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Construction Auditing Risk Detection Using Neural Network

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ABSTRACT

Audit report plays a key role in determining the validity of final accounting in the completion of any construction project. However, the quality of reports depends heavily on the quality of the auditors themselves, whose variety of skill set and bias level could lead to different assessment outcome of the accounting risk level. This paper presents a method that detects auditing risk using neural network. The criteria to assess auditing risks will serve as inputs in the neural network, and the output will be the ranking of low, medium, high level of auditing risk. The proposed neural network was tested on 80 construction projects in Vietnam and the result shows the high accuracy level of this method in auditing risk detection.

Keywords: auditing, audit risk detection, neural network.

INTRODUCTION

The purpose of the audit is to examine and verify the truthfulness of the financial statements provided by the accountant, thereby providing the most accurate information about the financial situation of the organization. The final product of an audit is a report express the auditor's opinion about the truthfulness and fairness of the financial statements as produced by the accountants. To do this, the auditor performs a survey to the company or project management unit to see if the internal control system follows the process properly. The assessment of this audit risk depends heavily on the subjective opinion of the auditor. Therefore, if we can build an automated risk assessment system based on objective criteria then the assessment of risk would happen more quickly and accurately.

Recently, artificial intelligence has been applied in many fields such as financial services, image processing, medical, natural language processing, text mining and many others [1 - 3]. In [1], Bahrammirzaee (2010) had reviewed three artificial intelligence methods applied to financial market. In another research, the same author proposed the hybrid intelligent system for credit ranking using reasoning transformational models [2]. In this method, the expert system is consid-

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ered as symbolic module and artificial neural network is considered as non-symbolic module. In [3], Kasman (2010) proposed the method using neural network with back propagation learning algorithm to evaluate credit risk. Information technology had employed in auditing and categorized the system into five groups according to audit areas: data extraction and analysis, fraud detection, internal control evaluation, electronic commerce control, and continuous monitoring [4, 5]. In [6] neural network has proposed to classify the credit risk into good vs. bad consumer groups for the bank.

Although there are many research works that apply artificial intelligence in audit and financial, these methods focus on evaluating audit risk in company, where there is statistical & historical audit data. In this paper, we present a method of audit risk detection in construction project using neural network. The difference between audits in construction project vs. other audit projects is that construction projects usually have short execution time and the audit is implemented when the project is finished. Criteria to assess audit risk will provide the inputs for a multi-layer perceptron neural network and the output is the three level of risk - low, medium, and high. We test the method using data from 80 construction projects in Vietnam. The experimental results show the efficiency of the method. In the first section, we describe the audit process and how neural network is applied to audit risk detection. In the next section, real data will be used to illustrate the performance of the method. Finally, we draw conclusion of the study and implication for future work.

MAIN CONTENTS

Auditing risk assessment

Risk is a problem arising in all fields, each field has to develop its own unique way of assessing and handling this problem. In construction project, auditing risk is associated with important errors in the final project settlement report. The final project settlement report is very important as its job is to assess how comprehensive and relevant are the samples that the auditor selects, how convincing the evidence collected by the auditor, whether the project is complied with the law, or at point the project is not in continuous operation, etc. To control this risk, the audit plan must be appropriately established to detect fraud, risks, and potential problems and also ensure that the audit is completed on time. Moreover, the auditor must consider and assess all kinds of risk in construction project including potential risks, control risks and detection risks with confidence sample. The audit risk assessment process is shown in Fig. 1. This paper focuses on the control risk, which is the possibility of errors occurred that have not been prevented, detected or corrected by internal audit.

Based on the internal control system description, the auditor will assess whether this system is effective or not, what risk could occur and how the enterprise could overcome the risk at some sensitive points. To assess the internal control system, several factors need to be considered such as model, operating framework and ability of the project management unit; financial management and accountancy; works related to policy changes; existed findings from previous audits; errors in planning strategies;

Fig. 1. Audit risk detection process.

Table 1. List of criterion for internal control.

Ability and quality of the project management unit (PMU) director		
1. Ability and experience of managers	2. Periodic staff training	3. Monitoring rule for staff working
4. Solution for handling mistakes	5. Requirement for individual staff position	6. Requirement for recruiting staff
7. Handling of unqualified staff	8. Independence of procuring agency with PMU	9. Ability of procuring agency specifically about the project
10. Inter-relationship between procuring agency and PMU on important activities	11. Significant problems and mistakes are reported to procuring agency	12. Procuring agency to monitor PMU'ss work
13. PMU needs to design and implement internal control	14. Effective management of operating procedures	15. Managers to oversee risk management of the project
16. Managers's oversee ability on the management and operating all the project	17. Managers to establish settlement report investment	18. Managers to use information technology to measure project work
19. PMU needs to be organized into several level to manage project	20. Organizational structure needs to be suitable with objective and scale of the project	21. Strong cooperation among departments
22. PMU is special in project management	23. PMU had worked in similar projects previously	24. Ability to breakdown suitable specific work to individual department level
25. Oversee and measure the quality of department level work	26. Staff needs to understand their responsibility	27. Supervisors have enough time to measure work
28. Assign work appropriately		
Risk management process		
29. Build risk management procedure related to project	30. Estimate the effect, likelihood of happening, and corresponding action correspondence to each risk	
Information, report		
31. Effectiveness of information technology in various operational procedures	32. Ways to receive and process information	33. Procedure to establish and present settlement report including accountancy and present
34. Procedure to supervise any arising financial work	35. Rule about information provided and reporting requirement	36. Rule for receiving feedback information
Control operations		
37. Following rules in control management including establishing, auditing and alignment on project	38. Follow accountancy requirement	39. Follow payment process with partners
40. Control information technology system		
Evaluation and Monitor (E & M)		
41. PMU has mechanism to control investment operation of project periodic	42. PMU maintain control system of investment operation suitable	43. Control department have adequate capability
44. Control department to participate in settlement work	45. PMU to receive control report on time	46. PMU has procedure to identify and fix errors through reports

weakness in management that leads to inadequate investment, slow progress, outstanding investment cost, falling to meet the objective, and environmental impact caused by the project. An assessment of control risk is to check the information of internal control system of the project management unit such as diagram of organizational structure, level of staffs, internal management documents, internal audit works. Also, the auditor needs to observe activity of the unit and discuss with managers and employees to understand the organizational characteristic, personnel policies, qualification of the managers and employees. To do this, auditor designs the survey form with 46 criteria, divided into five groups. List of criterion are shown in Table 1.

These criterions will be quantified by coding in range from 0 to 1. These values will be the inputs of neural network. Outputs of neural network are risks, measured on three levels of audit risk as low, medium and high.

Neural network

An Artificial Neural Network (ANN) is a computational model that simulates biological neurons and functions in the brain. Typically, an ANN has layers of interconnected nodes. The nodes and their inter-connections are similar to the network of neurons in the brain. Any basic ANN will always have multiple layers of nodes, specific connection patterns and links between the layers, connection weights and activation functions for the nodes that convert weighted inputs to outputs. The learning process for the network typically involves a cost function and the objective is to optimize the cost function (typically minimize the cost). The weights keep getting updated in the process of learning.

For the audit risk detection, we have considered them as classification problem. In this paper, we use a multiple outputs three-layer structure of multilayer perceptron (MLP) neural network. Although this classifier needs quite large training time but it is able to process data and classification fast [7]. Fig. 2 presents an example of MLP structure which consists of one input layer, one hidden layer and one output layer [8].

Let x_i, i = 1..d is the input value to the network, the output forms M linear combinations of these inputs to $a_j^{(1)}$ as:

$$a_j^{(1)} = \sum_{i=1}^{d} w_{ji}^{(1)} x_i + b_j^{(1)},\ j = 1,\dots,M \tag{1}$$

where w_{ji} are element of the weight matrix and b_j are the bias parameters associated with the hidden unit. Also, each variable aj was associated with each hidden unit and then transformed by the non-linear activation functions of the hidden layer. The output of the hidden units are then given by:

$$z_j = \tanh(a_j^{(1)}),\ j = 1,\dots,M \tag{2}$$

The z_j are then combined with weights and biases of the next layer to produce values $a_k^{(2)}$

$$a_k^{(2)} = \sum_{j=1}^{M} w_{kj}^{(2)} z_j + b_k^{(2)},\ k = 1,\dots,c \tag{3}$$

where c is the number of outputs.

These values are then passed through the output layer to produce output values $y_k, k = 1..c$. There are several forms of activation functions. For the classification purpose, we consider the logistic sigmoidal activation functions as follow:

$$y_k = \frac{1}{1 + \exp(-a_k^{(2)})} \tag{4}$$

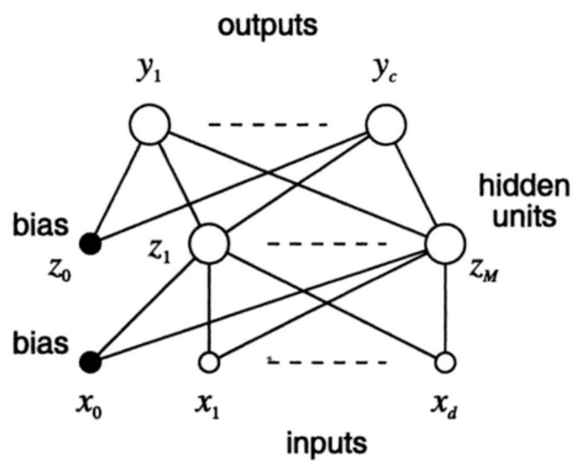

Fig. 2. Two layer feed-forward neural network.

The network need to train to model the data in order to make a best predictions of new input data. In this paper we consider the back propagation algorithm [8]. Assume we have the target vector t for input data *x*, the error of the network, *E*, is defined as:

$$E = \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{c}(y_k^n - t_k^n) \tag{5}$$

where y_k^n is the actual value of kth output unit for the nth input pattern, t_k^n is desired value of the kth output unit for the n^{th} input pattern.

The derivative of E with respect to the second layer weights are given by:

$$\frac{\partial E}{\partial w_{kj}^{(2)}} = \sum_{n=1}^{N}\delta_k^{(2)n} z_j^n, \tag{6}$$

where $\delta_k^{(2)n} = y_k^n - t_k^n$ is the error for the output unit on pattern *n*.

Also, the derivatives for the output unit biases are given by:

$$\frac{\partial E}{\partial b_k^{(2)}} = \sum_{n=1}^{N}\delta_k^{(2)n}. \tag{7}$$

The back propagation can be calculate as below

$$\delta_j^{(1)n} = g^{'}(a_j^{(1)n})\sum_{k=1}^{c} w_{kj}^{(2)}\delta_k^{(2)n} = (1-(z_j^n)^2)\sum_{k=1}^{c} w_{kj}^{(2)}\delta_k^{(2)n}, \tag{8}$$

The derivatives of the first layer weights are then given by

$$\frac{\partial E}{\partial w_{ji}^{(1)}} = \sum_{n=1}^{N}\delta_j^{(1)n} x_j^n, \tag{9}$$

And the derivatives for the hidden unit biases are given by

$$\frac{\partial E}{\partial b_j^{(1)}} = \sum_{n=1}^{N}\delta_j^{(1)n}. \tag{10}$$

The difference between the calculated output and the desired output is back-propagated to the previous layers, usually modified by the derivative of the activate function, and the connection weights are normally adjusted using the Delta Rule. This process proceeds for the previous layers until the input layer is reached.

RESULTS AND DISCUSSION

Data used in this paper have been collected from 35 construction projects in Vietnam. The survey forms for the internal audit includes 46 criterion as described in Table 1. From the data collected, we quantify these criterion to form the matrix with score from 0 to 1. In this data set, each row presents data from one project and each column presents a criteria. These criterion have brought to the input of neural network. The neural network structure here is designated with three layers, two hidden layers and an output layer. The number of nodes in each layer is selected by experiment, we used twelve nodes for the first hidden layer, eight nodes for second hidden layer and three nodes for the output layer, corresponding three levels of audit risk, low, medium and high, respectively. Activation function for each hidden layer was rectified linear unit (ReLU), and sigmoid function for the output layer.

The data set was divided into two parts, 70 % for training and 30 % for testing. The program was written using Python with keras backend tensorflow support GPU run on the computer Core i7, RAM 8GB. The training result is shown in Fig. 3.

Fig. 3 indicates that the values of lost function in both testing set and training set are equal at the starting point. The values of lost function in both sets tend to be convergent (declining and the declining speed is also slower). However, once the number of iteration increases gradually, the value of lost function in the training set will be smaller than that of the testing function as data in the testing set is less than that of the training set. While the accuracy hardly changes with the two functions, this is due to the fact that the data set is not sufficient enough to cover all cases. Fig. 3 shows that the accuracy of the testing set is more

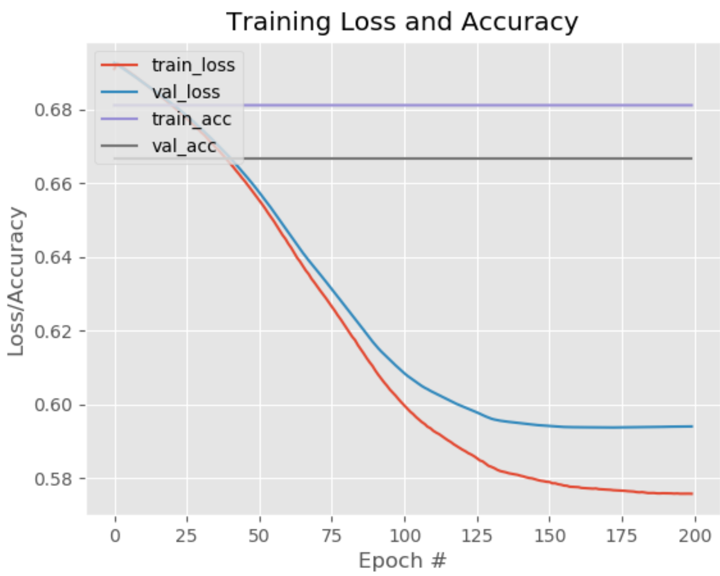

Fig. 3. Performance of the training process.

than 68 %, while the accuracy of the training set is about 66 - 67 %. The accuracy of the testing set is higher than training set about 2 % because data in testing set less than data in training set. Therefore, the accuracy of this model is about 66 % to 69 %. The accuracy is not very high because the lack of the data collected. If there is more data, the accuracy will be higher.

CONCLUSIONS

This paper proposed the neural network structure to detect the audit risk in construction projects. By quantifying the criterion survey, these variables can be used as inputs to the neural network to train the model which can be used to detect the audit risk in any new project. The experimental results show the efficiency of the method. This method can be applied to information system to quickly detect the audit risk and also recur the work load for auditors. This method can be applied to detect risk and can serve as a framework to identify risk in a comprehensive manner for construction projects.

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