

# Research on the Integrated Governance Model and Collaborative Utilization Mechanism of Data Resources

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**Abstract:** In the digital economy era, data acts as the core production factor driving social development. This paper explores the construction and implementation of data resources' integrated governance model and collaborative utilization mechanism to resolve existing data management challenges. It first defines data integration and confirms its function in eliminating data silos, improving data availability, and elevating data value. Then it compares Chinese and foreign data integration governance models, underlining the importance of standardization and multi-stakeholder collaboration. It further illustrates the concept, implementation approaches, and key technologies of collaborative utilization, among which cloud computing, big data analytics, and artificial intelligence significantly improve utilization efficiency. The information circulation mechanism and data sharing platform form the core of the governance framework. Moreover, policy support and technological investment are indispensable for model implementation. Ultimately, a scientific governance model and mechanism can accelerate the value release of data elements, promote the modernization of government governance, and facilitate high-quality socio-economic development.

**Keywords:** Data resource integration; Data governance; Collaborative utilization mechanism; Digital economy; Data value

**Online publication:** June 5, 2026

## 1. Introduction

### 1.1. Research background and significance

In the digital economy era, data has become the core production factor driving social development. The construction of digital government, smart city governance, and industrial digital transformation has accumulated massive data resources, providing unprecedented opportunities for decision optimization and service innovation. Data is growing explosively in all fields, and there is a significant positive correlation

between data value density  $\rho_{data}$  and integration degree  $\eta_{integration}$ , i.e.,  $\rho_{data} \propto \eta_{integration}^{\alpha}$  (where  $\alpha$  is the integration efficiency coefficient). This relationship indicates that fragmented and isolated data can hardly release its potential value, and systematic integrated governance is the only way to achieve the value-added effect of data resources.

In practice, the integrated governance of data resources faces multiple challenges. The compatibility of multi-source heterogeneous data is the primary technical obstacle, as data generated by different departments and systems differ greatly in format, standard, and semantics<sup>[1]</sup>. Data silos remain prevalent, and a weak willingness to share data and inconsistent standards among departments hinder data circulation<sup>[2]</sup>. The dispersion of urban and rural data resources, as well as non-standard data collection, lax management, and insufficient application, further increases governance difficulties<sup>[3]</sup>. These practical dilemmas restrict the cultivation of the data element market and the overall process of digital transformation.

Constructing a scientific integrated governance model and collaborative utilization mechanism of data resources bears important theoretical and practical significance. Theoretically, this study enriches the theoretical system of data governance, explores the internal laws of efficient allocation of data elements, and provides theoretical support for data asset management. Practically, establishing a unified, efficient, and interconnected data resource system breaks departmental barriers, promotes data opening and sharing, and improves data quality and application efficiency<sup>[4]</sup>. It is of great practical significance to promote the modernization of government governance, activate data transaction value, and support high-quality economic and social development.

## 1.2. Research purpose and questions

As a new production factor, data is profoundly changing the economic pattern and social governance model<sup>[5]</sup>. Against the background of accelerated digital transformation, how to effectively integrate fragmented data resources, build a scientific governance model, and realize cross-departmental and cross-domain collaborative utilization has become an urgent core issue. This study systematically sorts out the theoretical framework and practical path of data resource integrated governance, explores a collaborative utilization mechanism adapting to the characteristics of the big data era, and provides theoretical support and practical guidance for enhancing the value release capacity of data elements.

The study focuses on three core questions at different levels. At the governance model level, current data resources face complex challenges such as diverse sources, different formats, and uneven quality, and data silos between different business systems seriously hinder information circulation<sup>[6-7]</sup>. The primary question is how to break data barriers between vertical organizational levels and horizontal functional systems and establish a unified and efficient data governance system<sup>[8]</sup>. At the collaboration mechanism level, data integration involves not only the compatibility of technical platforms but also the design of collaboration modes among multi-stakeholders. The key research direction is how to promote the in-depth integration of public and social data and build a sustainable collaborative utilization mechanism on the premise of ensuring data security and privacy protection.

At the practical application level, the exponential growth of data volume makes traditional data management methods unable to meet new development needs. The study explores how to apply emerging technologies to improve data collection, cleaning, storage, and analysis capabilities, forming a complete chain from data supply to value realization<sup>[9]</sup>. Through in-depth analysis of these issues, this study strives

to provide operable solutions for the construction of a data governance community and promote the healthy development of the data element market.

## **2. Overview of the integrated governance model of data resources**

### **2.1. Definition and significance of data integration**

Data integration is the process of combining data from different sources into a unified and consistent dataset<sup>[10]</sup>. This process needs to address challenges such as semantic differences, data source structure differences, field relationships, and data duplication<sup>[11]</sup>. Data integration methods usually include data cleaning, data transformation, and data aggregation. Data cleaning detects, corrects, or deletes errors and inconsistencies in data; data transformation converts data from one form or format to another. Data preprocessing standardizes different data sources to unify their formats, coordinate systems, and map projections<sup>[12]</sup>.

The core value of data integration is to achieve data “entropy reduction”, transforming data from chaos to order, confusion to clarity, and low value to high value. This process eliminates data silos, reduces data redundancy, and improves data availability<sup>[13]</sup>. Data integration aims to convert data from different sources into a consistent format for subsequent analysis and decision-making, ensuring reliable and accurate data by eliminating redundancy, errors, and inconsistencies<sup>[14]</sup>.

Data integration also involves the connection and correlation of different data sources. Correlating sales data with marketing data reveals potential relationships between sales volume and marketing activities, helping enterprises better understand market trends and influencing factors. In integrating customer data, data matching and fusion technologies identify and merge different records of the same customer, ensuring the integrity of customer information and providing enterprises with a 360° customer view<sup>[15]</sup>. Data integration enables orderly extraction and query in database storage, creates conditions for data value realization, and transmits valuable information to analysis and application systems for reprocessing in a real-time and intelligent manner<sup>[16]</sup>.

### **2.2. Comparison of domestic and foreign data integration governance models**

Data integration governance models have diversified development paths worldwide. Different countries and regions have formed distinctive practical models based on their technical foundations, policy environments, and governance needs. A comparative analysis of the similarities and differences of these models provides an important reference for building a more scientific and efficient integrated governance system for data resources.

From the perspective of technical architecture, developed countries in Europe and America focus on the construction of a standardization system in data integration governance, realizing cross-departmental and cross-domain data interconnection by formulating unified standards for data collection, storage, and exchange<sup>[17]</sup>. This model emphasizes the in-depth integration of technical tools and data governance frameworks, and significantly improves the efficiency and effect of data integration by introducing advanced technologies such as data cleaning, data transformation, and data mining<sup>[18]</sup>. In contrast, China’s data integration governance model relied more on administrative promotion in the early stage, breaking information interaction barriers and converging multi-source data by establishing a unified data management platform<sup>[19]</sup>. This top-down approach achieves rapid centralized management of data resources in the short term, but needs continuous improvement in data quality control and long-term governance mechanism construction.

The collaboration mode of governance subjects is another important comparison dimension. Advanced international experience shows that effective data governance requires the joint participation of multiple subjects, such as governments, enterprises, and social organizations, forming a sustainable, standardized, and integrated collaborative governance pattern through establishing negotiation and collaboration relationships and formulating rules and systems. China's exploration in this field is gradually deepening, especially in urban digital governance. Through horizontal and vertical resource integration, it not only integrates public data of government departments but also actively incorporates enterprise and social data to build a comprehensive, diversified, and efficient digital governance system<sup>[20]</sup>. This multi-stakeholder collaborative governance model achieves complementary advantages and functional integration among organizations, maximizing the maintenance and promotion of public interests.

Differences in data quality management mechanisms are also noteworthy. Mature international models generally have a sound data quality assurance system, ensuring the accuracy, timeliness, and comprehensiveness of data collection by cleaning and standardizing low-quality data<sup>[21]</sup>. China also pays increasing attention to quality control in data governance practice, emphasizing the establishment of a strong data governance mechanism to ensure data quality and security, but there is still room for improvement in the integrity and closed-loop management of governance processes<sup>[22]</sup>.

### **3. Collaborative utilization mechanism of data resources**

#### **3.1. Concept and practice of collaborative utilization**

Collaborative utilization refers to the process in which multiple subjects effectively integrate and share fragmented data resources through technical means and management mechanisms. This concept emphasizes breaking data silos and realizing cross-departmental and cross-system data circulation and value mining. In the context of digital transformation, collaborative utilization has become the core path to improve the allocation efficiency of data resources, and its essence is to optimize business processes and enhance decision support capabilities through data interconnection<sup>[23]</sup>.

In practice, collaborative utilization presents diverse implementation modes. Centralized collaboration converges data from various departments to a central node for unified governance and distribution through a unified data management platform, which is conducive to standardized management and big data analysis applications<sup>[24]</sup>. Distributed collaboration maintains the relative independence of each data source and realizes on-demand sharing through interface invocation and permission control, suitable for scenarios with high data sensitivity or strong departmental autonomy<sup>[25]</sup>. Hybrid collaboration combines the advantages of both, ensuring centralized control of core data while allowing flexible invocation of edge data.

In practical applications, the effectiveness of the collaborative utilization mechanism depends on the matching degree between the technical architecture and organizational mechanism. Technically, it is necessary to build an ETL tool chain supporting heterogeneous data integration to realize data extraction, transformation, and loading<sup>[26]</sup>. Organizationally, it is necessary to clarify data ownership, usage rules, and responsibility boundaries, and strengthen collaboration motivation among departments through institutional arrangements. The construction of a digital collaboration platform responds to resource integration needs in real time, significantly improving data utilization efficiency and providing basic support for cross-domain business innovation.

### **3.2. Technical means of collaborative utilization**

The collaborative utilization of data resources is inseparable from the support of advanced technical means, which run through the whole process of data collection, integration, analysis, and application. Cloud computing provides an infrastructure guarantee for cross-departmental collaboration. By establishing a unified cloud platform, different departments can realize centralized storage and real-time access to data, breaking the limitations of traditional physical space.

This centralized storage method not only reduces the cost of independent system maintenance for each department but also creates conditions for subsequent data fusion. Data integration tools play a key role in collaborative utilization. As enterprises usually collect data from different departments and systems with inconsistent formats or duplicates, data warehouses, ETL tools, and data cleaning and standardization technologies become critical means to integrate various types of data.

Establishing a unified data framework ensures that all departments format and store data in accordance with the framework, guaranteeing data interoperability and reducing the time of conversion and proofreading caused by inconsistent data formats.

The introduction of middleware technology further coordinates data interaction among departments, enabling seamless connections between heterogeneous systems.

The application of big data analytics and artificial intelligence technologies enhances the depth and breadth of data collaborative utilization. Real-time and multi-source data collection enables enterprises to obtain more comprehensive and real-time information, and technologies such as sensor technology and social media data make data collection more comprehensive.

Artificial intelligence algorithms mine potential value from massive data and provide intelligent support for decision-making. The integrated application of these cutting-edge technologies achieves multi-dimensional effects such as data fusion, process optimization, decision support, and collaboration improvement, promoting resource integration towards digitalization and intelligence.

## **4. Construction of the integrated governance model of data resources**

### **4.1. Basic framework of the integrated governance model**

#### **4.1.1. Information circulation mechanism**

The information circulation mechanism is the core component of the integrated governance model of data resources, determining the efficiency and security of data transmission among different subjects. In the digital economy era, data generates value only through circulation<sup>[27]</sup>. Constructing a scientific and reasonable information circulation mechanism is the key path to breaking data silos and releasing data value. This mechanism realizes sufficient data flow and sharing on the premise of protecting data sovereignty and security.

From the perspective of technical architecture, the information circulation mechanism should be based on unified data standards. Inconsistent data standards among different departments, industries, and enterprises lead to differences in data formats and quality, forming data silos<sup>[28]</sup>. Formulating unified data standards, specifications, and sharing platforms promotes data integration and sharing among different departments, and facilitates data circulation and resource collaboration<sup>[29]</sup>. This standardization involves not only unified data formats, but also multi-dimensional specifications such as data interfaces, transmission protocols, and security authentication. The circulation mechanism should consider the full-link transmission of data from

the source to the user, enabling wider data utilization <sup>[30]</sup>.

In practice, the construction of the information circulation mechanism faces multiple challenges, such as unclear data ownership and benefit distribution, difficult value evaluation, and privacy protection <sup>[31]</sup>. Solving these problems requires building a safe and efficient data circulation mechanism to effectively resolve information asymmetry between data suppliers and demanders <sup>[32]</sup>. The mechanism design should include supporting systems such as data right confirmation registration, value evaluation system, and income distribution model, motivating data holders to participate in circulation through institutional innovation <sup>[33]</sup>. Meanwhile, the circulation mechanism balances efficiency and security, adopting technical means such as encrypted transmission, access control, and audit traceability to ensure the security and controllability of data in circulation.

$$V_{flow} = \alpha \cdot S_{standard} + \beta \cdot E_{efficiency} - \gamma \cdot R_{risk}$$

where  $V_{flow}$  represents the value of information circulation,  $S_{standard}$  represents the degree of standardization,  $E_{efficiency}$  represents circulation efficiency,  $R_{risk}$  represents circulation risk, and  $\alpha$ ,  $\beta$ ,  $\gamma$  are weight coefficients.

#### 4.1.2. Data sharing platform

As the core carrier of the integrated governance model of data resources, the data sharing platform undertakes the key function of connecting data suppliers and demanders. The platform centrally manages data resources scattered in different departments and systems through technical means, allowing users to read, operate, and analyze shared data with different devices in different locations <sup>[34]</sup>. This centralized management reduces repetitive workload, such as data collection and review, and facilitates all units to shift their focus to application development and system integration.

The traditional centralized data sharing mode relies too much on third-party storage services, facing risks such as a single point of failure, private data leakage, and server communication overload <sup>[35]</sup>. To address these challenges, modern data sharing platforms need to build a decentralized architecture and adopt distributed storage technology to reduce data leakage risks <sup>[36]</sup>. In the platform construction, governance objectives, functional responsibilities, leading units, and implementation agencies should be clarified. In the process of data centralization and redistribution, awareness of data sharing should be enhanced, data silos should be overcome, and the overall integration capacity of data resources should be improved.

The value realization of the data sharing platform depends on the construction of a multi-level service system. The platform is not only a practice base for data exchange and sharing, but also an important outlet reflecting the application value of data <sup>[37]</sup>. Establishing a unified public service platform and online service system provides users with centralized and unified service information. In platform operation, the overall development awareness of government departments should be strengthened, data resource exchange among departments should be encouraged, and a trust-based and mutually beneficial cooperative relationship should be established, promoting the formation of an integrated and coordinated governance mechanism for data resources between vertical levels and horizontal departments, and finally realizing the orderly sharing and efficient utilization of digital resources <sup>[38]</sup>.

## **4.2. Key factors for the implementation of the governance model**

### **4.2.1. Policy support**

Policy support is the core guarantee for the effective implementation of the integrated governance model of data resources. From the national to the local level, the construction of the policy system provides an institutional framework for the standardized management, orderly circulation, and innovative application of data resources<sup>[39]</sup>. Since the release of the Action Plan for Promoting the Development of Big Data in 2015, China has formed a multi-dimensional policy matrix covering data opening and sharing, security protection, and market-oriented allocation of elements, laying a solid foundation for data governance practice.

The establishment of a cross-departmental data sharing mechanism relies on top-level design and coordinated promotion at the policy level. Government departments need to break data barriers through institutional arrangements, establish a unified data sharing platform, and realize the circulation and exchange of data resources among different departments<sup>[40]</sup>. This policy collaboration not only clarifies the data management responsibilities and sharing obligations of each department, but also ensures data accuracy and consistency through legislation, avoiding repeated data collection and information errors. Policy makers can adopt more scientific and precise measures based on big data analysis results, and improve governance efficiency through a data-driven decision-making model<sup>[41]</sup>.

Policy orientations vary across regions due to objective differences in economic development level, resource endowment, and digital foundation<sup>[42]</sup>. Relying on advanced infrastructure and industrial agglomeration advantages, the eastern region focuses on in-depth exploration of data operation and sharing systems<sup>[43]</sup>. The central, western, and northeastern regions pay more attention to the construction of data transaction and circulation mechanisms, promoting resource optimization allocation and economic digital transformation through policy guidance. Despite regional differences, all regions have reached a policy consensus on core directions such as data management and data center construction, reflecting a coordinated trend of overall promotion. Policy support should coordinate in multiple dimensions, such as guidance, regulation, guarantee, and incentive, balance data opening and sharing with innovative development through innovative regulatory systems, and provide sustained institutional impetus for the integrated governance of data resources<sup>[44]</sup>.

### **4.2.2. Technology investment**

As the core support for the implementation of the integrated governance model of data resources, technology investment directly determines the integration effect and governance efficiency. In the context of digital transformation, sufficient and precise technology investment provides a solid infrastructure guarantee for data integration and promotes the transformation of the governance system from traditional management to intelligent operation<sup>[45]</sup>. Technology investment includes not only hardware infrastructure construction, but also software system development, data security protection system construction, and professional technical personnel training.

The construction of a unified data management platform requires continuous investment in a large number of technical resources. The platform needs strong capabilities in data collection, storage, processing, and analysis to centrally manage data scattered in various departments and realize cross-departmental and cross-level data circulation. The application of data mining and processing technologies deeply explores the potential value and correlation of data, and realizes standardized and efficient resource matching through intelligent algorithms<sup>[46]</sup>. Investment in data security technology is also indispensable, including the

deployment of data encryption, access control, security audit, and other measures to ensure the security and confidentiality of data in the process of integration and circulation.

The challenge of technology investment lies in the contradiction between high cost and rapid technological iteration. The construction of a data collaboration platform requires the introduction of cutting-edge technologies such as multi-party secure computing, privacy protection, and federated learning, whose research and development require continuous financial support<sup>[47]</sup>. Whether technical tools can break the existing pattern of power and interests, give full play to the advantages of new technologies, and support government decision-making supervision and resource mobilization becomes a key indicator for evaluating the effect of technology investment<sup>[48]</sup>. Establishing a reasonable technology investment evaluation mechanism, balancing short-term costs and long-term benefits, and adopting a phased and modular technology deployment strategy can effectively reduce investment risks and improve the utilization efficiency of technical resources.

## **5. Optimization of the collaborative utilization mechanism**

### **5.1. Analysis of the current situation of the collaboration mechanism**

#### **5.1.1. Current situation of data sources**

The primary problem faced by the collaborative utilization of data resources is the complexity and heterogeneity of data sources. Enterprises, government departments, and research institutions have accumulated massive data in daily operations, which are scattered and stored in different business systems with diverse formats and inconsistent standards<sup>[49]</sup>. Technically, structured relational database data, semi-structured log files, and unstructured document data coexist, and this multi-source heterogeneous data ecosystem poses significant challenges to subsequent integration<sup>[50]</sup>.

The activity status and accessibility of data sources constitute the basic conditions for collaborative utilization. Some legacy systems have outdated technical architectures with missing or imperfect data interfaces, making it difficult to effectively extract and invoke data<sup>[51]</sup>. Meanwhile, data barriers among different departments hinder cross-organizational data circulation, and data silos remain prevalent<sup>[52]</sup>. This situation not only affects the full release of data value but also restricts the in-depth promotion of the collaborative governance mechanism.

From the perspective of data quality, existing data sources generally have deficiencies in integrity, accuracy, and timeliness. The lack of unified quality control standards in data collection of business systems leads to frequent problems such as data redundancy, missing and errors<sup>[53]</sup>. Differences in variable coverage also affect the applicability evaluation of data, and the definition and measurement methods of some key business indicators deviate in different systems. If these quality problems cannot be effectively governed at the source, they will directly affect the effect and value output of collaborative utilization. Therefore, establishing a quality management system covering the entire data life cycle is an urgent task<sup>[54]</sup>.

#### **5.1.2. User demand analysis**

In the optimization of the data resource collaborative utilization mechanism, user demand analysis is the core basis for mechanism design. Different types of data users have significant differences in data resource acquisition methods, processing depth, and application scenarios, which directly affect the effectiveness of the collaborative utilization mechanism. Systematically sorting out the demand characteristics of multiple

subjects, such as government departments, enterprise organizations, and research institutions, provides guidance for building a precise data service system <sup>[55]</sup>.

From the perspective of demand hierarchy, basic users pay more attention to data availability and standardization, expecting rapid retrieval through unified data interfaces to avoid conversion costs caused by inconsistent data formats <sup>[56]</sup>. Such demand promotes the standardization of data resource platforms, requiring the establishment of unified metadata standards and quality control systems in the data collection stage <sup>[57]</sup>. Advanced users put forward higher requirements for in-depth data processing capabilities, needing not only raw data acquisition, but also value-added services such as data cleaning, correlation analysis, and visual presentation to support complex business decision-making scenarios <sup>[58]</sup>.

The dynamic characteristics of user demand are also noteworthy. With the evolution of business scenarios and the improvement of technical capabilities, users' requirements for data real-time performance, accuracy, and security continue to rise. Some users shift from utilizing single data sources to cross-departmental and cross-domain data integration applications, and this demand change forces the collaborative utilization mechanism to have flexible expansion capabilities. Establishing user feedback channels and demand tracking mechanisms captures demand change trends in a timely manner and provides continuous improvement impetus for mechanism optimization. This demand-oriented governance idea helps break the disconnect between data supply and practical application and promotes the full release of data resource value.

## **5.2. Research on optimization strategies**

### **5.2.1. Multi-stakeholder collaboration mechanism**

The collaborative utilization of data resources is inseparable from effective collaboration among multiple subjects. Establishing a scientific and reasonable multi-stakeholder collaboration mechanism is the key path to maximizing data value. This mechanism needs to form an integrated and coordinated governance architecture between vertical levels and horizontal departments, promoting data resources from fragmentation to centralization and from closure to openness by clarifying the responsibility boundaries and rights distribution of all parties.

From the perspective of organizational structure, the construction of a multi-stakeholder collaboration mechanism needs to break the shackles of traditional departmentalism, strengthen collaboration among subjects, and promote data opening, flow, integration, and sharing <sup>[59]</sup>. Different innovation subjects master different types of data resources, and combining their professional knowledge and resources creates new value growth points <sup>[60]</sup>. This requires the establishment of cross-departmental or cross-organizational cooperation institutions, with special teams responsible for coordinating cooperation among different subjects, coordinating the construction of distributed resource libraries, and realizing centralized storage and unified management <sup>[61]</sup>.

In terms of specific implementation paths, the multi-stakeholder collaboration mechanism should take a unified data management platform as the basis for resource integration, centrally managing data information of various departments and sections to realize data sharing and integration. Institutions should establish a resource sharing mechanism based on the principle of mutual benefit and win-win results, clarify the responsibilities and obligations of all parties, realize division of labor and collaboration in collection, cataloging, storage, and service, and avoid resource waste caused by work overlap. Signing clear cooperation agreements regulates the responsibilities and rights of all parties and stipulates reward and punishment mechanisms in the cooperation process, motivating all parties to fulfill commitments and improve work

efficiency<sup>[62]</sup>.

To ensure the sustainable and effective operation of the collaboration mechanism, it is necessary to regularly evaluate the effectiveness and efficiency of the cooperation mechanism and make necessary improvements based on the evaluation results. Continuous feedback and cyclic optimization help improve communication and collaboration processes and achieve better multi-win results. This standardized operation not only builds and enhances trust in multi-stakeholder interaction, but also effectively coordinates the relationships between different interest groups, finding reasonable solutions to potential interest conflicts<sup>[63]</sup>.

### **5.2.2. Technology upgrade path**

The optimization of the data resource collaborative utilization mechanism is inseparable from the continuous improvement of technical capabilities. The design of the technology upgrade path needs to balance the stability of the current system and the foresight of future development. From the practice of data governance, technology upgrades should follow the principle of progressive evolution, and gradually introduce advanced data processing technologies and intelligent tools on the premise of ensuring data security and integrity<sup>[64]</sup>.

The core of the technology upgrade is to build a multi-level technical support system. At the basic level, it is necessary to improve basic technical capabilities such as data cleaning, data transformation, and data mining, and enhance the efficiency and effect of data integration by establishing a standardized data processing process. At the platform level, it is necessary to promote the construction of data collaboration platforms, learn from the practical experience of mature enterprises at home and abroad, such as federated learning systems, to realize data connectivity between different systems and businesses. At the application level, it is necessary to strengthen the transformation of data thinking, enhance the information acquisition and processing capabilities of governance subjects through technical governance tools, and build an operation system based on data, supported by network technology and algorithms<sup>[65]</sup>.

The technology upgrade path also needs to establish a dynamic update mechanism to timely transform the latest technological achievements into practical capabilities of data governance to adapt to the rapid development of the digital economy<sup>[66]</sup>. This requires organizations to balance value rationality while pursuing technical rationality, ensuring that technological innovation serves the goal of maximizing data asset value. Establishing unified standards and specifications improves the compatibility and interoperability between different technical systems, reduces the time and capital costs of technology upgrades, and finally forms a sustainable technological evolution path.

## **6. Conclusion and prospect**

Against the wave of digital transformation, constructing an integrated governance model and a collaborative utilization mechanism of data resources has become a key path to promote high-quality economic and social development. Through a systematic analysis of data integration governance, this study reveals the core challenges and development opportunities faced by current data resource management. Factors such as multiple involved departments, inconsistent standards, and weak willingness to share data lead to difficulties in data opening and sharing, and insufficient departmental participation. These problems restrict the full release of data element value and need to be solved by innovating governance models and collaboration mechanisms.

From the practice of governance model construction, establishing a comprehensive data standardization system and an integrated governance platform significantly improves data quality. Practice shows that after adopting a systematic data integration governance platform, data efficiency can be increased from below 80% to over 80%, and the communication normality rate can be stabilized at over 90%<sup>[67]</sup>. This effect verifies the feasibility of the integrated governance framework proposed in this study. The optimization of the collaborative utilization mechanism requires not only technical support but also policy guidance and multi-stakeholder collaboration. Resource integration should not be limited to public data of government departments, but also include enterprise and social data to build a comprehensive, diversified, and efficient digital governance system.

In the future, the integrated governance of data resources will present three important trends. Firstly, with the in-depth integration of emerging technologies such as big data and artificial intelligence, data governance will shift from single data management to comprehensive strategic asset management<sup>[68]</sup>. Secondly, data security and privacy protection will become the core issue of governance system construction, requiring a balance between data opening and sharing and security protection. Thirdly, cross-departmental and cross-regional collaborative utilization mechanisms will be further deepened, solving the problem of fragmented distribution of data governance knowledge by integrating knowledge resources in different regions and spaces<sup>[69]</sup>.

This study provides a theoretical framework and practical path for the integrated governance of data resources, but it still needs in-depth exploration in aspects such as market-oriented allocation of data elements and dynamic governance mechanism design. Future research should focus on how to use new technologies to improve data collection and integration, data cleaning and standardization, data storage and management, as well as data analysis and application capabilities, promoting the data governance system to be more intelligent and precise.

## Disclosure statement

The authors declare no conflict of interest.

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