Information Resources Management Journal
Volume 37 • Issue 1 • January-December 2024

Optimizing Accounting for Data Assets Helpful To Developing Sustainable Regional Economies

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ABSTRACT

This paper aims to develop accounting methods for data assets helpful to developing sustainable regional economic development within the digital economy. By considering data-asset characteristics such as virtuality and sharing, it proposes accounting treatments and processes for data-asset evaluation and management. Through a case study of Guangdong Power Grid Co., Ltd., the optimized method is evaluated. Results show a 70% increase in data-asset valuation compared to intangible assets, with a 17.8% growth in total profits. The method reduces asset-management costs by 3.67% and amortization by CN¥98,600. These findings highlight the importance of optimizing accounting methods for data assets able to foster sustainable regional economic development in the digital-economy era.

KEYWORDS

Digital Economy, Data Assets, Accounting Treatment Method, Regional Economy, Sustainable Development

INTRODUCTION

In the context of the global digital revolution, data assets have become critical drivers of sustainable regional economic development. These assets encompass a wide range of resources, including big data, user profiles, and transaction records (Abid & Abid, 2023). Their scale and value within the digital ecosystem have grown significantly, playing a key role in stimulating economic growth. However, traditional accounting frameworks struggle to assess and quantify these assets accurately, often resulting in their incomplete representation in financial statements.

The process of developing data assets involves data acquisition, organization, purification, storage, and advanced analysis, extraction, and application. This complex process necessitates careful data collection, processing, and sharing, with a strong focus on data security and privacy (Andriani, 2022). Through the use of data mining, machine learning, artificial intelligence, and other technologies, large volumes of raw data are converted into actionable insights and valuable knowledge for businesses and

DOI: 10.4018/IRMJ.349948

institutions. Effectively utilizing data assets enables organizations to gain competitive advantages, foster innovation, and significantly enhance digital and sustainable economic development.

Addressing the gap in data-asset valuation requires the development of more precise and reliable evaluation and accounting methods. Improved accounting practices for data assets not only enhance the economic performance of enterprises and regions but also act as a catalyst for the maturation of the digital economy. Although entities are expected to disclose material data assets in compliance with accounting standards, the absence of a coherent valuation and accounting framework presents significant challenges (Baumgartner & Ambühl, 2023).

This paper investigates the treatment of data assets in the context of sustainable regional economic development and proposes a comprehensive evaluation method for their value. The research findings highlight that the optimized data asset processing method used for Guangdong Power Grid Co., Ltd. increased the value of data assets by 70% compared to intangible assets, with a 17.8% growth in total profit and a 3.67% reduction in asset-management costs. This method introduces innovations such as a comprehensive research perspective, consideration of data-asset characteristics, and the integration of risk management and privacy protection (Devamathan & Kamarasan, 2023).

In the digital economy, the optimized accounting treatment for data assets supporting sustainable development provides a theoretical basis for expanding data-asset theory and enriching the theory of a sustainable economy (Faridi et al., 2023). This paper refines asset-accounting methods and supplements the theoretical frameworks of sustainable regional economy and asset accounting. The practical application of the optimized method shows strong adaptability and practicality for effective decision-making and optimal resource utilization, promoting sustainable economic development and digital-economy transformation.

The study integrates the digital economy, sustainable regional economic development, and data-asset accounting into a comprehensive research framework. It also emphasizes data-asset disclosure, proposing relevant standards and guidelines to enhance transparency, which is crucial for enterprises and regulators in the absence of clear standards.

The aim of this study is to provide an in-depth assessment of the effectiveness and limitations of current data asset accounting treatment, with questionnaires revealing a number of shortcomings, including a lack of adaptability, unclear standards, and an inability to meet the needs of dynamically growing organizations. On this basis, we aim to comprehensively identify the shortcomings of existing approaches and lay the foundation for proposing a more robust and adaptable accounting framework. At the same time, we explore the feasibility and effectiveness of optimizing the accounting treatment of data assets through an example analysis, covering optimization measures such as capitalization and expensing of costs and adjustments to amortization methods. Our study aims to verify the usefulness of these optimization methods in improving the accurate treatment of data assets and promoting the sustainable development of the regional economy.

This study is of significant scholarly importance because of its contribution to the promotion of sustainability, digital-economy growth, enhanced decision-making accuracy, strengthened data-asset governance and protection, and standardized guidance. It identifies challenges posed by traditional accounting methods, proposes an optimized data-asset processing method, and evaluates its impact through a case study. The findings demonstrate the effectiveness of the method in improving data-asset valuation, reducing costs, and enhancing economic performance, thereby supporting improved decision-making and sustainable economic growth.

This paper proposes specific measures targeting the importance of optimizing the sustainable development of the regional economy through an in-depth study of the accounting treatment of data assets in the context of the digital economy. First, the key role and challenges of data-asset management are revealed through a detailed analysis of the five-year financial data of Guangdong Power Grid Co. Second, by conducting a questionnaire survey and analyzing examples of accounting treatments for different types of data assets, the main flaws and shortcomings of the current methods are identified. Then, by comparing and evaluating the practical application effects of the optimized

accounting treatments, the positive impacts on the company's financial status and business performance are demonstrated. Finally, by discussing the practical benefits and future application prospects of the optimized approach to data-asset management for sustainable regional economic development, important insights and directions for future research are provided. In summary, the main contribution of this paper is to systematically analyze the current situation, problems, and solutions of data-asset accounting treatment in the context of the digital economy, which provides useful theoretical and practical guidance for promoting sustainable regional economic development.

RELATED CONCEPTS

Literature Review

In recent years, scholarly interest in the accounting treatment of data assets concerning sustainable regional economic development within the digital economy has surged, both domestically and internationally (Girase et al., 2022). These methods are under critical examination as they transition into operational standards. Sustainable regional economic development seeks to harmonize economic, environmental, and social dimensions, emphasizing efficient resource use, environmental preservation, and equitable societal outcomes. The rapid evolution of the digital economy introduces new opportunities and challenges to this sustainability framework, underscoring the crucial role of managing and utilizing data assets to drive economic growth while achieving sustainability objectives.

Guan et al. (2022) have delved into the market valuation of data assets, employing established techniques such as market comparison and income approaches, although practical implementation hurdles persist. Concurrently, Hoffman et al. (2022) have proposed a data asset valuation methodology grounded in risk assessment and contribution analysis, acknowledging the unique and uncertain nature of these assets. Hosseinzadeh et al. (2023) have endeavored to align data-asset amortization with their economic contributions, thereby refining amortization calculations.

Gunjan and Bhattacharyya (2023) have formulated accounting treatment criteria tailored to data assets in the digital economy, fostering standardization and consistency. Arapović Ilić et al. (2023) have endeavored to construct a market-value model for data assets, employing various valuation techniques, including market comparison, income, and cost methods for appraisal and accounting. Similarly, Kitsantas and Chytis (2022) have integrated the utility and risk dimensions of data assets to enhance value assessment and reflect their economic benefits. Kumar et al. (2023) have concentrated on establishing uniform accounting standards to facilitate accurate disclosure of the value and associated risks of data assets in financial statements.

Nedjah et al. (2022) contend that the distinctive characteristics and complexities of data assets necessitate specialized accounting treatments due to their high replicability and variability. Otabek and Oybek (2023) have proposed a data-asset evaluation model based on information entropy and fuzzy evaluation principles to enhance value-estimation precision. Pechlivanidis et al. (2022) have underscored the significance of data-asset reliability and availability, advocating for transparency and verifiability in accounting practices. Saputra (2022) has introduced diverse amortization schemes to accommodate the evolving nature of data assets and reflect their contributions and value depletion over time.

Scholars in China and beyond are engaged in extensive research to optimize accounting treatment methods for data assets within the context of sustainable regional economic development in the digital economy. These studies furnish valuable insights and references for fostering sustainable digital-economy growth. Researchers are increasingly cognizant of the necessity to refine accounting methods for data assets to underpin sustainable development. Future research endeavors are poised to delve deeper into the evaluation, accounting, and disclosure of data assets, alongside innovations in risk management and sharing mechanisms.

International Accounting Framework

Existing international accounting frameworks, including the International Financial Reporting Standards (IFRS) and the Generally Accepted Accounting Principles (GAAP), serve as guiding principles for financial reporting practices worldwide. Developed by the International Accounting Standards Board, IFRS aims to establish a universal language for business transactions, ensuring transparency and comparability across different countries and industries (Sarkon et al., 2022). Embraced by more than 140 countries, including EU members, Australia, and Canada, IFRS covers various aspects such as revenue recognition, lease accounting, and financial-instrument valuation (Subiyanto et al., 2023).

On the other hand, GAAP, utilized predominantly in the United States, is shaped by multiple entities such as the Financial Accounting Standards Board and the Securities and Exchange Commission. While GAAP shares similarities with IFRS, it's tailored to ensure consistency and reliability within the U.S. jurisdiction. Despite its domestic focus, GAAP's influence extends globally, especially for multinational companies trading on U.S. stock exchanges (Tian et al., 2022).

Beyond IFRS and GAAP, regional or national accounting frameworks like the Chinese Accounting Standards and Japanese Generally Accepted Accounting Principles cater to local regulatory environments (Trichilli & Boujelbène Abbes, 2023). These frameworks, while aligning with global standards to some extent, incorporate unique principles to address specific business landscapes and regulatory needs.

Together, these international accounting frameworks provide a comprehensive structure for financial reporting, balancing global consistency with local relevance to support transparent and comparable financial statements across diverse business contexts.

METHOD

Accounting Treatment Methods for Different Types of Data Assets

Big data assets constitute a distinctive class of assets characterized by their substantial scale, rapid generation, and inherent diversity (Wahab et al., 2022). The systematic processing of such assets, particularly in the context of their application to sustainable regional economic development, follows a structured sequence of steps, as outlined below:

To effectively utilize data for enhancing local economies, a foundational step involves categorizing data assets into various types (Watson, 2022). These include structured data, such as organized and searchable databases; unstructured data, encompassing text, images, and videos without clear organization; semi-structured data, like XML or JSON files; time-series data, tracking changes over time such as stock prices or weather patterns; geospatial data, showing locations and relationships; and social-media data, capturing user-generated content and interactions. This systematic classification lays the groundwork for strategically leveraging diverse data sources to drive sustainable growth in regional economies (Wollstadt et al., 2022).

Once categorized, the next crucial step is processing these data assets effectively according to their respective types. For example, structured data can be managed using relational database systems, while unstructured and semi-structured data may require natural language processing techniques for information extraction. Specialized algorithms are essential for analyzing images and audio files, and tools for trend identification are necessary for time-series data. Geospatial data typically undergoes analysis using geographic information systems, and social-media data is mined for valuable insights. This tailored approach to data processing unlocks significant insights from diverse data sources, facilitating the development of sustainable regional economies.

In investigating the current accounting treatment of big data assets within the digital economy, especially in the context of promoting sustainable regional economic development, a focused survey

was conducted, specifically targeting practices in China. Out of 100 surveys distributed, 95 responses were received, providing a robust dataset for further analysis.

The collected survey data underwent rigorous statistical analysis to uncover patterns, trends, and potential correlations, thus yielding a comprehensive understanding of prevailing accounting practices and attitudes toward big data assets in China.

Based on empirical evidence from the survey, a synthesis of prevalent accounting treatment methods for big data assets was compiled. This summary encapsulates dominant approaches, common challenges encountered, and notable variations in practice across different sectors and organizational contexts.

Following our investigation, a critical assessment was conducted on existing accounting methodologies for big data assets. This analysis focused not only on identifying specific challenges but also on understanding their broader implications for the accuracy, valuation, and management of big data assets, particularly within the framework of sustainable regional economic development in the digital economy.

Optimization of Accounting Treatment Methods for Data Assets

In order to meet the needs of sustainable regional economic development under the digital-economy environment, it is necessary to optimize the current big data asset processing methods. The optimized data asset processing method is shown in Fig. 1.

In Fig. 1, the optimized framework incorporates a dedicated subsequent measurement component, which, in light of distinct usage intents, bifurcates into two principal categories: self-use and transactional. Each category then warrants tailored treatment methodologies. Specifically, the self-use segment undergoes amortization, accompanied by a valuation exercise, whereas the transactional portion is subject to direct evaluation, followed by appropriate asset disposal.

Step 1: Asset Recognition

This stage entails the meticulous confirmation of data-asset characteristics, adhering to the indicators depicted in Fig. 2.

In Fig. 2, in the course of asset recognition, data assets are meticulously classified into 10 distinct types based on their level, facilitating a nuanced approach to both initial and subsequent measurement.

Step 2: Initial Measurement of Assets

Assets are subjected to an initial quantification, employing one of five recognized measurement attributes: historical cost, reflecting the original acquisition expenses; replacement cost, denoting the expense to procure an equivalent asset at present; net realizable value, representing the estimated selling price less costs to sell; present value, discounting future cash flows to their current worth; and fair value, reflecting the price that would be received in an arm’s-length transaction between market participants.

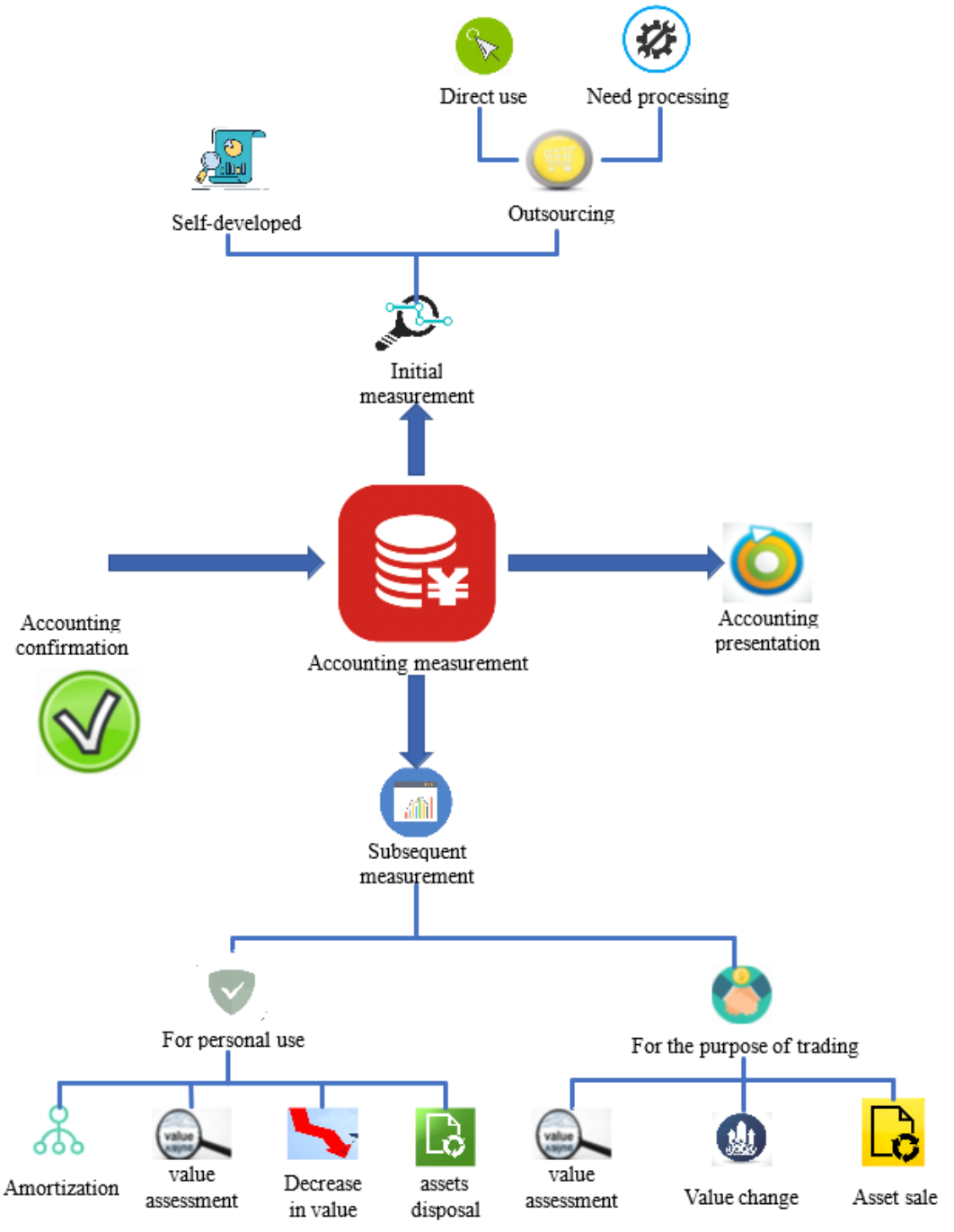
Step 3: Subsequent Measurement of Assets

Following the initial quantification, assets require ongoing monitoring and adjustment through subsequent measurement. This phase addresses both data assets retained for internal use and those earmarked for trading purposes, ensuring their recorded values remain aligned with their current economic realities.

Step 4: Asset Presentation

In this step, the results of the measurement processes are appropriately presented within the financial statements, conforming to applicable accounting standards and providing stakeholders with a clear depiction of the entity's data-asset portfolio, including their nature, amounts, and any relevant valuation assumptions or estimates.

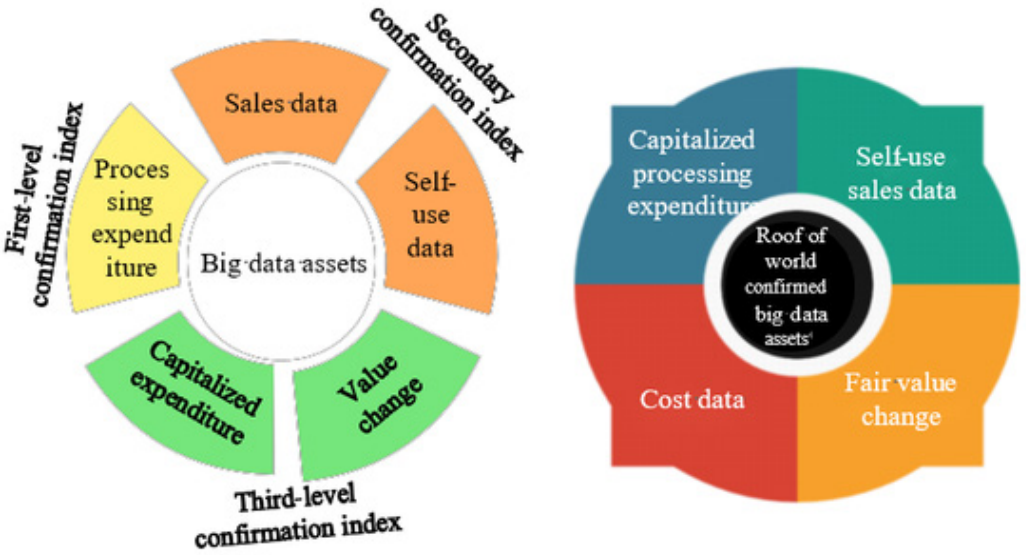
Figure 1. Improved data asset handling method



Step 5: Accounting Treatment of Data Assets Following Example Test Optimization

The final stage entails the application of the optimized accounting treatment methodology to a representative sample of data assets, serving as a test case to validate the efficacy and practicality of

Figure 2. Indicators for big data asset recognition



the proposed framework. This exercise yields valuable insights into the feasibility of the approach, potentially revealing further refinements needed or reinforcing its suitability for broader adoption in the context of accounting for data assets in the digital-economy era.

Selection of Analysis Objects and Data Collection

In terms of data analysis, a variety of techniques were employed to provide insight into the accounting treatment of big data assets in China. First, the collected questionnaire data were subjected to rigorous statistical analyses, including descriptive statistics, correlation analysis, and factor analysis, to identify patterns, trends, and potential correlations in order to gain a comprehensive understanding of the field. Second, content analysis was carried out on the responses to the open-ended questions to understand the views, perceptions, and opinions of the respondents, and the textual data was analyzed using natural language processing techniques to extract keywords and themes. Visualization tools, such as charts and graphs, were also used to present the results of the analysis, producing bar charts, pie charts, scatter plots, etc., in order to facilitate the understanding and communication of the main trends and differences in the methods of processing data assets. In addition, a qualitative analysis was conducted to analyze the qualitative data from the questionnaire in order to understand the respondents' attitudes and perceptions and to reveal potential problems and directions for improvement in data asset handling methods. Finally, a case study analysis was conducted in which the financial information of Guangdong Power Grid Co. was selected for the study in order to understand the actual situation of its big data asset treatment methods, and the optimization direction of big data asset accounting treatment methods was discussed in depth by combining the questionnaire and case study data.

To gain deeper insights into the data asset processing methodologies employed under the auspices of the digital economy, a targeted questionnaire survey was administered to corporate financial personnel—including cashiers, accountants, and finance professionals—engaged in big data transactions and harnessing big data within the context of G City. This empirical investigation sought to elicit firsthand perspectives and practices from those directly involved in managing and leveraging data assets in a contemporary business environment.

Guangdong Power Grid Co. was selected as a case study using the analytical data sourced from the company's officially disclosed financial information. Currently, the data landscape at Guangdong

Power Grid is characterized by an impressive scale: the aggregate volume exceeds 5PB, underpinned by a staggering 100-million real-time measurement points. The enterprise-level information housed within the data center spans across a diverse array of 10 distinct domains, reflecting the breadth and complexity of the data ecosystem managed by the organization.

The data center boasts an extensive repository of historical records, comprising 1.5-billion stock data entries, with a monthly growth rate of 20TB. This rapid and continuous accumulation of data underscores the imperative for effective processing, management, and utilization strategies, as well as the challenges and opportunities inherent in navigating the digital economy's data-intensive terrain. The comprehensive analysis of these data assets, guided by the insights garnered from the questionnaire survey and the empirical data from Guangdong Power Grid, offers a valuable lens through which to examine and refine the methodologies employed in the processing of data assets in the digital age.

RESULTS

Accounting Treatment Methods for Different Types of Data Assets

The information collected from the questionnaire is shown in Table 1.

As evidenced in Table 1, the prevailing accounting treatment methodology for data-asset development within the contemporary digital-economy context is structured around three core stages: asset recognition, asset measurement, and asset presentation. Despite the apparent comprehensiveness of this approach, the questionnaire findings reveal several significant shortcomings that undermine its effectiveness and appropriateness.

First, the current accounting treatment is inherently flawed, and its underlying logic and procedures are considered unsuitable for the rapidly evolving digital environment. The approach fails to adequately address the unique characteristics and complexities of data assets, which often do not fit into traditional asset classification and valuation frameworks.

Second, the lack of clarity surrounding measurement criteria poses a considerable challenge for practitioners. The absence of well-defined, standardized guidelines for assessing the value, quality, and utility of data assets leads to inconsistent and subjective valuations, impairing comparability and transparency in financial reporting. Moreover, the dynamic and intangible nature of data assets exacerbates this issue, as their value may fluctuate significantly over time due to factors such as technological advancements, market demand shifts, and data obsolescence.

The current approach addresses the ongoing expansion and evolution of enterprises within the digital economy. Rapid technological innovation and business model disruptions often necessitate frequent updates to asset inventories and valuations. However, the existing accounting treatment methodology falls short in facilitating prompt and responsive adjustments, leading to a disconnect between the reported asset values and their actual economic substance.

In conclusion, the prevailing accounting treatment method for data assets under the digital-economy environment, as outlined in Table 1, is beset by several critical weaknesses, including its fundamental inappropriateness, unclear measurement criteria, and inability to accommodate the dynamic nature of enterprises operating within this context. These findings underscore the pressing need for the development and implementation of a more robust, adaptive, and contextually relevant accounting framework tailored to the unique challenges and opportunities posed by data assets in the digital age.

An Example Analysis of the Optimized Accounting Treatment Method for Data Assets

Fig. 3 shows the income and profit of Guangdong Power Grid Co. from 2018 to 2022.

As illustrated in Fig. 3, the trajectory of Guangdong Power Grid's operating income vividly exemplifies the interplay between the company's performance and the broader sustainable regional

Table 1. Questionnaire information

Question	Proportion	Number of People	Proportion
Is it recognized as an asset after data collection and processing?	Confirm	17	16.4%
	Do not confirm	78	76.6%
Are assets identified after data-asset processing?	Confirm	61	64.0%
	Confirm most of them	9	9.2%
	Sometimes confirm	4	3.8%
	Do not confirm	21	23.0%
Reconfirm after updating the asset data?	Confirm	5	5.1%
	Confirm most of them	3	2.9%
	Sometimes confirm	7	7.3%
	Do not confirm	82	84.7%
Design accounting subjects related to data assets?	Yes	4	4.0%
	No	82	81.8%
	Unclear	9	13.2%
Are big data assets updated?	Update frequently	27	28.5%
	Update occasionally	28	30.7%
	Do not update	40	40.8%
What are the main uses of big data assets?	Have supporting business	55	57.0%
	External paid circulation	29	30.0%
	Added value	4	4.7%
	Unclear	7	8.3%
Are big data assets listed in the liability list?	Yes	7	8.6%
	No	75	77.0%
	Unclear	13	14.4%
Are big data assets disclosed in the statements?	Yes	17	19.0%
	No	49	50.9%
	Unclear	29	31.1%

economy. Over recent years, the firm has consistently registered substantial and ascending revenue figures, indicative of its integral role within the energy sector and its capacity to capitalize on opportunities afforded by the evolving economic landscape.

The primary driver of Guangdong Power Grid's profitability is its core power business, which contributes over 80% of the company's earnings. However, an examination of the financial performance during the 2018–2022 period reveals a marked degree of volatility. Notably, the company experienced negative growth in 2019, 2020, and 2022, suggesting that despite its overall upward trend, the business is susceptible to considerable fluctuations and setbacks.

Table 2 further enriches our understanding of the company's financial standing by offering a detailed breakdown of its assets across the same five-year timeframe. This quantitative overview serves as a complementary perspective, shedding light on the composition, evolution, and potential vulnerabilities of Guangdong Power Grid's asset base, thereby contextualizing the observed fluctuations in its profit trajectory within the broader economic and financial context. While Fig. 3

Table 2. Statement of assets in 2018–2022(yuan)

Year	Total Assets	Inherent Assets			Floating Assets
		Machinery Equipment	Factory Building	Total	
2018	69,031,320	29,251,460	7,159,349	52,193,037	1,835,895
2019	75,162,693	31,249,718	7,657,315	55,847,466	2,430,967
2020	85,525,966	51,196,600	8,325,941	62,185,260	2,768,499
2021	93,360,337	54,513,676	9,032,863	63,864,959	2,932,213
2022	102,249,548	58,858,137	8,406,215	70,027,911	3,128,933

portrays a generally upward trend in Guangdong Power Grid's operating income against the backdrop of a sustainable regional economy, it also exposes the company's vulnerability to significant profit fluctuations. These oscillations, as highlighted by the downturns in 2019, 2020, and 2022, are further elucidated by the asset profile detailed in Table 2, collectively painting a nuanced picture of the company's financial journey within the dynamic energy sector and broader economic landscape over the past five years.

As shown in Table 2, during the process of data-asset developing and accounting treatment, it was found that the total assets held by the enterprise are large, mainly fixed assets, of which machinery and equipment account for the largest proportion, followed by houses and buildings, which also

Figure 3. Revenue and profit of Guangdong power grid co. from 2018 to 2022

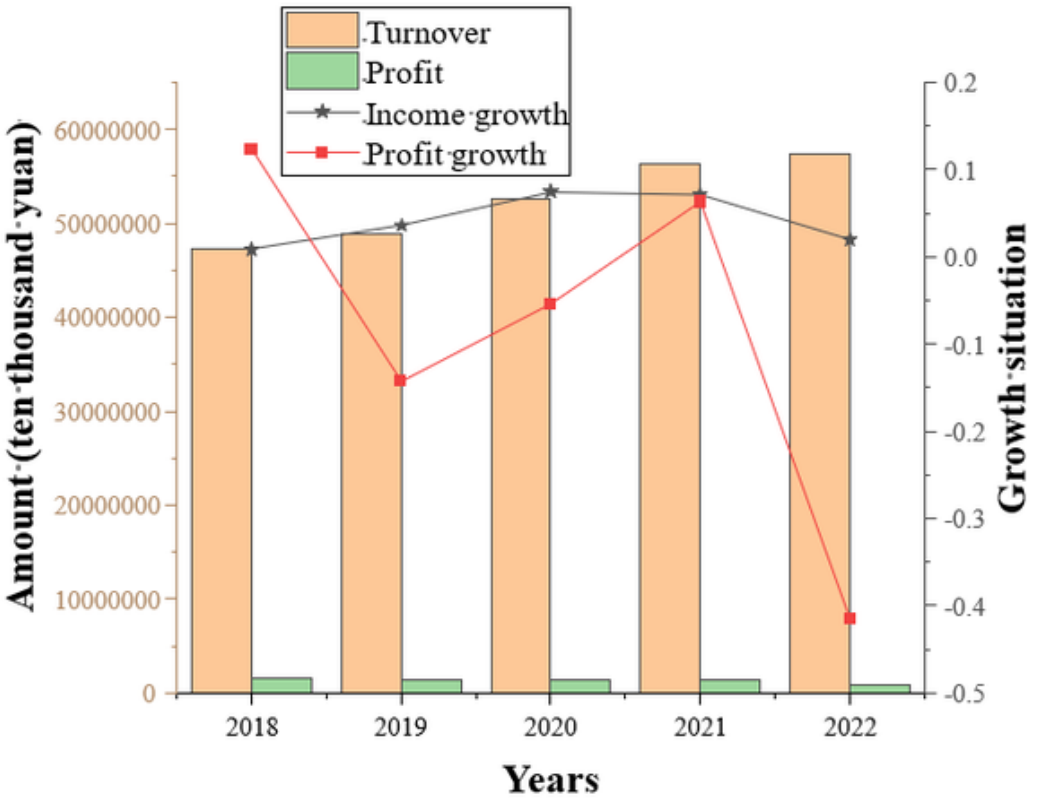


Table 3 Data assets confirmation judgment

	Outsourcing Data	User Data	Enterprise Product Evaluation Data
Does the enterprise own?	**Confirm**	**Confirm**	**Confirm**
Is there any economic benefit?	Unconfirmed	Unconfirmed	Confirm
Is the cost value predictable?	Confirm	Confirm	Confirm
Can it be recognized as an asset?	Unconfirmed	Unconfirmed	Confirm

Table 4. Accounting treatment after optimization according to intangible assets and data assets

Intangible Assets	Numerical Value (CN¥10,000)	Data Assets	Numerical Value (CN¥10,000)
R&D expenditure	25	R&D expenditure	25
Bank loan	25	Bank loan	25
Capital R&D expenditure	35	Data asset R&D expenditure	35
Capital expenditure	25	Data asset expense	25
Bank loan	60	Bank loan	60
Intangible assets	65	Self-use data assets	65
Capital expenditure	65	Capitalized expenditure	25
Management cost	25	Management expenditure	45
R&D expenditure	25	Charge against revenue	25
Management cost	35	Management cost	35
Amortization of intangible assets	35	Amortization of self-use data assets	30
Asset impairment reserve	3	Asset impairment reserve	4
Provision for impairment of current assets	3	Self-use data assets impairment reserve	4

reflects the characteristics of more power-generation equipment in power-grid enterprises. In addition, intangible assets owned by enterprises mainly include software, land-use rights, patents, nonpatented technologies, franchises, etc. As shown in Table 3, the judgment is confirmed for data assets.

In Table 3, when the company's data can be used by enterprises or meet the passive needs of users, it meets the conditions for asset recognition and can be recognized as data assets. Table 4 reflects the optimized accounting treatment according to intangible assets and data assets during the development of data assets for a sustainable regional economy.

In Table 4, after comparison in different ways, it can be found that in the process of data-asset processing, increasing capitalization and expensing expenditure in R&D expenditure effectively prevents the inflow of outsourced data that cannot bring economic benefits to enterprises alone. Table 5 is a comparison of different measurement methods.

In Table 5, when data assets are processed for transaction purposes as intangible assets, it is necessary to amortize the data assets according to the accounting requirements of intangible assets. Processing as data assets can meet the characteristics of data assets, and the impact of value changes on enterprises can be directly reflected. The impact of accounting treatment before and after optimization on liabilities and total profits in 2022 is shown in Table 6.

In Table 6, the optimized accounting treatment method for data assets makes the amount of data assets of the company 70% higher than intangible assets, and the difference in total profit growth is

Table 5. Comparison of expenditure in different measurement methods

Intangible Assets	Numerical Value (CN¥10,000)	Data Assets	Numerical Value (CN¥10,000)
Capital R&D	95	Capital R&D	95
Cost R&D	45	Cost R&D	45
Bank loan	140	Bank deposit	140
Intangible assets	95	Cost	95
Capitalized expenditure	95	R&D data capital expenditure	95
Management cost	45	Management cost	45
Expensive expenditure	45	Expensive data capital expenditure	45
Bank deposit	85	Bank deposit	85
Business income	85	Business income	85
Bank deposit	95	Business cost	21
Business income	95	Cost of assets	21
		Bank deposit	95
		Business income	95
Business cost	55	Business cost	23
Accumulated amortization	55	Cost of assets	23
		Changes in fair value of transaction data	25
		Changes in fair value gains and losses	25
		Business cost	11.3
		Changes in fair value of transaction data	11.3

17.8%. In the digital-economy environment, this means that the optimization method of data assets accounting treatment proposed in this paper will create greater economic value. In Table 7, in order to optimize the accounting treatment, the monthly cost of the company is compared before and after.

After optimizing the accounting treatment, Table 7 demonstrates a 3.67% reduction in the company's asset management costs, decreasing from CN¥1,180,000 to CN¥994,000. This reduction highlights the cost-saving potential of the accounting treatment method developed in this study. Table

Table 6. Influence of optimized accounting treatment on total liabilities and profits in 2021 and 2022

Item	2021		2022	
	Debt	Profit	Debt	Profit
Self-use data assets	9	32	24	47
Transaction data assets	52	91	100	96
Total data assets	61	123	188	143
Self-use data assets	9	32	38	66.89
Transaction data assets	89.2	108	173	101.56
Total data assets	97.3	140	211	168.45
Percentage of difference	50.3%	13.3%	70.02%	17.8%

Table 7. Comparison of monthly cost of the company before and after optimizing accounting treatment methods

Item	Before Optimization Treatment (in CN¥*10,000*)	After Optimization Treatment (in CN¥*10,000*)
Researcher's salary	27	22.4
Equipment depreciation	80	68
Cost of material	7	6
R&D expenses	4	3
Total	118	99.4

Table 8. Amortization changes of the company's big data assets after optimizing the accounting treatment

Year	2019	2020	2021	2022
Amortized assets (CN¥10,000)	99	99	99	99
Amortization ratio	0.4	0.33	0.27	0.1
Amortization amount (CN¥10,000)	40	30.71	19.67	9.86

8 illustrates the changes in the amortization of the company's big data assets over the past four years following the accounting optimization.

In Table 8, after optimizing the data asset processing method, the amortization amount is reduced to CN¥98,600, which can better maintain the profit of the company, realize the accurate processing of data capital, and promote the development of a sustainable regional economy under the digital-economy environment.

This research segment examines the role of data assets in sustainable regional economic development and illustrates the impact of accounting treatments on the management of data assets and the regional economy through questionnaire surveys and example analyses. First, understanding the accounting treatments for different types of data assets is crucial for business management and asset valuation, and the questionnaire survey reveals the shortcomings and challenges of the current methods, which directly affect the role of data assets in the regional economy. Second, an example analysis demonstrates the positive impact of optimized accounting treatments on a company's financial position and economic value. Optimized accounting treatments reflect the value of data assets more accurately and improve the efficiency and transparency of firms' asset management, thus providing more robust support for sustainable regional economic development. Thus, this study highlights the importance of data assets in promoting regional economies in the digital-economy environment and provides an empirical basis and guidance that can be useful for the sustainable development of regional economies.

DISCUSSION

Similarly, Sitinjak et al.(2023) proposed a novel accounting framework that highlights the significance of data assets to corporate value and explored evaluation methods and challenges in disclosure and measurement. Tian et al. (2022) investigated the digital transformation and accounting of data assets against the backdrop of sustainable regional economic development, proposing a comprehensive method for evaluating data-asset value.

This paper’s research indicates that the refined data asset management approach has increased the value of Guangdong Power Grid's data assets by 70% compared to its intangible assets, with a total profit growth difference of 17.8%. Post-optimization, the company’s asset-management costs decreased by 3.67% and the amortization expenses were reduced to CN¥98,600. This optimized

method, oriented toward a sustainable regional economy within a digital-economy context, introduces innovations such as a comprehensive research approach, full consideration of data-asset characteristics, and integration of risk management and privacy protection.

The optimized accounting treatment for data assets discussed in this study supports the expansion and refinement of data-asset theory and sustainable-economic theory, adding depth to both fields. In the digital economy, this study's rigorous approach to asset accounting addresses the complexity and unique requirements of data assets more effectively than traditional methods. The practical application of this optimized method demonstrates its adaptability and utility for effective decision-making, resource allocation and utilization, sustainable economic development, and digital economic transformation.

By integrating digital-economy concepts with sustainable regional development and data-asset accounting, this research builds a robust framework that aids in understanding data assets' characteristics and needs. It also underscores the importance of data-asset disclosure, proposing standards and guidelines to enhance transparency.

The direct practical benefits of optimizing data-asset accounting for sustainable regional development are significant. First, the study supports strategic enterprise decision-making, offering a more precise data asset evaluation model that facilitates smarter resource allocation and strategic planning. This not only boosts competitiveness but also helps companies capitalize on market opportunities. Second, it promotes efficient resource use, which is crucial in regions where resources are scarce. Optimized data management can prevent resource wastage, enhance efficiency, and reduce costs, thereby supporting sustainable growth. Furthermore, the study's focus on data-asset risk management is crucial for ensuring security and compliance in the digital economy, where data breaches and privacy issues can have severe repercussions. Last, the proposed disclosure standards and guidelines enhance the transparency and credibility of data assets, which is vital for building trust with partners and stakeholders and fostering a sharing economy.

The proposed data asset management optimization method has significant future application potential and strategy effectiveness. It emphasizes the need to develop and implement clear accounting standards and guidelines to manage the complexity and variety of data assets in the digital economy. Looking ahead, fostering cooperation among industry bodies, regulatory authorities, and international standards organizations to establish and disseminate best practices for data-asset accounting will be essential. Additionally, addressing global challenges such as cross-border data flows, standard setting, and information sharing will require international collaboration. As technology progresses, continual updates to data-asset accounting methods will be necessary, potentially incorporating advanced technologies such as artificial intelligence, blockchain, and big-data analytics. These advances will facilitate the integrated development of the digital and sustainable economies, influencing future economic trends.

CONCLUSION

The results of this paper helped reveal the inherent shortcomings of current accounting treatments while providing optimized solutions and providing important reference and guidance for business managers and accounting professionals in the digital-economy environment.

First, the paper showed that current accounting treatments for digital assets suffer from insufficient applicability, unclear measurement standards, and insufficient adaptability to the dynamic nature of the digital-economy environment. These shortcomings lead to inconsistency and subjectivity in financial reporting, thereby compromising its comparability and transparency. In addition, the value of data assets may fluctuate over time, and traditional methods cannot flexibly respond to such changes.

Second, through the case study of Guangdong Power Grid Co., we found that while its revenue continues to grow, there were significant fluctuations in profits. Optimizing the accounting treatment can better identify, measure, and report data assets, thus reflecting their actual impact on the company's

performance. Such optimization can also reduce asset-management costs, better safeguard profits, and promote sustainable regional economic development in a digital-economy environment.

Specific optimization measures include increasing capitalized and expensed expenditure on data assets, improving amortization methods for data assets, and adjusting financial statements to better reflect the value of data assets. These measures help improve the accuracy and comparability of data assets, reduce asset-management costs, and better reflect the impact of data assets on company performance.

In summary, the results of this paper helped demonstrate some of the problems with current digital asset accounting treatments. It offered implementable optimization options and important reference and guidance for business managers and digital asset accounting professionals in the digital-economy environment.

AUTHOR'S NOTE

The figures and tables used to support the findings of this study are included in the article.

The authors declare that they have no conflicts of interest.

This work was not supported by any funds.

The authors sincerely thank those who have contributed to this research.

PROCESSING DATES

07, 2024

This manuscript was initially received for consideration for the journal on 04/16/2024, revisions were received for the manuscript following the double-anonymized peer review on 05/27/2024, the manuscript was formally accepted on 06/02/2024, and the manuscript was finalized for publication on 07/02/2024

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REFERENCES

Abid, A., & Abid, F. (2023). A methodology to estimate the optimal debt ratio when asset returns, and default probability follow stochastic processes. *Journal of Industrial and Management Optimization*, *19*(10), 7735–7752. 10.3934/jimo.2023017

Andriani, E. (2022). Optimization of village funds with the development of village-owned enterprises (BUMDes) towards an independent village in Maryke Plantation Village. *Jurnal Ekonomi, 11*(03), 1547–1553. https://ejournal.seaninstitute.or.id/index.php/Ekonomi/article/view/912

Arapović Ilić, T., Krstić, S., Dašić, M., Brajković, B., Damnjanović, R., Trnavac, D., & Savić, A. (2023). The role of financial management in using data mining in agricultural companies. *Ekonomika Poljoprivrede*, *70*(1), 267–276. 10.59267/ekoPolj2301267A

Baumgartner, M., & Ambühl, M. (2023). Optimizing consistency and coverage in configurational causal modeling. *Sociological Methods & Research*, *52*(3), 1288–1320. 10.1177/0049124121995554

Devanathan, B., & Kamarasan, M. (2023). Multi-objective Archimedes optimization algorithm with fusion-based deep learning model for brain tumor diagnosis and classification. *Multimedia Tools and Applications*, *82*(11), 16985–17007. 10.1007/s11042-022-14164-5

Faridi, S., Madanchi Zaj, M., Daneshvar, A., Shahverdiani, S., & Rahnamay Roodposhti, F. (2023). Portfolio rebalancing based on a combined method of ensemble machine learning and genetic algorithm. *Journal of Financial Reporting and Accounting*, *21*(1), 105–125. 10.1108/JFRA-11-2021-0413

Girase, R., Ahmad, I., Pawara, R., & Patel, H. (2022). Optimizing cardio, hepato and phospholipidosis toxicity of the Bedaquiline by chemoinformatics and molecular modelling approach. *SAR and QSAR in Environmental Research*, *33*(3), 215–235. 10.1080/1062936X.2022.2041724352251l0

Guan, H., Guo, B., & Zhang, J. (2022). Study on the impact of the digital economy on the upgrading of industrial structures—Empirical analysis based on cities in China. *Sustainability (Basel)*, *14*(18), 11378. 10.3390/su141811378

Gunjan, A., & Bhattacharyya, S. (2023). A brief review of portfolio optimization techniques. *Artificial Intelligence Review*, *56*(5), 3847–3886. 10.1007/s10462-022-10273-7

Hoffman, S. C., Chenthamarakshan, V., Wadhawan, K., Chen, P.-Y., & Das, P. (2022). Optimizing molecules using efficient queries from property evaluations. *Nature Machine Intelligence*, *4*(1), 21–31. 10.1038/s42256-021-00422-y

Hosseinzadeh, M. M., Ortobelli Lozza, S., Hosseinzadeh Lotfi, F., & Moriggia, V. (2023). Portfolio optimization with asset preselection using data envelopment analysis. *Central European Journal of Operations Research*, *31*(1), 287–310. 10.1007/s10100-022-00808-2

Kitsantas, T., & Chytis, E. (2022). Blockchain technology as an ecosystem: Trends and perspectives in accounting and management. *Journal of Theoretical and Applied Electronic Commerce Research*, *17*(3), 1143–1161. 10.3390/jtaer17030058

Kumar, S., Gopi, T., Harikeerthana, N., Gupta, M. K., Gaur, V., Krolczyk, G. M., & Wu, C. (2023). Machine learning techniques in additive manufacturing: A state of the art review on design, processes and production control. *Journal of Intelligent Manufacturing*, *34*(1), 21–55. 10.1007/s10845-022-02029-5

Nedjah, N., de Macedo Mourelle, L., Alves dos Santos, R., & Torres Bispo dos Santos, L. (2022). Sustainable maintenance of power transformers using computational intelligence. *Sustainable Technology and Entrepreneurship*, *1*(1), 100001. 10.1016/j.stae.2022.100001

Otabek, A., & Oybek, R. (2023). Statistical study of accounting reports in manufacturing enterprises. *Open Access Repository*, *4*(04), 96–104.

Pechlivanidis, E., Ginoglou, D., & Barmpoutis, P. (2022). Can intangible assets predict future performance? A deep learning approach. *International Journal of Accounting & Information Management*, *30*(1), 61–72. 10.1108/IJAIM-06-2021-0124

Saputra, F. (2022). Analysis effect return on assets (ROA), return on equity (ROE) and price earning ratio (PER) on stock prices of coal companies in the Indonesia Stock Exchange (IDX) period 2018–2021. *Dinasti International Journal of Economics. Finance & Accounting*, *3*(1), 82–94. 10.38035/dijefa.v3i1

Sarkon, G. K., Safaei, B., Kenevisi, M. S., Arman, S., & Zeeshan, Q. (2022). State-of-the-art review of machine learning applications in additive manufacturing: From design to manufacturing and property control. *Archives of Computational Methods in Engineering*, *29*(7), 5663–5721. 10.1007/s11831-022-09786-9

Sitinjak, C., Johanna, A., Avinash, B., & Bevoor, B. (2023). Financial management: A system of relations for optimizing enterprise finances—A review. *Journal Markcount Finance*, *1*(3), 160–170. 10.55849/jmf.v1i3.104

Subiyanto, E., Ismiyanti, F., & Effnandya, A. F. (2023). Managing damaged asset: A case study optimisation between refurbishing and divestiture using capital budgeting in a logistics business in Indonesia. *International Journal of Management and Decision Making*, *22*(2), 160–181. 10.1504/IJMDM.2023.129834

Tian, K., Xia, X., Lu, C., & Peng, B. (2022). Research on the digital economy boosting the high-quality development of manufacturing in underdeveloped areas—Taking Kaifeng City as an example. *Open Journal of Business and Management*, *10*(6), 3048–3066. 10.4236/ojbm.2022.106151

Trichilli, Y., & Boujelbène Abbes, M. (2023). The impact of COVID-19 on the portfolio optimization. *EuroMed Journal of Business*, *18*(2), 207–228. 10.1108/EMJB-11-2021-0179

Wahab, A., Pfuderer, L., Paenurk, E., & Gershoni-Poranne, R. (2022). The COMPAS Project: A computational database of polycyclic aromatic systems. Phase 1: *cata*-condensed polybenzenoid hydrocarbons. *Journal of Chemical Information and Modeling*, *62*(16), 3704–3713. 10.1021/acs.jcim.2c0050335881922

Watson, R. (2022). The virtual economy of the metaverse: Computer vision and deep learning algorithms, customer engagement tools, and behavioral predictive analytics. *Linguistic and Philosophical Investigations*, *21*(0), 41–56. 10.22381/lpi2120223

Wollstadt, P., Bujny, M., Ramnath, S., Shah, J. J., Detwiler, D., & Menzel, S. (2022). CarHoods10k: An industry-grade data set for representation learning and design optimization in engineering applications. *IEEE Transactions on Evolutionary Computation*, *26*(6), 1221–1235. 10.1109/TEVC.2022.3147013

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