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Recognition of Data Assets in Financial Statements: A Systematic Literature Review on Concept Discrimination, Accounting Treatment and Management Systems

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Abstract

In the context of the rapidly growing digital economy, data has become an essential component of production, and the recognition of data assets in financial statements and the related accounting problems have also drawn much of the attention of scholars and the business world. It is through this research that a systematic literature review methodology is used to follow the conceptual development and definitional requirements of data assets in the local, as well as in global environments, defining the conceptual distinctions among data assets, digital assets, and information assets. Viewing this study through the lens of managerial accounting, the research synthesizes a management structure of data assets and summarizes the pragmatic approaches followed by companies in various ownership structures. Moreover, it is a systematic overview of the available literature on the issue of the recognition of data assets, their evaluation, further measurement, and reporting, and analyzes the practical value of the recognition of data assets in financial statements. There are a number of weaknesses in existing research indicated by the findings, such as: no uniform operating principles of rights and allocation of rights in the sphere of data assets; the absence of industry-based specific details of accounting measurement, as well as amortization and impairment; inadequate detailing and low practicality of the disclosure system; and the lack of empirical experiments and various case studies that can be used to facilitate the introduction of management systems. In turn, the present study suggests directions for further research. The result of refining the basic theoretical framework of data assets and filling the gaps in the research in the field is to offer practical references to the financial-statement recognition of data assets in Chinese enterprises and the development of industry-specific accounting standards.

Keywords

recognition of data assets in financial statements, data assets, accounting recognition and measurement, management accounting, disclosure of information

1. Introduction

The global digital economy wave keeps evolving in its depth, and China's national economic and social development have now fully shifted to a new stage where the digital transformation process as well as high-quality development go hand in hand. Data has gone beyond being a source of information resources to become

a fundamental part of production that generates economic growth, changes the structure of industries, and supports high-level development. The essential strategic worth of data assets is becoming more apparent, and the leading world economies, such as China, are concentrating on the market-driven distribution and uniform regulation of data as a production factor, and introducing systematic support policy documents consecutively.

Domestically, the development of the top-level design of China's data element sector has been ongoing, and the system is slowly developing. On 16 December 2015, the Second World Internet Conference initially came up with the concept of Digital China, which outlines the main line of digital development; the Fourth Plenary Session of the 19th CPC Central Committee incorporated data within the list of factors of production for the first time; and by 2023, Interim Provisions on Accounting Treatment of Enterprise Data Resources of the Ministry of Finance was officially implemented, signaling the beginning of a stage of standard implementation of the recognition of data assets in financial statements; subsequently, in 2025, the state further promoted the development of a Digital China by making it the central route to the creation of new-quality productive forces. On the international scene, the digital economy has been transformed into one of the central elements of the national strategy in many economies,[1] and the standardized accounting of the data assets is also recognized as a world consensus. In the System of National Accounts 2025 (2025 SNA), data is explicitly divided into a subcategory of intellectual property products, whereas the Organization for Economic Cooperation and Development (OECD) has continued to publish reports on the measurement of the digital economy and the accounting of data assets, searching for a common methodological structure in measuring data as a production factor statistically. In practice, the size of the digital economy in China continued to grow at a steady pace in 2024 to reach 59.2 trillion yuan (or 43.8 percent of GDP), up by one percentage point compared to the previous year. Total factor productivity of the digital economy was very useful in supporting stable economic growth, and its contribution to economic growth remained on the rise. Simultaneously, digital transformation may play an important role in helping businesses save money and increase profit margins in addition to its role in cost optimization in R&D and production and management being especially notable.[2] The listing of data assets in financial statements has numerous practical advantages: it not only enhances optimized corporate financial analysis structures and enhances operation and financing capabilities but also gives more power to government macroeconomic regulation and helps to enhance other systems that are connected to the data factor. Being valuable in terms of both theoretical studies and practical use, this subject has been a focal point of mutual concern among scholars and professionals alike.

According to the given policy background and present state, the paper will review the existing research in a systematic way concerning the definition of data assets, accounting recognition and measurement, valuation, disclosure, and management systems, and suggest further research areas as a means of guidance for improving the practical application of the recognition of data assets in financial statements and enhancing the conceptual framework in question.

The possible contributions of the study include: Firstly, the paper brings in a management accounting view to the literature of data asset recognition in financial statements. The current literature has mostly focused on the financial level of accounting and valuation only, with few studies on the creation of data asset management systems. Through the analysis of appropriate theoretical frameworks and the practice of companies under a management accounting perspective, the research adds to the extent of studies on the recognition of data assets in financial statements. Secondly, it defines future research orientation within the sphere of data assets, which not only can be used by enterprises to refer to the standardized management and practical accounting treatment of data assets but also by the regulatory authorities to develop literature support and conceptual understanding in order to refine the respective standards and guidelines and by scholars to perform further in-depth research. Third, it examines the definitions and defines the borders of data assets, digital assets, and information assets, which serve as the theoretical basis of data assets standardization and unification of the basic theoretical framework, as well as conceptual coherence in future research.

[1] China Academy of Information and Communications Technology, Annual Observation Report on Global Digital Economy and Trade Rules (2025) [R/OL], Beijing: CAICT, 2026-03. https://www.caict.ac.cn/kxyj/qwfb/ztbg/202603/P020260324613314950584.pdf

[2] China Academy of Information and Communications Technology, Research Report on the Development of China's Digital Economy (2025), Beijing: CAICT, 2026-03. https://www.caict.ac.cn/kxyj/qwfb/bps/202603/P020260323736507370748.pdf

It should be mentioned that the paper reviews systematically research on the recognition of data assets on financial statements by focusing more on literature related to traditional accounting, asset valuation, and management theory. The discussions on practical details, including the coordination between recognizing data assets and existing enterprise accounting standards, specific methods of accounting treatment of various kinds of data assets, and consistency among cross-departmental regulations, are quite sparse; thus, the degree of practical use of the research can be further improved.

2. Analysis of Core Concepts and Theories of Data Assets

2.1 Definition of Data Assets

Since the digital economy keeps on evolving, the conceptual interpretation of data assets has changed over time as the initial, immature perceptions have been replaced by the standardized and uniform models, the agreement on which was reached in both national and foreign academic communities, as well as the industry associations.

The concept of data assets was defined quite early in other countries, and followed a trend of generalization to specialization, and relevant studies were gradually increasing and improving with time. The concept was first presented by Richard Peters [1], who defined it as financial assets owned by businesses, including government bonds, corporate bonds, and physical bonds, which formed the basis of future studies on the subject. On account of this, Gargano and Raggad [2] pointed out that useful data that can be obtained via data mining may become data assets, which are worth using as a source of making decisions. This model was later improved by Rowley [3], who focused on data assets as merely the data that have been defined, assessed, and controlled strictly, and that have some utility value. Fisher [4] addressed previous constraints by making a close connection between data assets and business processes by explaining that data assets represent the respective systems, applications, and their output files that companies use to create income. The value implications of Bughin et al. [5] went beyond this, as it is seen as a smart asset that could improve the effectiveness of processes and offer new capabilities to products; Liu et al. [6], in a technical sense, added to this by stating that data assets are data that are made up of quintuple arrays that react to changing needs, which adds to the definition dimensions.

The existing domestic literature has also revealed that there are two dominant views concerning the concept of data assets. The first view utilizes the traditional formulation of accounting assets, which considers the data assets as data resources. According to the China Academy of Information and Communications Technology (CAICT), in 2018, the first official definition was given, according to which data assets are data resources owned or controlled by an enterprise with the ability to create economic value in the future and are documented in physical or electronic form;[3] This was further developed by Rongsheng Qin [7], who stated that data assets are data resources that an enterprise controls due to past events; Yanying Hou [8] emphasized that data resources should be clearly owned, tradeable, independently identifiable, and dynamically growing so as to be considered as assets.

The second viewpoint, which centers on the fundamental requirements of assetization, describes data assets by means of the critical requirements and inherent properties needed by data, to become an asset. Yangyong Zhu and Yazhen Ye [9] suggest that data assets should meet four core requirements: clear ownership, realizable value, measurable cost, and readability; according to Junrui Zhang et al. [10], based on the principles of accounting, data assets are defined as assets in digital form, identifiable, and non-monetary; three core features of assetization include controllability, quantifiability, and realizability, identified by Dan Ma and Xia Yu [11]; Xianchun Xu et al. [12], referring to the characteristics of factors of production, define data assets as data with a particular application context and can be reused or used over time in the production process during more than one year; On the contrary, Qi Kang et al. [13] point out that a data asset needs to have the property of a data asset and be able to generate value so as to be qualified as a data asset.

[3] China Academy of Information and Communications Technology, White Paper on Data Asset Management Practice (Version 3.0), Beijing: CAICT, 2018-12.
https://www.caict.ac.cn/kxyj/qwfb/bps/201812/P020181214608773379834.pdf

2.2 Distinguishing Related Concepts

Theoretical studies of the digital economy commonly define the terms data assets, digital assets, and information assets in overlapping fashion. To scientifically differentiate the meanings of the three concepts and demarcate their limits is essential to correctly define the theoretical position of data assets and prevent conceptual confusion, cognitive biases.

2.2.1 Evolution of the Concept of Digital Assets

The academic debate about digital assets started quite early with Helen Meyer introducing it in 1996, and the definition being constantly improved since then [14]. In 2006, Albert Van Niekerk suggested, in terms of digital encoding, that text and media carriers that have been transformed into binary code and given usage rights are all digital assets [15]. The authors Alp Toygar et al. pointed out in 2013 that digital assets are in binary format and owned, and the main idea behind them is the data created and saved on smart devices, digital devices, and in the cloud [16]. In 2017, Rod Genders and Adam Steena stated that every asset that may be accessed and maintained online in digital form could also be incorporated within the digital asset framework [17]. An analysis of the available literature shows that binary form and legal ownership or usage rights are the main features of digital assets.

2.2.2 Core Definition of Information Assets

The idea of information assets could be identified as early as 1977 when Stuart Kaback initiated it on the background of indexing systems [18]. The first ever formal definition of information assets was made in 1994 with the publication of the Holly Report by the KPMG IMPACT project, which defined information assets as data that is recorded or ought to be recorded and has value or potential value [19]. Having developed this fundamental definition, the Gartner IT Glossary elaborated and specified the boundaries of information assets, indicating that they are also a set of tacit knowledge about business processes, different kinds of structured and unstructured data, and information assets outside the company [20]. After that, information became officially recognized as an asset at the regulatory level by the international standard ISO/IEC 27000:2018 (E), which provided that it must be reasonably safeguarded, similar to other valuable assets [21].

2.2.3 Distinguishing Data Assets from Related Concepts

Data assets are not necessarily defined exclusively in terms of their digital nature but rather put more weight on the asset nature of the resources and the worth of production factors. The digital assets have a wider range than the data assets, which are more specialised and have specific accounting features. In comparison with information assets, which are oriented towards the value of content and informational usefulness, data assets are more consistent with the logic of accounting recognition, focusing on the concepts of controllability, measurability, and long-term value in use. These are the fundamental data resources that have acquired the asset status and play a central role in the data resource system.

3. Research on Data Asset Management Systems from a Management Accounting Perspective

The successful introduction of data asset recognition in financial statements depends on the presence of a scientific and holistic data asset management system, and the development of such a system is crucial to meet this requirement and bring about the systematic implementation of data asset recognition based on management accounting viewpoint.

3.1 Representative Framework and Models

The combination of the four main roles of management accounting, which are budgeting, costing, performance, and strategy, has led academics to create a multi-faceted approach to data asset management that in totality can be used to support the essential steps involved in identifying data assets as an asset in financial statements.

According to Yan Wang and Da Yang [22], in light of the fact that data is considered an asset, the management accounting system needs to be reformed to fit into the digital world, which results in formulating a model of a so-called Chinese-style shared value management accounting system. This model also helps

stimulate the vitality of the data factor market, helps transform data into services, and uses management accounting tools to unlock the value of data assets, such as rights clarification and measurement, to increase shared value. It has a very different structure compared to the Western systems because it centers on the concept of shared values, based on the institutional context of China, and utilises national policy support and the benefits of digital infrastructure to attain the simultaneous growth of corporate economic interests and social and environmental values. China Southern Power Grid's practice can be used as a good illustration of the Chinese-style shared value management accounting system. The company has actually attained win-win benefits to both the enterprise and society in the shared value paradigm by taking advantage of its large power big data, well-developed management strategies, and the close integration of business, finance, and data, and the scalability of data assets.

According to Guohe Li et al. [23], there is a three-dimensional architecture that involves organization, governance, and systems platforms that can be effectively integrated into management accounting functions through the clear definition of the division of responsibilities between the dimensions and the enhancement of technical support. A four-stage, eleven-step full-lifecycle system was created by Haisheng Liu et al. [24]. Following the principle of combining business, finance, and data, the system is able to explain the logic of the evolution of data assets and is consistent with the end-to-end control philosophy of management accounting, offering a clear path in the recognition and measurement of data assets in financial statements.

3.2 Practical Implementation and Insights

The management accounting view of a data asset management system is one of the vital protections to be taken into consideration when recognizing data assets in financial statements. To get the interdependence between the management system and the recognition of the data assets in financial statements, enterprises must develop a customized model that takes into account the industrial specificity of the organization. From the point of implementation, state-owned enterprises can use policy benefits to create a system of shared-values, taking full advantage of institutional incentives provided by the state as well as the effectiveness of digital infrastructure to achieve economic, social, and environmental values. On the contrary, non-state-owned enterprises may concentrate on creating value via data operations, enhance the use of management accounting tools, and facilitate the close link between digital strategy and management transformation.

In particular, the research by Yan Wang and Da Yang [22] shows that the assetization of data is an impetus behind a twin revolution in management accounting with a main emphasis on enhancing the application of management accounting systems to manage data assets and improving assessment techniques of data asset values; Weipei Yao [25] also notes that as enterprises move towards more advanced usage of data and product development, the market trade in data assets will be more active, and the procedures, models, and even the procedural mechanisms of their valuation will be a hot issue of research in the future. At the same time, Weipei Yao also notes that compliance, value creation, and marketization constitute the essence of data asset management. The current practice should focus on this core to address the issue of valuation, promote innovation in management accounting tools, provide proper and organized management of data assets, and facilitate the overall growth of data asset recognition in financial statements, and eventually contribute to the establishment of the Chinese independent management accounting system.

4. Accounting for Data Assets and Information Disclosure

4.1 Recognition of Data Assets

With the help of combining the results of the available studies, the paper classifies the recognition criteria of data assets in two broad categories, namely: core basic criteria and additional details criteria.

4.1.1 Core Fundamental Conditions

Academicians have acknowledged that the identification of data assets depends on three main fundamental conditions that are also critical conditions to consider in identifying data assets as assets. The first condition is the controllability of ownership. It is the initial condition of recognizing data assets, where the fundamental condition is that the enterprise has lawful ownership or control over the data resources, and their origin is known. The enterprise may obtain the necessary rights by using legal mechanisms, including licensing

agreements or procurement contracts, and provided that the enterprise has control over the data and can receive all the economic gains associated with it, the recognition requirement is satisfied even with no legal ownership of the data. The second condition is the certainty of benefits. A factor of production, the value of data is its capacity to produce real or potential economic benefits to the enterprise, and the likelihood of such benefits coming true should be relatively high. The third condition is the quantifiability of value. It is a key condition in bringing about data assets into the books of accounts, highlighting that the cost or value of data assets should be measurable and quantifiable in monetary terms. Valuing data assets does pose some challenges, but businesses need to come up with reasonable measurement approaches so that their costs or values can be quantified in a reliable way meeting the minimum criteria of accounting recognition.

4.1.2 Supplementary and Detailed Criteria

Considering the individuality of data assets, the paper examines the current literature and classifies the particular requirements addressed in it as supplementary information not falling within the basic fundamental requirements, as shown below: Mei Luo et al. [26] highlight that data assets should be practical to develop and based on previous transactions or events of an enterprise; Fangli Liu [27] states that data assets should be distinct in comparison with other assets, and able to be identified independently to define the borders of recognition; Rui Wang et al. [28] suggest that the data asset needs to meet both the conditions of ongoing profitability and lawful ownership, i.e., have the ability to create ongoing cash flows using market-related activities and be subject to the control of the enterprise that is law-abiding and compliant; Data assets should have a realization potential, and organizations should come up with value-adding mechanisms to appropriately show how and what chances there are in achieving assumed economic benefits, says Rui Sun [29].

4.2 Valuation Methods for Data Assets

There is an established variety of valuation models that are currently used in academia and industry which fall into three broad categories depending on the differences in valuation logic and technical methods: traditional valuation models and their optimization, theory-based new valuation models as well as valuation models made possible by intelligent technologies.

4.2.1 Traditional Valuation Methods and Their Optimization

The cost method, income method, and market method, which are frequently employed ways of valuing intangible assets traditionally, make up the backbone of data asset valuation. In view of the particularities of data assets, the specialists have done certain specific modifications and improvements to the three approaches. These three methods are also explicitly mentioned as the basic methodologies of data asset valuation by the China Association of Valuation (2019), in its Expert Guidance on Asset Valuation No. 9 - Valuation of Data Assets.

The foundational idea of the cost approach is to ascertain the value of data assets using the expenses made to create them; it mainly comes in two categories, namely, the historical cost approach and the replacement cost approach. The authors, Lin and Wu [30], who were interested in the cost aspect, integrated the purchasing expenses, operational expenditures, and maintenance expenses as well as the deployment conditions of data assets and came up with a data asset valuation model using the Analytic Hierarchy Process (AHP); The authors, Zhigang Zhang et al. [31], used the results of studies on the valuation of intangible assets and added the features of data assets to develop the Analytic Hierarchy Process (AHP) to form an indicator assessment system, thus creating a data asset valuation model that involves both cost and usage factors.

The main idea behind the income approach is to determine the present value of the anticipated future earnings that data assets have the potential to produce. According to Mark Berkman [32], it can be said that the income approach is the best way to evaluate data assets. The fundamental of this approach is to isolate the excess returns of data assets and establish a scientifically credible discount rate. Yuxin Si [33] started out with the business lines that use data assets within Internet companies and chose the incremental income approach as the model of valuation and creatively developed a valuation model to evaluate the value of Internet companies' data assets in terms of income. Fang Chen and Qian Yu [34] considered comprehensively the specific risks related to ambiguity of data asset property rights and data security and separated the discount rate of data assets from the general discount rate of intangible assets. Then, they created a multi-period excess

return model using the residual approach and assessed the value of data assets in companies that are experiencing digital transformation.

The market approach is mostly based on the market transaction prices of comparable data assets, and its main essence is the quantification and allowance of the differences between comparable data and the data to be valued. The market approach was used by Qi Liu et al. [35] to determine the value of data assets considering the critical indicators such as data technical specifications, value density, and data capacity, and developed various specialized adjustment coefficients to improve the valuation outcomes. Yonghong Li and Shuwen Zhang [36] used the Analytic Hierarchy Process (AHP) to derive factor weights in assessing the value of data assets and then used the Grey Correlation Analysis method to derive the correlation coefficients among data assets. They then computed the correlation degree using these weights and chose the most correlated data assets as comparable data assets. Eventually, they estimated the weights of comparable assets using their correlation coefficients based on the market approach and developed a model of valuation of data assets using the market approach.

4.2.2 New Theory-Integrated Valuation Methods

The further development of interdisciplinary studies has seen game theory, real options theory, and so on being slowly combined with the valuation of data assets and overcoming the restrictions imposed by the conventional valuation systems to offer novel perspectives and directions in valuation during complicated situations.

The valuation approaches based on game theory should mainly be viewed as a solution to the information asymmetry of transaction partners, which enables accurate valuation through the examination of strategic interaction among them. Through a review of the characteristics of big data, Li Zhao and Jie Li [37] applied the replacement cost approach and the present value of future cash flows approach to come up with a range of prices of big data assets. Using a bargaining model of big data assets, they used a feedback-driven pricing strategy to facilitate rational pricing of big data assets; Chongrun Wang et al. [38], extended the bargaining model and combined the concepts of game theory, incorporated the idea of the probability of buyer speculation to derive a utility function in case of information asymmetry, and hence evaluated the worth of data assets; Rihui Ouyang and Wei Gong [39] built a game theory-based analytical framework to develop an incentive-compatible data bidding mechanism. Their use of the rules of strategic interaction allowed them to eliminate information asymmetry and differences in valuation across the parties involved in the transaction and led participants to optimize their strategic decisions independently and eventually converge towards a Nash equilibrium, making the value of data assets manifest in the market.

The techniques of valuation that depend on real options theory are one of the important tools that have been developed to meet the peculiarities of the data assets. The relevant studies include: Systematic study of the shortcomings of the Black-Scholes (B-S) model regarding the valuation of the data assets, introduction of fuzzy set theory to address parameter bias in the model, and the development of the fuzzy-enhanced B-S valuation framework were conducted by Yanqing Guo and Peiyuan Sun [40]. The sample of listed internet finance companies was chosen to determine the value of their data assets; Jing Wang and Juan Wang [41] used the Black-Scholes theoretical model along with the Analytic Hierarchy Process (AHP) to develop an evaluation indicator system of the data assets of internet finance companies. They measured the weights of various factors in a scientific manner, calculated the correlation between data assets and the evaluation indicator system with the help of the model, and empirically demonstrated the accuracy of the model in evaluating; Jiaqi Li [42] enhanced the B-S model by integrating the dividend payout ratio and introducing the multi-period excess return approach to build the evaluation portfolio model. The current valuation procedure involved the use of the GM(1,1) fuzzy forecast model to estimate the future excess returns of the company, which reduced the effect of subjective factors. Finally, the total worth of the data assets was obtained using the developed evaluation portfolio model.

4.2.3 Valuation Methods Empowered by Intelligent Technologies

High speed growth of technologies like artificial intelligence and deep learning have introduced completely new technical support of data asset valuation, addressing the drawbacks of conventional valuation approaches when dealing with multidimensional and nonlinear factors of influence and increasing the quality and efficiency of valuation activities. Intelligent technologies have enabled data asset valuation techniques to

develop in many directions: Yuan Ni et al. [43] developed the AGA-BP neural network model to assess the worth of data resources. The model takes into account all the nonlinear relations between various factors that influence the value of data resources. It is able to overcome issues like low convergence of the traditional BP neural network, and consequently enhance the accuracy of value estimation; Chi Zhang [44] examined the factors determining the value of data assets, came up with five feature dimensions of measuring the value of data assets, and created a data asset value analysis model framework on the basis of these feature dimensions, and gave a universal approach to the quantification of data asset value. The study was built using the deep learning technology to calculate the values of feature dimensions and quantify the value of data assets.

4.3 Subsequent Measurement of Data Assets

The scholarly body has created an abundance of research results on follow-up measurement models, amortization and impairment, and treatment of follow-up expenditures, as listed below.

In terms of choosing further measurement models, Rongsheng Qin [7] has suggested that companies are likely to use the historical cost method, whereas the fair value method can be chosen in exceptional cases. The further suggestion made by Jing Cheng [45] is a dual measurement model, whereby the choice of the measurement method depends on the reason why the data asset is kept: the cost model ought to be used when the asset is intended to be kept over a long term but not sold, and the fair value model should be applied where the asset is kept to sell, and it is actively traded. Zehong Li and Xiaoyun Tan [46] indicated that the historical cost method cannot capture the appreciation nature of data assets; with the emergence of data trading markets, the market approach will take the lead in estimating the value of data assets.

The concept of amortization and impairment is key to further measurement. Data assets can be considered particularly time sensitive and therefore should have relatively short service lives. According to Yu Liu [47], the amortization term cannot exceed five years; due to their time-sensitive character, they might be subject to accelerated amortization procedures, including the sum-of-the-years digits approach. Also, in case the future economic benefits can be accurately estimated, economic benefits matching approach might be implemented as well. On the other hand, Xue Zhang et al. [48] divide data assets into two groups depending on the way they are used: assets held by an organization to use and assets held by an organization to trade. Among those in the first category, there are two sub-categories which include assets of finite useful life and assets of infinite useful life. The former need amortization, whereas the latter do not need amortization, but must be tested periodically to determine whether they are impaired; likewise, data assets held to trade are not amortized and only require periodic impairment testing throughout their useful life.

Concerning the handling of the subsequent costs, Xuran Lu [49] divides them into two groups, namely, management costs such as data storage and maintenance which should be expensed, and recognized in the current period profit or loss, whereas costs related to the collection and processing of new data should be capitalized, adding to the carrying amount of the asset. Furthermore, Zehong Li and Xiaoyun Tan [46] discussed the accounting treatment of changes in measurement models and suggested that, based on the model of investment property, a switch between the cost model and the fair value model should be regarded as a change in an accounting policy.

4.4 Disclosure of Information on Data Assets

Disclosing the information about data assets is one of the critical bridges between the treatment of accounting and the decision-making of stakeholders. The current studies in academia tend to recognize that the information disclosure of data assets needs to be done through the development of a diversified system of disclosure which includes both reporting in and supplements to financial statements, as they ensure both standardization and flexibility.

The presentation has been clarified by scholars who have different points of emphasis but are complementary. According to Rongsheng Qin [7], companies may consider creating a new sub-item, namely, Data Assets, in the Non-current Assets category on the balance sheet to provide a comprehensive view of the data asset changes and the data asset holdings at the end of the reporting period. Conversely, Yu Liu [47] claims that the book value of the data assets on the closing date can be disclosed as an item of the “Intangible Assets” line item and at the same time the disclosure can be enhanced in the financial statement notes to resolve the limitations of the one reporting approach. Moreover, Wenyan Nie et al. [50] state that companies must also

create a subsidiary account named Provision for Impairment of Data Assets to represent the impairment of data assets in the holding period, and Jiayu Zeng and Zhigang Zhao [51] suggest that data-driven companies may create another main level account of Data Assets to account for non-data-driven companies' simplification of their reporting in accordance with the principle of materiality.

The disclosures form the backbone of the data asset presentation, and most academic groups tend to believe that the classification and disclosure of data assets should be done according to whether the data asset is recognized in financial statements. On the topic of data assets recorded in financial statements, Wenjing Xiao [52] suggests that three main areas of notes to the financial statements must be addressed: basic information, risk information, and technical information such as the classification of data assets, impairment testing, ownership status, and technical support; Wenyan Nie et al. [50] also indicate that more disclosures are required concerning the source of data asset classification, changes in amortization methodology, and disposal-related information. In the case of unrecognized data resources, Wenjuan Fu and Jinjin Mei [53] advise that their acquisition processes, utilization conditions, and risks should be reported in the management report; whereas Yuanjun Xue and Gang Lu [54] focus on the necessity to provide an in-depth disclosure of their value models and the influences of value change to eliminate the shortcomings of reporting in financial statements.

Moreover, there are other researchers who believe that the single disclosure structure is not enough to indicate the worth of data assets, and there is a need to create a diversified and complementary disclosure mechanism. The increasing relevance of data assets prompted the authors, Junrui Zhang and Yanlin Wei [55], to suggest that the traditional financial statements do not correspond to the non-financial nature of the data assets, and that a fourth statement, which will complement the balance sheet, must be introduced. With regard to the formulation of the fourth statement, Wuxing Tian and Shuangshuang Dai [56] proposed creating it in the form of a Statement of Changes in Key Value Indicators, which would allow enterprises to have a certain level of flexibility in preparation in the transitional period and gradually approach the standardization of reporting forms. In contrast, Xiaoyan Xue [57] pointed out that internet companies must focus on users in their disclosures and report indicators concerning users, products, channels, and social responsibility.

5. The Significance of Recognizing Data Assets in Financial Statements

The overall implementation of the acknowledgment of data assets in financial statements is useful in many aspects, which are essential, and their fundamental value has been confirmed by the available studies of different approaches to the issue, such as the macro perspective of the country, the meso perspective of the industry, and the micro perspective of the enterprise.

Based on the viewpoint of government regulation and the macroeconomic development of the country, Qiang Li [58] discusses macroeconomic policy regulation and claims that financial statement treatment may add new policy space to the central bank, allowing it to use different types of monetary policy instruments in order to control market financial capital and thus influence the flow and direction of data in order to better correspond to the goals of macroeconomic regulation. Fiscal transformation-wise, Zhigang Zhao [59] suggests this treatment can be used to harness the catalytic and empowering effect of accounting to enable local governments to become independent of land-based fiscal income, offering a feasible pathway to the shift towards data-driven fiscal governance. Also, Qinhong Huang and Ting Chen [60] suggest that such treatment has a strong potential to release the value of current state-held public data and corporate-owned data, increase the benefits of public data, reduce government debts, and relieve debt stress through the implementation of data-driven fiscal policies. At the same time, it can activate the dynamism of the data market, attract science and technology innovation-oriented and data-intensive companies to open businesses in the area, adding new impetus to economic growth. On the topic of institutional and mechanism building, Zhiyun Zou [61] states that inclusion in financial statements may be useful to enhance other systems like data rights clarification and price, where the valuation requirements can bring about uniformity in the order of data asset transactions and circulation, whereas its measurement requirements will push the field to do more research and develop measurements of data technologies and encourage cooperation between the industry, academia, and research institutes to create uniform and standardized measures of data.

Xinxin Zhang and Zhixiang Miao [62] take the perspective of the development of an industry and factor markets and state that acknowledging data assets in financial statements can rejuvenate the data resources of the industry, increase the asset base of publishing organizations, diversify the financing options of industry

players, and streamline the process of data resource allocation, eventually making it possible to move towards the digital publishing industry. This is where Yong Wang [63] observes that the act of putting data assets in financial statements can release the highest potential of data as a factor of production, direct the leading companies and internet platform businesses to give examples and encourage the rest, and synchronize the adoption of data assetization, data industrialization, and industrial digitization, which will then promote the transformation and upgrading of the traditional industries. In addition, Zhigang Zhao [59] asserts that encouraging the practice of including data assets in financial statements contributes to the creation of leading data companies and extremely influential data service providers, hence speeding up the process of industrial upgrading. Zhiyun Zou [61] looking at the issue through the eyes of factor allocation and circulation efficiency states that recognizing data assets in financial statements can optimize the distribution of industrial data resources and create the desire to conduct research and development of data across the industry. At the same time, this recognition measures and displays the worth of the data in question; using the data valuation systems, it fills the gap between the participants involved in the industrial chain, directs the effective circulation of the higher quality data resources, and motivates enterprises to integrate and link the upstream and downstream sectors using methods such as mergers and acquisitions, thus increasing the overall efficiency of data utilization within the society as a whole.

On the side of micro-enterprises, according to Zhigang Zhao [59], financial statement recognition is not just the optimizer of the financial statements of data-driven and data-resource-based enterprises and the booster of the corporate valuations but also supports the overall improvement of the corporate awareness of data asset management and contributes to the perfection of the suitable systems and mechanisms of financial statement recognition. Similarly, Yuanfei Ni [64] also highlights, concerning the value of corporate assets, that financial statement recognition may increase the amount of a company`s book assets and optimize the structure of its assets, which subsequently reinforces the company`s base and increases its value and financing potential. In addition, Jingshan Qu et al. [65] also hold the financial accounting view that financial statements recognition will prompt the process of optimizing the standards of recognizing corporate data assets, measurement techniques, and disclosure of information in financial statements, enrich the aspects of financial analysis, and assist in the perfection of the financial analysis framework. As to data governance and business decision-making, Jinlin Li [66] believes that data assets could be added to financial statements to enhance data accuracy and dependability, offer reliable support to business decision-making, enable businesses to release the commercial value of data, and extend their competitive edge in the market. Simultaneously, this would help create corporate value and encourage innovation. Looking at the digital transformation, Yuanfei Ni also observes that putting the data assets in financial statements enables the enhancement of a company's capability to manage and apply data information, guarantees the authenticity of data assets, and thus facilitates the steady implementation of corporate digital transformation.

The presence of such value relationships in various entities, industries, and levels has obviously turned out to be the main point of concern among academia and practitioners because these value relationships have been found to exist among different entities, industries, and levels.

6. Research Conclusions and Outlook

6.1 Research Conclusions

The paper initially explicitly states the main concepts and their associated connotations of data assets and subsequently reviews the existing literature on the topic by both domestic and international researchers in fields like the identification and quantification of data assets, valuation, asset management, information disclosures, among others. The research includes all the core elements like the primary theory of data assets, accounting approach, valuation approaches, management systems, and practical value, and can serve as useful sources of references and information about data assets that could be explored academically or practically. However, despite the current research, there are many gaps in these domains that should be filled in the future by conducting more detailed research.

6.2 Future Research Directions

Considering the modern situation of the high-quality development of the digital economy, the market-oriented distribution of data as a production factor, and the move of data assets to financial statements into a stage of uniform execution, and filling in the gaps of the current research and shortcomings in fields like ownership delineation, accounting measurement and amortization/impairment, the creation of information disclosure systems, and their implementation, there is potential scope for conducting future studies from the dimensions of theoretical perfection, methodological improvement, and practical application, among other dimensions.

To begin with, it is necessary to improve the theoretical base and practice of defining ownership. Later, researchers may perform theoretical modeling and analysis of several cases in relation to the concept of data asset ownership and carefully consider the rationale underlying the allocation of data rights and interests across various stakeholders as well as derive practical and measurable principles of determining data asset ownership and dispute resolution mechanisms through empirical studies and case studies of typical situations which will theoretically justify the accounting recognition and practical implementation of data assets.

In the second place, optimize industry segmentation and practical suitability of the accounting measurement system. In the next few years, researchers have an opportunity to perform comparative research and empirical analysis of the accounting measurement of data assets across industries. Based on the operational features and value change trends particular to data assets in different industries, they may come up with specialized measurement frameworks, amortisation strategies, and conceptual frameworks of impairment testing and ensure the high level of integration and tight fit between accounting theory and industry practice by means of extensive empirical research and detailed case studies.

Thirdly, enhance the uniformity in the information disclosure process and the ancillary reporting structure. Scholars may also consider undertaking systematic theoretical and empirical investigations that will be devoted to the weaknesses of the information disclosure of data assets. First of all, further investigate the standardization of data asset information disclosure, especially the data asset risk information, valuation models and parameters, and non-financial value indicators. Perform normative analysis, empirical testing, and cross-case comparative studies to create a unified and comparable set of disclosure rules and an indicator system. Secondly, develop the theoretical background and statistical studies of the so-called fourth financial statement. Make theoretical research into its framework design, indicator building, and preparation logic and perform empirical testing and case analysis based on multiple industry data to develop the verifiable and generalizable academic research framework. Third time, enhance the study of the interrelations and logical connections between financial statements. Theoretical modeling, empirical investigation, and mechanism testing should focus on the internal connection between the book value of data assets and non-financial indicators to create a scientific and rigorous system of interrelationships and value verification mechanisms.

In conclusion, the attempt should be made to develop empirical testing and optimization of the data asset management system structure. Future researchers can do comparative research and quantitative research that focuses on the flexibility of the data asset management system framework. Depending on the operational features of various application situations and various stakeholders, it is possible to create a systematic performance evaluation system and an optimization paradigm of the framework. Using both large-sample-based analysis and multidimensional case studies, the limits of applicability and benefits of various management systems could be elucidated, which would help in filling the research gap of current theoretical frameworks, which are not practically verified.

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