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## 82. The Development of Audit Detection Risk Assessment System: Using the Fuzzy Theory and Audit Risk Model

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### Abstract

*The result of audit designation is significantly influenced by the audit evidence collected when planning the audit and the degree of detection risk is further depends on the amount of audit evidence. Therefore, when the assessment factors of detection risk are more objective and correct, audit costs and the risk of audit failure can be reduced. Thus, the aim of this paper is to design an audit detection risk assessment system that could more precisely assess detection risk, comparing with the traditional determination method of detection risk in order to increase the audit quality and reduce the possibility of audit failure. First, the grounded theory is used to reorganize 53 factors affecting detection risk mentioned in literatures and then employed the Delphi method to screen the 43 critical risk factors agreed upon by empirical audit experts. In addition, using the fuzzy theory and audit risk model to calculate the degree of detection risk allow the audit staff to further determine the amount of audit evidence collected and set up initial audit strategies and construct the audit detection risk assessment system. Finally, we considered a case study to evaluate the system in terms of its feasibility and validity.*

**Keywords:** Detection risk, Grounded theory, Fuzzy theory, Audit risk model

### Introduction

Many accounting and law experts thought that the main reason resulting in the lawsuits encountered by accounting firms was that the policymaker using financial statements misunderstood the relation between business failure and audit failure (Arens et al. 2005). Because of external economic environment or the corporate situations (for example, the industry is in depression and the manager's capacity, integrity, and capital are insufficient), the enterprises could not pay off the debts or satisfy the investors' expectation. The situation is called business failure. The most serious business failure refers to bankruptcy. When audit staff cannot practice the audit works according to the acknowledged audit criteria and submit wrong audit opinions (for instance, the audit staff do not pay professional attention and do not collect sufficient evidence), it becomes audit failure. Khurana and Raman (2004) also indicated that audit failure does not necessarily lead to business failure; however, after business failure, the investors and creditors of the enterprises would pay attention to the existence of the audit failure. For every audit case, the audit staff carried the audit risk and the possibility of submitting wrong opinions. Even though the audit staff has paid professional attention and presented proper audit opinion, which did not lead to audit failure, they might still face the risk of lawsuits because of the business failure of the auditee. Therefore, the auditors should understand more about the industry and the enterprise of the auditees when receiving audit authorization and planning the audit; they should also use and plan the audit work in order to upgrade the audit quality and further reduce the risk of

lawsuits (Arens et al. 2005; Krishnan and Krishnan 1997).

When planning the audit work, the auditors decide the degree of detection risk of the plans and the expected collection of audit evidence amount through their understanding of the target enterprise and industries and assessment of the auditees' operational risk, execution of analytical process, seriousness of assessment and acceptable audit risk, and the degrees of inherent risk and control risk (Audit Bulletin No.24 1993). Therefore, the determination of detection risk would not only influence the progress of audit strategies, but also significantly influence the results of the audit. When evaluating the detection risk, the auditors should be more precise and careful. When the auditors are determining uncertain affairs such as risks, they tend to use meaning terms such as "low", "medium" and "high", instead of sequential numbers. However, for the determination of detection risk, it was difficult to reflect the influences of audit risk, inherent risk, and control risk on detection risk only by using the meaning terms of low, medium and high. Therefore, the final determination of the audit result was according to the ultimate judgment of the auditors (Mock et al. 1998). However, many studies have been suspicious of the auditors' professional judgmental capability to distinguish audit evidence and proper responses and they indicated that the audit staff's professional judgment was profoundly affected by training, experience, and the capabilities dealing with time and complicated issues (Bedard and Graham 2002; Helliard et al. 1996; Khurana and Raman 2004; Krishnan and Krishnan 1997; Low 2004; Turner et al. 2002; Wustemann 2004).

At present, the risky environment faced by the auditors is further filled with risks such as dissymmetrical information and complicated and flexible selection of accounting methods, which might confuse the audit key points for the audit staff. Thus, the corruptions exposed one after another and the investors attributed the business failure to the audit failure. If the auditors still subjectively judge the influences of audit risk, inherent risk and control risk on detection risk, it might lead to the error of audit strategy establishment and further increase the risk of audit failure. Therefore, the research question in this research was that, comparing with the traditional determination of detection risk is there a more precise detection risk assessment model that can upgrade audit quality and reduce the possibility of audit failure? In order to find out the critical risk factors influencing detection risk, which were identified by academia and empirical circles, this research provided the auditors the base to assess the risks and establish a more objective method to decide the detection risk and eliminate the disadvantage, which only depended on the auditors' subjective judgment.

This paper is organized as follows. Section 2 reviews related literatures including audit risk and the fuzzy theory. Section 3 presents the research methodology of this paper. Section 4 describes the development of the audit detection risk assessment system. Section 5 provides a case study to evaluate the system. Conclusion and future researches are given in Section 6.

## **Literature Review**

### ***Definitions of audit risk and audit risk model***

AICPA (1983) defined that audit risk consists of inherent risk, control risk, and detection risk. The so-called inherent risk means that under the condition without internal control, the possibility of serious misstatement in financial statements is present. Wustemann (2004) pointed out that the factors influencing inherent risk included (1) asset flow; (2) the assessment method established according to accounting assumption; (3) general economic situation; and (4) technical development. Control risk means that the internal control of auditee could not immediately prevent or detect the risk of serious errors. Bedard and Graham (2002) also indicated that the following factors would influence the assessment of control risk: (1) the organizations and staff of accounting department of auditees; (2) the

internal conditions of auditees, which were beneficial for detecting or preventing fraudulence; (3) safety of EDP system; and (4) management information for detecting corporate activities. Detection risk means that the audit personnel's test could not detect the serious misstatement in the financial statements. Audit Criteria Bulletin No. 24 (1993) indicated that the factors affecting detection risk assessment are (1) selecting improper audit process; (2) error execution; (3) misunderstanding the audit results; (4) the adoption of random inspection.

Audit personnel's assessment of audit risk would affect the design of the following audit strategies. At the initial stage of audit planning, improper audit risk assessment would lead to wrong resource distribution and inefficient or ineffective audit results (Helliard et al. 1996; Khurana and Raman 2004; Krishnan and Krishnan 1997; Low 2004). At present, the common basic audit risk assessment methods include (Arens et al. 2005; Cushing et al. 1995; Low 2004; Messier and Austen 2000; Taylor 2000; Wustemann 2004): risk factor analysis; fuzzy combined assessment; internal control assessment; analytical audit; audit risk model; qualitative risk assessment; and <sup>2</sup>risk rate assessment. AICPA's (1983) audit risk model provided the major conceptual framework of the audit process, which described that when the audit personnel plan the audit work, according to their understanding of the auditees' business, they should professionally judge and set up the audit risk level, which could affect submit proper audit opinions for the financial statements, consider the remaining sum of each subject or various exchange factors and related internal control, and assess the degrees of inherent risk and control risk. According to the study of Arens et al. (2005), the factors influencing the accountants' professional judgment include the audit work environment, audit personnel's characteristics, audit evidence, decision-making process and quality characteristics determined. Therefore, the audit personnel should follow the audit risk limit accepted, the remaining sum of each subject or different exchanges, inherent risk and control risk to set up the acceptable detection risk limit for establishing the audit process.

The audit risk model is expressed as  $AR = IR * CR * DR$ . In other words, audit risk refers to the risk that the auditees' financial statements could not reveal misstatement or fraudulence after their internal control activities and audit personnel's detection. In the audit risk model, the items of  $(IR * CR)$  are sometimes called "auditee risk" or "occurrence risk", since these two risks mean the risk that before the audit, the misstatement has already existed in the financial statement (Low 2004; Khurana and Raman 2004). The audit personnel could not control these two risks; however, they must assess their levels in order to determine the scale of audit test in the regulated audit risk level (Messier and Austen 2000). Taiwan Audit Criteria Bulletin No. 24 (1993) also allowed the audit personnel to individually or collectively consider inherent risk and control risk. The determination of detection risk on

audit risk model is expressed as 
$$DR = \frac{AR}{IR * CR}$$
.

The criteria also indicated that when the audit personnel plan the audit work, they should initially judge the acceptable audit risk and significance standard in order to acquire sufficient and proper audit evidence. AICPA (1983) also defined significance as the degree of influence that when certain information was neglected, in error or unexposed, it might not be beneficial for the resource distribution policy making of the financial statement users. When the audit personnel distribute overall significant level to the remaining sum or each account or exchange, it is called tolerable misstatement. In the audit risk model, we realize that there is a positive relation between detection risk and audit risk; however, it has reverse relations with

<sup>2</sup> Risk rate = the occurrence frequency of the risk x the average loss of the risk.

inherent risk and control risk (Arens et al. 2005; Low 2004). When the audit personnel decide the remaining sum of certain subject or the process property, time, and scale of exchange patterns, the lower the significant level is, the higher the degree of audit personnel's acceptable audit risk. On the contrary, the higher the remaining sum of the subject or significant level of exchange pattern is, the higher the degree of audit personnel's acceptable audit risk. Therefore, there is reverse relation between audit risk and significance and there is also reverse relation between detection risk and significant level (Arens et al. 2005; Martinov and Roebuck 1998). The audit evidence refers to the data collected by the audit personnel upon their professional judgment in order to render opinions with respect to the propriety of financial statements. The sufficiency and propriety of audit evidence determine the amount and reliability of the evidence acquired. There is also reverse relation between audit evidence and audit risk (Arens et al. 2005; Low 2004; Khurana and Raman 2004). Figure 1 describes the relation among the risks of audit risk model, significant level, and audit evidence.

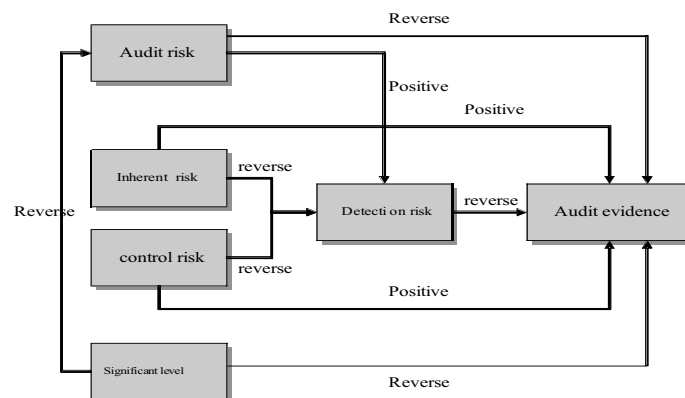


Figure 1 Relations among the risk composition in audit risk model, significant level and audit evidence

### *The Fuzzy Theory*

Zadeh (1965) proposed the Fuzzy Theory and introduced the concept of membership function in order to deal with the difference of linguistic variable. He thought that there was a certain degree of fuzziness in terms of people's thoughts, inference and perception. Its aim is to solve the data of uncertainty or fuzziness in the environment. The fuzzy theory has had considerable theoretical base for studying uncertain and subjective issues. The theory was later widely applied to fields such as AI, control engineering, expert systems, managerial science, business studies, multi-principle decision making and risk assessment, etc. (Akhter et al. 2005; Lee and Park 1997; Mujumdar and Sasikumar 2002; Ross et al. 1990; Tanaka and Sugeno 1992; Toshiro 1994). Thus, the theoretical framework of this paper is to apply the fuzzy theory to construct the assessment of audit risk. The content related to the fuzzy theory is as follows:

#### *Fuzzy set*

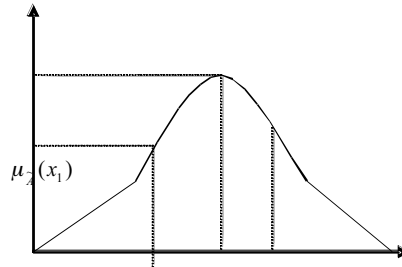
Fuzzy set means the set signifying things with specific properties and unclear boundaries. The fuzzy sets theory aims to solve the uncertainty or fuzzy data in realistic environment. The definition of fuzzy set is as follows (Arens et al. 2005; Lee and Park 1997; Mujumdar and Sasikumar 2002):

$U$  is treated as discourse target and is called universe of discourse (or universal set); the target in each universe of discourse is called element (or member) and is represented by  $X$ ; the fuzzy subset  $A$  on  $U$  means that for any  $X \in U$ , there is a real number

designated.  $\mu_{\tilde{A}}(x) \in [0,1]$  is the degree of  $\mathcal{X}$  membership on  $A$ .  $\mu_{\tilde{A}}(x): A \rightarrow [0,1]$  is called the membership function of  $A$ . When the universe of number of  $A$  is  $\{0,1\}$ ,  $\mu_{\tilde{A}}(x)$  becomes the characteristic function of an ordinary subset and  $A$  becomes an ordinary subset. The height of the fuzzy set means the maximum degree of membership, which is represented by  $hgt A$ .  $A$  is the fuzzy set of normalization and it means the fuzzy set in which there is at least one element of degree of membership referring to 1. The height of  $A$  is  $hgt A = 1$ .

*Membership Function*

Membership function is also called degree of membership, which means the compatible or real degrees between the element and set. In other words, membership function means the degree that one element belonged to a certain set. That is to say, when the element has higher degree of membership, it means the degree of the set is higher. We treat  $U$  as a universe of discourse and call  $A$  as one fuzzy subset of  $U$  and designate one number  $\mu_{\tilde{A}}(x) \in [0,1]$  for each  $x \in U$  to show the degree of membership of  $x$  for  $A$ , which is the degree of membership of  $U$ .  $\mu_{\tilde{A}}(x)$  is called the membership function of  $A$ . We can be sure that the fuzzy subset  $A$  of  $U$  correspond to a certain number  $\mu_{\tilde{A}}(x) \in [0,1]$  to  $x \in U$ . Figure 2 shows  $\mu_{\tilde{A}}(x)$  curve diagram of membership function.



**Figure 2  $\mu_{\tilde{A}}(x)$  curve diagram of membership function**

*Fuzzy Numbers*

In the assessment process of different projects, the satisfaction with different properties in the project is usually placed in a certain scale. If we signify it with a clear and precise number, it is less likely to reflect the reality. Therefore, in fuzzy multi-principle assessment, fuzzy numbers tend to be used to show the degree of satisfaction (Aren et al. 2005; Wustemann 2004). Fuzzy numbers were proposed by Dubois and Prade(1980) who indicated that fuzzy numbers refer to the fuzzy set on real line  $R$  and their membership function was  $\mu_{\tilde{A}}(x): R \rightarrow [0,1]$ , which has the following characteristics:

- $\mu_{\tilde{A}}(x)$  is piecewise continuous
  - $\mu_{\tilde{A}}(x)$  is convex fuzzy subset
- $\mu_{\tilde{A}}(x)$  is normality of a fuzzy subset. In other words, there is a real number  $x_0$ , which results in  $\mu_{\tilde{A}}(x_0) = 1$ .

**The Research Method**

First of all, we used the Grounded Theory (Glaser 1992) to reorganize and analyze the factors influencing detection risk in the past literatures and allocated them into three dimensions (audit risk, inherent risk, and control risk) according to the audit risk model. In order to increase the contribution of the research to audit cases, this research then adopted the Delphi method (Linstone and Turoff 1975) to distribute expert questionnaires to the experts in empirical audit circles. The distribution targets included the audit staff in accounting firms

and the internal audit personnel of ordinary enterprises. The researcher expected to find out the critical factors influencing audit risk, inherent risk, and control risk identified by the experts in real audit cases through the distribution of the expert questionnaires. After using the Delphi method to acquire the critical risk factors influencing detection risk identified by the experts, this research further used the fuzzy theory and the audit risk model to decide the degree of detection risk. First of all, we defined the triangular fuzzy numbers of linguistic variables of “possibility” and “significance” of each critical risk factor. Subsequently, a fuzzy assessment number is used to integrate different assessors’ fuzzy values on each critical risk factor. Then, the Efficient Fuzzy Weighted Average Method (Lee and Park 1997) was used to calculate the fuzzy values of audit risk, inherent risk and control risk. Afterwards, the fuzzy value of detection risk was calculated through the audit risk model. Finally, we used the modified Euclidean Distance method (Ross et al. 1990) to infer the linguistic degree of detection risk. In addition, in order to confirm the feasibility and usability of the detection risk assessment system, this research used a case study to manage the empirical study.

## **The Development of Audit Detection Risk Assessment System**

### ***Results of the Ground Theory***

In the aspect of audit risk, this research found out that according to the categorization of Beattie et al. (2002), the risk factors influencing audit risk could be further divided into two core categories: “auditor base” and “auditee base”. “Auditor base” means the risk caused by the auditors’ inability to detect significant error fraudulence in finance. Thus, the risk factors which might result in the auditors’ wrong judgment, such as the auditors’ understanding of the target business, the auditors’ professional knowledge, and the assessment of managerial level’s integrity were designated as “auditor base”. “auditee base” means the degree of influence when the auditors submit wrong audit report to the users of financial statements. Thus, the external users’ trust on the financial statements, the possibility of financial difficulty for target enterprises after submitting the audit report and the significant level were designated as “auditee base”.

As to the inherent risk aspect, based on the categorization of Helliard et al. (1996), we divided the factors influencing inherent risk into “financial statement level” and “account remaining sum level” according to the influenced scale. “Financial statement level” means the risk that the overall financial statement of the target business might have significant error or fraudulence. Thus, the risks affecting the overall financial statement of target enterprises, such as the scale of target business, external economic environment of target business, incentives of the managerial level to operate profits, financial statement error found in previous audit were classified as “financial statement level”. “Account remaining sum level” means the risk factors in which the specific account of target enterprises might have significant misstatement. Thus, the risks influencing the specific account, such as the complexity of auditee’s inventory calculation, difficulty of audit account or exchange, many errors in account receivable of the previous audit, and many errors in inventory of the previous audit were classified as “account remaining sum level”.

As to control risk aspect, according to COSO (1996), the researcher divided the risk factors influencing control risk into “control environment”, “risk assessment”, “control activity”, “information and communication”, and “supervision”. “Control environment” means the framework for creating the disciplines and internal control of the target enterprises. Thus, the risk factors such as the employees’ integrity, morality and abilities, managerial level’s managerial philosophy, risk orientation and power, and duty division of target enterprises were classified into “control environment”. “Risk assessment” was the method with which

target enterprises identified the impossibility of their goal accomplishment. Thus, the factors such as risk assessment of new accounting criteria announced, risk assessment responding to the changes of external environment, and risk assessment of safety of EDP system were classified as “risk assessment”. “Control activity” means the target enterprises ensured that the members in the organization actually executed the policy and process ordered by the managerial level. Thus, internal controls such as control of data dealing, actual control of accounting records and assets, authorization of transaction, and professional capacity division of transaction were classified as “control activity”. “Information and communication” was the process in which target enterprises and accounting information related to financial reports delivered and communicated. Since the risk factors of “information and communication” were rarely mentioned in the past literatures, this research includes “information and communication” into the core category of “control activity” and named the risk factors of the former as “the process of delivery and communication of accounting information related to the financial report”. “Supervision” was the process in which the target enterprises assessed the executive results of internal control. Thus, the risk factors of installation and duty division of internal audit department, the process the internal audit used to prevent/detect/correct the errors and the independent confirmation process on the corporate operational performance were classified under “supervision”. The related literatures and reorganized results of the Grounded Theory are shown in Appendix A.

#### ***Using the Delphi method to screen the critical audit detection risk factors***

Before distributing the questionnaires, we pretested them with three experts having experience in academic study and audit cases to confirm the design of the questionnaire and the categorization of the questions. After being assured that there was no error in the details of the questionnaire, we sent out the questionnaires. Before distributing the questionnaires, the research had the agreements of the experts interviewed after completely describing the research purposes and questionnaire progress to the experts. Through two rounds of questionnaire distribution, the researcher investigated the critical risk factors influencing the detection risk determination of target enterprises thought by internal and external audit staff. The experts in this research included 30 internal and external audit staff (15 internal audit staff and 15 external audit staff). Since the staff in charge of assessing the risk of target enterprises in the accounting firm was the audit manager, the external audit targets of questionnaire interview in this research referred to the staff with the level above managers in the accounting firm. As to internal audit, since the public companies were regulated by the Financial Supervisory Commission, they must submit internal control project annually. Therefore, we treated the internal staff of public companies as the targets.

In the first round, the questionnaire included 53 risk factors influencing detection risk assessment reorganized by the Grounded Theory and it was divided into three aspects: “audit risk”, “inherent risk” and “control risk”. The researcher thus designed semi-open questionnaires. The first-round questionnaires listed 53 factors and asked the experts about the degree of importance of each question. In addition, a blank column is left for the experts to add other critical factors or opinions (such as the propriety of categorization). In the first round, there were 30 questionnaires distributed and 25 experts responded. The return rate was 83%. This questionnaire was based on a five-point Likert scale and combined the opinions of 25 experts to calculate the average, maximum, minimum, plural number, and standard deviation of each item. The purpose of calculating the averages is to understand the average degree of the experts in terms of the importance of each question. The calculation of maximum, minimum, and standard deviation is to see the degree of difference of each expert’s opinion. To calculate the plural number is to understand most of the experts’ views



on the degree of importance of each question. The calculation of Quartile Deviation is for the degree of consistency of each expert for each question.

In the first round of using the Delphi method, the results of the questionnaires show that the averages of the questions were all more than 3. Thus, we cannot delete the less important questions. Therefore, after adding the experts' other opinions, the Delphi questionnaires were redesigned for the second round. In 53 items, the averages of "managerial level has the incentives to operate the profits" and "many errors in account receivable of the previous audit" were the highest (4.72). Maximum was 5 and minimum was 4. It showed that the experts all believed that the degree of importance of these two items were extremely high. Each audit detection risk factor analysis and the average result comparison in expert questionnaires of the first and second rounds are shown in Figure 3.

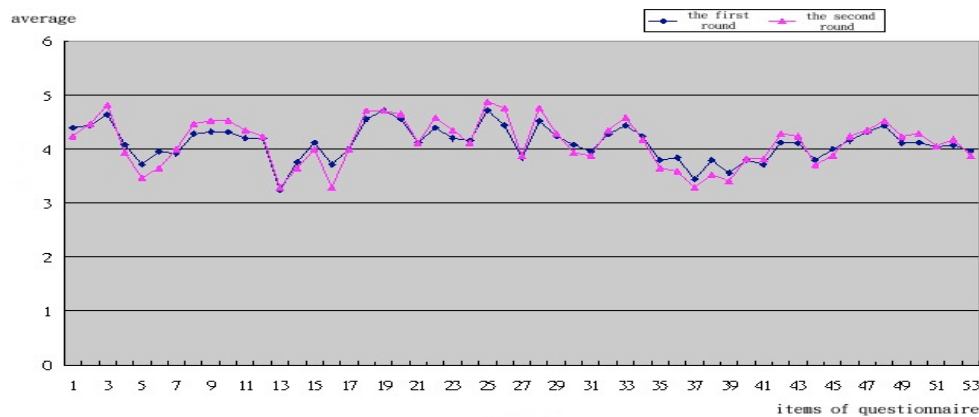


Figure 3 Each audit detection risk factor analysis and comparison in expert questionnaires

As shown in Figure 3, the questionnaires in the first and second rounds have reached a certain degree of consistency. Through the t-test scale of independent samples, only three risk factors are significant ( $t$  is less than 0.05), which are auditors' understanding toward target business, HR policy, and installation and responsibility division of audit department in internal target enterprises. It shows that there are differences among the audit experts with regard to the importance degree of three risk factors. It might be that there were too few internal auditors (six people) who replied to the questionnaires during the second round.

Since the risk factors with averages more than 4 means the experts all thought that the risk factor was "important", we should retain all of the risk factors with averages more than 4. As to the risk factors with averages less than 3.5, since their plural numbers were 3 and minimum was 1 or 2, and for each factor, there were about 60% of experts selecting less than 3, it shows that most of the experts thought that the risk factor is not important for the assessment of detection risk. Thus, we could eliminate them. For the risk factors with averages between 3.75 and 3.5, although their plural numbers are mostly 4 and the minimum is 2, there are about 40% of experts selecting less than 3, which show that the risk factor is not important for the assessment of detection risk. Thus, we eliminate these factors. For the risk factors with averages between 4 and 3.75, the plural numbers are mostly 4 and the minimum is 2 or 3. However, there are only about 20 % experts choosing less than 3. Therefore, we retain the risk factors with average between 4 and 3.75. As a result, 43 critical factors which influence audit detection risk assessment are retained which are shown in Figure 4.

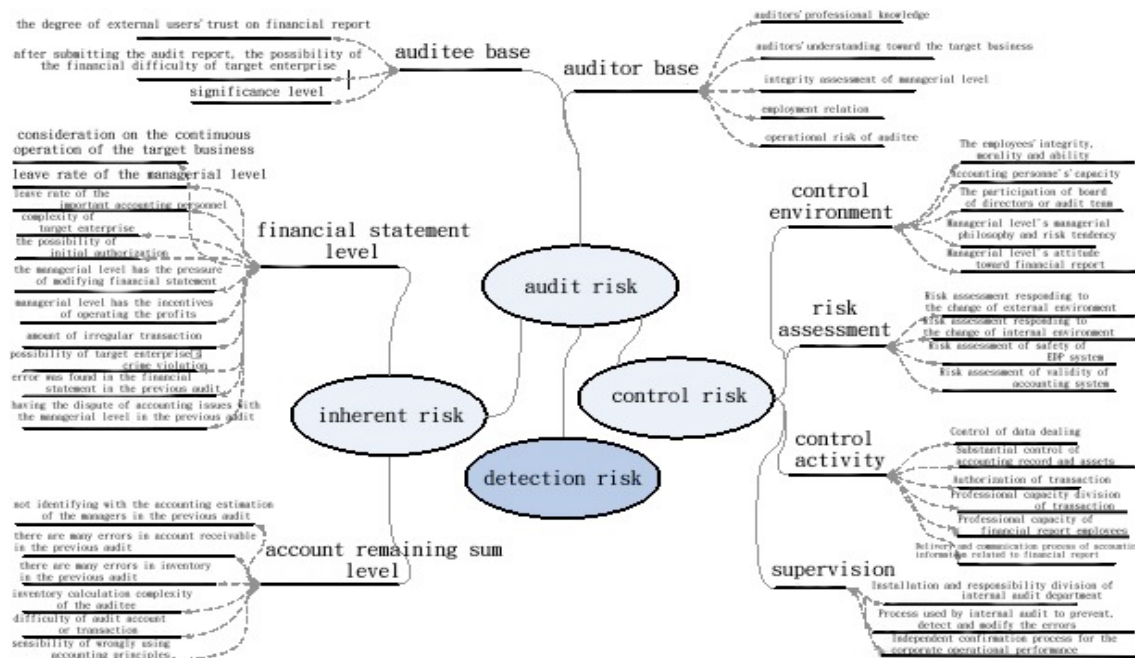


Figure 4 Critical factors influencing detection risk assessment

### Construction of the audit detection risk assessment system

To construct the audit detection risk assessment system, all of the steps of the fuzzy theory described in Section 2.2 are applied. That is, to define linguistic variable, use fuzzy assessment number to integrate the fuzzy numbers of each risk, use audit risk model to calculate the fuzzy value of DR, and infer the linguistic approximate value of DR by Euclidean Distance. All of the risk factors involved in this mechanism were based on three major dimensions (audit risk, inherent risk, and control risk), eight subcategories (auditor base, auditee base, financial statement level, account the remaining sum level, control environment, risk assessment, control activity, and supervision) and 43 risk factors were reorganized, designed and screened in the last section.

In order to avoid auditors' misunderstanding and error calculation of the fuzzy theory when assessing the risks, we designed five levels to assess the risk in the system. That is, the respondents assess the "possibility" of each risk factor in the target enterprises and the "significance" of the influence of the possible risk on financial statement. The "possibility" and "significance" of the risk factors were divided into five levels: "extremely possible", "possible", "ordinary", "impossible", "extremely impossible", and "very high", "high", "medium", "low" and "very low" (See Figure 5).

After all the respondents finish the assessment of target enterprises detection risk, we can look at the fuzzy calculation results. This system sequentially lists the risk degrees of the risk factors. The top of the picture also describe the calculation of detection risk of target enterprises and one simple conclusion to elaborate the risk degree of target enterprises in terms of three major dimensions (audit risk, inherent risk, and control risk), as well as the acceptable detection risk degree of accounting firms authorized by the target enterprises calculated by this system. In addition, in order to allow the assessors to understand the interaction among the risks, we move the arrow to the location of each risk degree and the picture will show the triangular fuzzy number of the risk factor to serve as the reference of the related personnel in the authorized accounting firms when they plan audit strategies.

Risk factor	Possibility	Significance
1. Audit risk		
1.1 Auditor base		
1.1.1 The auditor's understanding degree of the enterprise of manufacturing all kinds of locks is very low.	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.1.2 The auditor's professional knowledge is very low.	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.1.3 The sincerity of management is queried	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.1.4 The independence of the auditor is queried	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.2 Auditee base		
1.2.1 The business risk of the enterprise is very high	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.2.2 The external user trusts the degree of the financial statement is very high	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.2.3 After the audit reports are proposed, the financial crisis takes place in the enterprise.	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
1.2.4 Significance's level is very low	<input type="radio"/> Extremely possible <input type="radio"/> Possible <input type="radio"/> Ordinary <input type="radio"/> Impossible <input type="radio"/> Extremely impossible	<input type="radio"/> Very high <input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low <input type="radio"/> Very low
2. Inherent risk		
2.1 Financial statement level		

Figure 5 Assessment interface of the detection risk assessment system

## System Evaluation

The case company is a manufacturing plant established in 1954 and turned into a limited company in 1969 and the stock became public in November, 1994. By 1998, its capital volume has reached 3 billion NT dollars. There were about 1200 employees and it was the largest door lock manufacturing plant in Taiwan exclusively managing the manufacturing and sales of various door locks, such as cylinder lock. Besides promoting its own brand, it also dealt with OEM manufacturing for clients in the USA, Australia, and Japan. Since the case company valued the upgrading of product R&D and had over 120 patent techniques, it has established long-term and stable relations with the clients and suppliers under the continuous expansion of operational scale and it had world-class R&D capacity and top producing scale in Asia.

This paper used the interviews on the related personnel in the case company to collect the related data, such as the respondents' views on the possibility of each risk factor of case company and asked the case company to provide the list of internal and external auditors helping the operation of the system. With regard to internal auditors in the case company, there were only two employees (chief auditor and audit administrator). Thus, for internal auditors, there were only two respondents; in terms of external auditors, there were four respondents including the chief, deputy manager, and two accountants of the accounting firm in charge of auditing the case company. Among others, the deputy manager was the staff assessing the risks of the authorized cases.

The related data of the case industry and the basic information of the case company were acquired mainly through interviews with the internal auditors in the case company. Through two times of the interviews, the industry background information of the case, introduction of the case company, significant historical records, organizational framework, operational situations, and future development plans were gathered. We also recorded the interview process in order to understand the risk assessment model on the operation of the case company and the interaction between internal and external auditors. Besides the interview on

the internal auditors of the case company, we also performed two interviews with the related external auditors in the accounting firms of the case company in order to understand the accounting firm's detection risk assessment of the case company and its interaction with the internal auditors. Subsequently, the respondents were further asked to use the system to manage the detection risk of the assessment case company. The operational results of the system are as follows:

First of all, the respondents' assessment on the possibility and significance of each risk factor is reorganized and the answers of possibility and significance of each risk factor are then calculated. Next, the efficient fuzzy weighted average method is used to calculate the triangular fuzzy numbers of each risk factor and infer the linguistic degree of each risk factor of different levels by modified Euclidean distance. The triangular fuzzy numbers of audit risk, inherent risk and control risk are obtained as follows: (0.06197917, 0.19626437, 0.46949405), (0.00787602, 0.16353811, 0.42576058) and (0.00151910, 0.16236867, 0.42049180).

The audit risk model is then used and the triangular fuzzy numbers of audit risk, inherent risk, and control risk calculated above to further acquire the triangular fuzzy numbers of detection risk as (0.00132989, 0.28471029, 8649.64130453). Finally, we used modified Euclidean distance to infer and found out that the accounting firm's acceptable detection risk linguistic degree toward the case company was "high".

After gathering the acceptable detection risk degree of the case company, we further interviewed the audit managers in charge of the authorized accounting firms managing the detection risk assessment of the case company and the audit personnel in charge of assessing internal control activity of the case company. Through the descriptions of internal and external staff on each risk assessment of the company, they can confirm the validity of the assessment system as well as the feasibility and practicability of the assessment system. As shown in Table 2, the empirical result of the detection risk assessment system on the case company significantly and generally complies with current risk situations of the case company and the detection risk assessment system is actually feasible and useful.

Table 2 Interview results of case study

Aspects	Empirical results	External audit	Internal audit	Support of literatures	Conclusions
audit risk	Low	◆ Auditors' understanding toward target enterprises	◆ external audit is professional having long-term relation and understanding the company	◆ Low(2004) and Beaulieu (2001) thought that for the auditors' understanding toward target enterprises, the better the professional capacity was, the lower the risk was.	According to the interview results of internal and external auditors and the support of related literatures and the assessment system result constructed by this research, we realize that the risk degree of audit risk in the case company is low.
		◆ Auditors have professional capacities	◆ managerial level has good reputation	◆ Turner et al. (2002) believed that	
		◆ shareholders of the bank depend on financial statement	◆ being public again; thus, the investors value financial statement	◆ The better the managers' integrity was, the lower the risk was	
		◆ low risk to have financial crisis again	◆ low possibility of financial crisis again	◆ Arens et al. (2005) thought that when the users trusted the financial statement, the risk would be higher	
				◆ Messier and Austen (2000) indicated that the financial crisis occurred after submitting the audit report which increased the audit risk	
inherent risk	low	◆ Rare changes of managerial level and accounting personnel	◆ low leave rate of managerial level and accounting personnel	◆ Davutyan and Kavut (2005) thought that the higher the leave rate of the managers and accounting personnel was, the higher the risk was	According to the interview results of internal and external auditors and the support of related literatures and the assessment system result constructed by this research, we realize that the risk degree of inherent risk in the case company is low.
		◆ managerial level has incentives to operate profits	◆ there is no policy facilitating the managers to manage the profits	◆ Church et al. (2001) thought that when the managers had more incentives to operate the profits, the corporate risk would be higher	
		◆ case company adjust the suggested affairs	◆ accounting personnel respect the opinions of accounting firms	◆ Taylor (2000) thought that the errors of account receivable and inventory would increase the risk	
		◆ the risk that account receivable or inventory account remaining sum have serious error is low	◆ employees' integrity	◆ Bedard and Graham (2002) indicated that the more integrity the accounting personnel had, the lower the risk was.	
control risk	low	◆ Personnel's integrity	◆ managerial level does not pursue risk	◆ Johnstone (2000) indicated that the simpler the manager's operational risk was, the lower the risk was	According to the interview results of internal and external auditors and the support of related literatures and the assessment system result constructed by this research, we realize that the risk degree of control risk in the case company is low.
		◆ Simple operational style of the managers	◆ regularly having risk control in internal and external environments	◆ COSO (1996) believed that regular risk assessment and control activity could reduce the risk	
		◆ Regular risk assessment	◆ valuing internal control and actually practicing it	◆ Davutyan and Kavut (2005) believed that the more complete the internal audit function is the lower the risk is	
		◆ control activity is effective and complete	◆ regularly proposing internal control plan		
		◆ functions of audit department	◆ audit deputy manager usually does not go to the auditee company		
Acceptable detection risk	high	◆ Determine the detection risk degree at usual by the work backup of the past years	◆ The assessment result of this system is close to current situation of the company		Although the detection risk assessment acquired by this research is consistent with the assessment results of internal and external auditors, there is the difference between the internal audit of audit deputy manager who assesses detection risk at usual and audit chief who audits in the case company most frequently. Thus, there is significant error to only allow audit deputy manager to subjectively judge and determine the detection risk.

## Conclusion

The new audit bulletin criteria involved the application expected to strengthen the audit risk model and increase audit quality. However, the audit risk model was regarded as the theoretically ideal concept model. Since it was difficult to quantify the risk factors and we could not completely use precise numbers or terms to express their meanings, they were criticized as having low practical value. The assessment system constructed in this paper uses the fuzzy theory to help auditors in rendering professional judgment when facing fuzzy incidents and increasing the preciseness of risk assessment. It also allows the audit risk model to be more practical. At present, most of the risk management adopted by large-scale accounting companies, accounting firms and registered accountant business refers to risk rate risk assessment. The advantage is that the risk safety indicator is based on plenty of experience accumulation and statistical calculation, which considers the scientific technique standard, social and economic situations, legal factors and human psychological factors at the time, which are the least risk rate generally accepted.

This paper reorganizes 43 critical risk factors influencing detection risk assessment identified by academia and audit empirical circles and allocates the above critical risk factors into three dimensions and eight categories according to the categorization of the related literatures. We believe that it can function as the reference for future researchers when they study the risk identification of audit planning. In addition, the fuzzy theory is a type of research method considerably suitable for being applied to aspects with a high degree of subjectivity, such as audit. However, it is rarely used by audit scholars. Regarding the construction of the system, it is an encouragement for the future scholars in the accounting audit domain to consider the fuzzy theory.

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