

# Intelligence Accounting Information Fusion System: Theory, Model and Framework

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**Abstract.** It is defined in this paper that the intelligence accounting information fusion system is an intelligence accounting information system based on accounting information fusion (briefly AIF). This is a new accounting information system that goes beyond the traditional accounting information system, based on AIF and has the function of intelligent decision-making support. Intelligence accounting information fusion system must have four conditions or functions. First, the system should have basic accounting information generation functions. Second, the system should have the ability to obtain other relevant information from various channels, called information acquisition intelligence. Third, the information obtained should be expressed and stored intelligently, called information expression and information storage intelligence. Fourth, the system should have intelligent decision support function. This paper will research firstly on AIF, establish theory for AIF to support the stakeholders to make decision using both accounting information and non-accounting information. Then, the paper will study the intelligence accounting information system based on AIF. The theory and the realization of intelligence accounting information fusion system will be studied based on methods and technologies in the field of Artificial Intelligence and Expert Systems.

**Keywords.** Big data analysis, accounting information fusion, decision support, artificial intelligence, intelligence accounting information fusion system

## 1. Introduction

In recent years, the development of artificial intelligence has made unprecedented achievements, and the application of artificial intelligence in accounting, auditing and financial management has been carried out in a large number of studies. The big four accounting firms have launched their own financial robots. The use of electronic invoices, the establishment of financial sharing centers and automatic accounting are all important applications of artificial intelligence in accounting and auditing. But these financial intelligences are just automation in a particular area of financial accounting, not real artificial intelligence. What is artificial intelligence in the true sense? In this paper, decision-making is the true intelligence of human beings, especially, the ability to apply unstructured information to make decisions is the highest embodiment of human intelligence. This intelligence is currently difficult for machines to achieve. This paper

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will study the accounting information system with decision support function, which should be the higher level of intelligence accounting information system.

This paper first discusses the concept and theory of AIF, and discusses theory and model of using accounting information and non-accounting information to make decisions jointly. Then, from the perspective of decision support, the intelligence accounting information system is studied, and the theoretical system and design concept of the intelligence accounting information system based on AIF are put forward. Third, the computer implementation of intelligence accounting information fusion system is discussed by using the concept and technologies in the field of Artificial Intelligence and Expert Systems.

## **2. Research Background**

This paper will apply artificial intelligence, big data analysis, cloud computing technology, information fusion, XBRL financial reporting and Dempster-Shafer evidence theory to study intelligence accounting information system from the perspective of decision support, and put forward the research ideas and design concepts of intelligence accounting information system based on AIF.

Big data and cloud computing are the hot topics in the information technology industry in recent years. In May 2011, the McKinsey Global Institute released a report entitled "Big Data: The Next Frontier of Innovation, Competition, and Productivity"[1], formally introducing the concept of big data. Since then, big data technology has been widely used in all of the world, creating tremendous economic value. This paper will apply big data analysis and cloud computing technology to study the theory and practice of AIF and intelligence accounting information system, which is an attempt to apply big data in the field of financial accounting.

The research of this paper will start with the concept of information fusion, put forward the concept, theory and method of accounting information fusion, and then use it for the research of intelligence accounting information system. Information fusion, also known as data fusion, multi-sensor data fusion, or multi-source information fusion, originated in military applications. In 1991, JDL: Joint Directors of Laboratories in USA defined information fusion as a multi-layered, multi-faceted process to detect, correlate, estimate, and combine of multi-source data for accurately estimate the status, risks and threats of the battlefield.

Since the 1990s, the rapid development of computer technology has greatly promoted the research of information fusion theory, and the application field of information fusion has been rapidly extended from military to other fields. Such as: robot and intelligent instrument systems, intelligent manufacturing systems, aerospace applications, image analysis and understanding, inertial navigation, pattern recognition and so on.

Unfortunately, however, there is little research on the application of information fusion in enterprise management. Our research makes an effort to use information fusion in the area of management, especially accounting, financial management, and auditing.

The important problem in the theoretical research of information fusion is the expression and combination of information. Among the many combination methods, Dempster-Shafer evidence theory [2][3] provides a natural and powerful method for the expression and synthesis of uncertain information, so Dempster-Shafer evidence theory

has become a widely used and more researched field in information fusion theory [4-8]. Therefore, this paper will also take Dempster-Shafer evidence theory and its expansions as the main method of AIF, and establish the theoretical framework of AIF based on Dempster-Shafer evidence theory.

The author of the paper has also done some work in the research of Dempster-Shafer evidence theory. In 1993, he published a book, called "Evidence Theory, Decision Making, and Artificial Intelligence" [9]. Once published, the book has been well received by researchers and users of evidence theory and has been cited many times by various magazines and many researchers. In 1994, the project "Research on the belief function model of decision-making" (approval number: 79300020) is applied successfully from the National Natural Science Foundation of China, and after several years of research, another book "Evidence Decision-making" was published in 1996 [10].

In recent years, I have applied the theory of evidence to the solution of the problem of comprehensive evaluation, and put forward a model of "Evidential Synthetic Evaluation Model" [11].

In the paper "Using evidential synthetic model to evaluate the performance of RMB PE funds", the application of evidential synthetic model in private equity fund performance evaluation is discussed [12]. In the paper "Belief Function Model of Private Equity Fund Performance Measurement", the fund performance measurement is discussed using belief function model [13].

Regarding the concept and theory of AIF, Duan Xinsheng established the theoretical framework of AIF in two papers in 2014 and 2016, "Research on the Limitations of Accounting Information and the Integration of Accounting Information" [14] and "Accounting Information Fusion for Decision Making" [15]. In these two papers, the theory and thought of information fusion are applied to the comprehensive processing and use of accounting information, put forward the concept of AIF and established the theoretical framework of AIF based on Dempster-Shafer evidence theory and its expansions.

### **3. Intelligence Accounting Information System**

The main function of accounting information system is to provide accounting information, and mainly financial accounting information, which does not include the use of accounting information and decision support. This paper holds that the function of accounting information system should be expanded to provide not only information, but also decision support. In such a system, the system can automatically obtain the required information, including not only accounting information but also non-accounting information, according to different decision objectives, and can make the required decisions on the basis of this information. Among them, accounting information, including financial accounting information and management accounting information, can be produced by the traditional accounting information system and provided to decision makers or the decision engine of the system in a reasonable manner. Non-accounting information, including text, image, and video information, can be automatically crawled from the network or other sources using big data analysis. The decision engine of the system can make decision suggestions based on the unified expression, unified storage and unified use of the obtained accounting information and non-accounting information. If new information is found, including accounting and non-

accounting information, the system can automatically add new information to correct the original decision. Information can be added and decisions can be corrected one by one. Of course, the system can automatically identify the new information is financial accounting information, management accounting information, or non-financial information, so as to use different decision-making models to deal with. Such an accounting information system is called an intelligence accounting information system based on decision support perspective.

The idea of intelligence accounting information system can be realized by using the theory of AIF established in the earlier paper and here after.

#### **4. Intelligence Accounting Information Fusion System: A Framework**

This paper holds that the intelligence accounting information system based on AIF, referred to as the intelligence accounting information fusion system, is an accounting information system based on AIF and has ability providing decision-making support intelligently. To this end, intelligence accounting information fusion system must have three conditions or functions.

First, the system should have basic accounting functions, should be in accordance with the current accounting standards to complete the usual financial accounting, generating the usual financial reports and financial statements. It also has the ability to complete the management accounting and generate management accounting information.

Second, in addition to its own ability to generate financial accounting and management accounting information, it should also have the ability to obtain other relevant information from different sources, called information acquisition intelligence. It cannot refuse the entry and extraction of any information, can automatically identify the obtained information, financial accounting information or management accounting information, accounting information or non-accounting information, numerical information or text information, etc. The obtained information should be intelligently expressed and stored, called information expression and information storage intelligence. Therefore, intelligence accounting information fusion system is able to express and store any information, so there must be a strong database, knowledge base and rule base to support.

Third, intelligence accounting information fusion system should have intelligent decision-making mechanism. The information stored in different sources should be intelligently and uniformly processed. According to different decision-making purposes, the information stored in different sources can be identified and the relevant information can be extracted. The extracted information can be combined to give a suggestion that are useful for decision-making.

The realization of intelligence accounting information fusion system can be carried out in a layered way.

- It is the first step to discuss the information fusion of financial accounting and management accounting, and establish a unified financial accounting and management accounting processing engine. The theory and method of information extraction and data processing of XBRL financial report can be studied at the beginning. Especially, the XBRL representing and storing of management accounting information should be studied in depth. The technical background and theoretical support of the fusion algorithm of XBRL financial

accounting information and management accounting information should be explored in this stage.

- Second step discusses the fusion mechanism of accounting information and non-accounting information, and establishes a data processing engine that can handle accounting information (including financial accounting information and management accounting information) and non-accounting information based on the theory of AIF. The theories and methods of using big data and cloud computing technology to retrieve, extract, store and process information should be explored. In particular, the crawling and processing of information from internet, such as text information, image information and video information are studied in depth to lay the foundation for the realization of the subsequent intelligent system.
- Next discusses the technical realization of the integration of accounting information (including financial accounting information and management accounting information) and non-accounting information. To study the theoretical and practical problems of database, knowledge base and rule base. To study the identification and evaluation of the usefulness of information and establish a mechanism for real-time clean-up and updating of outdated information. The fusion algorithm and the establishment of self-learning algorithm are studied to realize the goal of automatic update, self-improvement and automatic learning of the system.

## 5. Conclusions and Future Perspectives

This paper is to study the acquisition, storage, integration and utilization of accounting information and non-accounting information in big data environment, to establish a theoretical model for the integration of financial accounting information with management accounting information, accounting information and non-accounting information, and to explore the theory and realization of intelligence accounting information system based on AIF.

Traditional accounting information systems either provide information to shareholders out of a duty of responsibility, or provide information for stakeholders to make decisions. In short, the goal of the traditional accounting information system is to provide information, the differences for two different views only lay on the place that the view of duty responsibility is to provide information to shareholders, while the view of decision support is to provide information to stakeholders. The decision support here is that the accounting system provides information to support the decision-making of stakeholders, not the accounting information system itself can make decisions or the accounting information system itself has the function of decision support. The intelligence accounting information fusion system discussed in this paper does not provide information for decision support alone, but the system itself has the function of decision support and even making decisions like human beings. Therefore, the decision support in this paper and the decision support in the traditional accounting information system are two different meanings.

The decision-making information generation mechanism in the intelligence accounting information fusion system discussed in this paper is fundamentally different from the traditional accounting theory. According to the three-tiered model established in paper "Accounting Information Fusion for Decision Making" (Xinsheng Duan, 2016),

the traditional accounting theory can only provide the first level of information, while the information provided by the intelligence accounting information fusion system is the third level of information. Therefore, the intelligence accounting information fusion system may be the innovation and subversion of the traditional accounting information system, which will also have a great impact on today's accounting theory, and may even lead to a major revolution in accounting theory.

The one of the roles or important functions of intelligent accounting information fusion system is to make decisions using accounting information and non-accounting information. We know that making decisions is a human-specific ability and an advanced intelligence. Therefore, compared with the traditional accounting information system and even the intelligent system mentioned in many literatures, such as automatic accounting system, it has a higher level of intelligence. With the improvement and development of intelligent accounting information fusion system, the level of intelligence will be higher and higher, and it may not be impossible to reach or approach the level of human intelligence.

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