Research on the Construction of a Coordinated Development Mechanism for Data Resource Accounting in the Hainan Free Trade Port

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Abstract: *Data, as a critical factor of production, presents fundamental challenges to the traditional accounting framework due to its economic characteristics such as non-competitiveness and strong complementarity. This challenge is particularly pronounced within the context of the Hainan Free Trade Port, characterized by high-speed data flows, coexisting multiple accounting standards, and diverse governance structures. It manifests as the complication of accounting recognition due to ambiguous control rights, the lack of comparability in measurement stemming from differing standards, and the impairment of information quality resulting from weak governance. This research aims to construct a coordinated development mechanism for data resource accounting suited to this specific context. By reviewing theoretical foundations and analyzing the triple coordination challenges, it proposes a systematic framework. This framework consists of core principles and multi-layered elements, relies on a technological synergy pathway, and embeds a sustainable evaluation and optimization cycle. Emphasizing dynamic adaptation and multi-dimensional compatibility, the framework strives to enhance information comparability and decision-usefulness, thereby providing a systematic solution for achieving coordinated, comparable, and transparent data resource accounting information within complex and dynamic environments.*

Keywords: *Hainan Free Trade Port; data resource accounting; coordinated development mechanism; asset recognition; measurement coordination; data governance*

Introduction

The realization of value from data resources necessitates adaptive reforms within the current accounting system. Characteristics such as non-physicality and value-derivativeness create theoretical dilemmas across the stages of recognition, measurement, and reporting. This issue becomes further complicated within the distinctive context of the Hainan Free Trade Port—a region marked by frequent cross-border data flows, the coexistence of multiple accounting standards, and diverse governance structures. Specific manifestations include coordination challenges such as ambiguous definition of control rights, insufficient comparability in measurement, and impaired information quality due to governance discrepancies. Consequently, constructing a coordinated development mechanism for data resource accounting—one that adapts to the Free Trade Port environment, reconciles multiple differences, and enhances information quality and comparability—holds significant theoretical value and practical importance. This study follows the logical pathway of "theoretical review-problem diagnosis-framework construction" to systematically address this subject.

1. The Theoretical Foundation and Core Dimensions of Data Resource Accounting

1.1 Defining the Accounting Attributes and Economic Characteristics of Data Resources

The definition of the accounting attributes of data resources serves as the logical starting point for constructing their accounting treatment framework. Under the traditional accounting element framework, the recognition of an asset must satisfy three core criteria: arising from past events, being controlled by the entity, and involving the expected inflow of future economic benefits. Data resources originate from ongoing operational activities or specific collection actions, and their formation is characterized by process orientation and cumulative development. Within the context of legal

ownership not being fully clarified, the concept of "control" primarily focuses on the entity's practical ability to exclusively access, process, and dispose of the data resources, rather than on complete legal ownership. The economic benefits of data resources are manifested in their potential to empower decision-making, optimize processes, drive innovation, or generate revenue through direct transactions after analysis. The realization of these benefits is indirect and probabilistic, heavily reliant on an enterprise's data analysis capabilities and specific application scenarios[1].

The economic characteristics that distinguish data resources from traditional assets form the unique foundation for their accounting treatment. Their non-competitive nature is manifested in the fact that data can be simultaneously used by multiple entities or applications without diminishing its intrinsic value, which challenges the traditional measurement logic based on scarcity. Strong complementarity means that the value of data does not exist in isolation but arises from its integration with other data, algorithms, and business processes, necessitating that value assessment be situated within a specific ecological context. Reusability and value derivability are core features; after processes such as cleaning, modeling, and analysis, raw data can continuously generate new information, knowledge, and business insights, with the potential for exponential growth in value. Collectively, these characteristics determine that the value of data resources possesses complex attributes such as dynamic evolution, context-dependence, and path-sensitivity, requiring adaptive responses from accounting theory.

1.2 The Theoretical Framework for Data Asset Recognition, Measurement, and Reporting

When data resources meet the criteria for asset recognition, particularly when their expected future economic benefits can be reliably assessed, they can be recognized as data assets. The timing of this recognition becomes a key theoretical issue, with differing perspectives on whether to capitalize costs at their initial incurrence or to recognize the asset at the point of data productization or generation of clear cash flows. The core controversy lies in the judgment criteria for the reliability of "future economic benefits." Initial measurement typically follows the cost principle; however, the cost composition of data resources is complex. Beyond direct acquisition or purchase costs, a significant portion involves the allocation of internally generated costs, such as salaries and infrastructure depreciation, making their identification and attribution highly subjective.

Subsequent measurement then faces the choice between the cost model and the value model. While the cost model offers reliability, it may significantly deviate from the actual economic value of the asset. Value models, including fair value and the value realization model, better reflect its economic substance, but the associated valuation techniques pose significant challenges. The income approach requires forecasting the future cash flows generated by the data asset and reasonably allocating them; the market approach is limited in application due to the lack of an active trading market; and estimating replacement cost under the cost method is similarly difficult. In the reporting phase, beyond presenting the carrying amount of the data asset, off-balance-sheet information disclosure is crucial. This includes the scale, type, and source of the data asset, key valuation assumptions, the reliant technological infrastructure, primary application scenarios, and associated risk exposures. This aims to compensate for the limitations of on-balance-sheet measurement and provide information users with incremental, decision-relevant information.

1.3 The Integration Mechanism of Accounting Information Systems and the Data Value Chain

The deep integration of accounting information systems and the data value chain serves as the technological and procedural foundation for translating the theoretical framework of data resource accounting into operational reality. The data value chain encompasses the entire value-creation process, from the collection and storage of raw data to its processing, analysis, and final application in decision-making and innovation. Modern accounting information systems have evolved beyond their traditional function of transaction recording to become integrated enterprise data management and analysis platforms. The mechanism of their integration is reflected in the deep embedding of the accounting system into each stage of the data value chain[2].

In the stage of data collection and storage, the accounting information system interfaces with operational systems such as ERP and CRM, automatically capturing structured financial and non-financial transaction data. Simultaneously, it defines metadata standards and storage logic for semi-structured and unstructured data, such as logs and images, ensuring data traceability and consistency. During the processing and analysis stage, accounting rules and algorithms are encoded as data processing scripts or models. This enables the automatic cleansing, classification, aggregation, and

calculation of massive datasets, transforming raw data into accounting information that meets the requirements for recognition and measurement. In the reporting and application stage, the system utilizes visualization tools and application programming interfaces to push information about data assets and derived analytical insights in real-time to both management decision-making and external reporting processes. This integration transforms the very production of accounting information into a continuous process of data value discovery. It facilitates a shift from lagged reflection to real-time insight, and from post-event accounting to process control, thereby providing foundational support for the coordinated accounting management of data resources.

2. Coordination Challenges for Data Resource Accounting in the Context of the Hainan Free Trade Port

2.1 The Complex Impact of the Free Trade Port's Data Flow Environment on Accounting Recognition

As a highly open economic zone, a defining characteristic of the Hainan Free Trade Port is its facilitation of high-speed cross-border and cross-regional flows of data as a factor of production. This fluid environment poses a fundamental challenge to the accounting recognition of data resources. One of the core prerequisites for accounting recognition is the entity's control over the resource. In scenarios involving frequent cross-border interaction and sharing of data, the boundaries of control become blurred and dynamic. When data undergoes collaborative processing and joint value creation among different entities within the Free Trade Port or with overseas entities, legal ownership arrangements may lag behind business practices. This lag results in a lack of stable grounds for accounting judgments based on "effective control." If the rights allocation agreements among data subjects, data processors, and data users are not clearly defined at the accounting point in time, they will trigger recognition difficulties regarding asset attribution[3].

The real-time nature and high frequency of data flows further challenge the traditional accounting principle regarding the timing of recognition. A dataset with potential economic value may see its value attributes continuously evolve during the processes of flow and aggregation, making the critical point of its transition from a "resource" to an "asset" difficult to pinpoint. For instance, in cross-border R&D collaboration, the real-time sharing of experimental data streams creates a situation where the realization of its value depends on subsequent analytical modeling outcomes. During the collaboration period, significant room for professional judgment and risk of mismatch exist, whether in opting for capitalization or expensing treatment. This control dilution and value-timing ambiguity, resulting from fluidity and collaboration, demand that accounting recognition standards possess greater flexibility and contextual adaptability.

2.2 Measurement Divergence of Data Assets Under the Coexistence of Multiple Accounting Standards

The diverse market entities attracted to the Hainan Free Trade Port may prepare their financial reports in accordance with different accounting standard systems, such as International Financial Reporting Standards, Chinese Accounting Standards for Business Enterprises, or other specific regional standards. This coexistence of multiple standards can lead to significant divergence in the measurement of data assets, impairing the comparability and coordination of financial information. The divergence is primarily reflected in the preference for measurement attributes. Different standards vary in their application conditions and hierarchy guidance for fair value measurement. For specific types of data assets within the Free Trade Port that lack an active market, some standards may prefer the cost model supplemented by impairment testing, while others encourage the use of valuation techniques based on discounted future cash flows. This directly results in reporting substantially different carrying amounts for the same economic resource.

The measurement divergence stems more fundamentally from differing regulations regarding the scope of cost capitalization for data assets and the treatment of value fluctuations. For internally generated data assets, the specific boundary defining whether development-phase expenditures should be capitalized or expensed varies across different standards. In the rapidly evolving data value environment of the Free Trade Port, the treatment of value increments in subsequent measurement becomes even more critical. Some standard frameworks have not yet established clear normative paths for the revaluation of data asset values, while those that permit revaluation lack uniformity in their

specific methodologies. This heterogeneity in measurement bases not only affects the financial statement presentation of individual entities but also creates informational barriers for investment analysis, credit assessment, and resource allocation decisions within the Free Trade Port that rely on consolidated statements or aggregated financial data. This constitutes a core bottleneck for coordinated development.

2.3 The Interactive Relationship Between Data Governance Structures and Accounting Information Quality

The data governance structure defines the framework of authority, responsibility, and processes for data management and decision-making within an organization. In the complex business ecosystem of the Hainan Free Trade Port, the maturity and specific characteristics of this governance structure directly and profoundly interact with the quality of information produced by data resource accounting. A data governance structure with low maturity or ambiguous authority and responsibility is a significant root cause of reliability deficiencies in accounting information. If the responsibilities for data rights confirmation, classification and grading, and quality control are dispersed or absent, the data sources ingested by the accounting system suffer from inherent weaknesses in completeness, accuracy, and consistency. For example, without clear governance bodies defining rules for data cleansing and standardization, the same data item may carry vastly different meanings across different business units. Asset measurement and reporting based on such data inevitably lose credibility[4].

The data governance architecture equally influences the relevance of accounting information. High-quality data governance can ensure that the value creation path of data assets is effectively recorded and tracked, thereby providing a reasonable basis for accounting to allocate and apportion value. Conversely, if the governance architecture fails to span the entire data lifecycle, accounting information may be confined to historical cost measurement, unable to reflect the synergistic value and option value generated through the combination and circulation of data assets in specific scenarios within the Free Trade Port. More critically, the strength of control measures within the governance structure concerning data security and privacy protection directly impacts the usability and risk profile of data assets. This risk information constitutes a vital component of accounting information disclosure. High risks arising from weak governance, if not appropriately reflected in accounting reports, will severely diminish the decision-usefulness of the information. Therefore, data governance and accounting information quality form a tightly coupled cycle. Deficiencies in governance systematically undermine the foundational quality of accounting information, while distorted accounting information fails to provide effective feedback for governance optimization.

3. Framework Design for the Coordinated Development Mechanism of Data Resource Accounting

3.1 Core Principles and Constituent Elements of the Coordinated Development Mechanism

To address the aforementioned challenges within the context of the Hainan Free Trade Port, the construction of a coordinated development mechanism for data resource accounting must adhere to several core principles. The Principle of Dynamic Adaptability requires the mechanism to be responsive to rapid changes in the value forms of data resources, technological conditions, and the market environment, possessing inherent flexibility for iterative updates. The Principle of Multi-dimensional Compatibility emphasizes that the mechanism must provide mappable and convertible interfaces for accounting treatments under different accounting standard backgrounds, aiming to enhance horizontal comparability of information rather than enforcing absolute uniformity. The Principle of Economic Substance Orientation advocates that the design of rules for accounting recognition, measurement, and reporting should look beyond legal forms and technical appearances, focusing on the capacity and manner in which data resources create future economic benefits. The Principle of Adequate Risk Disclosure requires the mechanism to embed identification and reporting requirements for risks specific to data assets, such as technological obsolescence, value attenuation, and security and compliance risks, ensuring information completeness[5].

Based on the aforementioned principles, the coordinated development mechanism is structured as a system comprising three key constituent elements. The first is the Conceptual Framework and Guidance Layer, which aims to establish a consensus-based set of conceptual definitions, recognition thresholds, and measurement objective guidance for data resource accounting, serving as the logical

foundation for coordination. The second is the Standards Coordination and Conversion Layer, whose function is to establish a mapping of differences and a methodology for adjustments in the key treatment areas of data assets among mainstream accounting standards, such as International Financial Reporting Standards and Chinese Accounting Standards for Business Enterprises. This provides a technical basis for preparing multi-standard reports or conducting comparative information analysis. The third is the Disclosure and Transparency Enhancement Layer. This element involves designing standardized data asset information disclosure templates and element checklists. It requires entities to go beyond on-balance-sheet presentation in financial statements and to systematically disclose the strategic role, value drivers, key measurement assumptions, and major risk exposures of data assets. This aims to compensate for potential information gaps arising from measurement diversity and to construct a disclosure system where on- and off-balance-sheet information corroborate each other.

3.2 The Synergistic Pathway Between Accounting Technical Standards and Data Technology Architecture

The implementation of the mechanism relies on the deep synergy between accounting technical standards and the underlying data technology architecture. The primary synergistic pathway is embodied in the mapping and integration of accounting classification standards with data attribute tags. For example, this involves extending the XBRL taxonomy to create core metadata elements for data assets and linking them to the technical metadata within an enterprise's data catalog and lineage maps. This enables drill-through traceability from financial statement line items to specific datasets and processing workflows, ensuring the reliability and verifiability of the accounting information production process.

Deeper-level synergy lies in embedding accounting control and measurement logic into the data lifecycle management platform. During the stages of data collection and processing, accounting rules can be translated into data quality rules and cost aggregation algorithms, enabling the real-time aggregation of costs and the automated preliminary review of capitalization criteria. In the valuation stage, valuation models can be modularly encapsulated, with their key parameters sourced directly from business systems, achieving semi-automated valuation and ensuring parameter traceability. Furthermore, distributed ledger technologies, such as blockchain, can provide immutable records for cross-border and cross-entity data ownership and transactions. This offers a credible third-party evidence chain for accounting recognition of "control" and the measurement of "fair value," thereby reducing coordination costs at the technological source.

3.3 Evaluation of Mechanism Effectiveness and the Optimization Cycle Under Sustainable Evolution

To ensure the vitality of the mechanism, it is necessary to establish a continuous effectiveness evaluation process and a dynamic optimization cycle. The evaluation should be centered on its core objectives, defining multi-dimensional key performance indicators. The Information Quality Dimension examines the extent of improvement in comparability, value relevance, and transparency. The Decision Support Dimension focuses on the reduction in the cost for information users to understand the data and the improvement in decision-making efficiency. The Coordination Cost Dimension monitors the additional burden and net benefits incurred by market entities in complying with the mechanism. This multi-dimensional assessment aims to comprehensively examine the actual effectiveness of the mechanism.

The establishment of an optimization cycle relies on a closed-loop system comprising monitoring, feedback, and revision. The monitoring system continuously collects data on the aforementioned performance indicators and pays attention to new accounting issues arising from emerging data business models and technologies, such as privacy-preserving computation and data spaces. Feedback channels, facilitated through academic seminars and consultation platforms involving multiple stakeholders including academia, standard-setting bodies, market entities, and professional service institutions, gather empirical observations on the mechanism's operational effectiveness and suggestions for improvement. The revision process, based on inputs from monitoring and feedback, regularly reviews the constituent elements of the mechanism. Optimization activities may manifest as clarifications to conceptual guidance, updates to standards coordination mapping tables, additions or deletions to elements in disclosure templates, or upgrades to recommended technical interface specifications. The essence of this cycle is to transform the coordinated development mechanism into a self-learning, self-correcting adaptive system, ensuring its continued effectiveness within the

dynamically evolving economic and technological ecosystem of the Hainan Free Trade Port.

Conclusion

This study systematically examines the theoretical foundations, practical challenges, and framework solutions for constructing a coordinated development mechanism for data resource accounting within the specific economic environment of the Hainan Free Trade Port. The research indicates that the unique economic characteristics of data resources necessitate adaptive responses from accounting theory, while the data flow environment, multi-standard landscape, and diverse governance structures within the Free Trade Port collectively constitute the primary obstacles to coordinated accounting development. To address these challenges, the proposed coordinated development mechanism is built upon core principles of dynamic adaptability, multi-dimensional compatibility, economic substance orientation, and adequate risk disclosure. Through the systematic integration of three major components—the conceptual framework and guidance layer, the standards coordination and conversion layer, and the disclosure and transparency enhancement layer—the mechanism provides a structural solution for resolving information divergence.

The implementation of the mechanism relies on the deep integration of accounting technical standards with the data technology architecture and requires an optimization cycle encompassing multi-dimensional effectiveness evaluation, continuous feedback, and periodic revision to ensure its vitality and continued relevance. Future research could further explore specific technical interface standards within the mechanism, such as the precise alignment of blockchain-based ownership records with accounting recognition, and the standardization of valuation parameters for data assets across different industry scenarios. Concurrently, investigating pathways for integrating this coordination mechanism with broader corporate reporting systems, such as environmental, social, and governance reporting, to address the development trend of integrated value reporting, represents a noteworthy prospective direction for inquiry.

Fund Projects

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