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A selection model for auditing software

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Abstract

Purpose – With the advancement in information technology, many companies have become heavily dependent on computer-assisted systems, and implemented various computer-based business activities and document system, among which computer-assisted auditing tools and techniques (CAATTs) is an important choice. CAATTs can assist auditors in conducting control and confirmation tests, analysis and verification of financial statement data, and continuous monitoring and auditing. When constructing computer-assisted auditing systems, enterprises must take many factors into consideration to determine whether to develop the software or purchase professional software packages. Therefore, the purpose of this paper is to construct an auditing software assessment model.

Design/methodology/approach – This study first conducted a focus group interview to determine the auditing software criteria and decision-making factors, and then identified the main decision-making factors. Finally, analytic network process was employed to evaluate the weights of the criteria and decision-making factors in order to construct an auditing software decision-making model upon both objective and subjective factors.

Findings – The most important auditing software criterion is the system functions, followed by data processing, and technical support and service provided by the software company. The most important factor of auditing software is cost and system stability, followed by data processing accuracy, technical support, and purchase cost.

Originality/value – The main contribution of this paper is the construction of an auditing software assessment model, which can be applied to other decision-making topics. Moreover, this study applies the model on audit command language, interactive data extraction and analysis, and Focaudit as examples. In addition to determining project priority sequences, the advantages and disadvantages of the model are presented in order to provide references to businesses on decision making regarding software purchases.

Keywords Auditing, Software tools, Product attributes

Paper type Research paper

1. Introduction

The major corporate scandals occurred in recent years, including the 2001 Enron scandal in the USA, have aroused more concerns on the auditing management systems of organizations. Internal auditing allows companies to keep track of their business operations and conditions. The Institute of Internal Auditors defined internal auditing as an independent function within an organization to check and evaluate the activities of the organization. Internal auditing uses modern management technologies to prevent a company from losses due to human negligence, reduces fraud opportunities, and increases working efficiency. It covers accounting and financial activities, as well as the general business activities of the organization. The advancement

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in information technology has changed business environments and customer demands. In order to increase the processing speed, reduce errors, and improve operating efficiency, many government bureaus and companies have relied on computer systems for operational/business activities and document systems, among which computer-assisted auditing tools (CAATTs) is an important choice.

CAATTs refer to various tools, technologies, and software that help auditors to conduct control and confirmation tests, analysis and verification of financial statement data, and continuous monitoring and auditing. CAATTs are mainly used for data analysis, data acquisition, and operational analysis. It can be widely applied in analysis of financial data and error inspections to identify frauds or false statements. The commonly used software include MS Excel and Access, as well as professional software, such as audit command language (ACL), interactive data extraction and analysis (IDEA), and active data. These tools can be used to analyze the financial and operational data of an organization, and determine the problematic items for detailed analysis and tracking, in order for auditors to monitor the high-risk areas.

In e-data processing environments, auditors must learn to use computer-assisted auditing software for auditing. Therefore, when constructing a computer-assisted auditing system, an organization should take into consideration of data analysis procedures, execution frequency, software demands, purchase fund limitations, after-sales services, data processing speed, and system functions in order to determine whether to develop the software or purchase professional software package. Past studies have focused on decision-making problems regarding ERP or KM software (Ayag and Ozdemir, 2007; Yazgan *et al.*, 2009; Ngai and Chan, 2005). The analytical hierarchy process (AHP) or analytic network process (ANP) methods, which are able to process multi-criteria and multi-factor problems, are often used. Wolfslehner *et al.* (2005) suggested that, the weights obtained by the ANP method, which considers factor interdependence, has higher identification capabilities. However, no discussion has been made on auditing software; thus, this study aims to establish an auditing software assessment model. It first conducts a focus group interview to determine the criteria and decision-making factors regarding the auditing software, and then identifies the major decision-making factors. ANP is employed to evaluate the weights of the criteria and decision-making factors to construct the auditing software assessment model upon both objective and subjective factors.

2. Literature review

2.1 Internal auditing

After a serious of major corporate scandals had taken place in 2001, including the Enron and WorldCom cases in the USA, the US congress passed the Sarbanes-Oxley Act (SOX) in 2002. Section 404 of the SOX provides a detailed provision regarding the assessment of internal auditing, and mandates governmental authorities to establish effective internal auditing systems. The first auditing report is the "Verification of Financial Statements," published by the American Institute of Accounts in 1912. In 1949, the US Commission on Auditing Processes proposed the "Internal Control – Elements of A Coordinated Systems and It's Importance to Management and Independent Public Accountants", which presented the first definition of internal auditing: internal auditing includes organizational rules, protection of property security, internal data accuracy and reliability, as well as relevant measures to enhance operational efficiency. In 1988, the American Institute of Certified Public Accountants (AICPA) proposed no. 55

statement on auditing statement (SAS No. 55), which definition on internal auditing covers control environments, accounting systems, and policy procedural controls.

From 1992 to 1994, the Committee of Sponsoring Organizations (COSO) of the Treadway Commission released two reports on the internal control-integrated framework, which proposed that internal auditing includes five elements, namely control environments, risk assessments, control activities, information and communication, and monitoring, which became the basis for later developments of internal auditing. In 1995, the AICPA revised SAS No.55 and proposed SAS No.78, in which the definition of internal auditing adopted the definition of the COSO report. In 2004, COSO extended the framework of internal auditing, and published an enterprise risk management (ERM)-integrated framework to ensure organizations established the strategies, operations, and reports, in compliance with law. In addition, ERM should focus on eight major factors: internal environments, goal setting, event identification, risk assessment, risk response, control activities, information, communication, and monitoring. In response to COSO-ERM, in the same year, the International Internal Auditing Association published "The role of internal auditing in enterprise-wide risk management," which proposed that key points of internal auditing should include:

- establishment of risk management system;
- assessment of enterprise risk factors;
- auditing assessment process;
- auditing assessment report; and
- review of internal auditing management.

The establishment of effective risk management systems and robust corporate governance are the key success factors of success to an organization. Therefore, the organization should have independent personnel in charge of internal auditing (Moller, 1999; Sawyer and Chichester, 1996), and elevate the status of the internal auditing department within the organization in order to ensure the independence and the implementation of an effective auditing system (Brink *et al.*, 1973). The responsibilities of the auditors are to audit the internal conditions of an organization according to the auditing standards, and produce fair and impartial auditing reports (Hayes *et al.*, 2005; Guy *et al.*, 2004) that expose the actual operational risks (McNamee and Selim, 1998). Rezaee (2002) suggested that the detection and prevention of financial statement frauds should be mutual responsibilities to the board of directors, the auditing committee, the senior management, the internal auditing team, and the accounts. When conducting internal auditing, the organization should make proper adjustments in response to the changes of environments (Hermalin and Weibach, 2003), maintain the effectiveness of the internal auditing system, and provide timely and continuous confirmation of auditing contents as a routines for the management personnel. Without proper confirmation mechanisms, the same errors and frauds could be repeated, leading to tangible financial losses, and intangible damage to the corporate image. Therefore, when implementing internal auditing, the organization should ensure the independence of the auditors and the effectiveness of the internal auditing system.

2.2 CAATTs

The advancement in information technology has revolutionized the auditing methods. Governments around the world are encouraging companies to implement corporate reengineering to improve inter-departmental and customer-supplier communications, thus enhancing operational efficiency. However, the information technology is also accompanied with new risks, and companies should establish a unique internal auditing model to prevent such risks. In addition, auditors should learn about new technology to deal with new challenges. In a knowledge-based economy, auditing has gradually transformed from the manual operation to computer-assisted operation. Thus, along with the demands on purchasing computer-assisted auditing software, there are new concerns on the information security and accuracy of data sharing.

Computer-assisted auditing operations include the auditing of data and information content, system auditing for security concerns, and timely confirmations. The internal control of computer-assisted auditing software relies on abundant data and information; therefore, auditors should be skilled in operating the system and accessing the data. Howard and Kanter (2001) pointed out that the adoption of computer-assisted auditing software can help an enterprise evaluating transactions and internal control status, as well as establishing an electronic auditing trail. The computer-assisted auditing system can collect and evaluate evidence, and confirm whether the computer system can protect corporate property and maintain data integrity.

The advantage of the CAATT system is the automated auditing procedures for overall auditing, rather than sample auditing. Thus, it can enhance the validity of auditing results, and enable auditors to expand the scope of auditing to focus on high-risk areas. By integrating the information technology and financial auditing, auditors can have greater independence, and be less dependent on information and financial personnel. Through automated programs and rapid execution efficiency, CAATT shortens the time required for auditing, and achieves cost effectiveness. Watne and Turney (1990) proposed the following factors of consideration relating to the adoption of CAATTs:

- Reasons for auditors to use computer-assisted auditing, including cost, efficiency, audit trail, data processing, etc.
- Time points for the implementation of CAATTs, including processing time and the completion of processing, which depends on the complexity of the system.
- Time points of the CAATTs processing cycle, including the implementation of CAATTs at the process stage for internal controls, and the implementation of CAATTs after obtaining the processed results, which is collected for evidence testing.

The Public Oversight Board (2000) pointed out that auditors' professional capabilities in an accounting information system (AIS) and the evaluation ability of a computer assurance specialist (CAS) are the main factors of auditing quality. Brazel and Agoglis (2004) further examined the impact of auditors' professional capability on CAS and AIS auditing systems. The findings suggested that auditors with high AIS professionalism would formulate higher standards in risk assessment of computerized auditing environments, while the auditors of high CAS capability would be able to provide more accurate auditing reports. Hermanson *et al.* (2000) investigated 100 internal auditing managers, and found that auditors in computerized environments should pay attention to information technology, property protection measures, applications, and data security.

The simplest computer-assisted auditing software used in auditing is Excel. Auditors can install predesigned programs and macros to lower the complexity of the verification equation. Similar software includes Active Data. The main advantage of professional software package, such as ACL or IDEA, is that the software can read the data in read-only mode, without changing the original data content. Contrarily, original data may be changed in Excel accidentally, thus affecting the validity of the auditing results. Therefore, the adoption of professional CAATTs is an important decision for a company.

2.3 ANP

Based on the types of decision-making problems, decision-making models can be divided into two types, hierarchical models and network models, according to its structure (Buyukozkan *et al.*, 2004). AHP can resolve hierarchical model problems, and ANP, as an extension of AHP, can solve network model problems. However, in real decision-making environments, the hierarchical method cannot be used to solve interdependent criteria of many problems because decision-making factors have interactive relations, which are similar to network relationships, rather than top-down linear relationships. Therefore, Saaty (1996) modified the AHP model to propose a comprehensive decision-making model, ANP.

When evaluating the weights of all criteria and factors, ANP can consider the relevance and feedback relationships that are integrated into the decision-making model. It is a systematic mathematical theory that can solve all criteria-related problems.

Cheng and Li (2007) suggested that organizations can use the ANP method to obtain the weights of various criteria and select a decision-making method. Wolfslehner *et al.* (2005) indicated that, weights obtained by the ANP method, which takes into consideration of indicator independence, have higher identification capability. The ANP network concept is as shown in Figure 1, and is divided into two parts, namely, a control level and a network level. The control level includes goals, criteria, and subcriteria; while the network level is composed of clusters or components controlled by the control level. Arrows are used to indicate the impact between clusters. For example, cluster affects cluster 4, and then, they mutually affect clusters 2 and 3. A number of elements are contained in a cluster, and when the elements of a cluster affect each other, there is a feedback relationship within the cluster. For example, the arrow of cluster 2 will point to itself.

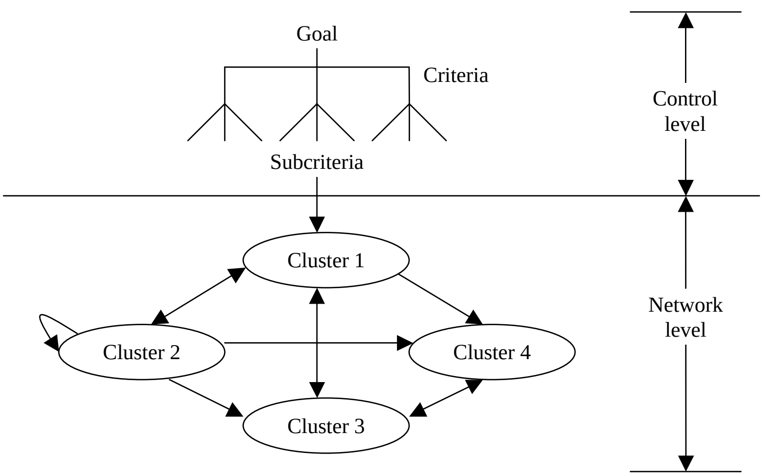

Figure 1.
ANP structure

AHP and ANP have been widely applied in various areas of decision-making issues, such as e-commerce (Kim and Lee, 2003), the establishment of decision-making systems (Zahir and Dobing, 2002; Zviran, 1998), and software selection. For example, Lee *et al.* (2009) integrated a cost benefit analysis method with AHP and ANP to construct a software project selection model. Yazgan *et al.* (2009) integrated an artificial neural network with ANP to construct an ERP software evaluation procedure. Lee and Kim (2000) used ANP and goal programming in the selection of an information system project. This study takes into consideration of the dependency of criteria and factors using ANP to construct an auditing software decision-making model, which can provide reliable group decision-making assessment results and achieve the goal of decision-making project selections.

3. Methodology

The auditing software assessment model constructed in this study is shown in Figure 2. First, a focus group interview is conducted to identify the main auditing software criteria and factors. Then, the impact relations between criteria and factors are determined by expert questionnaire that compare the weights of the criteria and factors to establish an auditing software assessment model. Morgan (1997) pointed out that focus group interviews can directly and quickly access information regarding the viewpoints and experience of the participants. Krueger and Casey (2000) proposed that researchers could collect necessary information through focus group interviews to develop preliminary research ideas, plans, or criteria. Therefore, this study uses focus group interviews to collect the criteria and factors to construct the auditing software assessment structure. Then, it conducts an expert questionnaire survey to determine the correlations among the selected criteria and factors, and applies the ANP to compare the significance of criteria and factors.

According to literature review (Saaty, 1996; Meade and Sarkis, 1999; Cheng and Li, 2007; Wu and Lee, 2007), this study divides ANP into five steps: establish the questionnaire structure, establish a pairwise comparison matrix, compute the eigenvectors, establish as supermatrix, and calculate the weights of criteria and factors, which are detailed as follows.

Stage 1 – establish the questionnaire structure

Determine the goals according to the characteristics of the problem, identify the criteria and factors, then determine the interdependence of the criteria (external interdependence) and the interdependence of the factors (internal interdependence), and finally, establish an overall decision-making structure.

Stage 2 – establish a pairwise comparison matrix and compute eigenvectors

The establishment of a pairwise comparison matrix includes two parts: comparison of various criteria and comparison of factors within the criteria. The comparison of factors includes comparing the factors within criteria and cross-criteria. The evaluation criteria are the same as the AHP, where experts use a scale of 1-9 to represent a series

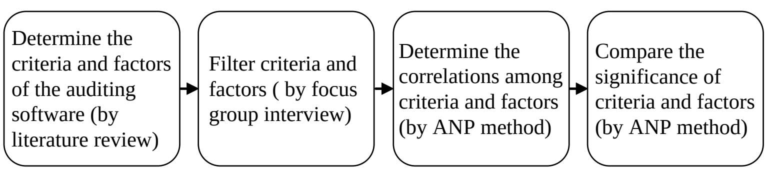

Figure 2.
Study process

of pairwise comparisons of criteria and factors, and then use geometric means to summarize the group decision-making scores, as shown in equation (1), where x_{iq} denotes the comparative score of the qth expert regarding the ith evaluation criteria. Equation (2) is used to determine the standardized eigenvectors:

$$G_i = \sqrt[n]{\prod_{q=1}^{n} x_{iq}} \tag{1}$$

$$A \times w = \lambda_{\max} \times w \tag{2}$$

Each comparison matrix is tested for consistency with consistency index (CI) and consistency ratio (CR), as shown in equations (3) and (4), where:

$$\lambda_{\max} = \sum_{j=1}^{n} \frac{W_j}{W_i}$$

tests whether each comparison matrix has any unreasonable or inconsistent judgment, if CI = 0, it means that the expert questionnaire has consistency in judgment. Saaty (1996) suggested that a CR value of less than 0.1 is optimal:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{3}$$

$$CR = \frac{CI}{RI} \tag{4}$$

Stage 3 – establish a supermatrix

A supermatrix, as shown in below, is composed of eigenvectors obtained from various comparison matrices, including comparisons of goals, criteria, factors, and projects. The sub-matrix includes eigenvectors of comparisons of criteria (w_{21}), criteria interdependence (w_{22}), sub-criteria (w_{32}), sub-criteria interdependence (w_{33}), and projects (w_{43}). It can explain the relationships and relative importance between elements, and the value of each sub-matrix is the eigenvector calculated from the pairwise comparisons. If the elements of matrix are interdependent, a fixed convergence value can be obtained after multiplications of the matrix, and the extreme value is fixed:

$$\begin{array}{c} \\ \mathrm{G} \\ \mathrm{C} \\ \mathrm{F} \\ \mathrm{P} \end{array} \begin{array}{c} \begin{array}{cccc} \mathrm{G} & \mathrm{C} & \mathrm{F} & \mathrm{P} \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & 0 \\ w_{21} & w_{22} & 0 & 0 \\ 0 & w_{32} & w_{33} & 0 \\ 0 & 0 & w_{43} & I \end{pmatrix} \end{array} = W$$

Stage 4 – calculate the weights

The calculation of weights include three matrices, namely, unweighted supermatrix, weighted supermatrix, and maximized supermatrix. The original supermatrix is the unweighted supermatrix, and it normalizes the row vectors of the supermatrix to obtain the total of row vectors 1, which then becomes the weighted supermatrix. The weighted matrix is multiplied by $2k + 1$, $k \rightarrow \infty$, as shown in equation (5) to obtain the converged maximized value, which is the maximized supermatrix. Thus, the weights of various criteria and factors can be obtained:

$$W_{sp} = \lim_{k \rightarrow \infty} W^{2k+1} \tag{5}$$

Stage 5 – select the optimal project

Finally, according to the weights of the maximized supermatrix, the priority of decision-making projects can be measured.

4. ANP results

4.1 Decision-making problem structure

This study invited ten experts with experiences using auditing software to a focus group interview. Based on their opinions, four major criteria and 19 factors were selected, which are described below:

(1) *SS. Technical support and service provided by the software company*

The descriptions of technical support, education, training, and operating manuals provided with the auditing software are as follows:

- *SS1.* Technical support – whether the software company will provide support for the system.
- *SS2.* Education and training – whether the software company will provide educational and training courses.
- *SS3.* Operating manual – whether the operating manual contents are easy to understand.

(2) *C. Cost*

Cost is an important factor influencing the purchase decision on software (Davis and Williams, 1994). The software costs include purchase cost, maintenance cost, and employee training cost, which are described as follows:

- *C1.* Purchase cost – cost of purchasing the system.
- *C2.* Maintenance cost – the annual system maintenance cost.
- *C3.* Employee training cost – the cost of training employees.

(3) *SF. System functions*

When selecting software, system functions are an important assessment factor (Lai *et al.*, 1999; Ossadnik and Lange, 1999). According to the focus group results, the system functions include system requirements, operating interface, data storage, system stability, and system security, as described below:

- *SF1.* System requirements – system requirements for the hardware.
- *SF2.* Operating interface – whether the operating interface is user friendly.
- *SF3.* Data storage – amount of data that the system can store.
- *SF4.* System stability – whether the system is stable.
- *SF5.* System security – whether the system can be easily compromised.

(4) *DP. Data processing*
Data processing capability is the most important assessment factor for computer-assisted auditing software. The capabilities include data processing speed, file support, data accuracy, data security, capabilities of data processing, audit tracking, complex transaction data processing capabilities, and statement readability, with descriptions as below:
- *DP1.* Data processing speed – time required for data processing.
- *DP2.* File support – whether data can be linked and processed with files in other formats.
- *DP3.* Data accuracy – whether the data processes are reliable.
- *DP4.* Data security – whether the data can be encrypted and read only.
- *DP5.* Data processing capabilities – the amount of data that can be processed.
- *DP6.* Data processing audit trail – whether the system maintains an audit trail.
- *DP7.* Complex transaction data processing capability – the logic data validation processing speed for complex transactions.
- *DP8.* Statement readability – whether the statements from data processing are clear and easy to understand.

4.2 The impact relationships of various criteria and factors
To confirm the impact relationships between criteria and factors, this study invited seven experts for a focus group interview to confirm the relationships between the four major criteria and 19 factors. The structured questionnaire contained 342 dichotomous items (yes or no) for pairwise comparisons of 19 factors, in order to determine the impact relationships among the factors. The relationships were confirmed with agreements from more than half of the experts. The results are shown in Table I. There were 44 interdependent relationships confirmed for the network model of criteria and factors, as shown in Figures 3 and 4.

4.3 Criteria and factor weights
After confirming the assessment criteria and factors for the auditing software, experts were invited to complete the ANP questionnaire. According to the results, the geometric

Table I.
Factor impact relationship

Impact factor	Affected factor	Impact factor	Affected factor
SS1	SS2, C1, C2, C3	SF5	SF2, SF4, DP3, C2, DP4
SS2	C1, C3	DP1	SF3, SF4, SF5
SS3	C3	DP2	C3, SF1, SF2
C1	SS1	DP3	SF4
C2	C1	DP4	SF5
C3	C1	DP5	SF2, DP3
SF1	SF3, SF4, C1, C2 DP1	DP6	DP4
SF2	SS3, C3, SF4, SF5	DP7	DP3, DP8
SF3	C1, DP1	DP8	C3, SF2
SF4	C2, DP7, DP1		

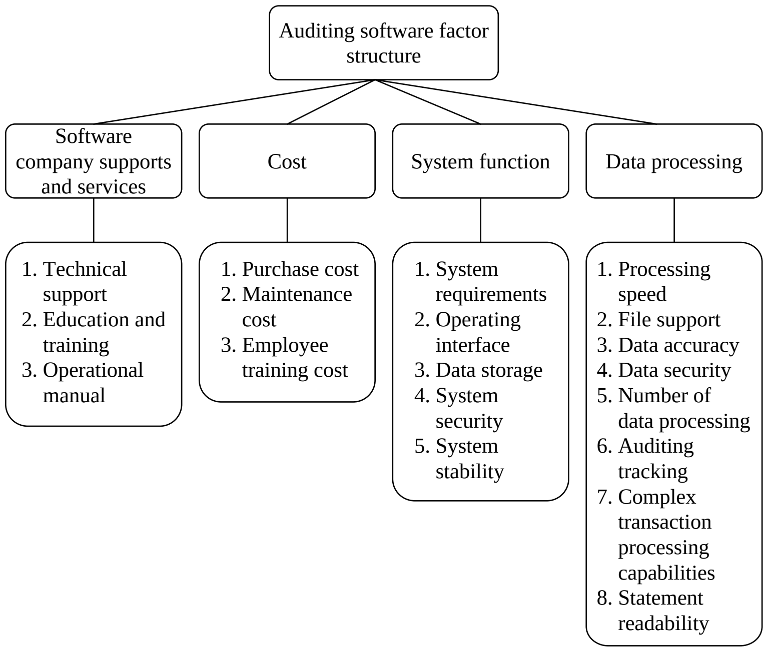

Figure 3.
Auditing software factor select structure

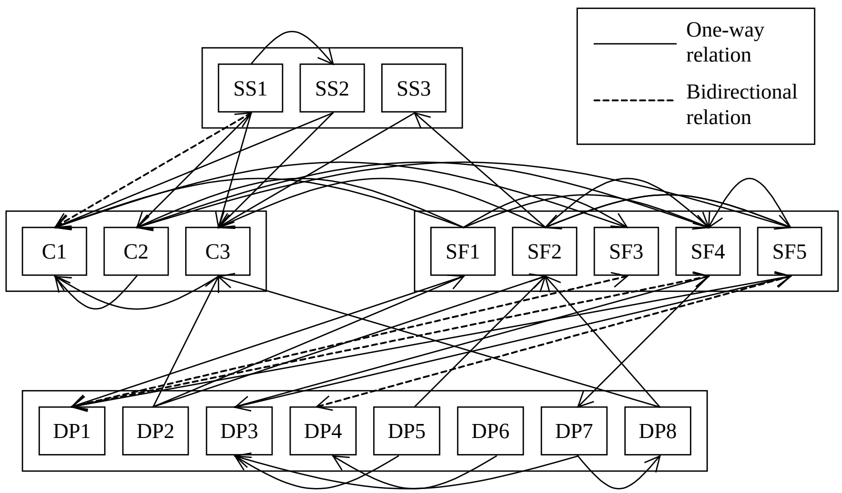

Figure 4.
Network structure

mean of equation (1) was used to integrate the combined decision-making scores, then the ANP method was applied to assess the weights of the criteria and factors. Equation (2) was used to obtain criteria (w_{21}), criteria independence (w_{22}), sub-criteria (w_{32}), sub-criteria interdependence (w_{33}), and inter-project (w_{43}) pairwise comparison eigenvectors, then, test the CI values and CR values of all the pairwise comparison matrices. The unweighted supermatrix is shown in Table II.

	Goal	SS	C	SF	DP	SS1	SS2	SS3	C1	C2	C3	SF1	SF2	SF3	SF4	SF5	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8
SS	0.11	0.07	0.04	0.24	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0.06	0.04	0.07	0.12	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF	0.56	0.44	0.44	0.32	0.52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DP	0.28	0.44	0.44	0.32	0.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SS1	0	0.18	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SS2	0	0.52	0	0	0	0.42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SS3	0	0.3	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0	0	0	0
C1	0	0	0.71	0	0	0.35	0.5	0	0	1	1	0.2	0	0.33	0	0	0	0	0	0	0	0	0	0
C2	0	0	0.14	0	0	0.09	0	0	0	0	0	0.09	0	0	0.2	0.14	0	0	0	0	0	0	0	0
C3	0	0	0.14	0	0	0.15	0.5	1	0	0	0	0	0.2	0	0	0	0	0.33	0	0	0	0	0	0.33
SF1	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0
SF2	0	0	0	0.18	0	0	0	0	0	0	0	0	0	0	0	0.12	0	0.41	0	0	0.33	0	0	0.67
SF3	0	0	0	0.06	0	0	0	0	0	0	0	0.15	0	0	0	0	0.15	0	0	0	0	0	0	0
SF4	0	0	0	0.31	0	0	0	0	0	0	0	0.41	0.29	0	0	0.16	0.69	0	1	0	0	0	0	0
SF5	0	0	0	0.35	0	0	0	0	0	0	0	0	0.34	0	0	0	0	0	0	1	0	0	0	0
DP1	0	0	0	0	0.13	0	0	0	0	0	0	0.15	0	0.67	0.31	0	0	0	0	0	0	0	0	0
DP2	0	0	0	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DP3	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0.67	0	0.83	0
DP4	0	0	0	0	0.18	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	1	0	0
DP5	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0.16	0	0	0	0	0	0	0
DP6	0	0	0	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DP7	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0.49	0	0	0	0	0	0	0	0	0
DP8	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0

Table II.
Supermatrix table

After standardizing the row vectors of the unweighted supermatrix, the maximized supermatrix was obtained by equation (5) to determine the weights of the ultimate criteria and factors, as shown in Table III. According to the analysis results of ANP, the most important criterion of auditing software is the system functions (0.4192), followed by data processing (0.3354), technical support and service of the software company (0.1268), and cost (0.1186). The most important factor of the system function criterion is system stability (0.6785), that of the data processing criterion is the data accuracy (0.3324), that of the technical support and service criterion is the technical support (0.7046), and that of the cost criterion is the purchase cost (0.6921).

4.4 Example

This study used three computer-assisted auditing software, including ACL, IDEA, and Focaudit, as the assessment examples. Each software is described as follows:

1. *ACL*. ACL has a user-friendly interface, consisting of a command mode for auditors that are familiar with the programming language.
2. *IDEA*. IDEA assists auditors in analyzing and auditing computer files, and provides a window interface for users who are not familiar with the programs.
3. *Focaudit*. Focaudit is developed from C and Focus languages, and can be executed on an IBM system or a PC. The main advantage is that users with no programming knowledge can use this auditing software as it provides a user-friendly interface and online Chinese instructions.

Ten auditors with experiences using auditing software were invited to assess the above three auditing software. The priority of preferences is as follows: ACL, IDEA, and Focaudit. The results indicate that users are most satisfied with the technical support

Criterion	Weight	Factor	Weight
Technical support and service of the software	0.1268	Technical support	0.7046
		Education and training	0.2952
		Operating manual	0.0002
Cost	0.1186	Purchase cost	0.6921
		Maintenance cost	0.0608
		Employee training cost	0.2471
System function	0.4192	System requirements	0.0161
		Operating interface	0.1029
		Data storage	0.0482
		System stability	0.6785
		System security	0.1543
Data processing	0.3354	Processing speed	0.2172
		File support	0.0054
		Data accuracy	0.3324
		Data security	0.0617
		Data processing/number	0.0375
		Auditing trail	0.0054
		Complex transaction processing capabilities	0.2869
		Statement readability	0.0536

Table III. Criteria and factor weights and service, data processing capabilities, and system functions of ACL, despite its high cost; while IDEA is rated as average, and Focaudit is favored for its low cost (Table IV).

5. Conclusions

The main contribution of this paper is the construction of an auditing software assessment model, which can be applied to other decision-making topics. Moreover, this study applies the model on ACL, IDEA, and Focaudit as examples. In addition to determining project priority sequences, the advantages and disadvantages of the model are presented in order to provide references to businesses on decision making regarding software purchases.

This study conducted a focus group interview to determine the auditing software assessment criteria and factors, and employed ANP to construct an auditing software decision-making assessment model. By pairwise comparison of all criteria and factors, a supermatrix was used to display the relative significance of the criteria and factors, while taking into consideration their interdependence. A maximized supermatrix was also developed to display the determined weights of the various criteria and factors.

The results indicated that, the system functions is the most important criterion, followed by data processing, technical support and service of the software company, and cost. Moreover, system stability is the most important factor of auditing software, followed by data processing accuracy, technical support and service, and purchase cost.

The priority of preferences is as follows: ACL, IDEA, and Focaudit. The results indicate that users are most satisfied with the technical support and service, data processing capabilities, and system functions of ACL, despite its high cost; while IDEA is rated as average, and Focaudit is favored for its low cost.

Criteria	Factor	ACL	IDEA	Focaudit
Technical support and service of the software company	Technical support	3.1707	2.6423	2.4661
	Education and training	1.1808	1.1070	1.0332
	Operating manual	0.0007	0.0006	0.0005
Cost	Purchase cost	2.0763	2.5954	2.7684
	Maintenance cost	0.1824	0.2280	0.2432
	Employee training cost	0.9266	1.0502	0.9884
System function	System requirements	0.0725	0.0644	0.0604
	Operating interface	0.4373	0.4116	0.3859
	Data storage	0.2049	0.1928	0.1808
	System stability	2.8836	2.7140	2.5444
	System security	0.6558	0.6172	0.5786
Data processing	Processing speed	0.9774	0.8688	0.8145
	File support	0.0230	0.0203	0.0189
	Data accuracy	1.4127	1.3296	1.2465
	Data security	0.2622	0.2468	0.2314
	Data processing number	0.1594	0.1500	0.1406
	Auditing trail	0.0230	0.0216	0.0203
	Complex transaction processing capabilities	1.2911	1.1476	1.0759
	Statement readability	0.2278	0.2144	0.2010
Total score		16.1681	15.499	14.9991

Table IV.
Project evaluation results

As auditors generally have the capabilities to follow operating instructions, the ACL system was rated higher as it has a command mode, as compared to IDEA or Focaudit that require no command instructions. The results of this study can serve as a reference for the development of computer-assisted auditing software in the future.

Based on the above results, the following suggestions are proposed: the three computer-assisted auditing software tested in this study was highly rated in technical support and system stability, but the purchase cost should be lowered, and the data processing accuracy should be improved. The system developers should regard data accuracy as the priority for improvement.

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