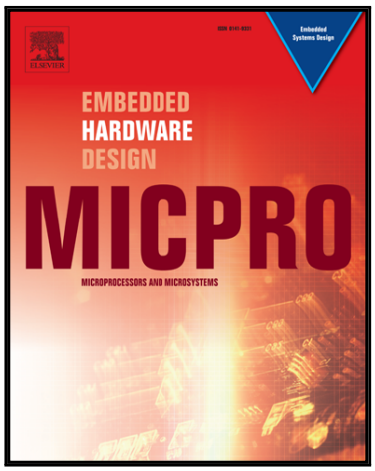

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Measurement of Internal Audit Effectiveness: Construction of Index System and Empirical Analysis

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Abstract: This study starts with the architecture design of the internal audit effectiveness measurement index system, taking internal audit effectiveness as the measurement target, from the three dimensions of audit performance, audit capability, and audit "three systems" effectiveness to build a set of 10 components and 30 measure indexes indicator system for internal audit effectiveness measurement. And we take the internal audit of colleges and universities as the research sample, and make an empirical analysis of the built-up internal audit effectiveness measurement index system using the AHP-Fuzzy method to measure the model. We found that the existing problems of internal audit effectiveness are mainly reflected in the obstacles of the audit management system, large losses and waste, ineffective audit rectification and lagging audit innovation. Based on this result, China should take the reform of the internal audit management system as a breakthrough point, promote full internal audit coverage, increase audit supervision and rectification, improve audit innovation capabilities, and establish an internal audit effectiveness measurement index system to strengthen the internal audit effectiveness management responsibility system.

Key words: Internal Audit; Efficiency Measurement; Index System; Empirical Analysis

1. THE PROPOSAL OF THE QUESTIONS

The modernization of national governance systems and governance capabilities have posed new challenges to internal auditing. The Third Plenary Session of the 18th

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CPC Central Committee proposed that the overall goal of comprehensively deepening reform was to improve and develop the socialism with Chinese characteristics, and to promote the modernization of the national governance system and governance capacity. This is the new mission put forward by the Party Central Committee on auditing as it deployed and advanced the modernization of national governance system and governance capabilities. And the new mission means the new challenge. As far as internal audit is concerned, it is facing challenges such as how to promote full audit coverage, how to improve audit capabilities, and how to carry out audit technological innovation.

The national implementation of a high-quality development strategy places new requirements on internal audit. The report of the 19th National Congress of the Communist Party of China made an important judgment that the Chinese economy had shifted from a high-speed growth stage to a high-quality development stage. This not only has indicated the direction for the reform and development of various industries in China, but also has put forward new requirements on how to achieve high-quality development for them. The new requirements would eventually be reflected and be implemented in various industries and units. In view of this, the key issue for internal audit to meet the new requirements of the country's implementation of a high-quality development strategy is achieving its own high-quality development.

China's internal audit is facing practical problems and dilemma. At present, in the era of comprehensively deepening reform and innovative development, China's internal audit is in full swings and has made great progress. China's internal audit is also facing many practical problems and dilemmas, such as: inadequate internal audit institutions, lagging quality and skills of auditors, low audit quality, and low audit effectiveness. Additionally, such "repeated offense after repeated trial" weird audit situation still exists to varying degrees. All these restrict the normal development and high-quality development of China's internal audit.

At present, the above-mentioned challenges and problems faced by China's internal audit can essentially focus on a key issue: whether the effectiveness of internal audit can be achieved normally. Then, solving this problem, we must know the crux of this

problem. We believe that the crux of the problem mainly is: how to define the desired state (standard value) and actual state (actual value) of internal audit effectiveness to measure and judge whether it is normal or not; how to analyze the formation mechanism and elements of internal audit effectiveness to build an internal audit effectiveness measurement index system; how to analyze the influencing factors of internal audit effectiveness to explore the specific path of internal audit effectiveness. It is obvious that to answer and solve these problems, it is undoubtedly necessary and urgent for solving these problems to build a set of internal audit effectiveness measurement index system that is suitable for it. At the meantime, it is also an urgent task facing the academic and practical circles. Based on this, this paper considers how to build an internal audit effectiveness measurement index system and its measurement model. At the same time, in view of the active development of internal audit in China's universities and its strong representation in China's internal audit, this study takes university internal audits as research samples to conduct an application and an empirical analysis of the internal audit effectiveness measurement index system and its measurement model.

2. LITERTURE REVIEW

Judging from the domestic data consulted, experts and scholars have a very scarce research literature on internal audit effectiveness measurement, which are limited to the concerns about the implementation and evaluation methods of internal audit effectiveness. In some aspects, we may learn from the research results of national (government) auditing. The first is the research on the improvement of internal audit effectiveness. Zhou S L (2020) hold the view that the implementation of internal economic responsibility auditing also needs to form a guarantee mechanism from improving the political positions of leading cadres, improving internal auditing posts, clarifying the positioning of internal auditing, deepening theoretical research, and strengthening internal systems and information construction. Sun W (2018) believed that the specific ways to achieve audit effectiveness were: scientifically allocate audit

resources, strengthen audit staff training, strengthen audit information construction, strengthen project management and assessment, and cultivate a new audit culture. Shen (2019) emphasized that specific strategies for improving the effectiveness of internal audit include: establishing an independent audit organization system and standing in the spirit of auditing; increasing investment in information technology and establishing a business with innovation and standardization; strengthening training for auditors and building confidence in themselves. Xia W N (2017) argue that measures to improve the effectiveness of internal audit supervision included: optimizing the audit environment and improving the status of internal audit supervision; highlighting the focus of audits, strengthening internal audit quality management; promoting the use of audit results, and playing a role in integrity risk prevention and control. Ma X X (2015) proposed to adopt appropriate audit methods, implement continuous monitoring and early warning, implement audit ratings and audit quality assessment and use of results to improve internal audit effectiveness [0]. The second is the selection of internal audit effectiveness evaluation indicators and the exploration of evaluation methods. Yang Q L et al. (2015) selected indicators from the four dimensions of finance, customers, business processes, learning and growth, and combined the expert consultation method and the analytic hierarchy process to set the index weights for improving the value-added internal audit effectiveness evaluation index system. The third is the research on the efficiency measurement of national (government) audit institutions. Qian R (2018) used the DEA evaluation model to measure the efficiency of audit institutions at various levels of the country from the exposure function, the defense function, and the precaution function, and used the Malmquist index to analyze the current status, regional distribution, and change trends of audit institutions at various levels in different years. Based on the perspective of production factor theory, we constructed an audit input-output model and an audit efficiency evaluation index, used data envelopment method to measure the audit efficiency of provincial audit institutions from 2007 to 2014, and used the Tobit regression model to empirically test provincial audit the degree of influence of internal and external factors on the audit efficiency of provincial audit institutions (Wang J, 2018). While

Guo Z Y (2018) used the analytic hierarchy process to select 8 indicators at three levels (this is omitted) from input indicators, outcome indicators and social influence indicators, and used software statistical analysis to measure the audit effectiveness of local governments[0].

Foreign experts and scholars have conducted relevant explorations on the internal audit effectiveness measurement indicators and measurement methods. Dominic and Nonna (2011) proposed that the internal audit participation in enterprise operations and value-added activities should be used as an internal audit effectiveness measurement indicator. Badea and Spineanu (2013) advocated starting from the "3E Principle" (Economy, Efficiency, Effectiveness) and restructuring a set of internal audit effectiveness measurement index system from the three dimensions of resource consumption, audit effect and audit efficiency. Munteanu (2014) argued that in order to find a balance between providing value-added consulting services and internal audit operating costs, the increase in value to the enterprise should be an important dimension of internal audit performance measurement. Qasim M Z (2014) conducted a questionnaire survey of listed companies and found that these listed companies used a combination of qualitative and quantitative indicators to measure the effectiveness of internal audits; some important indicators of qualitative and quantitative indicators both have provided valuable information for measuring the internal audit effectiveness. Ivana and Boris (2016) started by examining the correlation between the effectiveness of internal audit and the supportive environment. Using statistical analysis to survey the 54 large companies in Croatia, they found that internal audit effectiveness is more effective in a supportive environment. Moreover, the results of the survey analysis revealed a statistically significant correlation between perceived levels of internal audit effectiveness and higher-level supportive environments[0].

The existing domestic and foreign literature results provide the necessary research basis and useful reference for this article. At the same time, due to the lack of research literature on the design and empirical analysis of the internal audit effectiveness measurement index system, its research results are relatively limited, and it stays at the level of audit effectiveness realization, internal audit effectiveness evaluation

index selection and evaluation method. Therefore, this not only has indicated the direction for the research in this paper, but also has provided a broad research field. Compared with the results of existing research literatures, the marginal contribution of this article lies in: first, exploring and thinking from multiple levels, different angles and connotation depths, and building a set of internal audit effectiveness measurement index system. Second, in view of the internal audit effectiveness measurement index system, there are both qualitative and quantitative indicators. This paper uses the AHP method and Fuzzy technology to establish the AHP-FUZZY method measurement model. The third is the empirical analysis of the internal audit effectiveness measurement index system and its measurement model based on the university internal audit as a research sample.

3. CONSTRUCTION OF INTERNAL AUDIT EFFECTIVENESS MEASUREMENT INDEX SYSTEM

3.1. PRINCIPLES OF INDEX SYSTEM CONSTRUCTION

The internal audit effectiveness measurement index system is a dynamic system with a structural hierarchy, rich content, and extensive extension. In view of this, this article believes that it should be explored and considered from multiple levels, different angles and its connotative depth, and consider the characteristics of the indicators in the indicator system that are all independent and related, and strive to build an internal audit. The effectiveness measurement index system is comprehensive and systematic. Based on this, in the process of constructing the internal audit effectiveness measurement index system, we should follow the following principles:

(1) Scientific principles. The scientificity of the internal audit effectiveness measurement index system is the basis for ensuring that the measurement conclusions are true and accurate. Whether the measurement conclusion is scientific or not largely depends on whether the measurement price index, measurement standard and measurement method are scientific and reasonable.

Therefore, when constructing an internal audit effectiveness measurement index system, we must fully consider the overall structure of the internal audit effectiveness measurement index system, the scientific elements of the measurement elements and their specific indicators, and reflect the independence, representativeness, reliability, and relevance of the specific indicators.

(2) Systematic principles. As an indicator system, it should be systematic in itself. For this reason, when considering the specific indicators used in the internal audit effectiveness measurement indicator system, we not only design the indicator architecture from different levels, different angles, and different dimensions, but also pay attention to the organic combination of quantitative indicators and qualitative indicators.

(3) Comparable principles. We construct the internal audit effectiveness measurement index system, which is designed to comprehensively measure the general situation of China's internal audit effectiveness. Therefore, when designing the indicator system, this article should take full account of the universal applicability of specific indicators among various industries in China, that is, the spatial scope, content connotation, measurement caliber and measurement method of the indicators should be comparable. The horizontal comparison between industries must also facilitate the vertical comparison of various industries.

(4) Data availability principle. The specific measurement indexes in the internal audit effectiveness measurement index system are both quantitative and qualitative. If it is a quantitative indicator, it is necessary to be able to obtain true and reliable data information; if it is a qualitative indicator, it is necessary to have a well-defined measurement standard, and to find a suitable review expert to evaluate objectively.

(5) Operational principles. At present, it is an urgent need for audit practice to carry out internal audit effectiveness measurement. Therefore, it is imperative to construct an internal audit effectiveness measurement index system. Based on

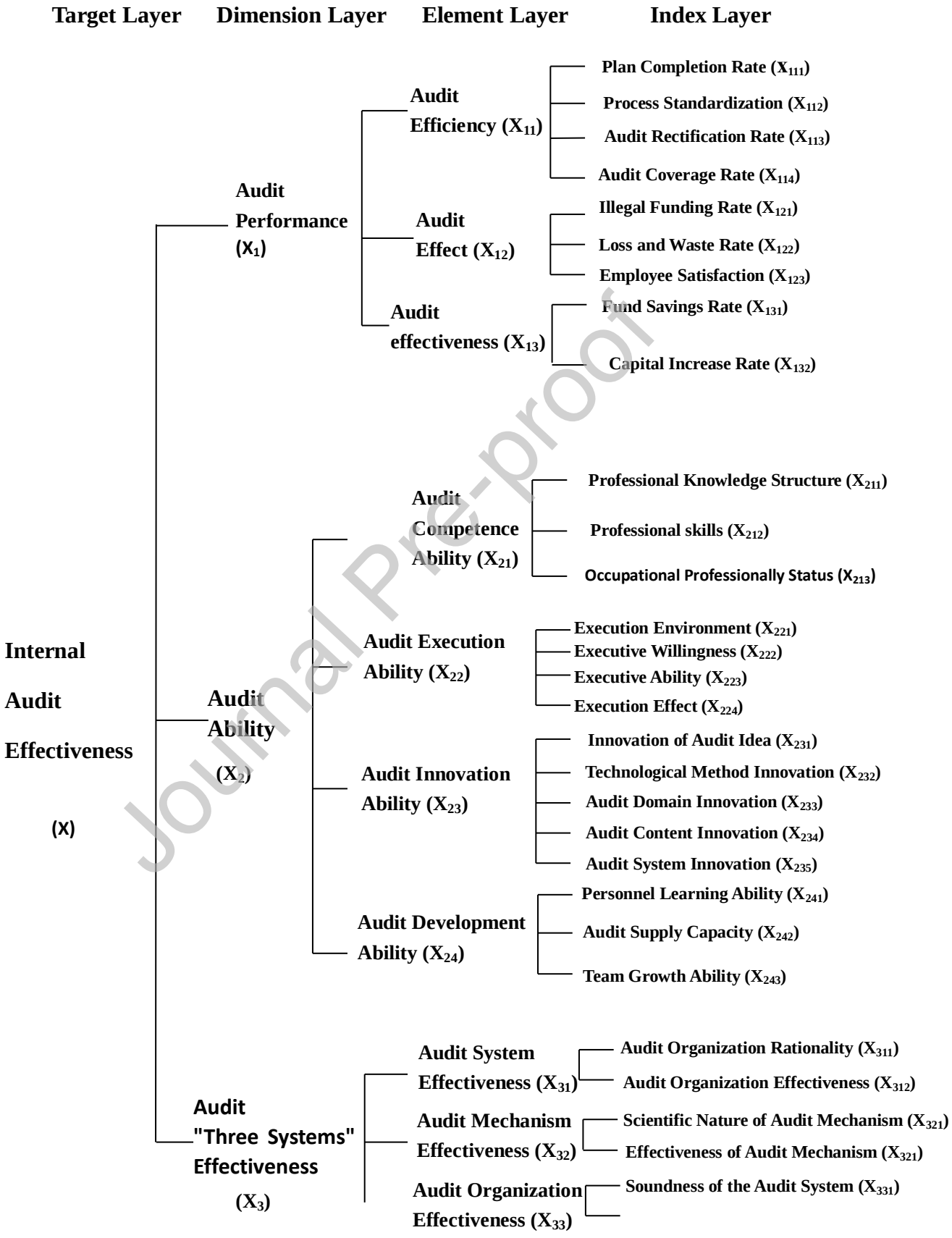
this, the internal audit effectiveness measurement index system should have strong practical operability. When designing specific indicators, we not only consider the practicality of indicators in the internal audit of various industries, but also analyze that indicators can be adjusted appropriately for the particularity of individual industries or individual units and selected to achieve the organic unification of commonality and personality.

3.2. INDICATOR ARCHITECTURE DESIGN

According to the above principles, considering the overall systemic and structural hierarchical characteristics of the internal audit effectiveness measurement index system, combined with the actual situation of quantitative indicators and qualitative indicators coexisting in the internal audit effectiveness measurement, this paper takes the internal audit effectiveness as the measurement goal, audit capability, and audit "three systems" effectiveness in three dimensions, constructing a set of internal audit effectiveness measurement index system consisting of 10 constituent elements and 30 measurement indicators. Its structural design is shown in Figure 1-1.

The above-mentioned internal audit effectiveness measurement index system constructed by the internal audit effectiveness measurement index system diagram starts from the internal audit effectiveness measurement dimensions and constituent elements, and designs the internal audit effectiveness measurement indicators at multiple levels and from multiple angles. It is not difficult to find that the measurement index system has three significant characteristics. The first is comprehensively systematic. The index system is hierarchically decomposed and designed according to the dimensions of internal audit effectiveness measurement and its constituent elements, so the structure level is clear and comprehensively systematic. The second is practical operability. The selection of specific measurement indicators in the indicator system is in line with the actual situation of China's internal audit,

which is easy to understand, concise, and reflects the practicality of practice. The third is universality. The indicator system is designed for China's internal audit industry, not for the internal audit of individual units. However, in view of the existence of more qualitative indicators in this indicator system, it is necessary to equip with appropriate experts to participate in practical operations, which will inevitably have a certain degree of negative impact on the objectivity of the measurement conclusion.



Effectiveness of the Audit System (X_{332})

Figure 1-1 Internal audit effectiveness measurement index system structure

3.3. INDEX MEANING AND MEASUREMENT METHOD

The internal audit effectiveness measurement index system has both quantitative and qualitative indicators. In order to be concise, simple, and clear, the meaning of the specific indicators in the indicator system and its measurement method are described in this paper. The explanation is shown in the following

Table 1-1 The Definition of Internal Audit Effectiveness Measurement Indicators and Measurement Methods

Index Name	Index Meaning	Measurement Method
Plan Completion Rate	The ratio of actual completion of internal audit work to annual audit work plan	Actual amount completed / Annual plan amount
Process Standardization	The degree of standardization of internal audit implementation of business process execution or operations in specific audit projects	Expert Evaluation
Audit Rectification Rate	The ratio of audit rectification opinions and suggestions which are implemented made by internal audit to all rectification opinions and suggestions	Actual number of audit rectification opinions / Total number of audit rectification opinions
Audit Coverage Rate	The ratio of the actual scope of internal audit to the scope of business that should be audited	The scope of actual business/The scope of business to be audited
Illegal Funding Rate	Reflect the situation where internal audit found that the unit used funds illegally through audit activities	Amount of Non-compliance Funds Found in the Audit / Total Audit Funds
Loss and Wastage Rate	Reflect the situation where internal audit found that the unit used funds illegally through audit activities	Lost and Wasted Funds Found in Audit / Total Audit Funds
Employee Satisfaction	Reflect the degree of satisfaction of unit staff on the development and effectiveness of internal audit	Survey Questionnaire

Fund Savings Rate	Reflect the savings of economic activities brought by internal audit activities, focusing on the perspective of cost reduction	Economic Activity Cost Reduction / Total Economic Activity Cost
Capital Increase Rate	Reflect the increase in funds for economic activities brought by internal audit activities, focusing on the perspective of increased income	Increase in Economic Activity Income / Total Economic Activity Income
Professional Knowledge Structure	Reflect the composition and distribution of audit expertise and business knowledge systems owned by internal auditors	Experts Evaluation
Professional skills	Reflect the professional quality of internal auditors and the auditing technology and business capabilities they possess	Experts Evaluation
Occupational Professionally Status	Reflect the differences and internal personality of internal auditors related to auditing professional behavior	Experts Evaluation
Executive Willingness	Reflect the motivation, intentions and desires of internal auditors to perform audit tasks	Survey Questionnaire
Execution Environment	Reflect internal and external environmental conditions and working conditions in which internal auditors perform audit tasks	Survey Questionnaire
Executive Ability	Reflect the actual work ability of internal auditors to perform audit tasks	Survey Questionnaire
Execution Effect	Reflect the intensity and actual effectiveness of internal audit staff in performing audit tasks	Survey Questionnaire
Innovation of Audit Idea	Reflect the innovation of internal auditors in audit thinking and concepts	Experts Evaluation
Technological Method Innovation	Reflect the innovation of internal auditors in the use of auditing techniques and methods	Experts Evaluation
Audit Domain Innovation	Reflect the innovation of internal audit in expanding the audit field and its business scope	Experts Evaluation
Audit Content Innovation	Reflect the innovation of internal audit in terms of audit objectives, project priorities and key links	Experts Evaluation

Audit System Innovation	Reflect the innovation of internal audit in terms of auditing mechanism, rules and regulations	Experts Evaluation
Personnel Learning Ability	Reflect the ability of internal auditors to recognize, accept, master and apply new knowledge	Experts Evaluation
Audit Supply Capacity	Reflect the ability of internal audit to provide effective supply to meet the actual needs of the audit	Experts Evaluation
Team Growth Ability	Reflect the status of internal audit at team level and structure optimization, personnel number and quality growth	Experts Evaluation
Audit Organization Rationality	The reasonableness of the leadership and leadership relationship between the internal audit agency and the subordinates within the audit agency	Experts Evaluation
Effectiveness of the Audit Organization	The effectiveness of the internal audit organization in the conduct of internal audit work and its effectiveness	Experts Evaluation
Scientific Nature of Audit Mechanism	The scientific degree of the interconnection and restriction relationship between the various constituent elements in the operation of the internal audit mechanism	Experts Evaluation
Effectiveness of the Audit Mechanism	How effective the internal audit mechanism is in carrying out internal audit work and achieving its effects	Experts Evaluation
Soundness of the Audit System	Soundness of the internal audit system	Experts Evaluation
Effectiveness of the Audit System	The effectiveness of the internal audit system in the conduct of internal audit work and its effectiveness	Experts Evaluation

4. EMPIRICAL ANALYSIS OF INTERNAL AUDIT EFFECTIVENESS MEASUREMENT Conclusion AND INSPIRATION

4.1. MEASUREMENT MODEL

The constructed internal audit effectiveness measurement index system has a multi-level hierarchy in structural design. There are both qualitative and quantitative indexes in the specific index layer.In view of this, this paper uses the AHP method (Analytic Hierarchy Process) and Fuzzy technology (Fuzzy Comprehensive Evaluation) to establish the AHP-Fuzzy measurement model to solve the measurement method problems in the application of the internal audit effectiveness measurement index system.The specific steps of AHP-Fuzzy measurement model are as follows:

(1) **Establish a factor set.** The factor set is a collection of evaluation factors that affect the evaluation object. This study constructs the internal audit effectiveness measurement index system from the target level, dimension level, element level and index level. Therefore, the constructed internal audit effectiveness measurement index system has obvious multi-level characteristics. Based on this, this study sets the factor set of the internal audit effectiveness measurement index system into 4 levels, that is:

X: target layer, that is, internal audit effectiveness. Among them, $X= (X_1 , X_2 ,\cdots X_i \cdots X_m)$;

X_i : dimensional layer, where $X_i = (X_{i1} ,X_{i2} , \cdots X_{ij} \cdots X_{in})$;

X_{ij} : feature layer, where $X_{ij} = (X_{ij1} , X_{ij2} \cdots X_{ijk} \cdots X_{ijp})$;

X_{ijk} : index layer, that is, a single measurement index.

(2) **Establish a comment set.** Comment is to form different qualitative comment grades for the evaluation object due to different evaluation index measurement values; comment set is a set composed of the evaluation results of each

evaluation factor; comment set is consistent for all levels of evaluation indicators. According to the characteristics of high and low internal audit efficiency, this article divides it into 5 levels, namely: high, high, general, low, and low, that is: Y = (high, relatively high, average, relatively low, low) = (Y_1, Y_2, Y_3, Y_4, Y_5).Where: $Y_1 \in [90,100]$, $Y_2 \in [80,90]$, $Y_3 \in [70,80]$, $Y_4 \in [60, 70]$, $Y_5 \in [0,59]$.

(3) **Establish a weight set.** The weight is used to describe the relative importance of each measurement index to the measurement target. The weight value can be obtained by objective weighting methods (such as analytic hierarchy process, principal component regression analysis method) or subjective weighting methods (such as Delphi method). In view of the hierarchical characteristics of the measurement index system, this study adopts the analytic hierarchy process to determine the index weight. $\mathbf{X_1, X_2, ...X_m}$ have weights that affect the target layer **X** as $\mathbf{A_1, A_2, ... A_i ... A_m}$.

Weight sets $\mathbf{A = (A_1, \sum_{i=1}^{m} A_i\ A_2, \ldots A_i \ldots A_m), =1}$. Similarly, the weight sets of other measurement layers can be established as follows:

$$\mathbf{A_i = (A_{i1}, A_{i2}, \ldots A_{ij}, \ldots A_{in}),} \quad \sum_{j=1}^{n} A_{ij} = \mathbf{1}$$

$$\mathbf{A_{ij} = (A_{ij1}, A_{ij2}, \ldots A_{ijp}),} \quad \sum_{j=1}^{n} A_{ijk} = \mathbf{1}$$

(4) **Establish a fuzzy evaluation matrix.** Set up a fuzzy evaluation matrix from factor set X to comment set Y:

$$R = \begin{pmatrix} R_1 \\ R_2 \\ \cdots \\ R_m \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1s} \\ r_{21} & r_{22} & \cdots & r_{2s} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{ms} \end{pmatrix}$$

The above matrix represents the results of a comprehensive evaluation by the reviewing experts on the level of each specific index. Among them: the quantitative index can be judged according to the calculation result of the evaluation score corresponding to the comment set (evaluation score = the measured value of the

underlying index / the largest or best measured value of the underlying index). Qualitative indexes can be given by analytic hierarchy process or evaluation by review experts. In R formula, $r_{ij} = K_{ij} / N$, which indicates the degree of possibility that experts think it belongs to the j-th level judgment for the i-th index; N is the total number of experts participating in the evaluation; K_{ij} indicates that A total of K experts believe that the i-th underlying index belongs to the j-th level.

(5) **Multi-level fuzzy comprehensive evaluation.** Because the internal audit effectiveness measurement index system has multiple levels (target level, dimensional level, element level, and index level), the final measurement results need to be comprehensively evaluated by multi-level fuzzy matrix operations. Starting from the lowest index, it is obtained by gradually moving up. The fuzzy evaluation matrix operation generally uses a weighted average algorithm to obtain a comprehensive comment set B, that is: $B=A \cdot R=(b_1,b_2,\cdots,b_i,\cdots b_s)$,其中：

$b_i=\sum_{j=1}^{m} a_i \bullet b_{ij}$ (i=1，2，.，n)； $\sum_{i=1}^{m} a_i =1$, “s” is the number of elements in the comment set, that is, the number of comment levels. In this article, “s = 5”.

The specific steps are as follows: First, start from the bottom layer and calculate according to the above formula to obtain the fuzzy evaluation matrix of the element layer; Secondly, according to the above formula, a dimensional layer fuzzy evaluation matrix is obtained; then according to the above formula, a target layer fuzzy evaluation matrix is obtained; finally, calculated according to $Y = A \cdot B$, and obtained the final measurement comment set .

(6) **normalization processing.** If $\sum_{i=1}^{n} Y_i =1$, normalization processing can be adopted, let $Y_i = y_i / \sum_{i=1}^{n} Y_i$, then the internal audit effectiveness measurement results can be obtained according to the principle of maximum membership.

4.2. EMPIRICAL ANALYSIS

This study takes the internal audit of Chinese universities as a research sample, and uses the established AHP-Fuzzy measurement model to conduct an empirical analysis of the internal audit effectiveness measurement index system. First, design a set of questionnaires on the status of internal audit effectiveness. Then, use the questionnaire to obtain information about the effectiveness of internal audit. Finally, use the AHP-Fuzzy measurement model to calculate the measurement results.

In the empirical analysis of this article, in order to ensure the reliability and validity of the research sample data obtained by the questionnaire survey, the following three aspects should be done: First, when designing the indicator system, the article carefully designs each indicator item. Second, the article starts from Design survey index items at different levels of the same question, and use Bartlett Sphere Test and KMO test to check the objectivity and rationality of the index system. Third, in order to ensure the reliability and validity of the data, in the process of the questionnaire research, we strictly standardize the survey process, carefully select the surveyed objects, emphasize the importance of the research sample data, avoid the surveyed objects fill in data at will, and ensure the rigor and objectivity of the survey data.

This study takes trainees who participated in the second board meeting and director training class of the 6th Council of China Education Auditing Association held in Shenyang in late June 2019 as the object, distributed 107 questionnaires on the status of internal audit effectiveness, and retrieved valid questionnaires. 102 copies, the recovery rate was 98.13%. The questionnaire was distributed to 107 people, including: a total of 98 department-level cadres (90 directors and 8 deputy directors), accounting for 91.59%; the rest were section chiefs and business backbones, a total of 9 people, accounting for 8.41%. The questionnaire collected 102 people, of which: a total of 98 department-level cadres, accounting for 96.08%; the rest are section chiefs and business backbones, a total of 4 people, accounting for 3.92%. At present, whether it is auditing theoretical discussions or auditing practice work in my country's

universities, the status and influence of internal auditing in Chinese internal audit industry have become more and more prominent, and it has a strong representativeness in the internal auditing industry. In particular, almost all of the subject of this questionnaire survey are heads of internal audit institutions (very few are business backbones). Therefore, this questionnaire survey and its empirical analysis results can not only reflect the overall status of the internal audit efficiency of my country's universities, but also reflect the industry status of my country's internal audit efficiency. The empirical analysis and its calculation process are briefly described as follows:

1. **Determine the weight of the index.** Index weights are coefficients that indicate the degree of function of each measurement index in the evaluation target. First, using the analytic hierarchy process, the review experts are invited to evaluate various indexes in the internal audit effectiveness measurement index system, and construct a judgment comparison matrix. Then, the eigenvalues of the matrix are obtained by the square root method, and the consistency check is performed. By checking the components of the feature vector corresponding to the judgment matrix, it is the weight of each index to the upper layer. The specific results are as follows:

The weight of the dimension layer to the target layer (1): A = (0.4,0.4, 0.2).

The weight of the feature layer to the dimensional layer (3): A_1 = (0.3,0.4,0.3), A_2 = (0.3,0.3,0.2, 0.2), A_3 = (0.4,0.3,0.3).

The weight of the index layer to the element layer (10):

A_{11}=(0.3,0.2,0.3,0.2);A_{12}=(0.3,0.4);A_{13}=(0.5,0.5);A_{21}=(0.3,0.4,0.3);A_{22}=(0.2,0.2,0.3); A_{23}= (0.1,0.3,0.2,0.2,0.2,0.2); A_{24} = (0.3,0.3,0.4); A_{31} = (0.6,0.4); A_{32} = (0.4,0.6)); A_{33} = (0.5,0.5).

2. **Determine the evaluation matrix.** According to the evaluation information

collected from the questionnaire survey on the status of internal audit effectiveness, organize 10 review experts to carry out information collation and comprehensive evaluation; then, based on the evaluation results, the proportion of each conclusion is obtained as the evaluation matrix, which is the evaluation matrix. Establish the fuzzy evaluation of the specific measurement index of the bottom layer (index layer) as a matrix R_{ij} (10 in total, 8 in the middle):

$$R11 = \begin{pmatrix} 0 & 0.1 & 0.5 & 0.1 \\ 0 & 0.2 & 0.3 & 0 \\ 0 & 0 & 0.6 & 0.2 \\ 0 & 0.1 & 0.4 & 0 \end{pmatrix}$$

…… ……

$$R33 = \begin{pmatrix} 0 & 0.2 & 0.4 & 0.4 & 0 \\ 0 & 0.1 & 0.4 & 0.5 & 0 \end{pmatrix}$$

3. **Perform multi-level fuzzy comprehensive evaluation.** According to the corresponding weights of each level in the index system and the fuzzy matrix operation rules, the fuzzy comprehensive evaluation is carried out from the lowest level (the index level) to the next level. According to the foregoing calculation formula: $B = A \cdot R$. Performs the first fuzzy matrix operation to obtain the feature layer fuzzy matrix B_i (a total of 3); then, through the second fuzzy matrix operation, a dimensional layer fuzzy matrix B (a total of 1) is obtained. Finally, the fuzzy matrix operation is performed again to obtain the required final measure comment set. The calculation process is briefly described as follows:

   After the first fuzzy matrix operation, the feature layer fuzzy matrix Bi (3) is obtained:

$$B1 = \begin{pmatrix} 0 & 0.09 & 0.35 & 0.47 & 0.09 \\ 0 & 0.09 & 0.30 & 0.51 & 0.10 \\ 0 & 0.15 & 0.30 & 0.50 & 0.05 \end{pmatrix}$$

$$B2 = \begin{pmatrix} 0.03 & 0.18 & 0.33 & 0.38 & 0.03 \\ 0.04 & 0.14 & 0.30 & 0.44 & 0.08 \\ 0.01 & 0.16 & 0.27 & 0.43 & 0.13 \\ 0.14 & 0.27 & 0.30 & 0.26 & 0.03 \end{pmatrix}$$

$$B3 = \begin{pmatrix} 0 & 0.14 & 0.30 & 0.50 & 0.06 \\ 0 & 0.10 & 0.40 & 0.46 & 0.04 \\ 0 & 0.15 & 0.40 & 0.45 & 0 \end{pmatrix}$$

After the second fuzzy matrix operation, the dimensional layer fuzzy matrix B is obtained:

$$B = \begin{pmatrix} 0 & 0.108 & 0.315 & 0.495 & 0.082 \\ 0.123 & 0.182 & 0.303 & 0.384 & 0.065 \\ 0 & 0.131 & 0.360 & 0.473 & 0.036 \end{pmatrix}$$

Do the last fuzzy matrix operation and get the comprehensive review set for the target layer Y = (0.0528, 0.1422, 0.3192, 0.4462, 0.0660).

Since 0.0528 + 0.1422 + 0.3192 + 0.4462 + 0.0660 = 1.0264≠1, it needs to be normalized to get the final measurement comment set Y (0.0514, 0.1386, 0.3110, 0.4347, 0.0643). Therefore, this article can be considered to have 5.14% certainty that the effectiveness of internal audit is "high", and have 13.86% certainty that the effectiveness of internal audit is “ relatively high, average,”, and have 31.1% certainty that the effectiveness of internal audit is “average”， and have 43. 47% certainty that the effectiveness of internal audit is “relatively low”,and have 6.43% certainty that the effectiveness of internal audit is “low”.According to the principle of maximum membership, this article can make a "relatively low" measurement of the status of internal audit effectiveness in Chinese universities.

5. CONCLUSION AND INSPIRATION

How to improve internal audit effectiveness management and measurement to promote the realization and improvement of China's internal audit effectiveness is a hot and difficult issue facing the academic and practical circles. This paper focuses on the construction of internal audit effectiveness measurement index system and empirical analysis. It starts with the design of the internal audit effectiveness measurement index system and takes the internal audit effectiveness as the measurement goal. At the same time, this paper constructs an internal audit effectiveness measurement index system from the three aspects of audit performance, audit capability, and audit. Taking the internal audit of China's universities as a research sample, this paper conducts an empirical analysis of the internal audit effectiveness measurement index system and its measurement model. The study reached three conclusions. First, this article explores and constructs an internal audit effectiveness measurement index system from multiple levels, different angles, and depth of contents and features. This reflects that the internal audit effectiveness measurement index system is a hierarchical structure, rich in content, and extensive in an organic system. Second, the construction of the internal audit effectiveness measurement index price system and its measurement model are both theoretical and strong in practice. Third, based on the on-site questionnaire survey information and the evaluation and analysis of review experts, this study found that the main existing problems of the effectiveness of my country's internal audit are the audit system obstacles, large losses and waste, ineffective audit rectification and lagging audit innovation.

For the purpose of strengthening the management of internal audit effectiveness in China, this study finds three implications. First, it has practical guidance. For one thing, the internal audit effectiveness measurement index system and its measurement model can be applied to the internal audit effectiveness management and its measurement practice activities to promote the realization and improvement of

China's internal audit effectiveness, and then improve the scientific level of internal audit management levels in China. For another, to address the prominent problems in internal audit effectiveness management, accurate measures are taken to solve problems, such as: promoting full coverage of internal audit, increasing audit supervision and rectification, strengthening the use of audit results, and improving audit innovation capabilities. Secondly, it has rich theoretical expansion. When designing the constituent elements and measurement indexes of the internal audit effectiveness measurement index system, this article explored and considered from multiple levels and from different angles of contents and features and striving to build a comprehensive index system. This is a theoretical promotion of the effectiveness and measurement of internal audit. Third, it has a policy significance. This article through the empirical analysis finds the practical problems that are urgently needed for the relevant Chinese departments or industry associations to formulate and improve relevant policies and measures, such as: reforming the internal audit management system, establishing a unified internal audit effectiveness measurement index system in the industry, and strengthening internal audit effectiveness evaluation standard management responsibility system. The significance of these policies and measures has positively responded to the 19th CPC Central Committee to reform the audit management system.

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Conflict of interests

The authors declare that they have no competing interests in this section.