Study on Computer Audit Based on OLAP Technology

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ABSTRACT: *It has become increasingly difficult for the traditional audit information system to find out the necessary audit information from the mass data generated in the large scale application of accounting computerization and ERP software, etc. For the current massive financial and operation information data of enterprises, a new audit model is necessarily explored to satisfy the requirements on massive information audit. Dynamic on-line analysis and audit information system can provide a brand new train of thought to conduct rapid and efficient audit in mass data. Under such a backdrop, selective introduction of the computer audit mode based on OLAP from Western Countries has become the necessity for the current audit development of our country. The computer audit based on OLAP technology mainly conducts multi-angle data observation, finding suspicious audit data, and create an audit data model in advance; it mainly includes five parts, i.e. data model subsystem, audit online analysis processing subsystem, auditing business management subsystem, expertise experience library subsystem and audit alarm subsystem.*

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K.6.4 [System Management]: Management Audit; **H.2 [Database Management]**: Data Models

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1. Introduction

In Western countries, the early start-up and rapid development of computer technology provides a good foundation for the development of computer audit information system based on dynamic online analysis processing (On - Line Analysis Processing, OLAP), so that it has rapidly developed in Western countries and achieved good social effects. At present, China has transferred from the traditional manual account audit to computerized account audit. The accounting computerization information system environment of audit information system is far more complicated than manual account book and there are some static standalone auditing information systems for some financial data copies copied afterwards.

At present, with the introduction of ERP and other integrated management systems by the enterprises in China, the financial data and operation data of enterprises are organically interwoven together. The business processing of financial software is also in rapid evolution towards the directions of electronization, digitization, integration, wide area, paperless, etc., which will make the audit objects more complicated. As the current enterprises have mass financial and operating information data, the traditional audit information system must have a new breakthrough in order to meet the requirements of massive information audit. Under such a backdrop, to selectively introduce the computer audit mode based on OLAP from Western Countries has become the necessity for the current audit development of our country. Therefore, accelerating the development of dynamic online analysis auditing information system has become the inevitable choice for overcoming the current predicament of traditional audit information system. [1]

2. New Characteristics of OLAP-based Computer Audit Mode

The main characteristic of online analysis processing is directly modeled on the user's multi-angle thinking mode. It builds a multi-dimensional data model in advance for users. Users can quickly access data from various

analysis perspectives and can dynamically switch among various angles or conduct multi-angle comprehensive analysis. It has great analytical flexibility. Its support for computer audit is mainly reflected in the following aspects:

2.1 Multi-angle in Data Observation

The most basic and core characteristic of OLAP technology is to conduct observation through the multi-angle flexible combination of data in order to find out the internal relations of data. However, our audit business is in urgent need of observation and analysis of audit data set in different angles, thus to identify suspicious aspects in data set. Therefore, OLAP technology is best suited for computer audit.

2.2 Drilling Suspicious Audit Data

In modern computer audit requirements, it is required to conduct layers of tracks for the suspicious data, in order to find the problems. The function of data drilling in OLAP technology is to make further refined analysis of data for the suspicious data found in observation and analysis of audit data, thus to obtain more precise information to determine and reach the purpose of judging whether there is any problem.

2.3 The Creation of Data Model in Advance Improves Audit Efficiency

OLAP technology can pre-create data model, to provide sufficient audit data in advance for auditors, thus saving the data collection time in audit procedures and greatly improving the work efficiency of audit. [2]It mainly pre-creates sufficient data models of various forms through the OLAP technology, thus to reduce the workload and time of data calculation for auditors.

But, it is worth noting that the above functions of OLAP technology are efficient for audit, but it only provides efficient, rapid, accurate and detailed data for audit, and it cannot and is unable to provide judgment on the audited data. It is also required to highly depend on the judgment of auditors. Therefore, OLAP technology can only give full play to technical means to support the foundation of business development through the combination of professional judgment of auditors.

3. Creation of OLAP-based Computer Audit Model

As shown in Figure 1[3], on the basis of learning from the advanced experience in western countries and the present

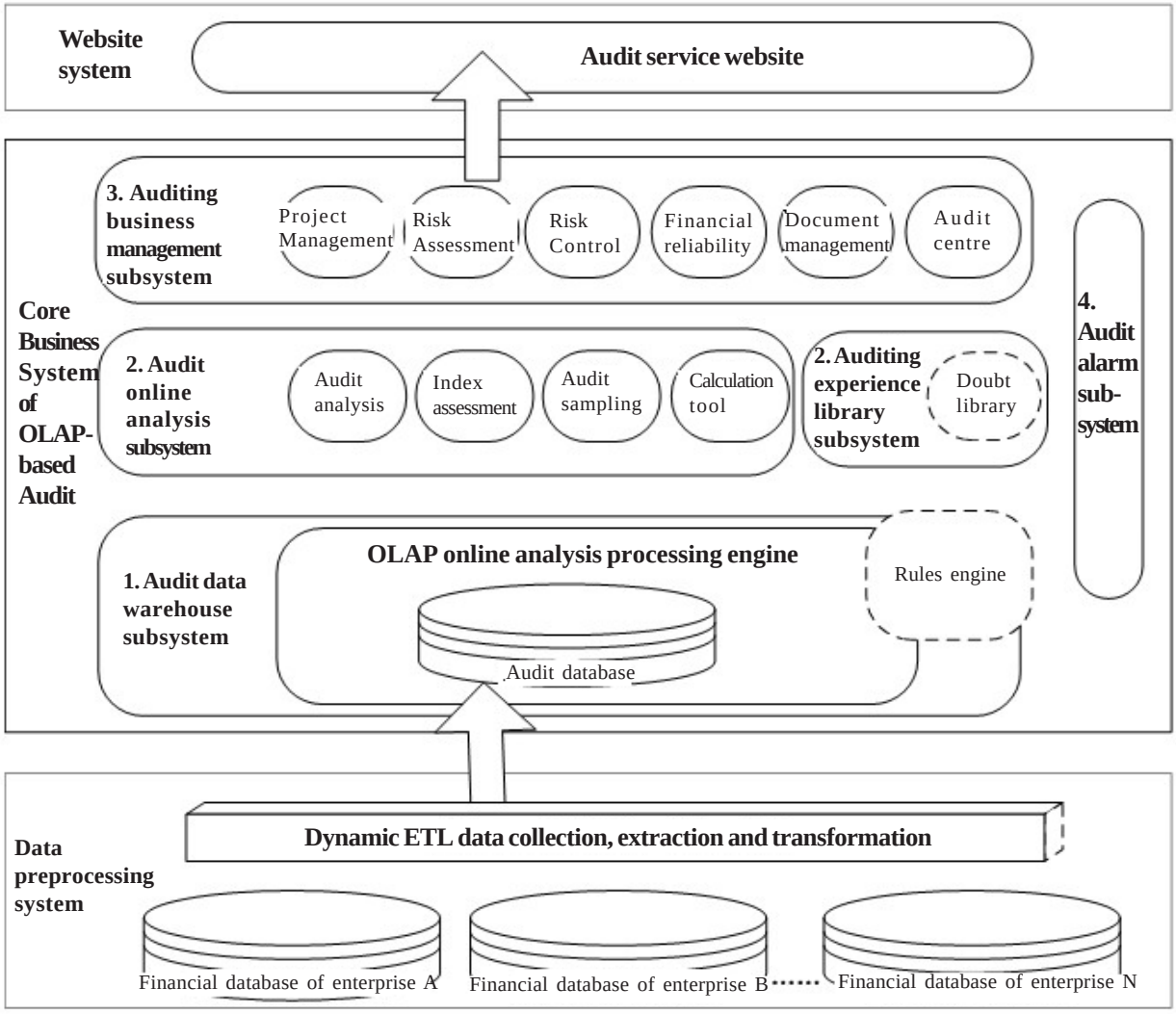

Figure 1. Overall Structure Diagram of Online Analysis Audit Information System

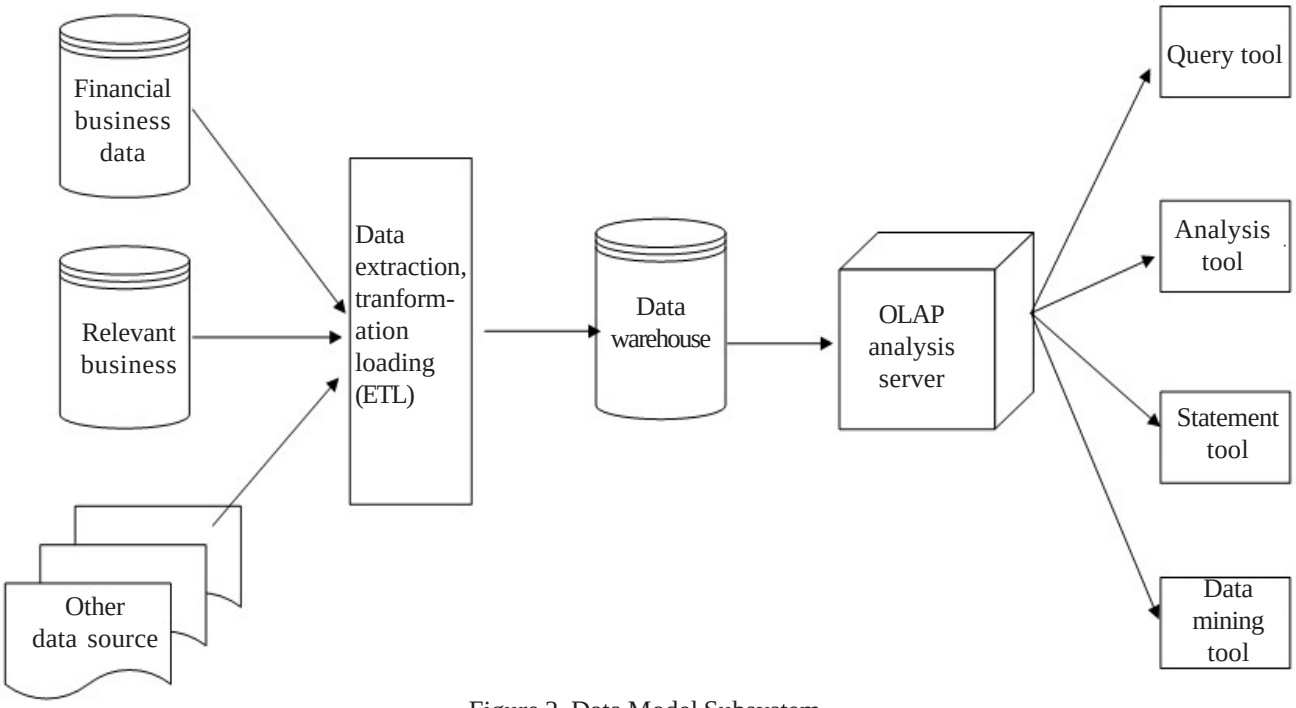

Figure 2. Data Model Subsystem

actual situation of the computer audit in our country, to build the OLAP-based computer audit model suitable for the audit development needs of China can be conducted from the following aspects:

3.1 Data Model Subsystem

Data model is established on the basis of financial data. In order to facilitate the observation and analysis by auditors, we apply the star schema design for the way of data storage in the data model of OLAP. The data in data model is stored in two ways, i.e. double-granularity and multi-granularity, and the audit data is selectively selected, thus improving the utilization efficiency of resources. Specific data analysis themes can be established on data model through utilizing the dynamic online analyzing tools in OLAP technology, thus powerful support is provided for auditors in respect of data analyzing tool.

From a practical point of view, the data model subsystem mainly includes three parts, i.e. data warehouse, OLAP engine and rules engine, of which the data warehouse mainly contains the fact tables and dimension tables for storing various data information; OLAP engine provides methods and effective ways for operating and realizing the multidimensional data of data warehouse and provides support and guarantee for other parts of the system to efficiently utilize the data in data warehouse; and rules engine mainly provides the mechanism for users to manage and control the data warehouse. Three parts are organically linked and are indispensable [4].

Based on the procedures of audit and the characteristics of audit data model, the design steps of audit data model are generally: determining audit items - selecting granularity - selecting dimension - selecting measurement.

The star schemas in audit data model in specific audit business mainly include the following:

(1) Account balance analysis star schema

Account balance analysis star schema mainly includes: fact table of balance information (including subject code, accounting time, beginning balance, ending balance, current debit amount, current credit amount, beginning number, ending number, debit amount, credit amount, etc.), dimension table of subjects (including subject code, subject name, accounting currency, subject level, etc.), dimension table of time (including time code, year, quarter, month, date, etc.) [5].

(2) Auxiliary contacts analysis star schema

Auxiliary contacts analysis star schema mainly includes: fact table of auxiliary accounting balance information (including subject code, department code, customer code, supplier code, project code, accounting period, beginning and ending balances, beginning and ending numbers, etc.), dimension table of subjects, dimension table of suppliers (including supplier code, supplier name, location, contact person, telephone, competent department, sales personnel, etc.), dimension table of departments (including department code, department name, etc.), dimension table of customers (including customer code, customer name, location, contact person, telephone, competent department, sales personnel, etc.), dimension table of projects (including project code, project name, etc.), dimension table of staffs (including staff code staff name, etc.), dimension table of time.

(3) Assets and liabilities statement analysis star schema

Assets and liabilities statement analysis star schema mainly includes: fact table of assets and liabilities statement (including accounting time, assets and liabilities

index code, opening amount, closing amount, changes, change ratio, etc.), dimension table of assets and liabilities statement (including index code, index name, etc.), dimension table of time.

(4) Profit statement analysis star schema

Profit statement analysis star schema mainly includes: fact table of profit statement (including accounting time, profit and loss index code, accrual, accumulated accrual, changes, change ratio, etc.), dimension table of profit statement (including index code, index name, etc.), dimension table of time.

(5) Economic benefit index analysis star schema

Economic benefit index analysis star schema mainly includes: fact table of statement information (including accounting time, company code, index code, beginning value, ending value, validation value, changes, growth ratio, etc.), dimension table of company (including company code, company name, etc.), dimension table of economic benefit indexes (including index code, index name, etc.), dimension table of time.

3.2 Audit Online Analysis Processing Subsystem

The key sections in audit business lie in multi-dimensional observation and analysis of financial data for finding out suspicious aspects, thus to determine the audit focus. Online analysis processing subsystem is a tool to provide intelligent data analysis for audit. Intelligent analysis is supported b the information model in audit data warehouse. It utilizes the advantages of multidimensional data model in data warehouse to allow users to acquire information from the data warehouse in a more rapid and convenient interactive mode for observation and analysis of the current and historical data from different perspectives. It is able to use the interactive graphical analysis method to observe and analyze the relationship of data. It can use figures or tables for any operations, e.g. slicing, rotating, up, down

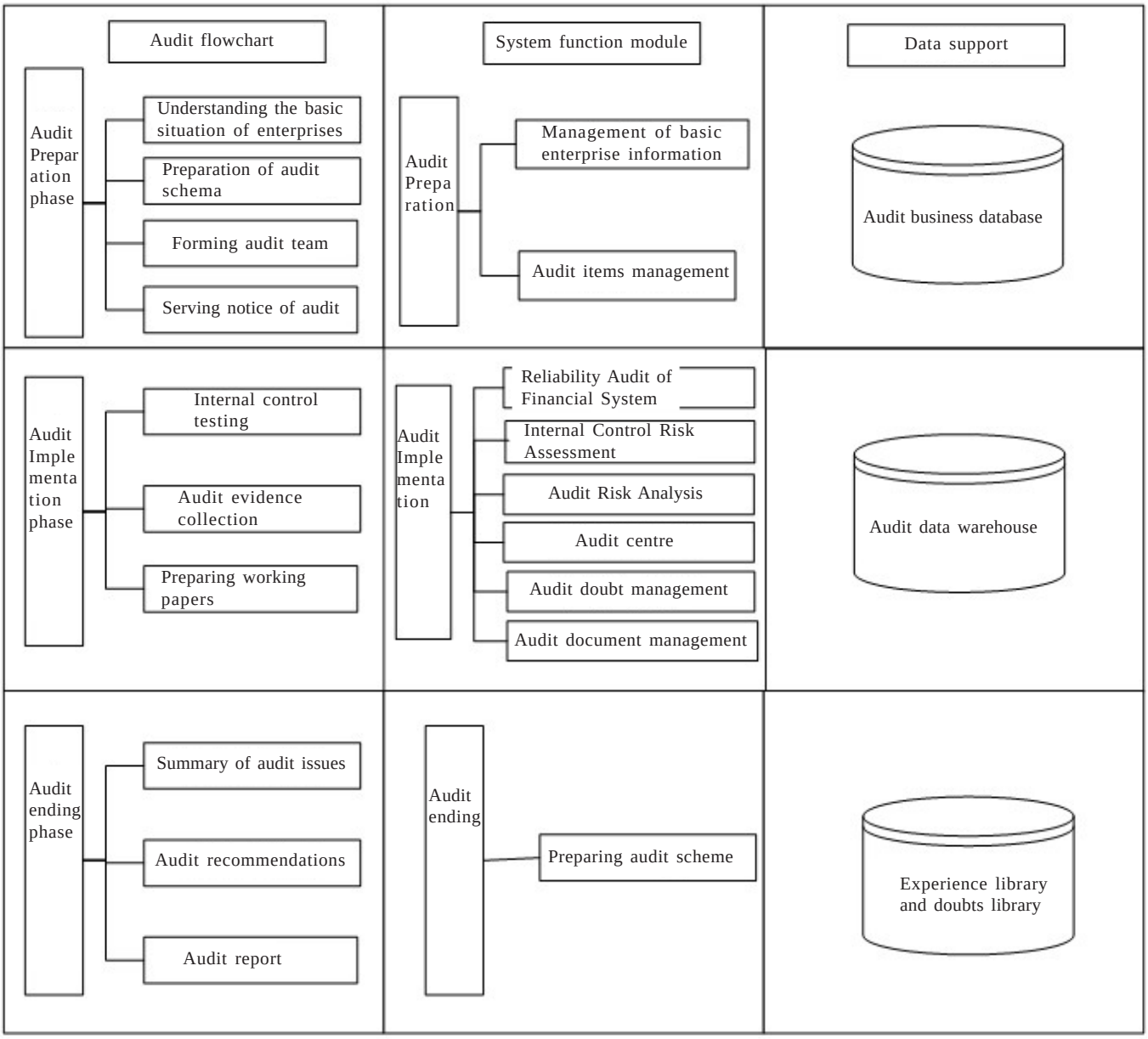

Figure 3. Schematic Diagram of Audit Business Management Subsystem

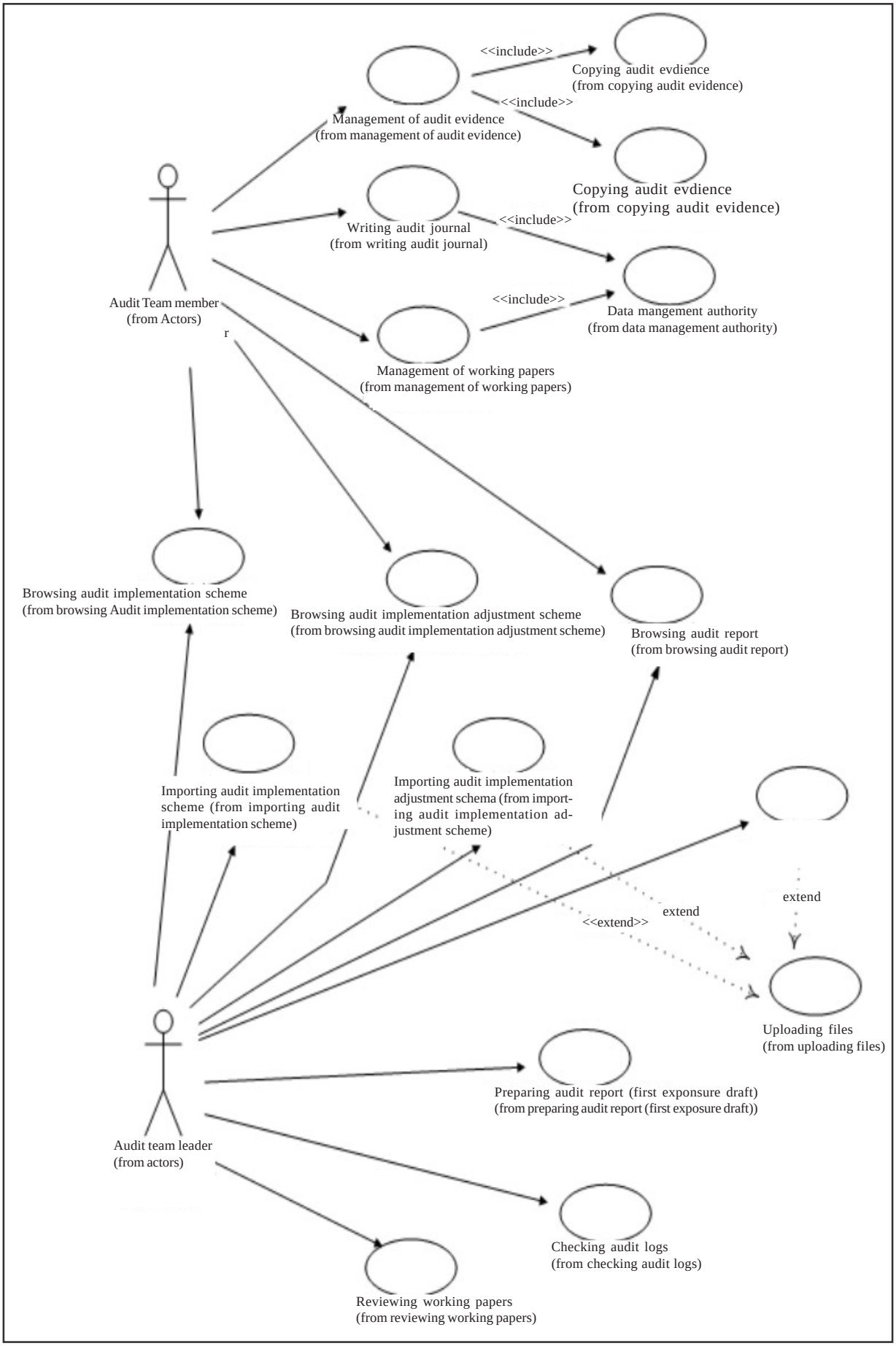

Figure 4. Use Case Diagram of Audit Business Management

drilling, etc., and shows data in layers according to various hierarchical relations, subordinate relations and correlativity. It is equipped with rich graphical displays to display pie charts, line graphs, scatter diagrams, stacked bar charts and other customized diagrams or complex diagrams. It utilizes the dynamic online analysis tool to achieve the multi-angle and multi-level dynamic three-dimensional exploration of financial data. In addition, the software also provides the basic functions for data, e.g. statistics and summary, averaging, arithmetical operation, classification screening, sorting, etc [6].

3.3.1 Computer audit can also be conducted in the 3 traditional audit phases, i.e. preparation phase, implementation phase and ending phase

3.3.1.1 Preparation phase
This phase is mainly to conduct preliminary investigation on the accounting information system of audited company, prepare plan, etc. Its main contents to be prepared include: basic conditions of audited company; audit objectives, scope, and beginning and ending time: arrangement, content and specific requirements of audit items; organizational labor division, time schedule and schedule of audit, etc.

3.3.1.2 Implementation phase
This phase is mainly to conduct a detailed investigation on the audited company, collect relevant data, test and evaluate the establishment and implementation of its internal control system, conduct compliance testing and substantive testing for the data and its processes and ultimately form working papers.

3.3.1.3 Ending phase
This phase is mainly to issue the audit report based on working papers and propose corresponding audit opinions, suggestions, etc.

3.3.2 In OLAP-based computer audit, it is required to utilize its own characteristics to review and evaluate the audit data in accordance with the characteristics of each implementation stage. The use case diagram of specific audit business management is shown below [7]:

3.4 Audit Alarm Subsystem
Audit alarm subsystem mainly uses the reminder function of computer audit for abnormal data, so that users can conduct purposeful random checks. It mainly includes the definition of alarm levels, setting of alarm indexes, determination of alarm threshold, alarm application rules, display and delivery of alarm information, etc. The thesis uses corporate financial analysis indexes to describe the audit alarm subsystem [8].

Relevant definitions of specific alarm subsystem are as follows:

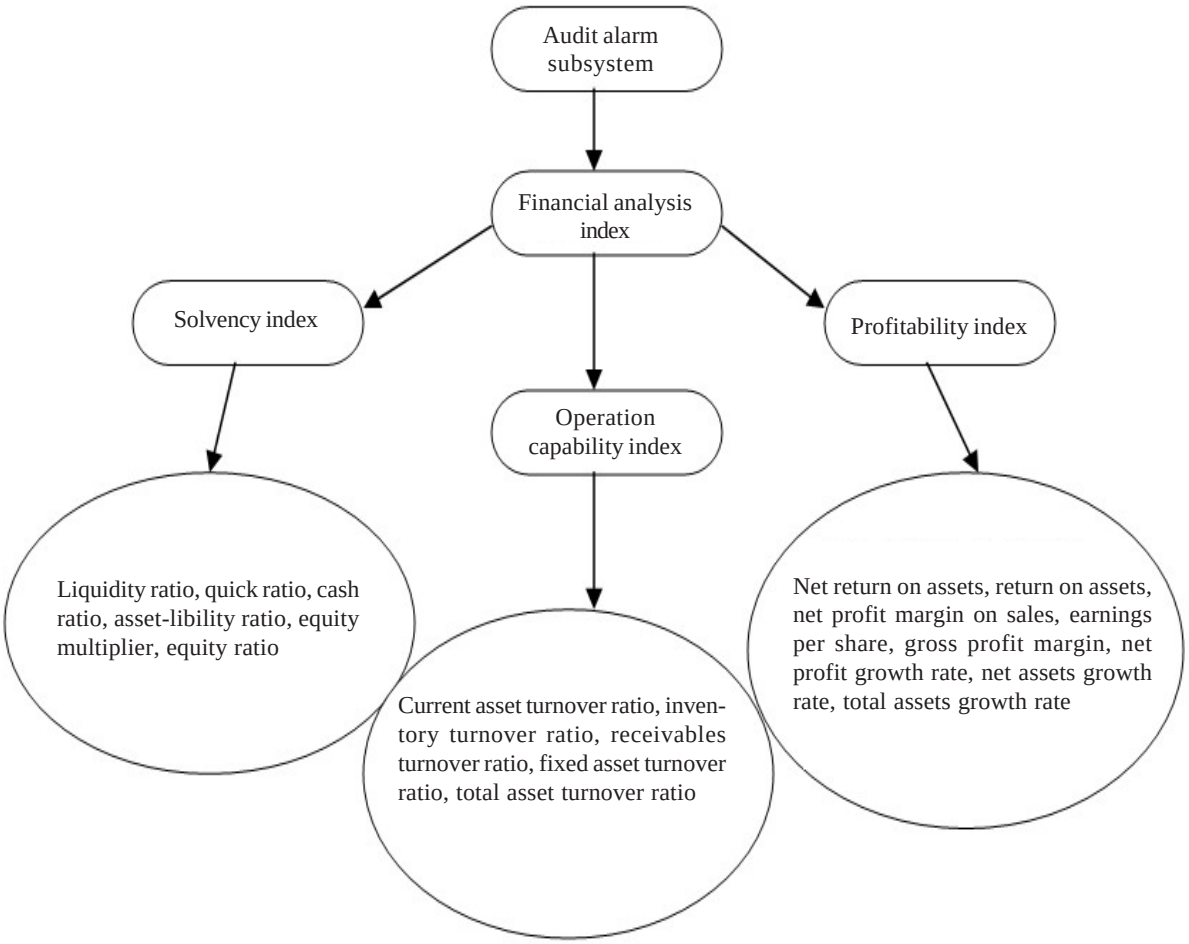

Figure 5. Audit Alarm System

Alarm threshold	>90	90 - 70	70 - 50	50 - 30	<30
Display Color	Red	Orange	Yellow	Blue	Green
Alarm level	Serious	More serious	Attention	Worth attention	Excellent
Information transfer	Yes	Yes	Yes	Yes	No

Table 1. Setting of Relevant Functions and Indexes

	Level 1 index	Weight	Level 2 index	Scores	Specific assignment instructions
Financial analysis alarm subsystem X	Solvency index X 1	0.3	Liquidity ratio	15	The specific assignment of alarm index applies the method of comparing with the comparable period. Indexes superior to those of last year will be assigned with 0. Those equal to those of last year are assigned with 50% of this index's score. Those inferior to those of last year are assigned with 100% of this index's score.
			Quick ratio	15	
			Asset-liability ratio	20	
			Equity ratio	15	
			Cash ratio	15	
			Equity multiplier	20	
	Operation index X 2	0.3	Receivables turnover ratio	20	
			Inventory turnover ratio	20	
			Current asset turnover ratio	20	
			Fixed asset turnover ratio	20	
			Total asset turnover ratio	20	
	Profitability index X3	0.4	Gross profit margin on sales	10	
			Net profit margin on sales	10	
			Return on investment	20	
			Net return on assets	10	
			Earnings per share	10	
			Net profit growth rate	10	
			Net assets growth rate	10	
			Total assets growth rate	20	

Table 2. Specific Alarm Indexes

In this example, we use the simple assignment method to describe the running process of alarm subsystem. It means that the method of comparing with the last year will be applied in the specific assignment of alarm index. Indexes superior to those of last year will be assigned with 0. Those equal to those of last year are assigned with 50% of this index's score. Those inferior to those of last year are assigned with 100% of this index's score. If we choose 2009 as the assessment year, then:

$$X1 = 7.5 + 0 + 15 + 0 + 7.5 + 10 = 40$$

$$X2 = 20 + 10 + 0 + 0 + 0 = 30$$

$$X3 = 0 + 10 + 0 + 10 + 10 + 5 + 0 + 10 = 45$$

$$X = X1 * 0.3 + X2 * 0.3 + X3 * 0.4 = 40 * 0.3 + 30 * 0.3 + 45 * 0.4 = 39$$

The ultimate alarm results are as follows: the alarm level is worth attention, the display color is blue and it will send alarm information.

3.5 Expert Experience Library Subsystem

Expert experience library subsystem is the auxiliary support module of audit system, including two types, i.e. expert experience and automatic analysis. Expert experience is the text document of expert experience formed based on the contents of doubt library. It mainly plays the role of guidance for auditors. Automatic analysis refines the static expert experience into computer language rules. The rules engine of system will conduct rule definition and rule execution monitoring and change these expert experiences into automatic analysis rules that can be performed by the system. The use case diagram of specific expert experience and audit doubts is shown below [9]:

5. Epilogue

In summary, the computer audit based on OLAP technology overcomes the limitations of traditional audit information system and greatly improves the efficiency

Items \ Year	2008	2009	2010	2011
Liquidity ratio (%)	1.41	1.40	1.45	1.48
Quick ratio (%)	0.37	0.41	0.45	0.49
Cash ratio (%)	17.06	17.42	23.63	24.50
Asset-liability ratio (%)	77.10	78.97	77.85	76.15
Equity multiplier	4.37	4.76	4.51	4.19
Stockholder's equity ratio (%)	22.79	26.60	31.89	37.36
Receivables turnover ratio (%)	46.18	22.64	15.15	5.91
Inventory turnover ratio (%)	0.25	0.20	0.17	0.13
Current asset turnover ratio	0.29	0.33	0.19	0.24
Fixed asset turnover ratio	18.25	19.23	16.32	13.07
Total asset turnover ratio	0.28	0.32	0.08	0.04
Gross profit margin on sales (%)	39.78	41.84	45.01	48.95
Net profit margin on sales (%)	16.16	14.01	16.27	14.93
Return on investment (%)	1.86	1.96	2.05	1.78
Net return on assets (%)	19.83	7.85	6.53	2.68
Earnings per share	0.88	0.77	0.72	0.65
Net profit growth rate (%)	41.74	25.09	15.83	32.15
Net assets growth rate (%)	20.29	20.80	0.16	24.26
Total assets growth rate (%)	22.79	26.60	31.89	37.36

Table 3. Financial Analysis Data of a Large Group Company

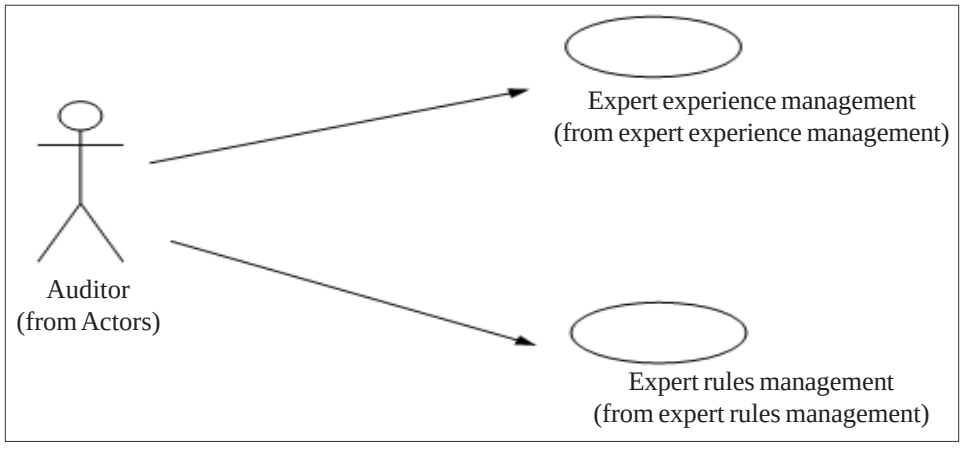

Figure 6. Use Case Diagram of Expert Experience

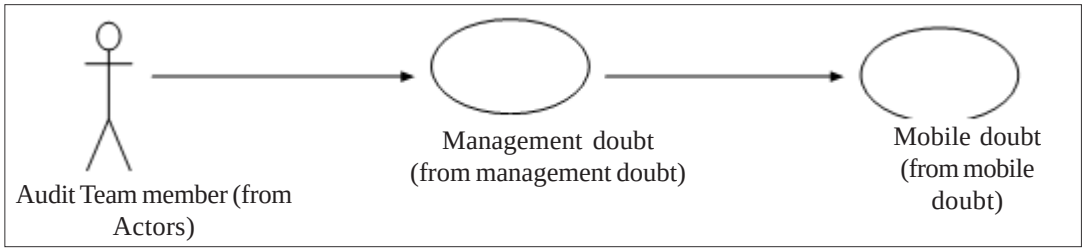

Figure 7. Use Case Diagram of Audit Doubt

and quality of audit, laying a solid foundation for the development of computer audit towards a higher intelligent direction. However, to achieve artificial intelligent audit, the computer audit system based on OLAP technology greatly relies on the thinking model of auditors' empirical judgments. The problems found on audit doubts still require the judgment based on the personal experience of auditors and the empirical judgments of auditors cannot be described with formalized language. Therefore, to let the computer audit system develop towards a higher level also requires to be based on the current OLAP-based audit software, continuously accumulate and record the detailed processes of actual audit conducted by auditors utilizing this system and gradually dig out the empirical judgment model of auditors based on the accumulated massive audit behavior data [10].

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