

A Fuzzy Approach for the Evaluation of Accounting Information Quality under Big Data Environmental——Case Study from China

Xiao-Juan WANG^{1,2,3,a,*}, Ying-Hong WAN^{1,2,b}, Lan-Lan DONG^{1,2,c}, Hong-Jun LV^{1,2,d}

¹School of Management, Xi'an Jiaotong University, China, 710049, China

²Experiment Center for Management Teaching & Learning, Xi'an Jiaotong University (Demo-Center at State Level for Experiment Teaching), China

³School of Finance and Economics, Tibet Institute for Nationalities, China, 712082

^awxjsfping_ok@126.com, ^byinghw@xjtu.edu.cn, ^c923262895@qq.com, ^d68327386@qq.com

*Corresponding author

Keywords: Big data, Accounting information quality, Indicator system, Evaluation study, Fuzzy logic, Fuzzy set, Fuzzy approach.

Abstract. The evaluation of accounting information quality is very important to the development of enterprise, especially, under the large data environmental. This paper based on the previous studies, combination the characteristics of big data to build an accounting information quality evaluation index system under big data environment. The evaluation system of accounting information quality includes fourteen indicators of four aspects that are reliability, correlation, timeliness and integrity. Then, we constructed five examples come from China to test and verify the accounting information quality evaluation index system by fuzzy approach, and the examples demonstrates the rationality and feasibility of the evaluation index system. Research findings have a certain theoretical and practical significance to the evaluation of accounting information quality under big data environment.

Introduction

The quality of accounting information refers to the sum of the accounting information to fit the needs of user's information provided by the accounting entity, and these accounting information should have common characteristics, including the quality of accounting information content and the quality of accounting information presentation and disclosure (Rongzhen Z & Zhian L, 2008)[1]. Accounting information is an important basis for business decisions, the quality of accounting information directly affect the efficiency of the market and national economic regulation, it related with the interests of investors, rapid economic development and social stability (Xiuqing Z and Xinxiu Z, 2008)[2]. With the advent of big data era, many researches have been focusing discussion the impact of big data on the business accounting information quality. Facing large amounts of data resources, it has become a major issue to be solved that was how to find and query data and information which was useful, timely, complete and reliable, and how to scientific and effective evaluation the quality of accounting information under big data environment.

There are many research on the issue, and most of them has focused on various perspectives and methods, and most research are based on qualitative research that can not accurately and objectively reflect the real issues of accounting information quality evaluation, and much of the accounting information related to quality is not quantifiable and precise with crisp boundaries. Rather, much of information can't be accurately represent or reveal the natural language. In view of this, this paper based on previous studies, combined with the characteristics of big data, proposed the accounting information quality evaluation index system for enterprise under the big data environment, proposes case study of china for evaluation system of accounting information quality based on fourteen specific evaluation criteria using a fuzzy approach, and the result indicate the rationality and feasibility of the indicators system. On the one hand, this paper calls attention to an alternative

method of the evaluation system as opposed to the traditional quantitative methods. On the other hand, the research has some theoretical and practical significance for the evaluation of accounting information quality under big data environment, and it also important to the related research of the accounting information quality.

Literature review

There exists a vast research works about accounting information quality. International Accounting Standards Committee (IASC) proposed ten quality characteristics of accounting information, it were comparable importance , understandability, relevance, neutrality, prudence , reliability, truthfully , integrity , substance over form , etc. , and the high-quality accounting information must comply with four aspects of the quality characteristics: understood , relevance , reliability and comparability , meanwhile, in which, cost- effectiveness and timeliness as a limiting factor[3]. UK Accounting Standards Board (ASB) published in 1999, " the announcement of financial reporting principles ", in which the quality characteristics of accounting information can be divided into: the quality on content of the financial statements information (mainly refers to the relevance and reliability) and the quality related information " expression" in financial statements (mainly refers to the comparability, consistency, understandability, and timeliness of disclosure, etc.)[4]. ME Barth et al (2001) and PM Dechow and ID Dichev (2002) to measure the degree of accuracy by predicting future cash flows, the quality of accounting information[5]. Barton and Waymire (2004) consider the trustworthiness and transparency of financial reporting is evaluation criteria, through the profit and loss account and balance sheet transparency to evaluate the financial statements, and presented the quantitative evaluation ideas [6].

Besides, Liqing L &Shi Ping (2005) established a measure of indicators system of the accounting information quality from a quantitative point of view, including the extent of full disclosure, degree of consistency in accounting policy, the quality of the cash flow and the quality of income asset, a total of 18 indicators of four areas, and test the indicator system by listed company empirical data [7]. Xiu-e Y (2006) builds a corporate accounting information quality evaluation system, including nine indicators in two fields that are reliability and relevance by using AHP and fuzzy comprehensive evaluation method [8]. Rongzhen D&Zhian L(2008) based on the perspective of government regulation, constructed ten index in accounting information quality evaluation system from authenticity, comparability, relevance; Shizhong Y (2008) divided the quality of accounting information system into financial accounting information quality system and management accounting information quality system , in which financial accounting information quality system consists of sixteen indicators, management accounting information quality system consists of twelve indicators[9]; Wenxuan D (2009) structure nine indicators of information quality from disclosure quality and earnings accounting information, qualitative and quantitative analysis methods to combine the fuzzy comprehensive evaluation theory, building the accounting information quality evaluation model, and using the model to evaluate a company's accounting information quality[10]; Yucui W and Nannan K (2010) using fuzzy comprehensive evaluation method from eight indicators of reliability and relevance to evaluate the quality of accounting information[11]; Chuan M (2011) evaluated accounting information quality based on entropy method[12]; Hong Xu &Nan Xiao, etc. (2012) from relevance and reliability analyzes the factors that affect the quality of accounting information, and established a quality assurance , including five areas of cash , asset quality, earnings quality , corporate governance, authenticity, a total of sixteen indicators of accounting information quality assessment[13]; Mingtao W, Ying L and Yao S (2012) evaluated the quality of accounting information based on projection pursuit model, including eight indicators of relevance, reliability[14]; Yucui W and Nanna K et al (2012)using artificial neural network evaluation method to evaluate the effectiveness of accounting information quality, building accounting information quality evaluation index system from authenticity, relevance, comprehensiveness , timeliness four aspects[15]; Ping B(2012) constructed quality of accounting information systems by using AHP and poor law changes under the perspective of investor protection, including thirteen indicators in three parts, that is financial reporting quality, quality of

information disclosure and audit quality [16], and so on.

Table1 Accounting information quality evaluation system under a large data environment

Target layer	Elements layer	Index layer	Indicator Description	
Accounting information quality evaluation system under a large data environment	Reliability	Authenticity of accounting information	Normative basic accounting, operational quality of accounting staff the perfection of corporate governance structure, internal control system, Government departments and other law enforcement inspection etc.	
		Prudence of accounting information	Rationality in Asset impairment provision, Something recognized rationality as well as the objective reasonableness on the analysis of major investment projects	
		Substance over form on Accounting Information	The substance of revenue recognition follows the business, Relationships Identified on related party , substance situation of follows the business on the deal with business combination and asset restructuring	
	Correlation	Importance of accounting information	The level of detail in the financial statements on the major financial issues analysis	
		Comparability of accounting information	Accounting Policies, Changes in accounting estimates	
		Clarity of accounting information	the clear level of information expression meaning	
	Timeliness	Timeliness of financial reporting disclosures	Timeliness of financial reporting disclosures	Timely of the financial report disclosure
			Timeliness of accounting business processing	Timely of accounting business processing
			Timeliness of significant events notice	Timely notice on the significant events
		Integrity	Timeliness of additional information reflects	timely manner on the additional information reflects
Integrity of annual information disclosure			Whether annual information is fully disclosed	
Integrity of accounting policies, changes in accounting estimates disclosure			whether adequate disclosure the accounting policies, accounting estimates change	
Integrity of matters disclosed			whether disclosures fully on the related matters	
Integrity of the related party transactions disclosed	whether disclosures fully on related party transactions			

Based on previous research, this paper has some differences from previous studies on the enterprise information quality evaluation system. Firstly, the background of this paper is big data environment. Under big data environment, accounting data have the characteristics of timeliness, accuracy, centralization and automation, diverse of data sources, data processing capacity and etc.. Combined with the characteristics of big data (4V), the vast amounts of data will affect the integrity, timeliness, relevance and authenticity of accounting information quality and so on. In view of this, this paper evaluates the quality of accounting information from completeness, timeliness, relevance, and reliability of the four aspects. Again, A fuzzy approach is a comprehensive evaluation method based on fuzzy mathematics, according to the theory of fuzzy mathematics degree of membership of the qualitative evaluation into quantitative evaluation, which uses fuzzy math to a variety of factors constraining things or objects to make a general evaluation, it has a clear result, systematic

and strong features, can solve vague, difficult quantify problem, it is suitable for solving a variety of non-deterministic problem. Fuzzy control is used to optimize the number of shifts under the constraints of input variables. Paul and Azeem (2010b) used fuzzy sets and logic to tackle uncertainties inherent in actual flow shop scheduling problems to minimize work-in-process inventory. In this paper, indicators included are also fuzzy, it is difficult to establish and measure a qualitative or a quantify indictor. Given the fuzzy method characteristics, the main fuzzy approach based on five enterprises case which were about accounting information quality in china were selected for constructing and test the quality of accounting information evaluation index system under big data environments.

According to the previous studies, this paper proposed evaluation index system of enterprise accounting information quality under big data environment from four aspects: reliability, correlation, timeliness, and integrity, and a total of 14 indicators. Specific indicators are shown in Table 1.

Methodology and application

The model proposed in this research utilizes fuzzy inference system (FIS) which is an optimization technique that considers different inputs and relates those inputs with output with some rules. Rules indicate the relationship between inputs and outputs. The output is optimized based on relationship between variables. The final output is obtained from the aggregated optimized result of individual rule. Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned.

In Fuzzy Logic Toolbox, there are five parts of the fuzzy inference process: Stage 1, fuzzification of the input variables; Stage 2, application of the fuzzy operator (AND or OR) in the antecedent; Stage 3 implication from the antecedent to the consequent; Stage 4 aggregation of the consequents across the rules; Stage 5, defuzzification.

The fuzzy inference diagram is the composite of all the smaller diagrams presented so far in this section. It simultaneously displays all parts of the fuzzy inference process; Figure 1 presents the description of fuzzy inference system. Information flows through the fuzzy inference diagram is shown in Figure 2. In Figure 2, the flow proceeds up from the inputs in the lower left, then across each row, or rule, and then down the rule outputs to finish in the lower right. This compact flow shows everything at once, from linguistic variable fuzzification all the way through defuzzification of the aggregate output.

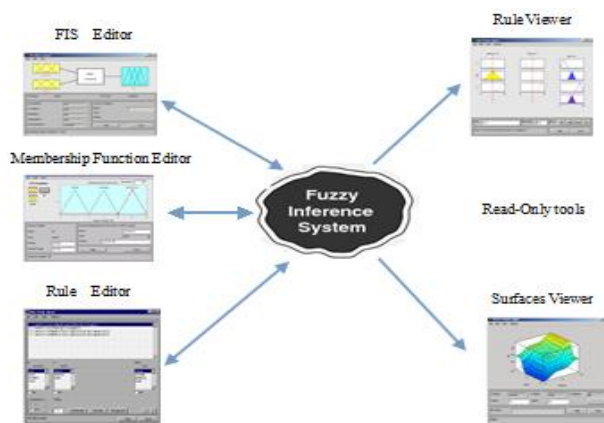


Figure 1. Fuzzy inference system

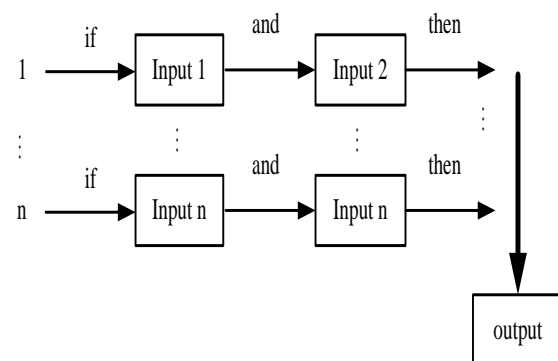


Figure 2. Interpretation of fuzzy inference diagram

In this paper, during the generation of the fuzzy model's linguistic variables, accounting information quality evaluation system includes 14 indicators of four areas. These are the most important and commonly used criteria for quality evaluation and hence considered for model formulation. Moreover the appraisal rule for each of the considered criteria is also obtained from the

information gathered during authors' visit. For each of these criteria four linguistic variables are developed which are used for evaluating accounting information quality. For all of these inputs in the model the linguistic variables used are "low," "medium," and "high". For the output termed as "accounting information quality index" five linguistic variables are considered which are termed as "very low," "low," "medium," "high," "very high". The range and boundary values considered for linguistic variables could be unique to specific enterprises. Here these values are taken to relate the model of five enterprises.

The FIS for proposed model is shown in Figure 3, from which we can see the input and output variables in general. After the membership functions and linguistic variables for both input and output are entered, the rules are designated and written in MATLAB Fuzzy Toolbox for evaluation. When all the needed data are entered, inputs are solved according to changing input positions for solving of fuzzified systems.

Result analysis and findings

To judge the model just formulated data of five enterprises termed as "C₁", "C₂", "C₃,"C₄" and "C₅", collected from the accounting information quality of enterprises, has been considered and the result is then analyzed on the basis of the data. The input data for these five enterprises are shown in Table 2 and results obtained from the fuzzy model is shown in Table 3. Enterprises who obtained the evaluation scores of the accounting information quality is ranked in table 3.

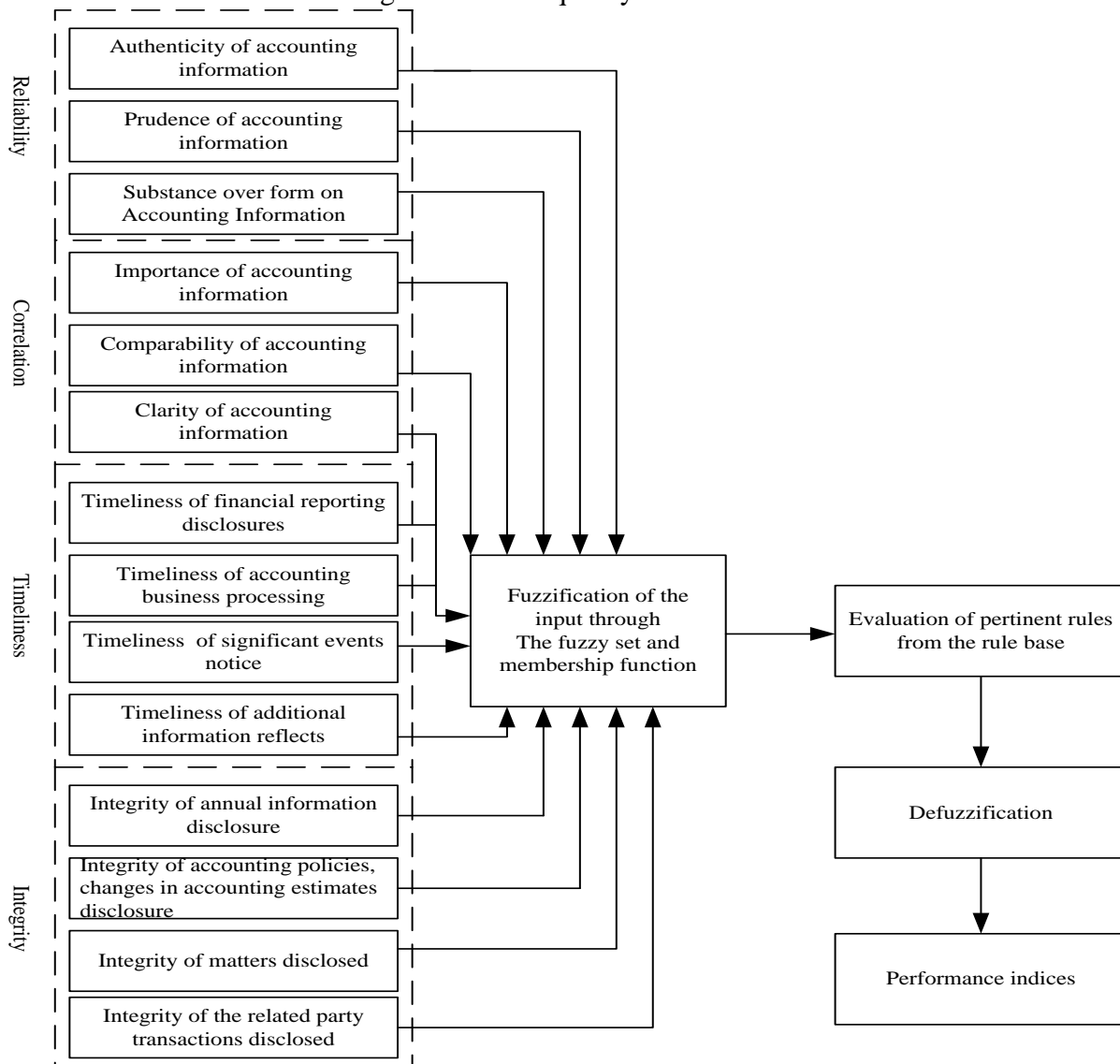


Figure 3. Fuzzy model of proposed system

Table 2 Data of five enterprises

Input parameters	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Enterprises														
C ₁	7	6	7	6	7	7	8	7	8	8	7	8	7	7
C ₂	6	6	5	5	6	6	5	6	7	6	5	6	6	5
C ₃	8	7	7	7	8	8	8	9	8	8	7	9	8	7
C ₄	7	6	7	7	6	8	6	8	7	7	6	7	7	6
C ₅	6	7	7	6	7	7	8	7	8	7	7	7	7	8

Table 3 Results obtained from the fuzzy model

enterprise	Fuzzy results(performance indices)	Accounting information quality ranking
C1	0.664	4
C2	0.571	5
C3	0.779	1
C4	0.678	3
C5	0.707	2

The results obtained from the fuzzy model are show in table 3,from the table, we can see that the ranking of enterprises “C₁,”“C₂,”“C₃,”“C₄,”“C₅” is”4”, “5”, “1”, “3”, “2”, and the highest score on the accounting information quality is enterprise “C₃”, then is “C₅”, “C₄” “C₁”and”C₂”. The result were consistence with the evaluation findings by experts on the accounting information quality of the five enterprises in practice, and the results of a fuzzy approach using in this paper illustrate the rationality and feasibility of the index system from another way.

Conclusions

This paper building an accounting information quality evaluation index system under the big data environment by a fuzzy approach, based on previous studies and combined with the characteristics of big data, constructing 14 indicators in four areas(reliability, completeness, relevance and timeliness),and the results reflect the reasonableness and feasibility of the accounting information quality evaluate indicator system . Fourteen input variables of five enterprises are considered to determine the result, for each input and output variable triangular membership functions are considered to design the model. Other membership functions also may be considered to design the model based on the results of this paper, it shows that the greatest impact factor for enterprise accounting information quality is reliability, and then it is integrity, correlation and timeliness. The results is similar to Zhancheng L (2008); however, it is different from the studies of Rongzhen Z and Zhian L (2008)as well as Muhua C and Hainan L (2013) ,in their research, they considered the most important is reliability , then followed by the correlation, completeness and timeliness. Chase the reason, maybe the research on the accounting information quality under the big data environment, and the relationship between big data and enterprise gradually increased, its impact is profound to the business, especially on the accounting information. Big data is not only affects the quality of the content of the accounting information, but also affect the application of accounting information quality evaluation in practice. The results are consistent with the enterprises’ accounting information quality evaluation in practical environment, meanwhile, it illustrates that the reasonable of indicator system constructed and it’s feasibility in practice.

References

[1]Rongzhen Z & Zhian L...An evaluation of accounting information quality system - based on the

- perspective of government regulation. *Journal of Accounting Communications in China*, 8(2008), 26-27.
- [2]Xiuqing Z & Xinxiu Z.. Quality of accounting information listed on fuzzy comprehensive evaluation. *Journal of Statistics and Decision in China*, 23(2008), 173-175.
- [3] IASC.. *International Accounting Standards: China Accounting Standards Committee (translation)*. China. Financial and Economic Publishing House, 27(2000).
- [4] ASB. (1999). *Statement of Principles for Financial Reporting*.
- [5] PM Decho & ID Dichev. (2002)The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review*.
- [6]Barton and Wymire. (2004). Investor Protection under unregulated financial reporting. *Journal of Accounting and Economica*.
- [7]Li qing L& Ping S. Measure accounting information quality and comprehensive evaluation index system.. *Journal of Taiyuan University of Technology (Social Science Edition) in China*, 23(2005), 52-56.
- [8]Xiu-e Y..Chinese listed companies accounting information quality evaluation methods an applications. North Electric Power University master's degree thesis in China. 2006.
- [9]Shizhong Y. Evaluation and identification of the quality of accounting information. *Learned journal of Shanghai Lixin University in China*, 4(2008), 18-22.
- [10]Wenxuan D. Enterprise accounting information quality evaluation methods and applied research. Zhongnan University master's degree thesis in China. 2009.
- [11]Yucui W, Nannan K . Accounting information quality evaluation model. *Journal of Liaoning Technical University (Social Science Edition) in China*, 12 (2010), 2: 151- 154.
- [12]Chuan M. Evaluation based on the quality of accounting information entropy method. *Journal of Mathematics Practice and Theory in China*, 41(2011), 13:59-63.
- [13]Hong X., Nan X & Mingrong C.. Accounting Information quality evaluation system. *Journal of Economic and Management Research in China*, 11(2012)122- 128.
- [14]Mingtao W, Ying L& Yao S. Evaluation the quality of accounting information based on projection pursuit model .*Learned Journal of the University of Liaoning Technical University (Social Science Edition) in China*,14(2012),4:383 -385.
- [15]Yucui W, Nanna K, etc. Listed company accounting information quality evaluation system construction and empirical research. *Journal of Value Engineering in China*, 14 (2012), 96- 97.
- [16]Ping B. Several basic theoretical issues of accounting information quality evaluation. *Journal of Accounting Monthly in China*, 3(2012):89 -91.