Internal Control Evaluation System of Manufacturing Enterprises

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Abstract
By study on the COSO report and the characteristics of manufacturing industries and manufacturing enterprises, and in combination with the internal control theory of the related companies and the relative data, information and documentation of internal control evaluation methods, a complete internal control evaluation system of manufacturing enterprise with twolevels and twenty-three indexes is established. Taking the actual internal control evaluation of a manufacturing enterprise as example, the author calculates the weighting of each index by using AHP-Fuzzy method and sets up the fuzzy function of internal control evaluation of the manufacturing enterprise, and then calculates the grade of internal control state of the manufacturer according to the principle of maximum membership, so as to find an effective evaluation system of internal control state for manufacturing enterprises.

Key words: AHP-Fuzzy Method, Internal Control, Manufacturing Enterprise, Evaluation System.

1. INTRODUCTION
As a pillar industry of national economy, the manufacturing industry got rapid development in the last two decades, and many manufacturing companies also grew rapidly. But the manufacturing companies have some problems in internal control management, for instance, the internal control environment is not standardized, communication is not smooth, risk awareness is weak relatively, internal control awareness is not strong and internal supervision is not in place; on the other hand, the manufacturing resources are redistributed in the world, and many manufacturing enterprises are facing challenges of industry restructuring, which make their business risk increased. Lehman, Merrill Lynch and some other large companies claimed by themselves or are authenticated by external audits that they have "a sound internal control" or "a sound risk management", but also some other large companies declared bankruptcy or were acquired in the financial crisis of 2008, which not only put forward a great challenge for the theory of internal control, but also made company's risk behaviors become the attention focus of academia, industry and governmental regulators (Core, Guayand Larcker,2008). From the interview of internal control theory of enterprises and the practical development, after the United States issued 'Sarbanes-Oxley' Act, the six departments in China including the Ministry of Finance have jointly issued the "Application and Guidelines for Internal Control of Enterprises" in 2010, and then enterprise managers began a new cognition on the importance of functions of Enterprise Internal Control.

According to the current research results from domestic scholars, the basic objective of internal control is to supervise and regulate the decisions of enterprises in business, production, finance and others and to further protect the interests of investors.

Dai thinks that internal control is a very important internal governance mechanism of modern enterprises and has the important functions of error correction, internal business risks prevention and reduction of enterprise and ensure the healthy development of the organization (Dai, 2013). Yang believes that internal control is a systematic process of organizations and individuals at all levels to correctly identify the "self and benefiting self" by use of assessment methods (Yang, 2011).

From the viewpoint of evaluation index system construction, Hollis Ashbaugh-Skaife et al. finds in their studies that the internal control risk factors depend on the organizational complexity and rapid organizational reform, and are concerned with the internal-control-related investment and the discovery and disclosure of internal control deficiencies (Hollis et al., 2007). Maijoor thinksthat different business objectives will cause the difference of management focus, and further the difference of indicators choice of enterprises in internal control structure (Maijoor, 2000). Zhang et al. takes the "Internal Control Application and Guidelines" as the carrier and combines with a large number of internal control evaluation theories and practicedata of enterprises to explore and establish 5 primary evaluation indexes and 11 secondary evaluation indexes of strategic objectives, financial statements authenticity, operation efficiency and effectiveness, business activities and implementation of laws and regulations, etc. (Zhang and Dai, 2011). Bie and Zhao analyze the enacting background of the SOX Act and the provisions related to internal control and combine with the current internal control status of China’s listed companies to propose the dimensions of internal control system construction of listed companies (Bie and Zhao, 2005).
From the perspective of the evaluation method, Chen purposes to make measurement and evaluation of internal control quality of enterprises by use of the comprehensive evaluation method and the risk sampling assessment method. The comprehensive evaluation method takes it as the entry point of research whether the five elements of internal control have effective functions based on the "Internal Control of Enterprises-Integrated Framework"; and the risk sampling assessment method, based on the viewpoint of risk assessment, applies the principle of statistics to develop evaluation on the risk points that exist possibly in the process of achieving the business objectives of an enterprise (Chen and Zhang, 2008). Other scholars also propose the questionnaire method, hierarchical method, written expression method, flow chart method and experience judgment method.

Current literature study on internal control of enterprises rich but there are some problems, for instance, the index system is not clear, the applicability of evaluation method is not strong, the evaluation results also have certain limitations, particularly as the prominent problem, no efficient internal control evaluation system is formed in manufacturing enterprises, so that the results of internal control evaluation of manufacturing enterprises is inconsistent with the actual operation of manufacturing enterprises, and ultimately the manufacturing enterprises have no very effective internal control. Thus, in the complex competitive conditions, we should strengthen the internal control conditions construction of manufacturing enterprises, build a scientific and rational internal control evaluation index system based on the characteristics of manufacturing enterprise, calculate each index weight by use of AHP and construct the fuzzy function of internal control evaluation of manufacturing enterprises, calculate the internal control level of manufacturers according to the maximum membership principle, so that an effective evaluation system of internal control can be explored, for which I wish an acceleration of effective operation of manufacturing enterprises, helpful for the management level promotion of the whole manufacturing industry.

2. BUILD THE FUZZY COMPREHENSIVE EVALUATION MODEL OF INTERNAL CONTROL OF MANUFACTURING ENTERPRISES

2.1. The AHP-Fuzzy Evaluation Method

Analytic Hierarchy Process (AHP), proposed by the American operations research expert Saaty, is a decisions optimizing method that first breaks down the overall goal into multi-level objectives, and builds pairwise judgment matrices for the factor of each level, then makes calculation by using the pairwise judgment matrices, so as to get the specific weight of each evaluation index. At present domestic and foreign scholars have introduced the method into the multi alternatives priority, project quality evaluation, enterprise performance appraisals; from the current practice situation, the effect is quite significant. Fuzzy mathematics is a fuzzy membership function developed on the base of fuzzy sets and fuzzy logic, and also a mathematical tool to make quantification process of many qualitative issues in real life that are difficult to settle.

AHP-Fuzzy evaluation method combines the above two methods to first calculate the weighting of each internal control evaluation index by AHP method and then the grade of internal control evaluation of enterprises in combination with the membership matrix and the maximum membership principle.

2.2. The Feasibility of Fuzzy Comprehensive Evaluation Model Application

First, the index boundaries is fuzzy because the internal control evaluation factors of manufacturing companies may overlap; secondly, the internal control element content of manufacturing companies is very rich, involving more evaluation indicators, and internal control evaluation needs a weighting measurement of specific and detailed indicators for each element so there are problems of inconsistency. Thirdly, there are a large number of qualitative indicators in the internal control factors of manufacturing companies, and after the quantification of qualitative indicators, how to make grade sorting of the internal control state should be considered. The above characteristics of internal control evaluation system of manufacturing enterprises determine the feasibility of AHP-Fuzzy Evaluation Method for application.

2.3. Establish an Internal Control Evaluation System of Manufacturers

Establish the internal control evaluation system of manufacturers

On the one hand, take the five elements of internal control as the primary index in combination with the content of COSO report; on the other hand, the current manufacturing enterprises are transferring from the traditional manufacturing and sales functions to supply chain management and have a fast development; thirdly, excellent manufacturing companies take customers' satisfaction as their goal and make extensive use of IT technology on base of recombining the manufacturing work processes and improving the information system. In combination with these characteristics of manufacturing industries and enterprises, build 18 secondary evaluation indexes, and the detailed internal control evaluation indexes system of manufacturing enterprise can be seen in Figure 1.
2.4. The Calculation of Internal Control Level of Manufacturing Enterprises

The calculation of internal control index weight is decisive for fully and truly reflecting the internal control of manufacturing enterprises. The Analytic Hierarchy Process can be used to break down the overall internal control evaluation system into target level (the total index of internal control evaluation), main criteria level (the primary indicator of five elements of internal control), sub-criteria level (18 secondary indicators) and then build the two levels and six pairwise comparison and judgment matrix $B_i = b_{ij}$ combination of the practical work and data of internal control evaluation of a manufacturer, and use the square root method and nine-point scoring method to calculate the index weighting. The judgment and comparison matrix of the main criteria level is $B_0$, of which the relative weight of evaluation index $C_0 = (\beta_j)$; The judgment and comparison matrix of sub criterion level is respectively $B_1, B_2, B_3, B_4, B_5$, of which the relative weight of evaluation index is $C_i = (\beta_i)$. The final comprehensive weight of all evaluation indexes of sub criterion levels is $C = C_0 \times C_1 \times C_2 \times \cdots C_5$, represented as $X_i$; in addition, the biggest feature root for calculating all judgment matrix is $\lambda_{\text{max}}$, and the consistency test is done, if $C.I \leq 0.1$, it is determined that the matrix $B_n$ is satisfactory. The calculating formula is as follows:

$$\bar{\beta}_j = \sqrt[n]{n} \prod_{j=1}^{n} b_{ij}$$ \hspace{1cm} (1)
$$\beta_j = \frac{\bar{\beta}_j}{\sum_{i=1}^{n} \bar{\beta}_i}$$ \hspace{1cm} (2)
$$\lambda_{\text{max}} = \frac{\sum_{i=1}^{n} \lambda_i - n}{n - 1}$$ \hspace{1cm} (3)
$$C.I = \frac{\lambda_{\text{max}} - n}{n - 1}$$ \hspace{1cm} (4)

All the judgment matrix of internal control evaluation index of manufacturers, the index weight calculation of all level and the consistency test can be seen in Table 1-5.

<table>
<thead>
<tr>
<th>$B_i$</th>
<th>$B_{i1}$</th>
<th>$B_{i2}$</th>
<th>$B_{i3}$</th>
<th>$B_{i4}$</th>
<th>$B_{i5}$</th>
<th>$C_i(\beta_i)$</th>
<th>$\lambda_i$</th>
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<tbody>
<tr>
<td>$B_0$</td>
<td>1</td>
<td>1/2</td>
<td>1/3</td>
<td>1/2</td>
<td>2</td>
<td>0.123</td>
<td>1.023</td>
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<tr>
<td>$B_01$</td>
<td>2</td>
<td>1</td>
<td>1/2</td>
<td>2</td>
<td>3</td>
<td>0.253</td>
<td>1.023</td>
</tr>
<tr>
<td>$B_02$</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0.361</td>
<td>1.023</td>
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<tr>
<td>$B_03$</td>
<td>2</td>
<td>1/2</td>
<td>1/2</td>
<td>1</td>
<td>2</td>
<td>0.177</td>
<td>1.023</td>
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<td>$B_04$</td>
<td>1/2</td>
<td>1/3</td>
<td>1/3</td>
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<td>1</td>
<td>0.086</td>
<td>1.023</td>
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<td>$B_05$</td>
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$\lambda_{\text{max}}=5.135$ \hspace{1cm} C.I=0.0284
2. Determine the internal control evaluation set of manufacturers and collect the evaluation views of experts.

The internal control evaluation of manufacturing companies is divided into four grades $Y = \{Y_1, Y_2, Y_3, Y_4\} = \{\text{Excellent}, \text{Good}, \text{General}, \text{Bad}\}$, we use the Delphi method to collect the evaluation views of experts and make statistics to form fuzzy index evaluation set, as shown in Table 6.

3. Build the fuzzy function of Internal Control Evaluation of Manufacturing Enterprises and calculate the internal control grade.

The evaluation opinion of experts for each main criterion level forms a fuzzy evaluation matrix set, and all the fuzzy index evaluation sets consist of the fuzzy index evaluation matrix of whole internal control of enterprise, represented as,
of which, $E_0$ is the fuzzy index evaluation matrix of whole internal control of manufacturing enterprises.

The relative weight of each sub-criterion level indicator $C_1, C_2, C_3, C_4, C_5$ respectively is multiplied by the corresponding fuzzy evaluation matrix set to obtain the comprehensive fuzzy evaluation grade of internal control of each sub-criterion level.

**Table 6. The Internal control of a manufacturer**

<table>
<thead>
<tr>
<th></th>
<th>The index weight of main criteria level ($C_0$)</th>
<th>The index weight of sub-criteria level ($C_i$)</th>
<th>The final index weight of sub-criteria level $X$</th>
<th>Fuzzy index evaluation set</th>
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<td></td>
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<td>Excellent $Y_1$</td>
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<td>Interior environment</td>
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<td>Control activities</td>
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<td>Information</td>
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<tr>
<td>Internal supervision</td>
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Fuzzy evaluation rank for internal environment:

$$C_1 \times E_1 = \{0.3552, 0.368, 0.176, 0.1\}, C_1 = \{0.359, 0.193, 0.325, 0.123\}$$

$$E_i = \begin{pmatrix}
0.4 & 0.4 & 0.1 & 0.1 \\
0.4 & 0.3 & 0.2 & 0.1 \\
0.3 & 0.4 & 0.2 & 0.1 \\
0.3 & 0.3 & 0.3 & 0.1
\end{pmatrix}$$

Fuzzy evaluation rank for risk assessment: $C_2 \times E_2 = \{0.386, 0.275, 0.222, 0.118\}$

Fuzzy evaluation rank for control activities: $C_3 \times E_3 = \{0.442, 0.258, 0.20, 0.1\}$

Fuzzy evaluation rank for information communication: $C_4 \times E_4 = \{0.316, 0.357, 0.242, 0.1\}$

Fuzzy evaluation rank for internal supervision: $C_5 \times E_5 = \{0.245, 0.245, 0.355, 0.155\}$

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The rank of comprehensive fuzzy evaluation of overall internal control of manufacturers is calculated as: 

\[ X \times E_0 = \{0.378,0.292,0.233,0.109\} \]

According to the principle of maximum membership (Cao Bingyuan, 2005), select the maximum value 0.378 of comprehensive fuzzy evaluation, and by this it can be judged that the overall internal control of the manufacturer is excellent; in addition, we can also determine the enterprise is excellent in risk assessment and control activities, and it is good in internal environment and information communication, and general in internal supervision. The internal control in these three respects should be improved.

3. CONCLUSIONS

The paper has combined with a large number of document literature of internal control and management of enterprises, attempted to establish a set of internal control evaluation system of manufacturing enterprises. Taking the actual internal control evaluation work of a manufacturing enterprise as example, it has made comparison and adjustment of 23 indexes of internal control quality evaluation of manufacturing enterprise by use of AHP method to calculate the relative weight and the final weight of each index in its affiliated level, and then made calculation of evaluation level by use of fuzzy function, and finally got the grade of the manufacturer’s internal control in evaluation results. When each enterprise applies this internal control evaluation model, the secondary index system can be adjusted according to the practice and when the relative weight of index is determined, it should be considered greatly as a pivot according to the actual characteristics of the industry and enterprises. In the actual application the Delphi method to determine the fuzzy index evaluation set, anonymity is the major feature, but when several rounds of comments are not uniform, it is very necessary to timely convene experts to discuss make face-to-face communication, so as to reflect the real internal control state of manufacturing companies.

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REFERENCES


