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Application of Data Governance Models in the Context of the Digital Economy

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Abstract: In the context of the digital economy, the volume of data is growing exponentially, the types of data are becoming more diverse, and its value is increasing, often providing critical support for decision-making by enterprises and government institutions. Effective data governance is a crucial tool for maximizing data value and mitigating data risks. This article examines the application of data governance models in the digital economy, aiming to offer technical insights and guidance for data-driven enterprises and governments in China. By elevating their data governance standards in the new era, this approach will comprehensively enhance their ability to harness digital value and ensure security in the digital economy, ultimately driving the continued growth of both the digital economy and society.

Keywords: Digital economy; Data governance; Artificial intelligence; Blockchain technology

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1. Introduction

Since the 21st century, the global economy has rapidly shifted towards digitalization, fostering numerous vibrant new economic models, industrial structures, and even emerging industries. However, in the digital economy era, effectively processing massive amounts of economic data, utilizing governance functions, extracting data value, and ensuring secure data storage alongside high-speed circulation are key challenges being examined by the global economic sector. Therefore, exploring the effective application of data processing models in the context of the digital economy can not only unlock the value of digital economy data but also contribute to the enhancement of China's digital economy governance system.

2. Characteristics of data in the context of the digital economy

2.1. Data scalability

With the rapid advancement of the Internet, Internet of Things (IoT), and big data technologies, the speed of data generation and accumulation in the digital economy has significantly accelerated. Consumer behavior data, enterprise operational data, and social and economic activity data continuously produce vast amounts of

information, constantly expanding the scale of data. This presents both opportunities and challenges for the development of the digital economy.

2.2. Data diversity

In the digital economy, data comes in various forms, including structured data (e.g., relational databases), semi-structured data (e.g., XML, JSON), and unstructured data (e.g., text, images, audio, video). This diversity enables more comprehensive and multi-dimensional information acquisition but also increases the technical demands for data storage, processing, and analysis.

2.3. Data value

Data holds immense potential value. Through data analysis and mining, it can provide critical decision support for enterprises, social systems, and economic development, as well as optimize resource allocation. For instance, in the digital economy, by analyzing consumer behavior data, enterprises can precisely target market demands, refine product designs, and optimize marketing strategies. Similarly, in the public sector, data analysis can enhance the efficiency and accuracy of public services. The value of data in the digital economy era underscores its role as a key "factor of production" in the new era.

3. Analysis of data governance needs in the context of the digital economy

3.1. Unified standards for multi-source data

In the era of the digital economy, the diversification of data sources across different platforms, systems, and industries results in varied data formats, structures, and standards. This creates significant challenges for data integration and analysis. Therefore, the establishment of unified standards for multi-source data is critical for effective data governance in the digital economy.

3.2. Improving data quality through filtering

In the digital economy, data quality directly impacts enterprise decision-making and business operations. Within massive datasets, there is often a significant amount of redundant, noisy, and erroneous data, making data quality issues particularly pressing. Consequently, enhancing data quality through filtering has become essential for modern data governance.

3.3. High-security data storage

As data becomes a key asset for enterprises and society in the digital economy, ensuring data security is paramount. With the rapid expansion of data and the emergence of diverse data types, the risks of data theft, tampering, and leakage are continuously increasing, posing serious threats to both enterprises and individuals. In this context, the demand for high-security data storage solutions is more urgent than ever.

3.4. Enhancing data circulation capabilities

In the digital economy, data must not only be stored and protected but also circulate efficiently across systems, platforms, and departments. Strengthening data circulation capabilities is essential for maximizing data value. Efficient data circulation supports real-time data processing and analysis, improves the timeliness and accuracy of enterprise decision-making, and fosters cross-department and cross-platform data sharing and collaboration, helping to break down information silos and enhance the efficiency of data utilization across economic sectors [1].

4. Application of data governance models in the context of the digital economy

4.1. Overall governance framework

In the digital economy, the application of data governance models can be based on emerging data collection technologies and data processing technologies combined with blockchain technology to form a macro data governance framework. This framework is based on the process of data collection—processing and cleaning—storage—circulation, thoroughly revitalizing data to leverage data value while ensuring data security. **Figure 1** is a data governance framework based on multiple technologies in the context of the digital economy.

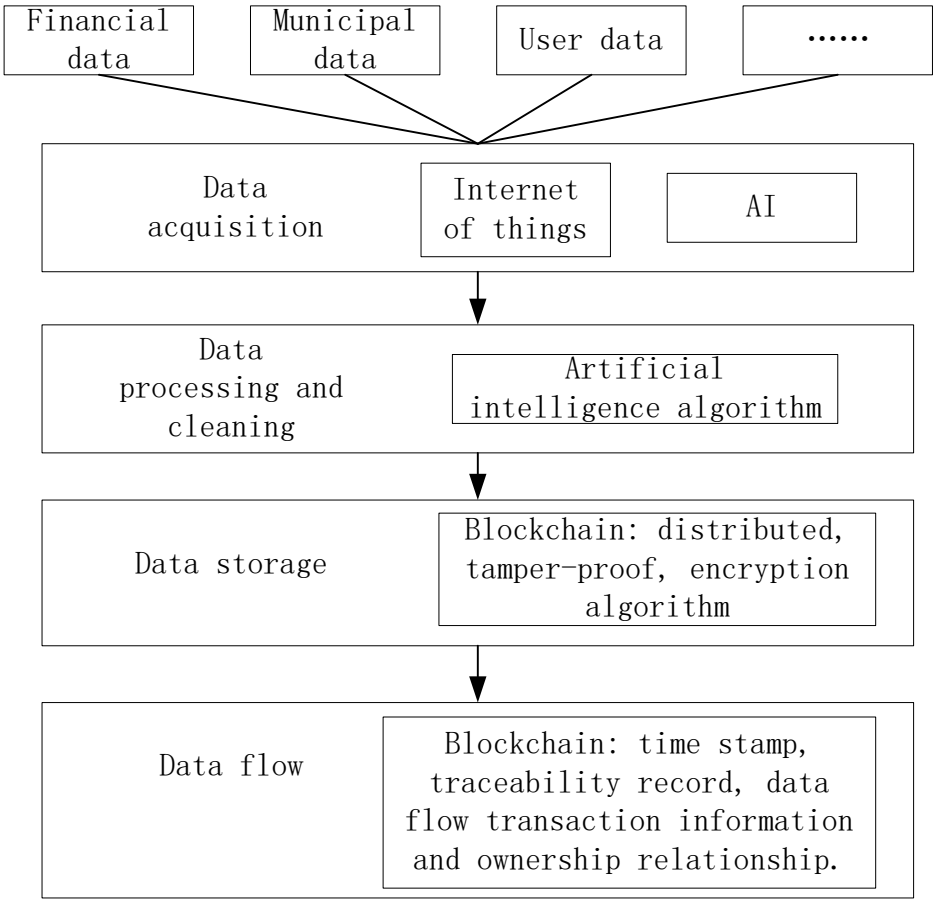

Figure 1. Data governance framework based on multiple technologies

4.2. Emerging technology for data collection

In the context of the digital economy, the combination of IoT technology and artificial intelligence technology can significantly enhance data collection capability and precision. IoT technology can achieve data collection based on sensors. For example, in smart transportation, the reasonable distribution of cameras and sensors covering key roads can achieve effective traffic flow data acquisition.

4.3. Advanced data processing and cleaning

In the network era of the digital economy, the acquisition and processing of massive data are increasingly important for enterprises and research institutions. Data processing and cleaning strategies based on artificial intelligence algorithms can not only improve data quality but also provide a solid foundation for subsequent data analysis and mining [2].

4.4. Blockchain for data storage

4.4.1. Distributed architecture

One of the core concepts of blockchain technology is its distributed architecture, composed of multiple nodes, each maintaining a complete copy of the data on the chain at all stages. The redundancy, fault tolerance, and decentralization characteristics of this architecture resolve the shortcomings of traditional centralized systems that rely on a single server. Through its distributed network, blockchain can effectively eliminate the risk of single points of failure in data storage and enhance system security by reducing potential attack surfaces [3]. During the data storage phase, enterprises and government institutions can leverage the distributed nature of blockchain to create a consensus network, ensuring that all participants in the digital economy (banks, regulatory bodies, and businesses) have real-time access to and can verify data, significantly increasing the transparency and efficiency of data processing. Hash algorithms like SHA-256 under cryptographic hash functions generate a unique identifier for each block in the blockchain. The one-way nature of hash functions makes it difficult for criminals to deduce the input from the output, ensuring data irreversibility and immutability [4].

4.4.2. Data encryption

Encryption algorithms in blockchain technology further enhance the security of data storage. Blockchain data encryption typically focuses on symmetric and asymmetric encryption. Symmetric encryption, such as the AES algorithm, uses the same key for both encryption and decryption, making it highly suitable for large data scenarios in the digital economy that require efficient encryption [5]. Asymmetric encryption, such as RSA and ECC algorithms, effectively utilizes a public key for encryption and a private key for decryption. Public and private key pairs are not only highly suited for transmitting sensitive data but also form the basis for digital signatures, ensuring the authenticity and integrity of transaction data changes.

5. Blockchain technology data circulation

In the digital financial era, the efficiency, security, and transparency of data circulation are basic elements to leverage data value. Blockchain, as a distributed technology, can significantly promote data circulation levels through distributed architecture's consensus mechanism and smart contracts.

5.1. Consensus mechanisms

As a core component in blockchain networks, consensus mechanisms ensure that all nodes reach a high level of agreement on data updates in the era of the digital economy. Currently, common consensus mechanisms include Proof of Work (PoW) and Proof of Stake (PoS). Based on these mechanisms, blockchain networks can guarantee the authenticity and consistency of data, effectively preventing malicious nodes from tampering with data [6]. During the economic data circulation phase, consensus mechanisms ensure the reliability of transaction data and customer information, thereby enhancing trust during data interactions.

5.2. Smart contracts

Smart contracts are automated execution programs deployed on the blockchain, which predefine transaction rules and conditions that automatically execute once those conditions are met. The trustless and automated nature of smart contracts can significantly enhance the efficiency and transparency of data circulation in the digital economy era. During the data circulation phase, smart contracts can be used for automated settlement, clearing, and payments of data, effectively simplifying business processes and reducing the risk of human

intervention and errors during data transfer [7,8].

6. Conclusion

This article studies the application of data governance models in the context of the digital economy, proposing a data governance framework with blockchain technology as the core, combined with IoT and artificial intelligence. This framework, applied to data governance in the digital economy era, will significantly improve data collection efficiency, processing quality, storage security, and data circulation capability, comprehensively extracting data value and providing strong support for enterprise and government decision-making. However, the application of this governance framework has certain requirements for the informatization technology and digital operation level of its users. Therefore, organizations applying this governance framework need to strengthen the training of personnel's informatization and digital capabilities to fully utilize the data governance framework, enhancing their data governance ability in the digital economy era.

Disclosure statement

The author declares no conflict of interest.

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