the performance of ERP systems at the post-implementation stage under evaluators' subjective, uncertainty, and vagueness judgments.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

The high-tech industry has played a central role in the economic development of Taiwan in recent decades. However, the characteristics of this industry include shorter product life cycles, increasing global competitive pressure, and a variety of customer demands. In response to these trends, numerous high-tech firms in Taiwan have accelerated the integration of production and manufacturing information through the use of enterprise resource planning (ERP) systems across the entire firm, in order to maintain a long-term competitive advantage. ERP is a tool to standardize and integrate business processes to accelerate access to common resources across the organization so that ERP systems help organizations facilitate information sharing and improve operational efficiency [8]. The successful deployment and use of ERP systems is critical to organizational performance and survival [42]. ERP is increasingly important in modern business because of its ability to integrate the flow of material, finance, and information to support organizational strategies [78,80]. Davenport [16] reported that many ERP vendors, such as SAP, Baan, Oracle, and People-Soft, provided commercial software packages to favor the seamless integration of all the information flowing across a company's different functions. Take SAP's R/3 package as an instance, it supports the integration of information flows across a company's functions, including financials, human resources, operations and logistics, sales and marketing. These commercial ERP packages promise an "off-the-shelf" solution to the problem of business integration for managers who have struggled, at great expense and with great frustration, to coordinate incompatible information systems and inconsistent operating practices [16]. For serving as the organization's platform to support such cross-functional integration, ERP architecture enables different business applications to share a common database.

Various studies have asserted that ERP systems can increase competitive advantage in the information technology (IT) era. Particularly in the e-business era, there has been a global trend to integrate business processes based on the company's strategic implementation. A review of the potential benefits from ERP implementation can be classified into tangible and intangible benefits [1,67]. Tangible benefits include reduction of inventory, reduction of personnel, increased productivity, improvements in orders management, quicker closing of financial cycles, increase of 'on-time' deliveries, improved customer service, reduction in IT and procurement costs, improvement of cash flow management,

* Corresponding author. Tel.: +886 5 2732834; fax: +886 5 2732826.
E-mail addresses: syc@mail.ncyu.edu.tw (Y.-C. Shen), hideko@mail.ncyu.edu.tw (P.-S. Chen), chwang@mail.ncyu.edu.tw (C.-H. Wang).
[1] Tel.: +886 5 2732877; fax: +886 5 2732874.

http://dx.doi.org/10.1016/j.compind.2015.05.006
0166-3615/© 2015 Elsevier B.V. All rights reserved.

increase of revenue and profits, reduction in transportation and logistic costs, and reduction in the need for system maintenance. Intangible benefits refer to the increased visibility of corporate data, new or improved business processes, improved responsiveness to customers, improved communications, unanticipated reduction in costs, better integration between systems, standardization of computing platforms, increased flexibility, global sharing of information, improved business performance, and improved visibility into the SCM process [1]. Despite these significant benefits, one major problem is that ERP systems cannot measure the performance which the systems impact on the firms. As Davenport [16] pointed out, many companies failed to consider whether the system they were evaluating will match their overall business strategy. The balanced scorecard (BSC) approach, though, is designed to support a variety of organizational performance measurement structures. The original BSC, proposed by Kaplan and Norton [33], was a performance measurement system consisting of four dimensions: financial, customer, internal business processes, and innovation and learning. It became a popular performance assessment technique because it was not only easy to implement across different departments but also provided a well-defined framework through integrating the tangible and intangible perspectives and delivering the firm's objectives, and therefore giving the business a competitive advantage. Chand et al. [8] thus argued that the BSC approach may be an appropriate technique for evaluating the performance of ERP systems, if well-defined performance measurement and related indicators are used to keep the strategic targets on track.

In theory, it is difficult to quantify information systems (IS) due to the intangible nature of many of the benefits, such as improved customer satisfaction. By applying the fuzzy set theory, this research undertakes an empirical study of numerous high-tech firms with the aim of systematically measuring ERP system performance via decision-makers' evaluations, taking the intangibles and tangibles into account. Furthermore, the BSC proposed by Kaplan and Norton [33] argues that the interrelationships exist among financial, customer, internal business process, and learning and growth perspectives. Additionally, there are many situations where observations cannot be described accurately as, for instance, when they depend on environmental conditions or on individual responses [68]. Specially, the BSC framework employed in this study relies on evaluators' subjective judgments, the imprecise and vague nature embedded in human perception is inevitable. Therefore, fuzzy linguistic variable scale proposed by Hersh and Caramazza [29] provides a simple and heuristic method to capture the meaning of natural language. In addition, the traditional multi-criteria approach assumes that decision factors are independent. In other words, the aggregation of performance value is additive based on the independent relationship among decision factors. However, the interdependence among various factors is common in real world. To reflect this reality, fuzzy measures [72,47]—or more generally, non-additive set functions—can be used [73]. Therefore, a nonlinear integral i.e., Choquet integral, or so-called non-additive fuzzy integral, is recommended in place of the traditional weighted average methods [73].

Consequently, this study intends to construct a systematic performance measurement framework based on hierarchical balanced scorecard (HBSC) for ERP and adopts fuzzy linguistic variables incorporating with non-additive fuzzy integral to deal with the ambiguity and vagueness existing in evaluators' subjective judgments in order to reflect the subjectivity, uncertainty, and interaction embedded in the HBSC framework and the process of performance evaluation. Specifically, the findings would enable decision-makers and managers to better understand the performance of ERP implementation and, more generally, would contribute to the understanding of the performance level and strategic decision of high-tech firms implementing ERP systems. Using the balanced scorecard dimensions, high-tech firms can also assess their relative performance after ERP implementation, the results of which can then be used to understand and monitor how performance affects strategic decision-making.

This paper is now organized as follows: Section 2 reviews the literature on ERP performance; Section 3 derives the ERP performance criteria to respond to BSC perspectives; Section 4 constructs the hierarchical balanced scorecard framework for ERP performance measurement; Section 5 elaborates on the linguistic variables, fuzzy measures, and non-additive integral employed in this study; Section 6 uses the proposed method to assess the ERP performance of high-tech firms; and finally, the results and conclusions are presented in Section 7.

2. Review of the relevant ERP and performance literature

2.1. The implementation of ERP

Various studies have been conducted to identify critical factors affecting the successful implementation of ERP. Many focus on individual case studies and industry surveys, and have covered a broad range of research issues. Motwani et al. [46] applied a case study methodology to compare a successful and unsuccessful ERP implementation, finding that the main factors behind a successful implementation consisted of cautious, evolutionary, bureaucratic implementations backed by careful change management, network relationships, and cultural readiness. Yen and Sheu [79] also used case study method involving direct observation and systematic interviews to examine five US and Taiwanese manufacturing firms, the results of which indicated that ERP implementation should be aligned with a firm's competitive strategy. Meanwhile, Ash and Burn [2] expressed their concerns with ERP implementation by using embedded, multiple case studies to investigate the complex phenomenon of an e-ERP project. Umble et al. [67] pointed out a new set of key issues for successful ERP implementation, which was also considered by Sun et al. [63]. They studied ERP implementation in 26 firms and used five critical success factors, with a total of 22 attributes, in a simulation model to assess strategic ERP implementation. Mabert et al. [41] surveyed 193 manufacturing firms in the US and pointed out that successful ERP implementation depended on the organization's size, motivation, implementation strategies, the modules and functionalities implemented, and operational benefits. Ehie and Madsen [22] also adopted an empirical study surveying 36 manufacturing companies in the Midwestern region of the US, identifying the critical issues affecting ERP implementation as project management principles, human resource development, business process re-engineering, cost/budget issues, IT infrastructure, consulting services, and top management support. Given such a range of perspectives, though, it is unlikely that a consensus on a final definition of ERP implementation can be achieved.

2.2. The benefits of ERP

Another research theme focuses on the details of implementing ERP and their related success and benefit. Chand et al. [8] pointed out that implementing an ERP system not only increased customer satisfaction and reduced operational costs but also eventually resulted in increased profits and growth of an organization. Furthermore, Davenport [17] and Markus et al. [42] indicated that the benefits of an ERP system were related to process productivity improvement, reduced error, and timely availability of consistent information. They also suggested that ERP benefits should be measured from different perspectives. Trimmer et al. [64] reported that support for the continuing use of critical success factors

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات