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# Study on the performance evaluation of ERP implementation based on ERP

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## Abstract

A new evaluation method is put forward: the fuzzy hierarchy comprehensive evaluation method and the balanced scorecard method are used to evaluate the performance of ERP system, and the practicability of this method is proved by experiments.

## Keywords

Enterprise Resource Planning, ERP implementation success, Fuzzy Hierarchy Comprehensive Evaluation, Balanced Scorecard, Implementation Effect Evaluation.

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## 1. Introduction

### 1.1 Background

Enterprise Informatization refers to a strategic strategy for the enterprise that through implementing management information system to integrate information technology as well as enterprise management, and according to established guidelines and strategies to integrate internal processes and resources, so as to improve the management status and then improve operational efficiency, ultimately enhance the core competitiveness of the enterprise. Information construction has gradually become the driving force of global economic development, but also considered by many enterprises as the main means to enhance the core competitiveness. In the last two decades of enterprise information tide, ERP has succeeded in striving to become the focus of the field. In September 17, 2013, the Ministry of Information Industry and the State Economic and Trade Commission jointly issued the "on accelerating the construction of enterprise management information construction guidance", requiring enterprises to vigorously carry out the ERP system construction and application, and list the enterprise information as Treasury bonds focus support special, and provide financial policy support to ERP investment .

However, while ERP is widely used in China, its effect is far from satisfactory. The shadow of the so-called "IT investment black hole" that is popular in other parts of the world (i.e., a large amount of investment in information technology and no return) is shrouded in China. For investors and managers of enterprises, ERP is a complex system project because of its large investment, high implementation cost and long implementation cycle. Therefore, if the enterprise decision-makers can not keep abreast of the implementation of the ERP system whether it can bring higher output and better performance to enterprises, in the investment decision-making he or she will be hesitant, and affecting or even mislead the development of enterprises. Some research shows that 35% enterprises unable to determine the IT value of the investment projects and give up investment. For the ERP system vendors and consulting companies, if you do not understand what is the system of enterprise benefits, not only unable to convince customers to adopt ERP system, leading to the loss of potential customers, but also makes the system research ,development as well as implementation of the project loss of objectives and pertinence. In addition, the cost of implementing ERP is huge, according to CCID statistics, Chinese enterprise ERP investment has been rapidly growing year by year in recent years, which starting from

570 million yuan in 2010, to the end of 2014 the rapid expansion of the scale of investment was 5-6 times, and the forecast for the next five years Chinese enterprise ERP investment will be 20.7% compound annual the growth rate of growth, if the high cost for hire consultants and the implementation of maintenance cost counted, a set of ERP application system will enable enterprises to bear. Therefore, the ultimate benefits of the implementation of ERP have become the key to the success for enterprises to offset huge investment, and then, the evaluation of the implementation effect of ERP has become the focus of many enterprises. However, the current situation is not optimistic, many enterprises are evaluating the implementation effect of ERP often from the financial perspective rather than establish a scientific and reasonable ERP implementation performance evaluation system analysis its impact on all areas, which causes the enterprise is not comprehensive, in-depth understanding to ERP, and not lack of consciousness to the effect of ERP system bring into.

Based on the above backgrounds, this article will carry on the thorough research and analysis to the ERP implementation performance appraisal system.

### 1.2 motivation

The significance of performance evaluation research based on ERP are summarized as follows.

**Project Control.** In the early stage of ERP implementation, appraisal system may evaluate enterprise resources to optimize the integration of resources in order to choose the optimal solution of ERP information system. And determine the completion of the project in the implementation process, then decided how to improve; Then at the ERP runtime, judge the result of the project construction, and plan the business process optimization.

**Deviation Correction.** Provide a series of evaluation criteria for project control, as a tool for correcting deviations and coordinating the interests of all parties. In fact, the evaluation itself is not the purpose, but a means in order to obtain a higher level of performance. Expected value of enterprise project may transfered to all relevant personnel of the project through the evaluation, and then affect the project behavior of these personnel is in the true meaning of evaluation.

**Knowledge Accumulation.** Evaluation system is a powerful tool to improve system performance evaluation and system construction level, which is able to grasp factors that impact the project, and accumulate knowledge for similar projects to improve the ability to solve problems as well as summarize the experience to enhance their practical ability and the theoretical level.

**Deeply understanding.** A better understanding of the nature of the interaction between ERP and enterprise systems, as well as the possible advantages and problems posed by the ERP system, and the various factors that need to be taken into account in understanding the implementation of ERP. In the long run, the evaluation can help the relevant personnel to better understand the commercial value of ERP, and then improve the relationship between the IT department and the business department, and reach a consensus within the enterprise.

### 1.3 Contribution

At present, many enterprises in the ERP system software and hardware and human resources invested heavily, but can not achieve the desired effect, fall into a whirlpool that needs continuous investment but unable to get a reasonable output of investment. Therefore, the implementation of performance evaluation based on ERP has become an urgent problem that enterprises need to solve. Study on the performance evaluation of ERP implementation based on ERP can not only improve the existing performance evaluation system, but also can promote the individual enterprise Informatization strategy transformation as well as the comprehensive competitiveness, so that promote the implementation of national policy of industrialization driven by informatization. Secondly, sustained inputs are needed so as to establish evaluation system and evaluation model as the project schedule change, because the implementation of ERP is not always going smoothly.

Accordingly, the subject of my research is to improve the ERP performance evaluation system, and help enterprises to improve the success rate of ERP implementation and guide the enterprise to improve business processes and performance.

## 2. Method

ERP is a huge system which including not only the financial management module, but also the production control module, management module, logistics as well as human resources management module and so on. The key factors for the successful implementation of the enterprise is not only financial factors, more important is the non-financial factors such as senior managers' support, enterprise's internal processes and the enterprise staff's quality etc. Therefore, it is necessary to evaluate not only financial indicators, but also non-financial indicators when evaluating enterprise performance in ERP environment.

The main advantages of the Balance Scorecard was taked the non-financial indicators into account which balanced scorecard based on financial indicators and increase the customer, internal business process, learning and growth three aspects of non-financial indicators, which not only overcomes the financial index to quantity index measurement shortcomings, but also it can reflect the deep cause reason for financial index changes, such as the "internal business process" reflects the enterprise's value chain. On the other hand, through the using of Balanced Scorecard, managers can timely and continuously monitor the indicators that need to be controlled, so that some problems can be solved in a timely manner.

In view of this, this paper aimed to build a performance evaluation system based on the idea and method of the balanced scorecard.

## 3. Evaluating Indicator

The evaluation index system proposed in this paper include the following seven aspects:

●**Financial Goals**, an ultimate goal that enterprise always pursuit, is the core and goal of other goals; other goals are to provide support and services to achieve financial goals, and ultimately to the implementation of the target property.

●**Human Resources**. Employee ability refers to the ability of an employee to do his or her job. It can be measured by the staff's knowledge level, suggestion ability and individual productivity. The first condition to satisfy customers is to satisfy employees, and only when employees are satisfied can we maximize the enthusiasm of our employees and serve our customers

●**Business Process**, an index that can be obtained by statistical analysis of the survey results in the form of questionnaires. Mainly through the evaluation of enterprise material purchasing, production control, management and sales aspects as well as other aspects, such as customer service service, stable supply of raw materials, heterogeneous resources, complementary enterprises vertically or horizontally, to avoid barriers to sales.

●**Innovation and Reform**. Inpet, a respected leader of innovation management, points out, "the true meaning of entrepreneurship is innovation, and innovation is a management function.". "Management guru Drucker has made it clear that" innovation is the creation of a resource". Evidently, innovation is very important to an enterprise. Innovation enables enterprises to stay away from the competitive market, optimize the allocation of resources, and constantly improve the competitiveness of enterprises, promote the rapid development and expansion of enterprises. Management innovation can be considered from the angle of cost, quantity, effect and efficiency of implementing management innovation plan or adopting rationalization proposal.

●**Customer Market**. Customer level performance evaluation should include two aspects: customer satisfaction and market share. Customer satisfaction is the degree to which the customer is satisfied with the products, services, etc, provided the enterprise. Customer satisfaction with the enterprise

depends on many aspects, such as delivery time, product quality, service level, product price, and so on. Market share reflects the proportion of enterprises in the market to sell products, it can be calculated through product market share index in a certain period of time to calculate and evaluate.

● **Corporate Social Contribution** refers to the enterprise comprehensive effect on economic growth, social development and environmental protection; social ecological indicators include energy consumption index, investment improvement index and environmental pollution control; any enterprise that in the current and production operation and the long process of development can survive without the social this environment’s support. Therefore, enterprises are reasonable to bear the corresponding social responsibility, including energy conservation, environmental protection, charitable donations, public welfare and so on rather than just to create profits,

● **External Image and Intangible Assets**. The evaluation of external image, reputation, mainly refers to the degree of trust of the enterprise when the enterprise and other groups do their activities. According to the characteristics of enterprise management, its evaluation can be evaluated by other groups and customers, such as economic reputation and enterprise reputation. The external image and intangible assets of an enterprise have a direct impact on the survival and development of an enterprise. A good - looking business can obtain loans from banks and finance from the capital markets, thereby obtaining substantial financial support.

The framework of ERP evaluation index system is shown in Figure 1.

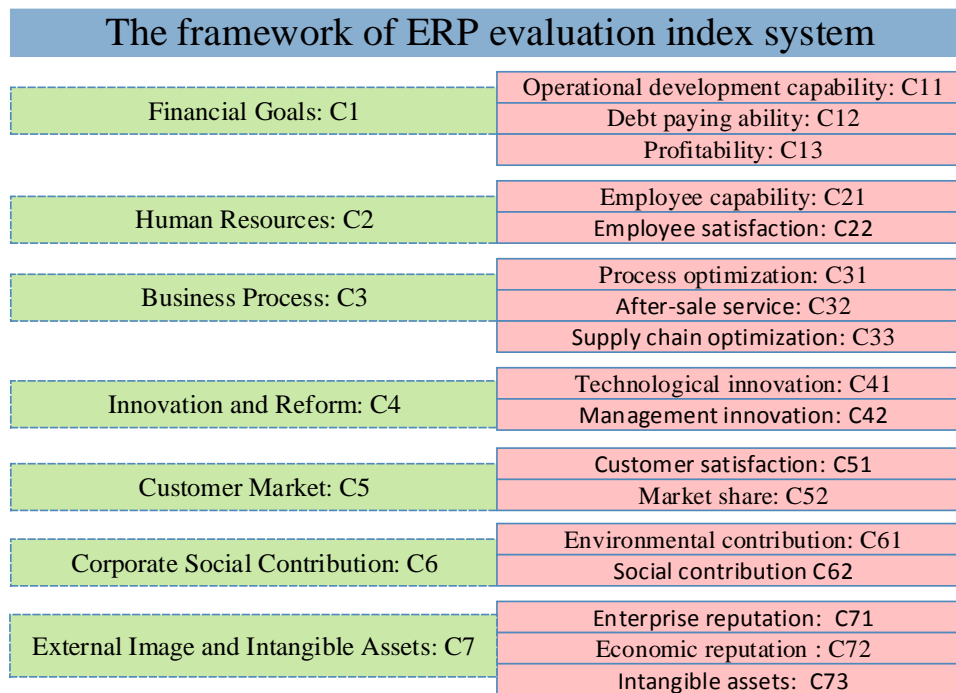


Figure 1. The Framework of ERP Evaluation Index System

## 4. Procedure

### 4.1 Materials

In the evaluation index system, the index value can be determined by statistical method, while some qualitative indexes can only be obtained by expert evaluation method. For this kind of evaluation problem, the fuzzy AHP method can be used to solve the problem.

The following "Xi'an Hans Group Co., Ltd." as an example.

4.2 Factor set

As shown in Figure 3, The factor set is the set of the indexes and is represented by C.  $C=\{C1, C2, C3, C4, C5, C6, C7\}$ ,  $C1=\{C11, C2, C13\}$ ,  $C2=\{C21, C22\}$ ,  $C3=\{C31, C32, C33\}$ ,  $C4=\{C41, C42\}$ ,  $C5\{C51, C52\}$ ,  $C6=\{C61, C62\}$ ,  $C7\{C71, C72, C73\}$

4.3 Factor weight

As Figure 2 shows: throughing questionnaire survey, we get the score of each index, and weighting of each index is shown in Figure 3.

First grade evaluation index	Financial Goals C1	Human Resources C2	Business Process C3	Innovation and Reform C4	Customer Market C5	Corporate Social Contribution C6	External Image and Intangible Assets C7	W	Wo
Financial Goals C1	1	3	1	2	2	3	2	1.842	0.242
Human Resources C2	1/3	1	1/2	1	1/2	2	1	0.774	0.102
Business Process C3	1	2	1	2	1	2	2	1.486	0.195
Innovation and Reform C4	1/2	1	1/2	1	1/2	1	2	0.82	0.108
Customer Market C5	1/2	2	1	2	1	2	3	1.426	0.187
Corporate Contribution C6	1/3	1/2	1/2	1	1/2	1	1	0.635	0.083
External Image and Intangible Assets C7	1/2	1	1/2	1/2	1/3	1	1	0.635	0.083

Figure 2.Evaluation Factor Scoring Table of Performance Based On ERP Implementation

Evaluation Factor Weighting Table of Performance Based On ERP Implementation		
Financial Goals: C1	Operational development capability: C11	0.3
	Debt paying ability: C12	0.3
	Profitability: C13	0.4
Human Resources: C2	Employee capability: C21	0.7
	Employee satisfaction: C22	0.3
Business Process: C3	Process optimization: C31	0.4
	After-sale service: C32	0.4
	Supply chain optimization: C33	0.2
Innovation and Reform: C4	Technological innovation: C41	0.5
	Management innovation: C42	0.5
Customer Market: C5	Customer satisfaction: C51	0.5
	Market share: C52	0.5
Corporate Social Contribution: C6	Environmental contribution: C61	0.5
	Social contribution C62	0.5
External Image and Intangible Assets: C7	Enterprise reputation: C71	0.4
	Economic reputation : C72	0.4
	Intangible assets: C73	0.2

Figure 3.Evaluation Factor Weighting Table of Performance Based On ERP Implementation

**4.4 Evaluation vector**

The evaluation set is a collection of various evaluation results that the evaluator may make to the object of evaluation, which is expressed as  $V=\{V1, V2,... Vn\}$ , this article takes  $V=\{\text{excellent, good, qualified, substandard}\}$ .Results are shown as Figure 4.

First floor		Second floor			Results		
Index	Weight	Index	Weight	Excellent	Good	Qualified	Substandard
C1	0.242	C11	0.3	0.7	0.2	0.1	0
		C12	0.3	0.2	0.3	0.4	0.1
		C13	0.4	0.1	0.3	0.4	0.3
C2	0.102	C21	0.7	0.3	0.1	0.6	0.3
		C22	0.3	0.1	0.2	0.6	0.1
C3	0.195	C31	0.4	0.5	0.1	0.2	0.2
		C32	0.4	0.7	0.2	0.1	0
		C33	0.2	0.4	0.4	0.1	0.1
C4	0.108	C41	0.5	0.8	0.1	0.1	0
		C42	0.5	0.2	0.5	0.2	0.1
C5	0.187	C41	0.5	0.6	0.1	0.2	0.1
		C42	0.5	0.7	0.2	0.1	0
C6	0.083	C41	0.5	0.4	0.3	0.2	0.1
		C42	0.5	0.4	0.1	0.3	0.2
C7	0.083	C31	0.4	0.7	0	0.1	0.2
		C32	0.4	0.9	0	0.1	0
		C33	0.2	0.1	0.8	0.1	0

Figure 4. Evaluation Set Results

The weights are represented as matrices are as follows:

$$W1 = \begin{pmatrix} 0.3, & 0.3, & 0.4 \end{pmatrix} \quad W2 = \begin{pmatrix} 0.7, & 0.3 \end{pmatrix} \quad W3 = \begin{pmatrix} 0.4, & 0.4, & 0.2 \end{pmatrix}$$

$$W4 = \begin{pmatrix} 0.5, & 0.5 \end{pmatrix} \quad W5 = \begin{pmatrix} 0.5, & 0.5 \end{pmatrix} \quad W6 = \begin{pmatrix} 0.5, & 0.5 \end{pmatrix}$$

$$W7 = \begin{pmatrix} 0.4, & 0.4, & 0.2 \end{pmatrix}$$

**4.5 Factor membership degree**

According to the above data, the factor membership degree is obtained and expressed as a matrix:

$$R1 = \begin{pmatrix} 0.7 & 0.2 & 0.1 & 0 \\ 0.2 & 0.3 & 0.4 & 0.1 \\ 0.1 & 0.3 & 0.4 & 0.3 \end{pmatrix} \quad R2 = \begin{pmatrix} 0.3 & 0.1 & 0.6 & 0.3 \\ 0.1 & 0.2 & 0.6 & 0.1 \end{pmatrix}$$

$$R3 = \begin{pmatrix} 0.5 & 0.1 & 0.2 & 0.2 \\ 0.7 & 0.2 & 0.1 & 0 \\ 0.4 & 0.4 & 0.1 & 0.1 \end{pmatrix} \quad R4 = \begin{pmatrix} 0.8 & 0.1 & 0.1 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 \end{pmatrix}$$

$$R5 = \begin{pmatrix} 0.6 & 0.1 & 0.2 & 0.1 \\ 0.7 & 0.2 & 0.1 & 0 \end{pmatrix} \quad R6 = \begin{pmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.4 & 0.1 & 0.3 & 0.2 \end{pmatrix}$$

$$R7 = \begin{pmatrix} 0.7 & 0 & 0.1 & 0.2 \\ 0.9 & 0 & 0.1 & 0 \\ 0.1 & 0.8 & 0.1 & 0 \end{pmatrix}$$

$$B1 = W1 R1 = \begin{pmatrix} 0.3 & 0.3 & 0.4 \end{pmatrix} \begin{pmatrix} 0.7 & 0.2 & 0.1 & 0 \\ 0.2 & 0.3 & 0.4 & 0.1 \\ 0.1 & 0.3 & 0.4 & 0.3 \end{pmatrix} = \begin{pmatrix} 0.31 & 0.27 & 0.31 & 0.15 \end{pmatrix}$$

$$B2 = W2 R2 = \begin{pmatrix} 0.7 & 0.3 \end{pmatrix} \begin{pmatrix} 0.3 & 0.1 & 0.6 & 0.3 \\ 0.1 & 0.2 & 0.6 & 0.1 \end{pmatrix} = \begin{pmatrix} 0.24 & 0.13 & 0.6 & 0.24 \end{pmatrix}$$

$$B3 = W3 R3 = \begin{pmatrix} 0.4 & 0.4 & 0.2 \end{pmatrix} \begin{pmatrix} 0.5 & 0.1 & 0.2 & 0.2 \\ 0.7 & 0.2 & 0.1 & 0 \\ 0.4 & 0.4 & 0.1 & 0.1 \end{pmatrix} = \begin{pmatrix} 0.56 & 0.20 & 0.14 & 0.10 \end{pmatrix}$$

$$B4 = W4 R4 = \begin{pmatrix} 0.5 & 0.5 \end{pmatrix} \begin{pmatrix} 0.8 & 0.1 & 0.1 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 \end{pmatrix} = \begin{pmatrix} 0.50 & 0.30 & 0.15 & 0.05 \end{pmatrix}$$

$$B5 = W5 R5 = \begin{pmatrix} 0.5 & 0.5 \end{pmatrix} \begin{pmatrix} 0.6 & 0.1 & 0.2 & 0.1 \\ 0.7 & 0.2 & 0.1 & 0 \end{pmatrix} = \begin{pmatrix} 0.65 & 0.15 & 0.15 & 0.05 \end{pmatrix}$$

$$B6 = W6 R6 = \begin{pmatrix} 0.5 & 0.5 \end{pmatrix} \begin{pmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.4 & 0.1 & 0.3 & 0.2 \end{pmatrix} = \begin{pmatrix} 0.40 & 0.20 & 0.25 & 0.15 \end{pmatrix}$$

$$B7 = W7 R7 = \begin{pmatrix} 0.4 & 0.4 & 0.2 \end{pmatrix} \begin{pmatrix} 0.7 & 0 & 0.1 & 0.2 \\ 0.9 & 0 & 0.1 & 0 \\ 0.1 & 0.8 & 0.1 & 0 \end{pmatrix} = \begin{pmatrix} 0.66 & 0.16 & 0.10 & 0.08 \end{pmatrix}$$

$$R = \begin{pmatrix} B1 \\ B2 \\ B3 \\ B4 \\ B5 \\ B6 \\ B7 \end{pmatrix} = \begin{pmatrix} 0.31, 0.27, 0.31, 0.15 \\ 0.24, 0.13, 0.6, 0.24 \\ 0.56, 0.20, 0.24, 0.10 \\ 0.50, 0.30, 0.15, 0.05 \\ 0.65, 0.15, 0.15, 0.05 \\ 0.40, 0.20, 0.25, 0.15 \\ 0.66, 0.16, 0.10, 0.08 \end{pmatrix}$$

The comprehensive membership matrix is obtained:

$$Q = W \circ R = \begin{pmatrix} 0.242 \\ 0.102 \\ 0.195 \\ 0.108 \\ 0.187 \\ 0.083 \\ 0.083 \end{pmatrix}^T \begin{pmatrix} 0.31, 0.27, 0.31, 0.15 \\ 0.24, 0.13, 0.6, 0.24 \\ 0.56, 0.20, 0.24, 0.10 \\ 0.50, 0.30, 0.15, 0.05 \\ 0.65, 0.15, 0.15, 0.05 \\ 0.40, 0.20, 0.25, 0.15 \\ 0.66, 0.16, 0.10, 0.08 \end{pmatrix} = \begin{pmatrix} 0.472 \\ 0.208 \\ 0.256 \\ 0.114 \end{pmatrix}$$

### 5. Results and Discussion

**B1** is the financial objective evaluation results, the overall score is 0.242, which can be seen is that the company evaluation was excellent in the process of ERP implementation, enterprise operation and development ability is improved greatly, the solvency increased, huge benefits have been bring after the implementation of ERP.

**B2** is the human resources evaluation results, the comprehensive score is 0.102, indicating that ERP system increases the ability of the employees, and employees is satisfied; ERP system is to achieve a better integration.

**B3** is the business process of the evaluation results, the comprehensive score is 0.195. results show that enterprises in the supply chain has been improved effectively after the implementation of ERP, this improvement can be reflected in the enterprise supply chain partners increased, fuller. On the other hand, the production process has been optimized, this process can improve productivity as well as higher degree of labor substitution through the implementation of ERP.

**B4** is the innovation of the evaluation results, the overall score is 0.108, which shows that the technology and management has been improved. This process is reflected in: through the implementation of ERP, the production technical means of enterprise and management philosophy reformed.

**B5** is customer level evaluation results, its comprehensive score is 0.187. The results show that through the implementation of ERP, customer satisfaction has been effectively improved, the market share also increased.

**B6** is evaluation results of enterprise society contribution, its comprehensive score is: 0.083. The data show that this module enterprise is not enough consummate, and make little enterprise social contribution through ERP implementation.



**B7** is the enterprise external image and intangible assets evaluation results, the comprehensive score was 0.083, which shows that economic reputation, reputation are not significantly improved as well as intangible assets in the process of implementing ERP.

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