Information Systems and e-Business Management (2020) 18:809–822
https://doi.org/10.1007/s10257-018-00398-0

ORIGINAL ARTICLE

Design process optimization and profit calculation module development simulation analysis of financial accounting information system based on particle swarm optimization (PSO)

Jianfei Shen[1] · **Lincong Han**[1]

Received: 8 December 2018 / Revised: 17 December 2018 / Accepted: 26 December 2018 /
Published online: 11 January 2019

Abstract

The rapid development of information technology and the tremendous changes of management ideas and management methods promote the continuous updating of management financial accounting system. The advantages of accounting information system are based on abundant data sources, timely business processing and fast transmission and reflection of all-round faithfulness. Based on the influence of information technology, this paper studies the related theories of process optimization and profit calculation module of financial accounting information system reconstruction by particle swarm optimization algorithm. The various data interfaces are gradually unified to better realize the sharing of information. The research shows that the particle swarm algorithm is used to compare the core functions of accounting information system (such as accounting, certificate filling, voucher review, voucher query, detailed ledger, general ledger, end-of-year carry-over, financial analysis, etc.). Calculation. Research shows that reorganizing accounting business processes can greatly improve the usefulness of accounting information decision-making, thereby enhancing the competitiveness of enterprises.

Keywords Particle swarm optimization algorithm · Financial accounting information system · Process optimization · Profit calculation module development

1 Introduction

Financial accounting information system is an important part of enterprise management information system (Taipaleenmaki and Ikaheimo 2013). China's accounting information system based on accounting standards and theoretical methods in

✉ Lincong Han
Hlincong@163.com

[1] School of Economics and Management, North China Electric Power University, Beijing, China

different periods has deeply imprinted the traces of different management methods and systems of enterprises in different stages (Michel et al. 2015). The development of accounting information system in China has gone through the stages of theoretical development and research of accounting information system, research and development of accounting information system, development of accounting information system and management of accounting information system (Oh et al. 2014) In the process of commercial implementation of lean operation, managers have gradually realized the importance of management accounting information system construction for enterprises to optimize resource allocation, reduce operating costs, and locate high-quality customers and superior products (De Waegenaere et al. 2015). Based on the accounting information system reengineering method: from the overall situation of market competition, through the analysis of the industrial value chain and the internal value chain of the enterprise (Bhimani et al. 2013). Restructure the company's process operation model and organizational structure with the aim of improving competitive advantage, satisfying customer needs, achieving rapid response to work processes, and agile patency. Therefore, it is better to serve the management of the entire enterprise (Crawley and Wahlen 2014).

In 2013, the challenges of management control and stakeholder theory in the SME environment were proposed (Järvenpää et al. 2013). In 2014. Owner and financial reporting information was studied as a predictor of bank loan bookings (Bhimani et al. 2014). After that, the theory of reliability and security distribution extension planning based on POS algorithm was proposed by relevant scholars (Aghaei et al. 2014) Since 2015, research on local financial accounting has been proposed (Brown and Jones 2015). The financial accounting information system is more special in terms of system design guiding ideology. The construction of financial accounting information system reflects the development trend of "transaction and accounting separation—transaction and accounting are getting closer—transaction and accounting need to be separated" (Lee et al. 2014). With the gradual deepening of enterprise informationization, the implementation of systems with high functional integration, full data sharing, and highly coordinated business processing, the original data of accounting is more directly collected by the business departments where data is generated (Kiani and Pourtakdoust 2015). Accounting sharing can be done, which simplifies the accounting business processing steps (Rahimikia et al. 2018).

Particle swarm optimization (PSO) algorithm is widely used in intelligent optimization algorithm, and its application potential is great. At present, it has been successfully applied in many fields, such as neural network training, model parameter determination and so on (Wang et al. 2015). In the process of setting up accounting subject system with assistant accounting, process optimization and profit calculation module are developed (Hung 2015). Even if the accounting method has not changed, in the case of business processing and accounting, the functional structure related to accounting in the system also needs to be redesigned (Kaspersen and Johansen 2016). Therefore, the accounting functions in the business system need to be separated to quickly respond to and support business changes and product innovation. From the point of view of modern management information systems, accounting information systems and models are inseparable (Hu and Yen 2015). The early accounting information system was only a simple data processing system, and the

current accounting information system has developed into an accounting information system that integrates data processing, transaction management and decision support. This paper is based on the analysis of financial accounting information system design process optimization and profit calculation module development based on particle swarm optimization algorithm (Mahmoodabadi et al. 2014).

2 Materials and methods

An improved particle swarm optimization (PSO) algorithm is proposed and tested with relevant standard test functions. The experimental results prove the feasibility and superiority of the new algorithm (Niknam et al. 2013). At the same time, this paper also gives different selection strategies for the important parameters in the algorithm, and tests and analyses them in order to find a more appropriate selection strategy. It has an important influence on the setting of accounting subjects. Simplifying and stabilizing the overall system of accounting subjects and developing the process optimization and profit calculation module are the advantages of assistant accounting. The pre-established auxiliary project information can be shared by different accounting information users. The interaction between project information and subjects becomes the accounting book system. Particle swarm optimization (PSO) can be used as an ideal tool to build models by means of cost driver selection, cost behavior analysis and cost prediction tools. For example, in the application of the financial function, the function can conveniently calculate the depreciation of fixed assets according to the straight-line method, and the depreciation of fixed assets can be calculated according to the sum of years method. The function can be used to calculate the depreciation of fixed assets according to the double-declining balance method. The time value of the real-time and final value of the compound interest can be calculated separately. The function can calculate the internal rate of return and the net present value in the investment decision. Focus on system compatibility and openness, and the system is more in-depth application of distributed, database and other technologies, and realize the management functions of accounting information system information collection, accounting processing and internal control throughout the value chain. When the enterprise's weighted average score falls within a certain score interval, the corresponding model should be adopted as shown in Table 1 and Fig. 1. The information feedback rate for the financial accounting information system is shown in Table 2 and Fig. 2.

Table 1 Assessment of enterprise receipt maturity

	Basic value	Optimization value
Process control	22	83
Time control	28	86
Plan compilation	29	91
Business integration	33	99

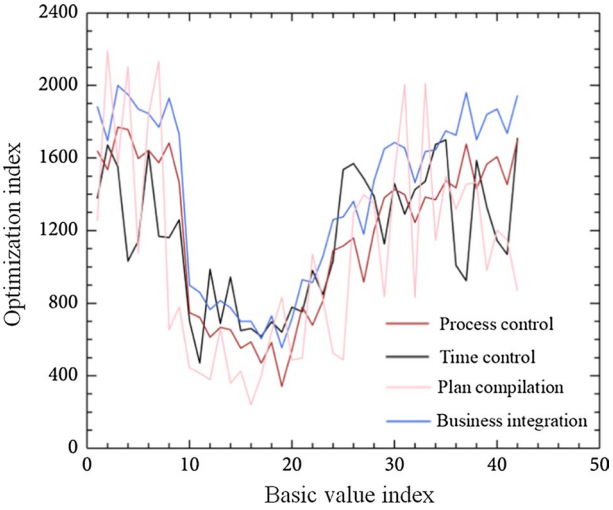

Fig. 1 Assessment of enterprise receipt maturity

Table 2 Information feedback rate of financial accounting information system

	Control device	Controlled object
Input quantity	11.96	12.34
Output	8.15	12.33

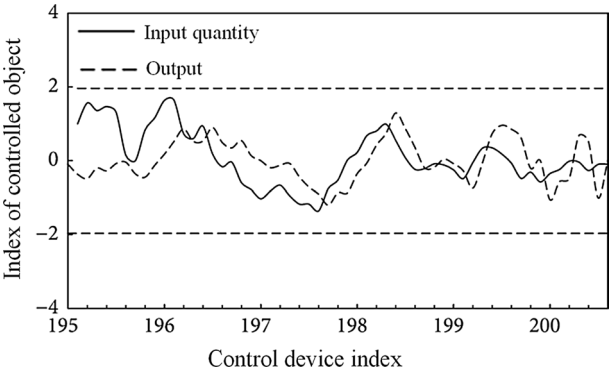

Fig. 2 Information feedback rate of financial accounting information system

We find that based on social informatization and enterprise informatization, with the help of the powerful function of financial accounting technology, real-time accounting information system can achieve the coordination and synchronization of enterprise financial activities and business activities. From the perspective of the whole industry, this paper analyses the industrial value chain, aiming at optimizing

Table 3 Sample data content of an enterprise external database

Valuation standard	Depreciation	Cost of inventory sales
Historical cost	63.41	58.63
Replacement cost	61.28	55.31

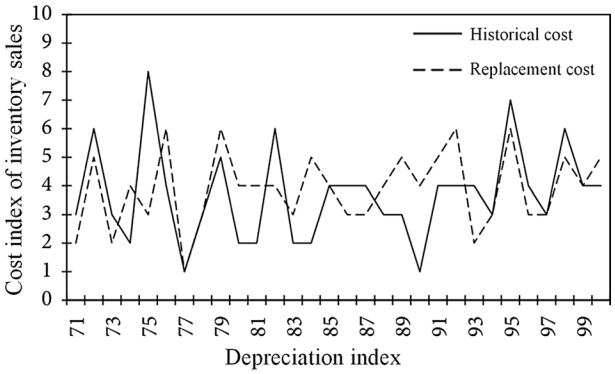

Fig. 3 Sample data content of an enterprise external database

the industrial process, achieving agility and smoothness, tacit cooperation among enterprises and maximizing the industrial profits, and looking for their ideal partners. When building management information system, we should first consider the process optimization and profit calculation module development of the system, and secondly consider improving the optimization degree of the whole value chain. The software process implemented by any unit "may be more mature in one aspect" and not mature in another aspect "but it must belong to a certain level in the hierarchy as a whole. There is also a difference in maturity within a certain level. It is likely that the upper edge of a lower level is close to a lower level of a higher level, and it is easier to evolve from this lower level to the higher level. Conversely, it is more difficult to evolve to a higher level at a lower level. At the same time, the accounting information system and other subsystems of the enterprise have the following significant points: the huge complexity of the system and the strict internal control. The accounting procedures are normative and scientific, and there is a certain system linkage with other systems. The sample data content of an enterprise external database is shown in Table 3 and Fig. 3. Since the users of the accounting information system make information-centric decisions, we should use the information that the users need as events as shown in Table 4 and Fig. 4.

We find that although event accounting information system is called the development direction of future accounting information system, its inherent theoretical defects have been hindering its further development (Stoppato et al. 2014). Especially, compared with the rigorous logic of current value accounting, the concept of event law is relatively arbitrary and generalized. Today, with the continuous development

Table 4 Event driven program

	Enterprise information	Task value
User requirement information input	32.64	36.55
Output of user requirements information	29.16	17.71

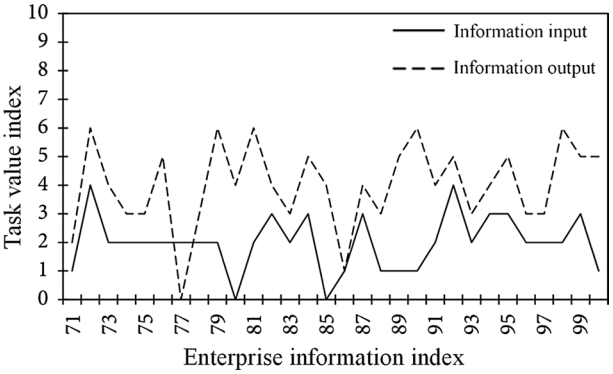

Fig. 4 Event driven program

of economy and technology, the focus of the research on event law is not the specific technical realization problem. The deep reason for hindering its development is the imperfect theory. Any software development unit can only evolve from its own level to the next level when devoting itself to the improvement of software process, that is, the evolution of software process is gradual rather than jumping. Moreover, those existing capabilities in the original level when evolved from a mature level to a more mature level should be maintained and carried forward in the course of business activities such as supply, production, sales, control, and pre-operation. At every node, every kind of information is generated every moment. If accompanied by financial information, the company must promptly send this information into the financial system for calculation and processing, optimize the process and feedback the results to the business system, ensure the coordinated processing of financial services and integrate various management information. On the other hand, its existing business operation model determines that it is impossible to send key employees to undertake our projects. Thirdly, although individual software companies have been developing and practicing related aspects, their product functions are mostly single. It's just a simple report query, summary and financial ratio analysis, and more for manufacturing. The convergence values of the particle swarm optimization algorithm in the financial accounting information system are shown in Table 5 and Fig. 5. The particle swarm optimization algorithm calculates the test function results as shown in Table 6 and Fig. 6.

Table 5 Convergence number of particle swarm optimization in financial accounting information system

	Iteration times	Fitness value
Particle swarm optimization	35.31	19.21

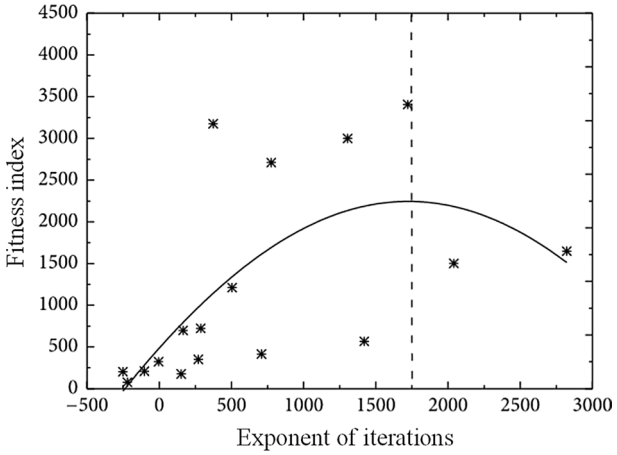

Fig. 5 Convergence number of particle swarm optimization in financial accounting information system

Table 6 Particle swarm optimization algorithm for calculating test function results

Function	Search space	Best position
Function 1	15.63 ± 35.31	19.61 ± 41.21
Function 2	17.62 ± 36.61	21.52 ± 43.97
Function 3	8.31 ± 40.21	12.34 ± 43.31

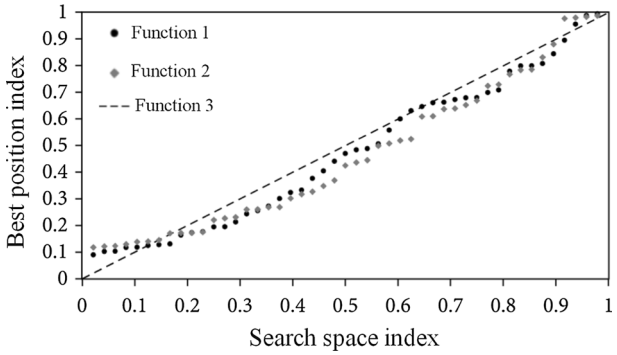

Fig. 6 Particle swarm optimization algorithm for calculating test function results

3 Result analysis and discussion

It is precisely because the management accounting information system is largely based on the deep processing of accounting system data. At the beginning of the system construction, we put a lot of energy into adjusting and improving the basic information of the original accounting system. In order to fully understand the operation effect and efficiency of the basic data provided by the original accounting system, it conforms to applicable laws and regulations. The criterion divides internal control into five components: control environment, risk assessment, control activities, information and communication, and monitoring. Because enterprises need to establish customer-oriented management information system in order to make timely response to customers, the accounting information system of enterprises must also meet and serve this requirement. Therefore, real-time accounting information system is no longer a simple simulation manual system. It is also a "smart" system for human–computer interaction. In the face of fierce market competition and challenges, enterprises urgently need to establish an "intelligent" accounting expert system that combines calculation, forecasting and decision-making functions. Typical characteristics of the basic level model! The business event boundaries are clearer. "Single business event design process control" There is no process control between business events. There is no document level audit control between business events. Design Process Optimization and Profitability Module Management Presents Loose Business with Low Coupling Status This model applies to business events that have been basically standardized. Establish an enterprise that uses the basic order of internal control. Inertia weight is an extremely important parameter in the particle swarm optimization algorithm. When it is small, it will enhance the local search ability of the algorithm. When it is large, it will enhance the global search ability of the algorithm, so the selection of its value directly affects the optimization ability of the algorithm. The experimental results of the inertia weighting strategy are shown in Table 7 and Fig. 7. The information processing flow chart (Fig. 8) of the financial business integration is shown.

Set up the calculation formula of the system table and select it through the wizard function provided by the system:

$$G^m = \left[G_1^T, G_2^T, \ldots, G_k^T\right]^T \tag{1}$$

By adjusting the value of inertia weight, the algorithm can achieve an effective balance between global search and local search, so as to improve the search ability of the algorithm. Corresponding Velocity Updating Formula:

Table 7 Experimental results of inertial weight strategy

	Average optimal value	Convergence rate
Fixed strategy	19	8.3
Linear strategy	25	9.1

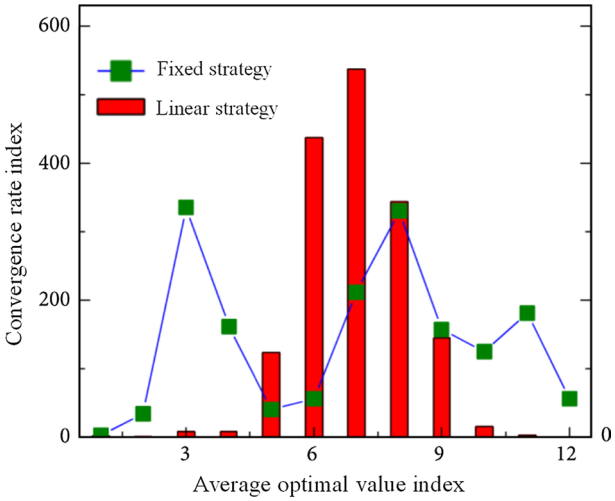

Fig. 7 Experimental results of inertial weight strategy

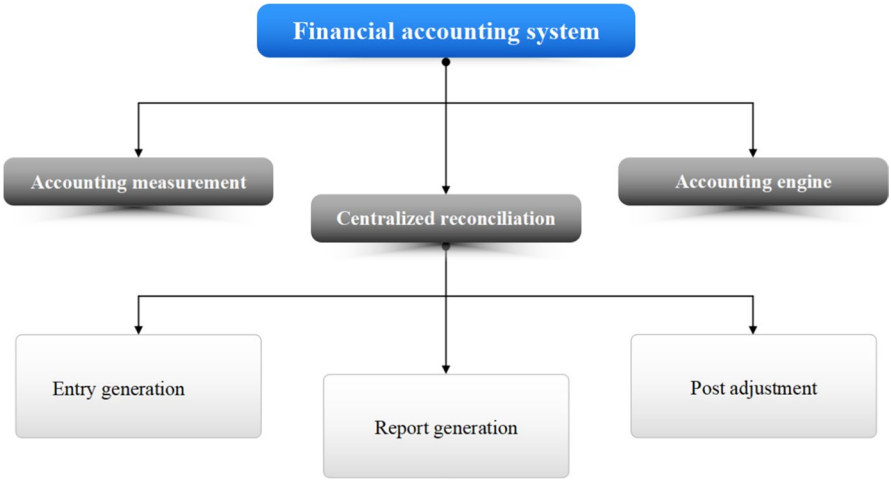

Fig. 8 Information processing process of financial business integration

$$A^T G = \sum_i A_i^T G_i \tag{2}$$

By properly choosing these controllable parameters, the corresponding algorithm speed update formula can be expressed as:

$$G_i^{(m)} = \begin{cases} I_m, & i = m \\ 0_m, & i \neq m \end{cases} \tag{3}$$

Evaluate the initial fitness of each particle, preserve the historical optimal position of the initial particle and the historical optimal position of the initial population:

$$S_1 = R_1 = \left[G^1, G^2, \ldots, G^k\right] \tag{4}$$

Calculate the fitness of all particles after updating:

$$S^* = \arg\{f(S)\} = \sum_{i=1}^{n} \max\left\{\left(T_{s_{m,j},m} - D_{s_{m,j}}\right), 0\right\} \to \min \tag{5}$$

The fitness of each particle is compared with its historically optimal position:

$$c\left(j_1, 1\right) = t_{j_1 1} \tag{6}$$

The velocity and position of each individual are updated according to the population velocity and position update formula:

$$c\left(j_1, k\right) = c\left(j_1, k-1\right) + t_{j_1 k}, \quad k = 2, \ldots, m \tag{7}$$

To update the target individual, two vectors are compared:

$$c_{\max} = c\left(j_n, m\right) \tag{8}$$

$$a_i = (\tau_i - \tau_{i-1})/(\rho_i \mathrm{h_i}) \tag{9}$$

In order to judge whether the aggregation degree of particles reaches a certain limit, the aggregation degree factor of particles is introduced as the criterion of its limit:

$$x_l = \langle w, g_l \rangle \tag{10}$$

$$l = (i, x, y) \tag{11}$$

Adding a constant term to each objective:

$$z_l = v_i \cdot x_l + t_i \tag{12}$$

Considering boundary conditions:

$$\mathbf{M}_{AB}(\psi) = \left\{\psi_{j,\ell,k}(x) = |\det \mathbf{A}|^{j/2} \psi(\mathbf{B}^{\ell}\mathbf{A}^j x - k), j, \ell \in \mathbb{Z}, k \in \mathbb{Z}^2\right\} \tag{13}$$

The solution of the system model can be obtained as follows:

$$\mu_{s,d} = \frac{1}{MN} \sum_{m=1}^{M} \sum_{n=1}^{N} \left|W_{s,d}(m,n)\right| \tag{14}$$

In this paper, the framework of activity-based accounting information system is designed with the concept of activity management and event accounting theory mentioned above. Secondly, after the business pipeline enters the unified data platform, it needs to standardize the data, and then input the accounting business module. Unified data platform mainly extracts and transforms the detailed data of

Table 8 Results of optimization

Parameter	Seeking value	Absolute error
A1	0.2011	0.001
A2	0.3214	0.012
A3	0.4136	0.009

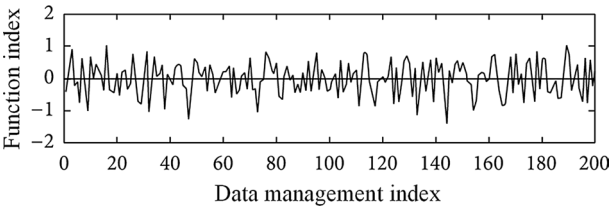

Fig. 9 Trend map of automatic generation of accounting information

business transactions received, and realizes the transmission and standardization of transaction data. The key of data transmission layer is to ensure the integrity and consistency of data transmission; the standardization of transaction data is mainly to verify and integrate the information of different accounting dimensions. This paper makes an analysis of the operation process optimization of the profit calculation module of enterprise accounting activities. Change the concept of function, redesign the accounting process of the enterprise, and always aim at improving performance, thereby improving the quality of accounting information and improving the efficiency of accounting information reporting. In the process of reorganization, we will use information technology to analyze every operation in the accounting activity process around the goal of the accounting information system. Retain value-added operations, improve or remove invalid jobs, and optimize the workflow of accounting activities. The enterprise information system we designed here is based on the accounting information system. At this time, the job-based accounting information system can record the job performance by directly recording the input, output, and efficiency data of the job, and simultaneously recording the financial information and the non-financial information in the job database. The results of the particle swarm optimization algorithm in the financial accounting information system optimization values are shown in Table 8. The accounting information is automatically generated as shown in Fig. 9.

Enterprise financial personnel can make statistical analysis of the auxiliary accounting information through the accounting information system from various aspects and angles. Particle swarm optimization (PSO) algorithm is used to optimize the population globally and reduce the solution space. Then the simplex is constructed by the historical optimal position of some particles with better fitness value optimized by PSO. According to the idea of simplex algorithm, the historical optimal position of particles is updated and the fitness value of each particle is calculated. In the discussion of deep excavation of cross-design according to departments and personnel. According to this function, it can provide information users with the

following four aspects of sample comparative analysis: sample comparative analysis of the management costs of personnel in different departments. Sampling and comparative analysis of the management cost of all personnel in different departments. Sampling and comparing the management expenses of each staff in different departments and professional accounting software to achieve the above functions requires a large number of programming in professional programming languages. Not only is it difficult and the programming workload is quite large, but it also provides limited data analysis and processing functions, and lacks strain adjustment capability and flexibility in practical use. Based on the secondary development of the particle swarm optimization algorithm, the accounting information system can easily design various data processing models. The system can be easily and flexibly solved by the system's rich data analysis tools. The accounting information feature system in the financial accounting information system is shown in Fig. 10.

4 Conclusion

Based on the basic theory of accounting information system by using particle swarm optimization algorithm, this paper studies the guiding significance of establishing accounting information system. This paper demonstrates the importance of system reconfiguration based on system design process optimization and profit calculation module development business changes. At the same time, users of financial information can execute their own process processing programs by event-driven way, and get real-time financial processing results. Therefore, the functions of the enterprise organization will be more detailed and precise, and the efficiency of business processing and the integration of functions between departments will be realized. Researchers and financial personnel must change the concept of investigating the functions of accounting information systems from

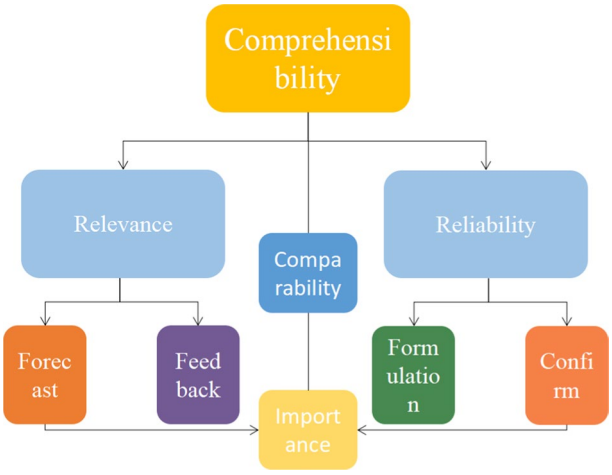

Fig. 10 Characteristic system of accounting information

the perspective of traditional accounting management, and turn their attention to the data management functions of accounting information systems and powerful financial data processing functions. Applying them fully to realize the value applied to accounting and management, at this time, the innovative auxiliary accounting function of the accounting information system can be appropriately and timely applied to daily business management. Secondly, it is necessary to be able to truly use the auxiliary accounting function and integrate its functions into the management accounting of the enterprise to play its due role.

References

Aghaei J, Muttaqi KM, Azizivahed A et al (2014) Distribution expansion planning considering reliability and security of energy using modified PSO (particle swarm optimization) algorithm. Energy 65(2):398–411

Bhimani A, Gulamhussen MA, Lopes SDR (2013) The role of financial, macroeconomic, and non-financial information in bank loan default timing prediction. Eur Account Rev 22(4):739–763

Bhimani A, Gulamhussen MA, Lopes SDR (2014) Owner liability and financial reporting information as predictors of firm default in bank loans. Rev Account Stud 19(2):769–804

Brown R, Jones M (2015) Mapping and exploring the topography of contemporary financial accounting research. Br Account Rev 47(3):237–261

Crawley M, Wahlen J (2014) Analytics in empirical/archival financial accounting research. Bus Horiz 57(5):583–593

De Waegenaere A, Sansing R, Wielhouwer JL (2015) Financial accounting effects of tax aggressiveness: contracting and measurement. Contemp Account Res 32(1):223–242

Hu W, Yen GG (2015) Adaptive multiobjective particle swarm optimization based on parallel cell coordinate system. IEEE Trans Evol Comput 19(1):1–18

Hung J-C (2015) Robust Kalman filter based on a fuzzy GARCH model to forecast volatility using particle swarm optimization. Soft Comput 19(10):2861–2869

Järvenpää M, Teittinen H, Pellinen J (2013) ERP in action—challenges and benefits for management control in SME context. Int J Account Inf Syst 14(4):278–296

Kaspersen M, Johansen TR (2016) Changing social and environmental reporting systems. J Bus Ethics 135(4):731–749

Kiani M, Pourtakdoust SH (2015) State estimation of nonlinear dynamic systems using weighted variance-based adaptive particle swarm optimization. Appl Soft Comput 34:1–17

Lee YL, Elsaleh AA, Ismail M (2014) Gravity-based particle swarm optimization with hybrid cooperative swarm approach for global optimization. J Intell Fuzzy Syst 26(1):465–481

Mahmoodabadi MJ, Salahshoor Mottaghi Z, Bagheri A (2014) HEPSO: high exploration particle swarm optimization. Inf Sci 273(18):101–111

Michel M, Menini A, Parbonetti A (2015) Fair value accounting: information or confusion for financial markets? Rev Account Stud 20(1):559–591

Niknam T, Narimani MR, Jabbari M (2013) Dynamic optimal power flow using hybrid particle swarm optimization and simulated annealing. Int Trans Electr Energy Syst 23(7):975–1001

Oh K, Choi W, Jeong SW et al (2014) The effect of different levels of internal control over financial reporting regulation on the quality of accounting information: evidence from Korea. Asia Pac J Account Econ 21(4):412–442

Rahimikia E, Mohammadi S, Rahmani T et al (2018) Detecting corporate tax evasion using a hybrid intelligent system: a case study of Iran. Int J Account Inf Syst 25:1–17

Stoppato A, Cavazzini G et al (2014) A PSO (particle swarm optimization)-based model for the optimal management of a small PV (Photovoltaic)-pump hydro energy storage in a rural dry area. Energy 76:168–174

Taipaleenmaki J, Ikaheimo S (2013) On the convergence of management accounting and financial accounting—the role of information technology in accounting change. Int J Account Inf Syst 14(4):321–348

Wang L, Geng H, Liu P et al (2015) Particle swarm optimization based dictionary learning for remote sensing big data. Knowl Based Syst 79:43–50