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# Studies on the Evaluation Method for Small and Medium Enterprises' EPR Project Risks

Li-Yongming

*College of Economics and Management, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China*
*Department of Finance & Planning, Jiangsu State Farms Group Corporation Nanjing China*

***Abstract***

*This paper explains the studies of recent years on development of EPR system and the project risk and then illustrates respectively the external risks and internal risks of EPR project based on the theory. Taking the EPR project of G company the author actually took part in as an example, the author firstly applies fuzzy evaluating method to evaluate project risks and draw a clear distinction between the primary and the secondary to achieve overall evaluation for project risk. And then the author worked out a plan for the main risks of the project and applied multiple management methods to control. And in practical implementation steps, the author implemented management method in every segment and did supervising and controlling to gain the lowest negative influence resulting from risks. Lastly, the author concluded the effects of risks management, learned lessons and proposed perspectives.*

***Keywords:*** *ERP; Fuzzy evaluating method; Project risk; Risk evaluation*

## 1. Introduction

### 1.1. Description of Risk

Risks refer to various potential, uncertain factors of activities or events which may cause results that people do not expect. Project risk is the uncertainty of project during it's implementation process. When study on risks, people pay more attention to the loss or damage of activities or events. To avoid loss or damage, one must grasp the reasons and internal and external conditions of risk events. The source of risks is the reason which create opportunities for project to bring about loss or damage. The source of risks can be classified into the internal and external sources of organization or projects. Risk is potential and can only bring about risk event after possessing certain conditions which are called transformation conditions. Even the transformation conditions are possessed, risks may also not evolve into event risks and some other conditions are needed to bring about the actual risk events and the latter conditions are called trigger conditions. Grasping the transformation conditions , trigger conditions and their process which make risks convert into reality from being potential is very important to control risks. Controlling risks is actually to control the transformation conditions and trigger conditions of risk events.

### 1.2. Implementation Steps of ERP Project

The implementation of ERP project needs professional implementation methods to provide standard guidance for project. It can be separated into six steps according to the order of project process and the phased targets of project, as following:

Step one, set up project organization, work out the aims and plans of implementation and hold project start-up meeting;

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Step two, system installation, training of system principles, training of business process, training of ERP product;

Step three, arrange business process, define new business process, define encoding principle;

Step four, arrange the preparation of data, guide data, check data and system interface;

Step five, work out switching schedule, proceed training of system switching, affirm system initialization and switching;

Step six, field maintenance of service provider, the telephone, fax, E-mail and Internet long-distance technology service of software applier, the maintenance and second development of company's internal department, IT department for ERP system, *etc*.

## 2. Risk Indicators of Small and Medium Enterprises' EPR Project

To achieve the goals of small and medium enterprises' EPR project, risks of small and medium enterprises' EPR project can be divided into two aspects according to the reasons of risks, the one is the external risk of project, *i.e*. The risks resulting from the external environmental conditions that the company lives on, and the other is the internal risk of project, i.e risks resulting from the internal reasons of project. The external risks of project can be separated into risks of social environmental conditions and risks of external resource conditions, and the internal risks of project can be separated into four types, the first one includes decision risk such as risks of software and hardware selection, *etc*.; the second one includes management risks and risks of organizing structural adjustment, transforming management ideas and reforming performance assessment system, *etc*.; the third one includes implementation risk such as risks in project organization stage, risks in the aspect of time and progress control, risks of cost control and quality risk, *etc*.; the fourth one includes operation risks, system switching risks and risks of disasters or accidents. The particular risk structure is showed by figure one.

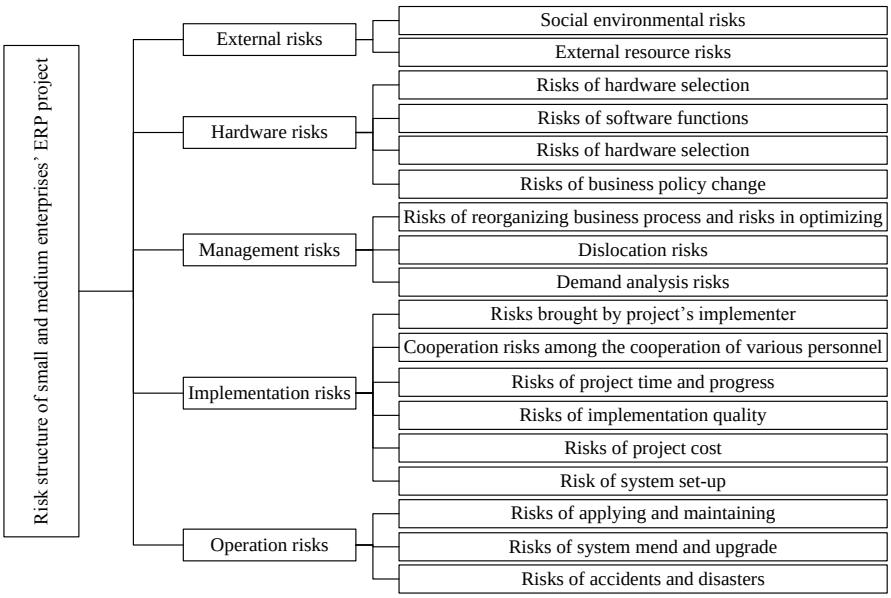


**Figure 1. Risk Structure Frame of Small and Medium Enterprises' ERP Project**

## 3. The Selection of Risk Evaluation Methods for ERP System of EPR Enterprises

The performance assessment for small and medium enterprises' ERP application refers to comprehensively, systematically and roundly evaluating enterprises' changes in various

 

respects after applying ERP in advantage of the established indicator system. For ERP is a responsible system engineering including many functional modules and involving each department of enterprise, thus there are some problems when the performance assessment for enterprises' ERP application is progressed, for example considerations of a large of factors, the obscure relationship among factors, demands of particular data from each department in enterprise to be samples and the difficulties in solving the weight problem among various indicators, *etc.* For these many characteristics, this study selected fuzzy comprehensive evaluation to evaluate small and medium enterprises' ERP risks.

### 3.1. The Weight Sets of Fuzzy Comprehensive Evaluation

Take the set constituted by various influential factors of ERP system as factor sets and signify it by *U:*

$$U = \{u_1, u_2, u_3, \cdots, u_m\}$$

$$U = \{u_1, u_2, u_3, \cdots, u_m\}$$

Among which $u_i$ represents ith influential factor and m represents the number of factors.

Generally speaking, each factor has different importance and important factors should be paid more attention while for those unimportant factors, even though one should pay attention to them but there is no necessities for one to value them too much. To reflect degree of importance of each factor, a corresponding weight $a_i$ should be allocated to each factor $u_i$.

$a_i \geq 0$ ; $\sum a_i = 1$.

So, each weight $a_i$ constitute a fuzzy set above *U:*

$$A = (a_1, a_2, \cdots, a_m) = \frac{a_1}{u_1} + \frac{a_2}{u_2} + \cdots + \frac{a_m}{u_m}$$

For the same factor, if different weight is took, the result of assessment will also be different. To improve the suitability of weight, the author compared the influential factors of small and medium enterprises' financing efficiency and recorded the estimated value of relative importance of ith indicator to jth indicator as $a_{ij}$ by which the score results formed a group of fuzzy judgment matrix and then the author transformed this scoring matrix into one comprehensive judgment matrix and finally obtained the weight of each indicator.

To define relative importance more clearly between two arbitrary indicators, this paper adopted ratio scale method of 1~9 to present it. (see table 1)

**Table 1. 1~9 Ratio Scale Method**

| Relative importance | Definition | Explanation |
|---|---|---|
| 1 | Equally important | Two indicators are equally important |
| 3 | Slightly important | Be a little important |
| 5 | Quite important | Confirm to be important |
| 7 | Obviously important | Be Uncertainly important |
| 9 | Absolutely important | Be important without doubt |
| notice：2,4,6,8<br>Note: 2, 4, 6,8 | The median between two adjacent judgments | Strike an average when there are two adjacent judgment values which are difficult to be fixed. |

So, the results of paired comparison of n indicators can be presented by following judgment matrix *W*

$$W = \begin{pmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \ddots & \cdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{pmatrix}.$$

If matrix W is consistent matrix, then elements in matrix W satisfy

$a_{ij} = 1/a_{ji}$, $a_{ii} = 1$, $a_{ij} = a_{ik}a_{kj}$ (i,j=1,…,n)

$a_{ij} = m_i / m_j; (i, j = 1, 2, \cdots, n) \ \forall i, j = 1,2, \cdots, n$

And now W can also be called reciprocal matrix. According to matrix theory, we can know that the largest eigenvalue of A $\lambda_{\max}$ must be arithmetic number and all components of it's corresponding eigenvector are same, and if the corresponding unit eigenvector of the largest eigenvalue $\lambda_{\max}$ is $M = (m_1, m_2, \cdots, m_n)^T$, then

$a_{ij} = m_i / m_j; (i, j = 1, 2, \cdots, n)$, $\forall i, j = 1,2, \cdots, n$.

Thereby $M = (m_1, m_2, \cdots, m_n)^T$ is the weight vector relative to superior indicator of each indicator in the same subset which is to be obtained by us. But in actual operation, because each element in matrix *A* is the result of the paired comparison of indicators in the same index set and is obtained by subjective estimation which thus may not be consistent matrix and as weight vector, the corresponding positive unit eigenvector of the largest eigenvalue $\lambda_{\max}$ obtained by solving the matrix may not be credible which needs our consistence check.

### 3.2. Consistence Check

The consistence check index adopted in this paper is :

$$CR = \frac{CI}{RI}$$

Among which $CI = \frac{\lambda_{\max} - n}{n-1}$, $\lambda_{\max}$ is the largest eigenvalue of the judgment matrix, *n* is the order of judgment matrix. $RI$ is average stochastic consistency index and it's values are showed as the following table:

**Table 2. R.I. Values of Multiple Order Judgment Matrix**

| n<br>Order n | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| $RI$ | 0.00 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 |

When $CR < 0.10$, it shows that the importance relative to superior indicator of each indicator owns a satisfactory consistence and this analysis results are accepted, otherwise modification for weight coefficient of each indicator is required. Only when all corresponding test indicators of judgment matrix pass the test, the weight coefficients calculated are credible.

### 3.3. Evaluation Set

Evaluation set is the gather of all results of possible overall evaluation done by estimators on evaluation object. So *V* can be presented as:

 

$$V = \{v_1, v_2, \cdots, v_n\}$$

Among which, $v_i$ represents ith evaluation result and n represents the number of overall evaluation.

The aim of fussy evaluation is to select the best evaluation result from the discourse domain of comments level based on comprehensive consideration of all influential factors. To make the comments for financing efficiency concise and intuitive, therefore the author selected two evaluation results and constructed a comment grade discourse domain: *V*={high, low}.

### 3.4. Fussy Evaluation

Solely starting from one factor to assess hereby to ensure the membership of evaluation objects to evaluation gather *V* is fussy evaluation of factors. Suppose the evaluation object is evaluated as the ith factor $u_i$ in factor gather *U* and it's membership degree to the jth factor $v_j$ in factor gather *U* is $r_{ij}$, then the evaluation result of $u_i$ can be presented by following fussy gather:

$$R_i = r_{i1} / (u_i, v_i) + r_{i2} / (u_i, v_2) + \cdots + r_{in} / (u_i, v_n)$$

$R_i$ is called factor evaluation gather and can be simplified as $R_i = (r_{i1}, r_{i2}, \cdots, r_{in})$, and after respectively evaluating all factors, the following matrix can be obtained:

$$R = \begin{pmatrix} R_1 \\ R_2 \\ \vdots \\ R_m \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{pmatrix}$$

*R* is called factor evaluation matrix which can be considered as one fussy relationship between factor *U* and evaluation set *V, i.e.* the "reasonable relation" between influential factors and evaluation objects. From the point of this, $r_{ij}$ can be understood as the degree of affiliation to "reasonable relation" between $u_i$ and $V_j$, *i.e.* when it is evaluated as $u_i$, assess it's reasonableness to $v_j$, and respectively proceed fussy transformation between them and weights set whereby can obtain the module of fussy comprehensive evaluation:

$$B = A \circ R .$$

Here, "$\circ$" represents one synthetic method, *i.e.* the combination of fuzzy operator. Fuzzy operators have multiple combination and different combination can constitute different evaluation module. Here, the author choose weighted average models $M(\bullet, \oplus)$ to proceed comprehensive evaluation for financing efficiency, and in this module:

$$b_j = \min[1, \sum a_i r_{ij}]$$

$b_j$ is called evaluation index which represents the evaluation of evaluation object's membership to factor $V_j$ based on the comprehensive consideration of all influential factors.

# 4. The Application of Evaluation System in G Company's Implementation of ERP

## 4.1. Construct fuzzy Evaluation Factors Gather

Construct fuzzy evaluation factors gather according to the factors of G company's ERP project risk. Among which $u_1$ represents the first evaluation factor. For G company's ERP project, the external economical environmental changes or the inappropriate software selection will directly cause the abortion of project which compared with other risks, is the most serious risk. Valentino, Milco, Vinson, Roger and Daniele in project leadership committee assess weight for these factors. Hereby, applying weight analytic hierarchy process for each factor in evaluation factors can obtain judgment matrix Table 3:

**Table 3. Judgment Matrix Table**

| $A$ | $U_1$ | $U_2$ | $U_3$ | $U_4$ | $U_5$ |
|---|---|---|---|---|---|
| $U_1$ | 1 | 1 | 3 | 4 | 5 |
| $U_2$ | 1 | 1 | 3 | 4 | 5 |
| $U_3$ | 1/3 | 1/3 | 1 | 3 | 5 |
| $U_4$ | 1/4 | 1/4 | 1/3 | 1 | 3 |
| $U_5$ | 1/5 | 1/5 | 1/5 | 1/3 | 1 |

## 4.2. Confirm Factors Weight Set

For different importance of each factor, each evaluation factor should take different weight which can be presented as: $W = \{w_1, w_2, w_3, w_4, w_5\}$ . Among which, $w_1$ represents the weight value of the first evaluation factor $u_1$ . Obtain the relative weight of each factor in above table by applying root method and the following is the calculation process:

$W_1 = \sqrt[5]{1 \times 1 \times 3 \times 4 \times 5} = 2.2679$ ;

$W_2 = \sqrt[5]{1 \times 1 \times 3 \times 4 \times 5} = 2.2679$ ;

$W_3 = \sqrt[5]{1/3 \times 1/3 \times 1 \times 3 \times 5} = 1.1076$ ;

$W_4 = \sqrt[5]{1/4 \times 1/4 \times 1/3 \times 1 \times 3} = 0.5743$ ;

$W_5 = \sqrt[5]{1/5 \times 1/5 \times 1/5 \times 1/3 \times 1} = 0.3056$ .

Get $W = (2.2679, 2.2679, 1.1076, 0.5743, 0.3056)^T$ . Proceeding normalization processing for $W_i$ can obtain:

$$W_1 = \frac{W_1}{\sum_{i=1}^{n} W_i} = \frac{2.2679}{6.5233} = 0.3477 ;$$

$$W_2 = \frac{W_2}{\sum_{i=1}^{n} W_i} = \frac{2.2679}{6.5233} = 0.3477 ;$$

 

$$W_3 = \frac{W_3}{\sum_{i=1}^{n} W_i} = \frac{1.1076}{6.5233} = 0.1698 ;$$

$$W_4 = \frac{W_4}{\sum_{i=1}^{n} W_i} = \frac{0.5743}{6.5233} = 0.0880 ;$$

$$W_5 = \frac{W_5}{\sum_{i=1}^{n} W_i} = \frac{0.3056}{6.5233} = 0.0468 .$$

Then the relative weight of each factor is :

$$W = (0.3477, 0.3477, 0.1698, 0.0880, 0.0468)^T .$$

In general evaluation problems, it is impossible for estimators to accurately judge the value of $B_{ij}$ but can only evaluate it by experience. If there is error in the process of evaluating, the deviation of eigenvalue of judgment matrix must be brought about and hence consistency check must be adopted:

$$BW = \begin{bmatrix} 1 & 1 & 3 & 4 & 5 \\ 1 & 1 & 3 & 4 & 5 \\ 1/3 & 1/3 & 1 & 3 & 5 \\ 1/4 & 1/4 & 1/3 & 1 & 3 \\ 1/5 & 1/5 & 1/5 & 1/3 & 1 \end{bmatrix} \begin{bmatrix} 0.3477 \\ 0.3477 \\ 0.1698 \\ 0.0880 \\ 0.0468 \end{bmatrix} = \begin{bmatrix} 1.7908 \\ 1.7908 \\ 0.8996 \\ 0.4586 \\ 0.2492 \end{bmatrix}$$

$$\lambda_{max} = \frac{1.7908}{5 \times 0.3477} + \frac{1.7908}{5 \times 0.3477} + \frac{0.8996}{5 \times 0.1698} + \frac{0.4586}{5 \times 0.0880} + \frac{0.2492}{5 \times 0.0468} = 5.227$$

$$CI = \frac{\lambda_{max} - n}{n - 1} = \frac{5.227 - 5}{5 - 1} = 0.05675$$

$RI$ is the average random consistency index, for matrix of 1~9 order, $RI$ is:

**Table 4. Consistency Index Judgment Matrix**

| Order | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 |

For this matrix, $RI = 1.12$

$$CR = \frac{CI}{RI} = \frac{0.05675}{1.12} = 0.0507 < 0.10 ,$$

So, judge that the matrix satisfies consistency index

### 4.3. Determine Evaluation Gather

The quality evaluation grade can take the regulations of nation, department standards or enterprise as the foundation and set up risks factor evaluation gather for the project:

$V = \{v_1, v_2, v_3, v_4, v_5\}$ , and the description of risks are respectively{very big, big, middle, small, very small}

### 4.4. Establish Model Judgment Matrix

For factor $u_1, u_2, u_3, u_4, u_5$ , through the discussion and evaluation of project leadership committee, the ratio of each factor above evaluation gather *V* can be obtained, as showed in Table 4.

**Table 5. Project Leadership Committee Comments Set**

| Risks factor | *U* | *V* | | | | |
|---|---|---|---|---|---|---|
| | | $V_1$ | $V_2$ | $V_3$ | $V_4$ | $V_5$ |
| *A* | U1 | 0 | 0 | 0 | 0.1 | 0.9 |
| | U2 | 0 | 0.1 | 0.2 | 0.3 | 0.4 |
| | U3 | 0.1 | 0.5 | 0.25 | 0.1 | 0.05 |
| | U4 | 0.1 | 0.55 | 0.25 | 0.05 | 0.05 |
| | U5 | 0.1 | 0.3 | 0.4 | 0.1 | 0.1 |

According to additive and multiplicative algorithm, the following can be obtained:

$$S_A = \begin{bmatrix} 0.3477 \\ 0.3477 \\ 0.1698 \\ 0.0880 \\ 0.0468 \end{bmatrix}^T \times \begin{bmatrix} 0 & 0 & 0 & 0.1 & 0.9 \\ 0 & 0.1 & 0.2 & 0.3 & 0.4 \\ 0.1 & 0.5 & 0.25 & 0.1 & 0.05 \\ 0.1 & 0.55 & 0.25 & 0.05 & 0.05 \\ 0.1 & 0.3 & 0.4 & 0.1 & 0.1 \end{bmatrix} = \begin{bmatrix} 0.0305 \\ 0.1821 \\ 0.1527 \\ 0.1651 \\ 0.4696 \end{bmatrix}^T$$

### 4.5. Obtain Result

According to the degree of difference of orders, confirm $H(h_1, h_2, h_3, h_4, h_5)^T = (90, 70, 50, 30, 10)^T$ . Then :

$$N_A = H \square S_A = (90, 70, 50, 30, 10) \begin{bmatrix} 0.0305 \\ 0.1821 \\ 0.1527 \\ 0.1651 \\ 0.4696 \end{bmatrix} = 32.78 .$$

According to this result, we think G company's ERP project implementations own low risks.

## 5. The Conclusion and Perspectives of Small and Medium Enterprises' ERP Project Risks Management

Small and medium enterprises' ERP project in our country generally need several months to be completed. Although it's system automation is in constant promotion, risks management has obvious effects in ERP project and has certain actual significance.

Firstly, it promoted the smooth transformation of management level's ideas. The implementation of ERP is the challenge to existing management ideas which has changed

 

company's management inertia following the old routine and is a set of advanced and effective management ideas and methods. In the implementation of ERP project, there unavoidably will be reformation needs in company's some aspects. Reformation may cause the reorganization for responsibility power of original organization structure which may bring about conflicts among administrators. At this moment, leadership team in company must own overall consciousness and achieve agreement through communication, then take the management ideas of ERP system as the guiding and apply relevant scientific management method to promote the all-round improvement of company's management level. Only in this way, the subjective risks of project can be reduced which can make a positive environment for the implementation and construction of project.

Secondly, it decreased the target risks of project. Before, it is better for company to own much needs of functions before it's selection of one project and actual efficiency of functions may not be paid more attention. Such as the financial module in this system, for laws and regulations, it cannot not only satisfy company's demands, but also may cause waste in manpower, material resource and financial resource or even other negative effects. By risks analysis, some unpractical demands can be eliminated for project to make sure the correctness of targets.

Thirdly, it controlled the risks of company's production and operation. The implementation of project is premised on that daily production and operation should not be influenced because once much inconvenience is brought inside the company or to external cooperative firms, the internal and external environmental risks may be caused. Therefore, by risks recognition and evaluation, one should take measures in advance for influences of each link of project and be make sure to prepare for a rainy day. And finally in the implementation of project, no cases of stopping production or customer complaints has been caused by this project which made the project completed in good cooperation.

Fourthly, it ensured the human resources of system. Trained and educated key personnel and relevant documentation can reduce the risks resulting from personnel change when system operators are changed. The operation of ERP maintains the organization of teams and eliminates risks resulting from company's one-sided technology which can deal with problems quickly and effectively and make sure the stable operation of system.

Fifthly, it can improve company's competitive power. Reducing risks can lessen costs and improve efficiency which can not only help small and medium enterprises strengthen internal resource but also can integrate internal and external resources and improve company's competitive power.

Finally, risks management has been fully developed in G company's ERP project which has protected project and had certain remedial effects in some risks caused by some irresistible factors. Through this practice, it has been powerfully proved that risks management is an indispensable part of project and it's theory and methods also has much actual significance for many aspects in social life. Risks management is bound to bring forth the new through the old and develop ceaselessly.

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## Author

**Li Yongming** was born in Jiangsu, China, in 1985. He received his M. S. degree in software engineering from University Of Electronic Science And Technology Of China in Wuhan, China. Now he works in Jiangsu province agricultural reclamation group co., LTD,at the same time he is studying doctorate class in management information system in NUAA. He once taught classes for six years in university, and have Lecturer and engineer titles .He has published several article in the field of enterprise informatization and electronic commerce.

 