【論　説】

Historical Review and Perspective on Automatic Journalizing

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Introduction

The accounting information system is aiming to perform an accurate accounting processing with as little time spending and as little human resources as possible, regardless in any journalizing system. Especially, the study of the automatic journalizing has been conducted by a various approaches. The aims of this study are to suggest a future direction of the progress of the accounting information system by analyzing the current situation. To begin with, we will summarize which directions the earlier researches followed on development of the automatic journalizing for small and medium sized businesses. And then, the purpose of this study is to present of direction of the progress of the accounting information system.

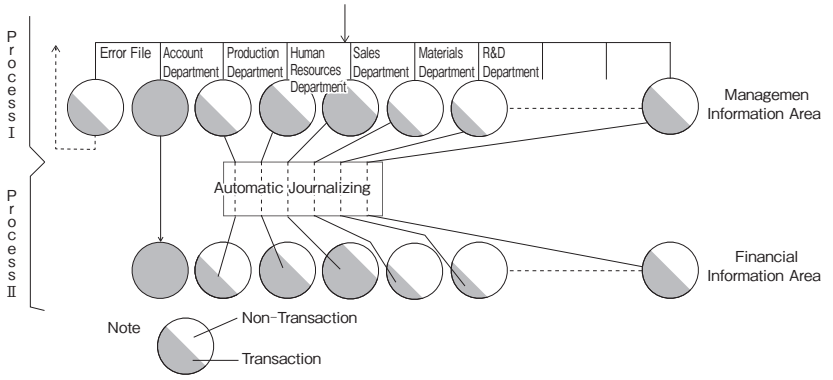
1. EDP Accounting and Automatic Journalizing

A study of the automatic journalizing has been around since the computer accounting was called EDP accounting. Shimizu（1977）claims in the computer accounting work, we can standardize the processing of business, assuming possible transactions in journals, developing a certain pattern, and reprogramming to make it a smooth handling for the accounting processing for example in a general rule, when the sale of goods are accompanied by an accounts receivable, computer can journalize automatically as the followings,

（Debit）accounts payable ××××　（Credit）account receivable ××××

in the computer for a pattern of frequent transactions, it is able to perform a total journalizing, including a compiling work in the journal. By performing comprehensively these tasks, the time and effort for journalizing are saved, which required a professional knowledge of accounting, and simplified source records for an easy input. An account processing can be carried out without a person with poor accounting knowledge occasionally makes any mistakes. As a

Figure 1　Process of the Automatic Journalizing with EDP account



Note : From Shimizu（1977）

result, the computer has improved the effective processing.[1)]

Figure 1 shows a process of the automatic journalizing with EDP account. In the Process 1, the information managed by each section. The financial information is finally made-up through the automatic journalizing. The journalizing by program without manual processing, the data was output to the cards by the automatic puncher, then the cards input the data for financial accounting. Shimizu (1977) pointed out the advantaged merits of the automatic journalizing such as a burden reduction of the input tasks, prevention of human errors, cooperation with other systems, speed up of the monthly closing, automation of all accounting process. These allow us to concentrate on intellectual tasks humans basically have. These have been accepted as the basic theory of the current accounting software and ERP (Enterprise Resource Planning). On the other hand, it was only major corporations that were able to afford computer systems at that time, and a big investment was also needed for building up a necessary accounting system. In addition, it was not easy for a person without an accounting expertise to operate computer accounting at that time, there were many cases the accounting expertise of certified accountants or designated persons is greatly needed to carry out each tasks.

Abe (1985) described the system of computer accounting, saying the knowledge of accounting system was required even at an early stage of computer set-up (installation). When personal computer accounting system is introduced a ledger file should first be created. In the ledger file, these were recorded as cash in item 1, current deposit in item 2, fixed deposit in item 3, etc. In each page of the accounting items to be opened, these were recorded as record number (a number of pages: serial number), code of accounting items, name of subject items, and initial Values respectively. The initial value is defined as a balance brought from the previous term in case of the beginning of the fiscal year, the balance brought from the previous month in case of

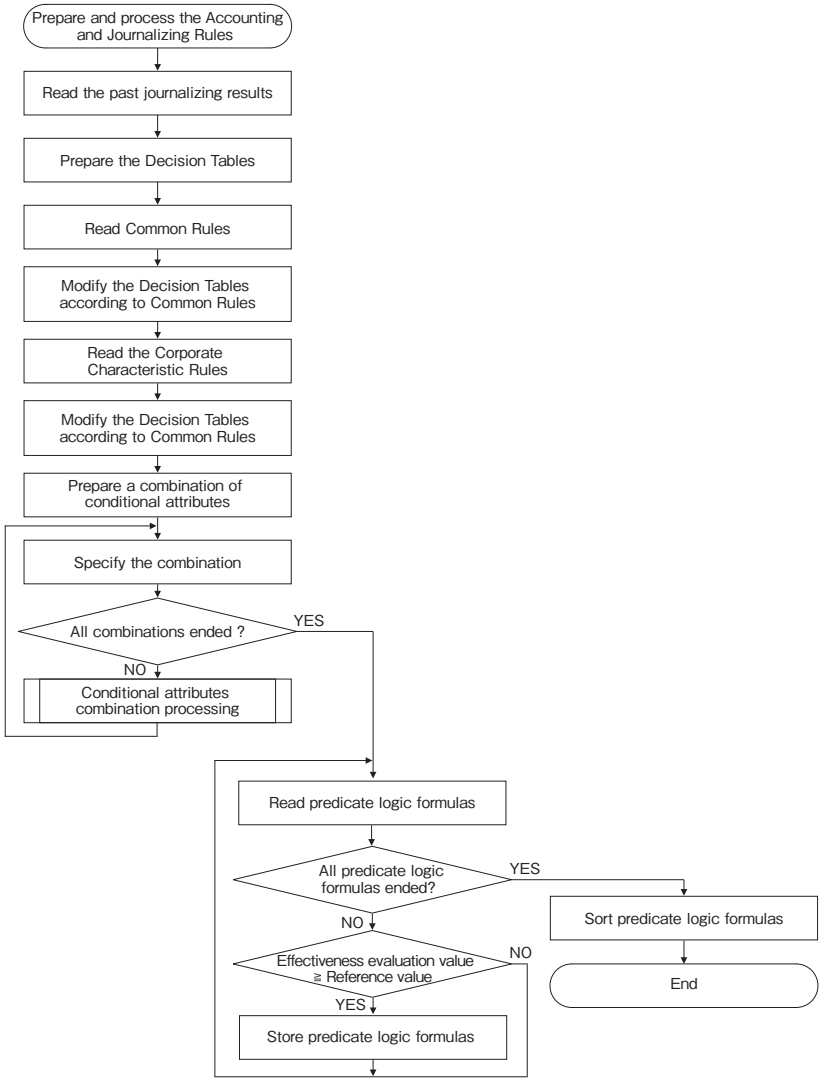
introducing PC accounting in the middle of the term. Next, enter for journal slip corresponding to daily transactions by typing a keyboard (key in) and create a journal file.[2)]

2. Learning System of Automatic Journalizing

Small size companies were spotlighted by Nagai, Takahashi and Sasaki (2005), where the learning system of automatic journalizing was adopted. Many small size businesses often do not have a full-time accounting person in charge, so they charge accounting works to accounting specialists in accountant firms However, the efficiency in a work of journalizing based on source records is needed in the viewpoint of cost and workload. Therefore, an account processing by connecting to VPN (Virtual Private Network) can be introduced. Since journalizing itself needs an expertise of account specialists, it is difficult for small companies to do it unless they have a full-time staff in charge. Many journals of small companies are relatively simple, we focus on a fact that the same type of account items and journals appeared repeatedly in the past, and develop a learning system of the accounting knowledge of the predicate logic formula in journalizing processing. Specifically, we learn patterns of journalizing as followings.[3)]

The information (data) of account transactions directly available are defined as followings; the past journals done by accountants, characteristics of the company, and knowledge (expertise) of the accounting (in general / in common). By using the information (data), accountants carried out journalizing. In a case of automatic journalizing, a certain index is needed to show how far a classification is carried out in positive way if full information for journalizing is not available. Therefore, the learning system of automatic journalizing knowledge is developed by means of the rough set analysis. Specifically, after a

Figure 2　Operational Process of Learning Automatic Journalizing



Note : From Nagai, Takahashi, Sasaki (2005)

set of debit / credit account items of an existing journal is defined as decision attributes, we create the decision chart. Of the rough set as the conditional attributes as followings: summary information of the existing journal; information of the other party; distinction of the available（accessible）money; characteristic feature of the companies. In sorting out the classification rule from the decision chart, it is common to create an identification chart from a matrix of conditional attributes. Therefore, from the journalizing results selected by accounting experts, we create a cluster with data vectors of each row in the decision chart as individual elements, and search out classification decision rules. That is the learning process. In addition, an experiment of the learning method of automatic journalizing was carried out as the followings:

Step 1:

Degenerate a decision chart by using background knowledge

Remove a column of the date data from the background knowledge.

Step 2:

Create clustered condition attribute data by a combination of decision attributes

Sort out rows in the decision chart within a set of combination value of the decision attributes and create an element cluster in the data row having the same decision attribute value.

Step 3:

Search for a possible combination of predicate logic formulas in all combinations of conditional attributes.

We consider [business partner, information provider contract] as a combination of conditional attributes for explanation.

Step 4: Create sub-determinant matrix combination only of conditional attribute and decision attribute.

Step 5: Reduce the data row containing undefined columns.

If there is a row which value of the conditional attribute is undefined in the sub −matrix, the data row is deleted and a sub matrix is newly created.

Step 6: Calculate the range of conditional attribute values.

The value of the conditional attribute of the data column, having a group of the value of the same decision attribute（in each column,（entertainment expenses, current account）and（sales commission, current account））, is divide into the current cluster and the other（second cluster）, and calculate the range of condition attribute values.

Step 7: Calculate the lower approximate set and the upper approximate set.

Calculate the lower approximate set and the upper approximate set, then, calculate the number of individual elements belongs to the lower approximate set and the number of individual elements belongs to the lower approximate set, and then finally calculate the approximation accuracy of the rough set. For the value of the approximation accuracy, to create the predicate logic formulas for the total number of data, Corrections were carried out based on the ratio to the number of data directly used and the number of the conditional attributes used, it was defined as an evaluation value of creating the current predicate logic formula

Step 8: Generate a predicate logic formulas

Output the predicate logic formula with text format, therefore, the predicate logic based inference mechanism can be used.

Note : From Nagai, Takahashi, Sasaki（2005）

In this research, the learning methods of automatic journalizing were presented. But the details of the practical data were not presented about what kind of journals were fitting for automatic journalizing or what kind of journalizing were in difficult cases. Bookkeeping and accounting are to

comprehend economic events by means of an amount of money, and realize it through journalizing by checking account items. Journals have the levels of difficulty. Some are easy to journalize with basic knowledge of bookkeeping or accounting, others require a considerable expertise, because there is a wide range of difficulty. However, it is not realistic not to journalize difficult transactions, but journalizing is needed in all economic events. In automatic journalizing, if simple journals can be automated and challenging（complicated）journals cannot, practical time efficiency will not be realized. That is why it still needs the accounting knowledge provided by accountants. In addition, when day-to-day transactions, settlement accounts, and declarations pile up, it is difficult for small and medium-sized enterprises to carry on business completely without accounting knowledge from accounting experts.[4)]

3. Automatic Journalizing by the Artificial Intelligence

The system of the automatic journalizing, which we have studied, has now passed on to accounting software widely used in small and medium sized enterprises. However, even with a help of modern accounting software that has evolved（drastically）in various field, but it is still difficult for those who have a little knowledge of bookkeeping or accounting to handle software smoothly without someone's advice. There have been a various economic events enterprises are confronted with, the events are to comprehend by journalizing. That is not easy, it contains mixing ones from relatively simple ones to very high level ones which a serious accounting judgments needed. However, newly artificial intelligence accounting has a potential possibility to solve such problems.

On May 20, 2016, Freee Corporation Co., Ltd. dated received a patent right of the artificial intelligence technology on the automatic journalizing of cloud

accounting software and provides automatic journalizing function by artificial intelligence. The scope of the patent claims described in the patent publications is as follows.[5)]

［Claim(s)］

［Claim 1］

It is an accounting device for holding accounting by cloud computing,

It has a web server which provides a user with cloud computing, and is the aforementioned web server,

Web detailed data is identified for every dealings,

A description of a transaction content of each aforementioned dealings is articulated in a keyword, and each dealings are automatically journalized to specific account headings with reference to the frequency of occurrence of 1 or a plurality of account headings matched with each keyword,

Journalizing data which includes the date, a transaction content, the amount of money, and account headings at least is created,

An accounting device characterized by what the created aforementioned journalizing data is transmitted to a computer by which a user accesses the aforementioned web server, and is displayed on a web browser of the aforementioned computer as a journalizing processing screen.

［Claim 2］

An accounting device described in Claim 1, wherein the frequency of occurrence of 1 or a plurality of account headings matched with each keyword is normalized for every keyword.

［Claim 3］

The accounting device according to claim 1 or 2, wherein the aforementioned journalizing totals as a score the frequency of occurrence which each keyword has for every account headings and journalizes automatically to account

headings of the highest score.

［Claim 4］

The accounting device according to any one of claims 1 to 3 not taking into consideration a sign of a single character, or a keyword of only a number in the sum total of the aforementioned score.

［Claim 5］

The accounting device according to any one of claims 1 to 4, wherein the aforementioned journalizing processing screen has a menu for changing account headings.

［Claim 6］

The accounting device according to claim 5 storing matching with a description of a transaction content, and corrected account headings in a storage part of the aforementioned accounting device as a user rule for every user when a user chooses from the aforementioned menu account headings journalized automatically and corrects them.

［Claim 7］

The accounting device according to claim 6, wherein the aforementioned frequency of occurrence is defined based on a plurality of users' user rule stored in the aforementioned storage part.

［Claim 8］

The accounting device according to claim 7, wherein the aforementioned frequency of occurrence articulates in a keyword a description of a transaction content included in each user rule, **********s a count of appearance frequency of corrected account headings and is defined about each keyword.

［Claim 9］

The accounting device according to any one of claims 1 to 8, wherein the aforementioned keyword is a morpheme.

［Claim 10］

The accounting device according to claim 9, wherein a division to a morpheme is performed without requiring domain processing.

［Claim 11］

It is an accounting method for holding accounting by cloud computing which a web server provides,

A step from which the aforementioned web server discriminates web detailed data for every dealings,

A step to which the aforementioned web server journalizes each dealings automatically to specific account headings with reference to the frequency of occurrence of 1 or a plurality of account headings which articulated a description of a transaction content of each aforementioned dealings in a keyword, and was matched with each keyword,

A step which creates journalizing data in which the aforementioned web server includes the date, a transaction content, the amount of money, and account headings at least

An implication,

An accounting method characterized by what the created aforementioned journalizing data is transmitted to a computer by which a user accesses the aforementioned web server, and is displayed on a web browser of the aforementioned computer as a journalizing processing screen.

［Claim 12］

Accounts for holding accounting by cloud computing which a web server provides

It is a processing program and is the aforementioned web server,

A step which identifies web detailed data for every dealings,

A step which journalizes each dealings automatically to specific account headings with reference to the frequency of occurrence of 1 or a plurality of account headings which articulated a description of a transaction content of

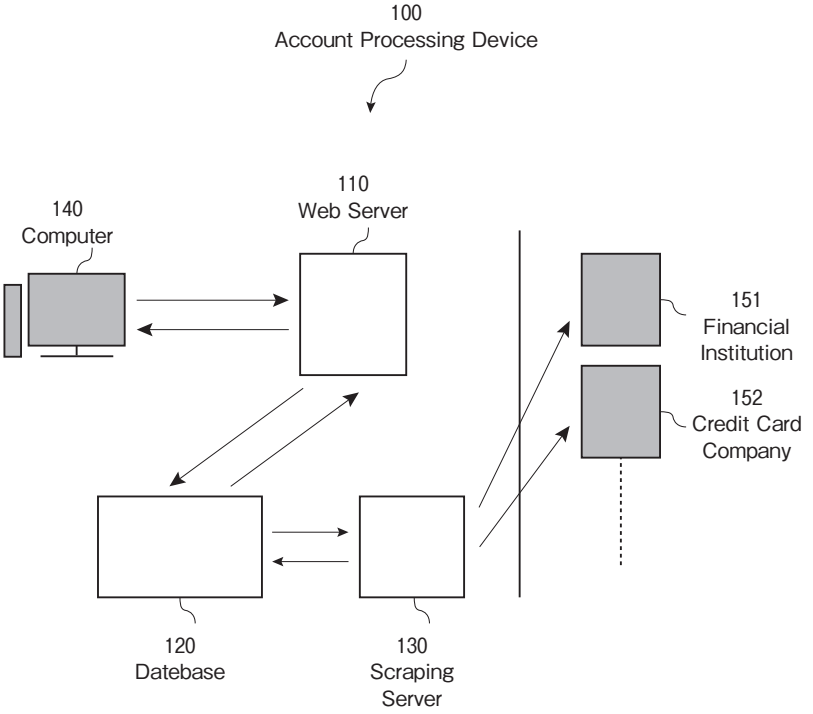
each aforementioned dealings in a keyword, and was matched with each keyword,

A step which creates journalizing data which includes the date, a transaction content, the amount of money, and account headings at least is included,

An accounting program for performing a method, wherein it is transmitted to a computer by which a user accesses the aforementioned web server and the created aforementioned journalizing data is displayed on a web browser of the aforementioned computer as a journalizing processing screen.

Note : From Japan Patent Office, Patent Publication（B2）（Patent No. 5936284）

Figure 3　Conceptual Diagram of Accounting Apparatus in One Embodiment of the Patent No. 5936284



Note : From Japan Patent Office, Patent Publication（B2）（Patent No. 5936284）

Cloud accounting software provided by free Co., Ltd. basically a journalizing function from receiving / paying data of bank account. However, as the account items were estimated by a keyword basis, it ended up a need of humans to check and correct account items. The patent is equipped with advanced automatic journalizing and writable/erasable function by AI. It is able to estimate appropriate account items even in unknown Japanese word; the more the number of users are increased through a learning engine; the more estimation accuracy may be improved. Those are great feature. Based on cloud computing, it is being developed, focusing on small businesses and individual business owners etc. and solving the problem of the traditional accounting software by analysis of the big data.[6)]

4. Direction of the Progress of the Accounting Information System

A complicated and challenging journalizing requires a high level of accounting knowledge, so that the traditional automatic journalizing systems could not deal with it, and there were many cases that required the expertise of accounting experts. However, AI accounting was able to analyze the big data and estimate the computer journalizing and account items with a high accuracy, then, we found a clue to solve the problems that the traditional automatic journalizing had. The automobile industries have been aiming to realize a fully automatic driving system that transport people to their destination without touching a driving wheel. Looking back the development of the accounting system, their objectives could be summarized into “how could we achieve an accurate accounting with as little accounting knowledge as possible and as much time to save as possible” In other words, the final picture of the accounting information system, similar to fully automatic driving the automobile industry have aimed for, is *that automatic journalizing of all*

economic events must be recorded without any human touch, it is a complete automatic accounting system in which accurate financial statements are automatically created. AI accounting will be a major impact on future accounting information systems, but there are still many obstacles to be cleared before achieving the fully automated accounting.

When we focused on a fully automated account processing, a big wall appeared and stood before us, which was how to handle and manage the primitive analog information such as cash receiving and paying managed in the safety box, process of return-discount items, and shortage of cash account processing. In the future, for a reality of such a fully automatic accounting, we have to work on how these information can be converted into digital data by means of sensor technology and Internet of Things（IoT）/ Internet of Everything（IoE）, that will be the key of success.

If fully automatic accounting is realized and a mistake is found in financial statements, it will be disputable who is responsible for the mistake. For instance, it is discussed who is responsible for accident by a self-driving car in case of automatic driving. There are 3 points at issue as follows.

I. Responsibility for bodily injury/property damage to others by system defect
II. Accident damage caused by hacking
III. Responsibility for a self-inflicted accident caused by system defect

There will be some debate over who should be responsible; a car owner, a car manufacturer, or a system development company? It may possibly be the similar discussion for fully automatic accounting. A technological progress can brings us a benefit, but also brings us a new issue simultaneously. The correct directionality for fully automatic accounting will be left to the further research in the future.

1) Tetsuo Shimizu. (1977), "On Automated Journalizing in EDP Accounting" *Hikone-Ronso*, Vol. 184, pp. 74-96.
2) Jyosuke Abe. (1985), BASIC niyoru Boki kaikei Nyuumon, KYORITSU SHUPPAN (in Japanese)
3) According to Nagai, Takahashi, Sasaki (2005), they reported the 77% of the existing journals have the same type of summary as those that occurred in the previous month, and 98% can be sorted out by the automatic journalizing rules if it included specific characteristics of the company.
4) In conclusion of Nagai, Takahashi, Sasaki (2005), they commented "the experimental data was prepared based on a current journalizing data, and the experiment was conducted, with a cooperation of a tax accountant office, to make it a practically high level of process, we collect many account journalizing data (which were) occurred in real situation, and verify a practicality of the learning system of automatic journalizing knowledge (which were) developed in our research, and improve its learning system."
5) Japan Patent Office, Patent Publication (B2) (Patent No. 5936284)
6) [Summary of Invention]
[Problem to be solved by the invention]
[0006]
Although commercial accounts software is provided with the function required since it corresponds to such business-accounting business, the defect of being general-purpose software which can respond to the demand of various companies is also holding it.
[0007]
That is, the speediness which holds accounting in alignment with the principle of accrual basis on a daily basis is not searched for from all the companies that require accounting. When the applicant focused on not a major company but small and medium-sized enterprises, an independent contractor, etc., commercial accounts software found out that the function suitable for the actual condition could not be provided. The settlement of accounts for which small and medium-sized enterprises, an independent contractor, etc. are asked including Japan has only common once for a year, If the journal data and ledger data of what, needs to announce publicly without delay according to the law of law at the time of this settlement of accounts which were along the year at the principle of accrual basis at the time of one-time settlement are obtained, it is sufficient, and the journalizing processing of a daily base of an unnecessary flume is good.

Note : From Japan Patent Office, Patent Publication (B2) (Patent No. 5936284)

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Japan Patent Office, Patent Publication（B2）（Patent No. 5936284）

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Yoshiaki Nagai, Mitio Takahashi and Koji Sasaki.（2005）, “A Knowledge Discovery Method for Accounting Entry Classification Service”, *The 19th Annual Conference of the Japanese Sciery for Artificial Intelligence, 2005 Ronsyu*, JSAZ 105（0）, pp. 89-89.