Adaptive models of digital government governance in smart shared services

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Abstract

Based on the basic platform supporting the overall e-government framework, this paper builds an application system for the intelligent management of government departmental business and three major databases of basic, departmental and thematic categories. Secondly, under the collaborative information governance model of blockchain, the data are jointly managed by all the regional governments in the distributed network, plus the application of smart contracts makes each governance link respond intelligently. Finally, an empirical study is conducted on employees of three types of government departments to analyze the regularity of the influencing factors of smart shared services in digital government. The results show that the regression coefficient of the strategic policy of government agencies on the degree of realization of information sharing is 0.829. The regression coefficient of the platform organization of government agencies on the degree of realization is 0.705. To promote the construction of digital government in China, this paper utilizes blockchain technology in digital government governance.

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1   Introduction

Social digitization and digital socialization in the context of the new technological revolution have been accompanied by a subtle reshaping of the behavioral patterns of members of society [1-2]. The changes in the basis of social governance challenge the effectiveness and appropriateness of traditional governmental governance forms [3-4]. With the arrival of the digital era, governments have accelerated the development of digital strategies for the digital transformation of government [5]. Smart government is a new type of management mode, which needs to fully utilize several technical supports such as artificial intelligence, big data technology, cloud computing technology, and the Internet of Things [6-7]. The construction of a smart government can greatly improve the government's emergency response capability and effectively achieve accurate positioning and efficient management [8]. However, the construction of smart government requires the integration of intelligent technology and the transformation of government functions to effectively and efficiently play the advantages of smart government and provide effective support for social development [9].

Collaborative shared governance theory is an effective theory of public management. Governance is through constructing a multi-party communication platform mechanism, so multiple stakeholders can express their views and effectively achieve common development goals [10]. In a study of a one-stop service center in China, literature [11] examines the influencing factors, strategies and effectiveness of cross-sectoral governmental collaboration. The authors concluded that administrative reform is also one of the important factors affecting the effectiveness of cross-sectoral collaboration in China. Literature [12], by investigating the Coordinated Management and Emergency Response (CMER) of the governments of the United States and Ireland in response to the COVID-19 pandemic, concluded that the effectiveness of the politics of scaling organized by CMER is critical to understanding the differences in public health response within and between political jurisdictions. Literature [13] observes through practical experience that policy and decision-makers take measures to coordinate governance, integration and coherence based on the logic of solving complex problems. These measures may include establishing cross-sectoral cooperation mechanisms, developing harmonized policy goals and action plans and ensuring consistency and coordination in policy implementation.

Smart government is an emerging concept. Although several countries and cities have proposed building a smart government, many problems are still in practice [14]. Literature [15] describes the transformation of the Swiss public sector in its efforts to create a digital ecosystem by describing the shift that he argues has led to a more effective public service centered on the needs of citizens and businesses, reducing administrative costs and improving their operations, as well as using emerging technologies to create a smart government that benefits from the digitization of services. Literature [16] argues that IoT's real-time sensing and responsiveness can facilitate digital transformation, unlocking the potential of digital government to become a data-driven smart government that delivers policies and services in the public interest and for public value. Literature [17] argues that smart government is considered the foundation for developing smart governance, which utilizes ICT tools such as social media and openness to increase citizen engagement and support the development of new smart governance models.

This paper aims to achieve intelligent government management by transforming information into knowledge and then applying and implementing the obtained knowledge. This is done by constructing a basic platform to support the overall framework of e-government, an application system to promote the intelligent management of departmental business and three major databases of basic, departmental and thematic categories. Secondly, under the blockchain-based information collaborative governance model, data is jointly managed by all regional governments in the distributed network, coupled with the application of smart contracts, which makes each link respond intelligently. A new model of digital governance governance is constructed from the three-dimensional perspectives of governance subject,

governance technology, and governance supervision. Finally, an empirical study is conducted by empirically investigating employees in three types of departments, specifically government agencies, institutions and state-owned enterprises, which have a greater association with government digital governance, and the information obtained is highly valid.

2   Smart Government collaborative governance model

2.1   Smart Government

Intelligent government, also known as intelligent e-government, online super-government, 3.0 era of government, etc., is the development direction of e-government, by the "wisdom" and "government" constitutes the "organism"! It is the development direction of e-government, an organism composed of "wisdom" and "government". The first model related to the generation of smart government is the "Data → Information → Knowledge → Wisdom" model, referred to as the DIKW model, shown in Figure 1. It can be seen that the smart government to "data" as the basis of support. The first is to collect massive data; in the information stage of the data processing, will analyze the data into information, transform information into knowledge, and then the knowledge obtained to be applied and implemented to achieve the wisdom of government management.
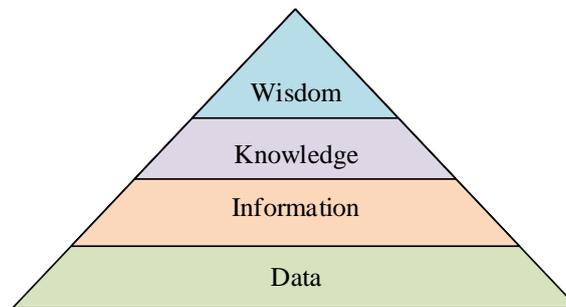
Figure 1. Schematic diagram of the DIKW model of smart government

1) Flat organizational structure

The manifestation of smart government is the flat organizational structure. In the era of big data, the rapid dissemination of information breaks the centralization of power, and every individual can become a "self-media." The data show a trend toward transparency, openness and sharing and promote the government's organizational structure toward flat change.

2) Data-based governance

The construction of smart government is oriented towards social demand, which is different from the previous hierarchical government and e-government. The smart government utilizes an intelligent service approach to seamlessly connect social demand and public service supply. Data governance is introduced into the smart government construction process and internalized into social governance through data integration and sharing.

3) Standardization and integration of government affairs platforms

The smart government's main feature is establishing a standardized and integrated government affairs platform, primarily built from both online and online aspects. The first goal is to create an online service platform and virtual office hall to provide comprehensive public services with business synergy and information-sharing integration. The second is to build offline one-window acceptance

self-service terminals, constructed through the simple functions of self-service scheduling, reservation, business inquiries, and business matters, breaking the overlapping functions of traditional government departments.

2.2   Objectives and Planning Framework for Smart Government

    1)   Realizing the sharing of government information resources

The construction of smart government is aimed at improving the e-government architecture system and realizing the sharing of government information resources and is committed to promoting the construction of key areas such as regional development, social governance, people's livelihood services and government effectiveness. To create a new development model integrating regional culture with intelligence and digitalization in-depth, realizing a magnificent turn to smart government governance, as shown in Figure 2. It can be seen that the construction of smart government will build a framework, build systems, and gather data as the basic structure, mainly through the construction of the basic platform to support the overall framework of e-government, the construction of application systems to promote the intelligent management of the departmental business and the construction of the basic class, departmental class, the theme of the three databases, to help the government to the digitalization, networking and intelligent transformation.
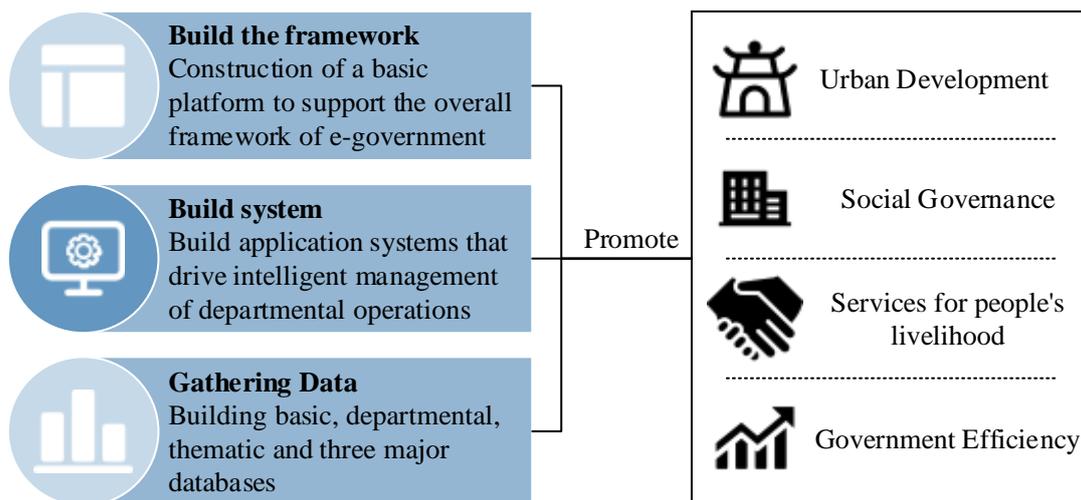
Figure 2. Diagram of the objectives of smart government

    2)   Efficient operation of government information system shared services

The key core of the smart government lies in the data, and when a huge amount of data is introduced into the government governance, after the information management and analysis, the whole government becomes smarter and smarter. If the data between departments is not connected, it will affect the operation of a business, so it is necessary to constantly enrich the data resources on the information system shared service platform so that more data can be connected, used and live.

Intelligent government construction attaches great importance to the collection of data resources and pushes forward the construction of three types of information databases: basic database, departmental database and theme database.

The construction of three types of information databases, namely the basic library, departmental library, and theme library, has been fully promoted to achieve the sharing and common use of data.

Firstly, the government information resources catalog system has been compiled, and four basic databases, namely, population database, legal person database, geographic information database and credit information database, have been built, and the data of the basic databases have been centralized.

Collecting data for a basic database. Secondly, it actively promotes the construction of departmental libraries and focuses on the data of urban management, market supervision, housing construction, ancient city protection and administrative approval by each department according to departmental functions and business lines. Finally, to create the theme of area protection, urban management, social governance, livelihood services, industrial economy and government services as the key areas, the theme library accumulated data, government information resources sharing service platform schematic shown in Figure 3.
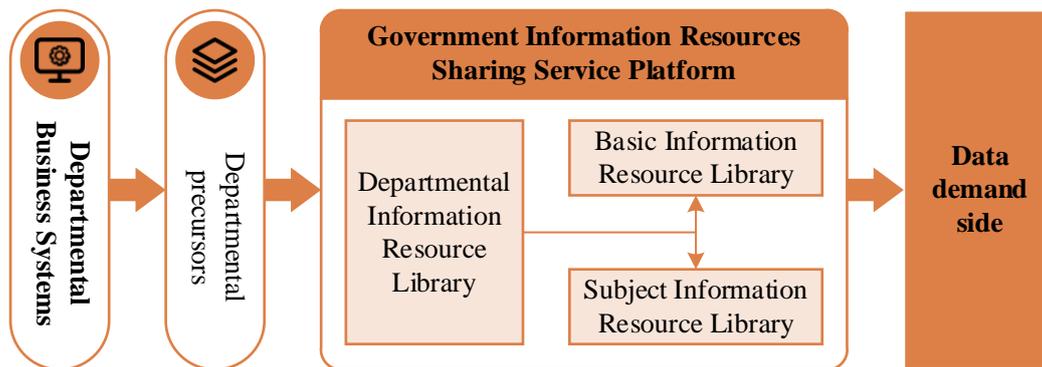

Figure 3. Schematic diagram of the government information resources sharing service platform

2.3 Three-Dimensional Variables and Analytical Framework for Smart Government Construction

2.3.1 Three-Dimensional Variables of Smart Government Construction

The relationship between the internal structure, function and environment included in the construction of smart government, the three-dimensional variables of smart government construction, is shown in Figure 4. Explore the relationship between internal structure, function and environment in the digital environment and the functions and effects achieved by digital transformation on the internal structure of the government, or analyze the internal structure of the government and the functions of digital reform and construction of the process of adaptation to the external environment.
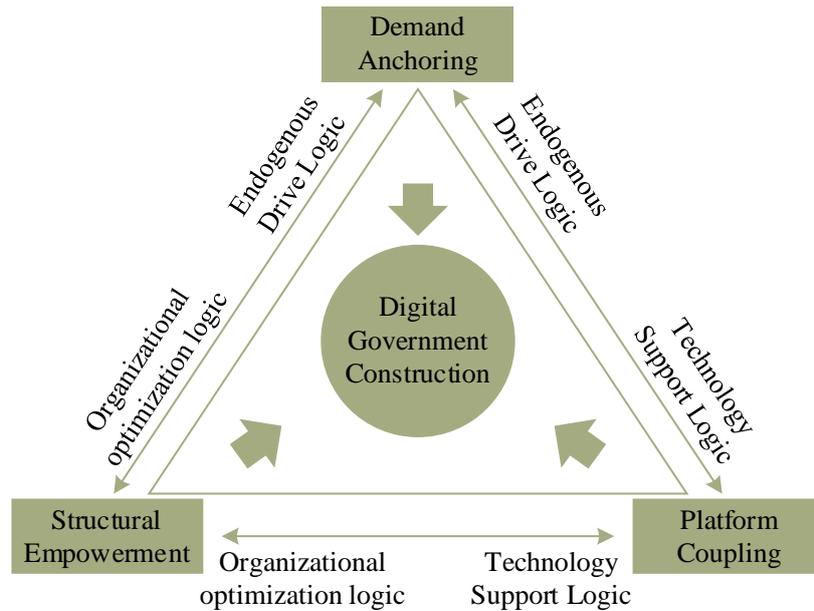
**Figure 4.** The three-dimensional variables of a digital government building

On the one hand, the three dimensions of demand, structure and platform can more concretely present the governmental governance model's essential changes than the macroscopic elements such as environment and function. On the other hand, compared to microelements such as operation mechanism, demand, structure, and platform, they are more generalized and inclusive.

2.3.2   Framework for transforming the government governance model driven by smart government construction

The most important reason why the smart government can bridge the new information gap, solve the problems that could not be solved during the period of office automation and e-government, and ultimately realize the transformation of the government governance model is that it has successfully anchored the needs of the society and made corresponding changes, and at the same time, it has also empowered its governance structure.

The former aims to provide accurate public services to the public and enterprises, while the latter helps policymakers solve social problems. At the same time, it enables the government and society to collaborate and operate flexibly in the current digital environment. To achieve seamless public service provision and realize the purpose of digital smart city governance, it is necessary to use a platform where demand and supply can be coupled.

As the cornerstone of the smooth operation of the entire system, it is not only closely related to the anchoring of social demand and the operation of the government structure but also the supporting foundation of the government-society coupling relationship, which provides a platform for both parties to fully interact and communicate. As a result, the study constructs an analytical framework for the transformation of government governance mode driven by smart government, as shown in Figure 5, which takes the anchoring of social demand, the structural adjustment and empowerment of government, and the construction of the coupling platform in the construction of smart government as the analytical dimensions, and provides an explanatory elaboration of the theoretical logic of the construction of smart government.
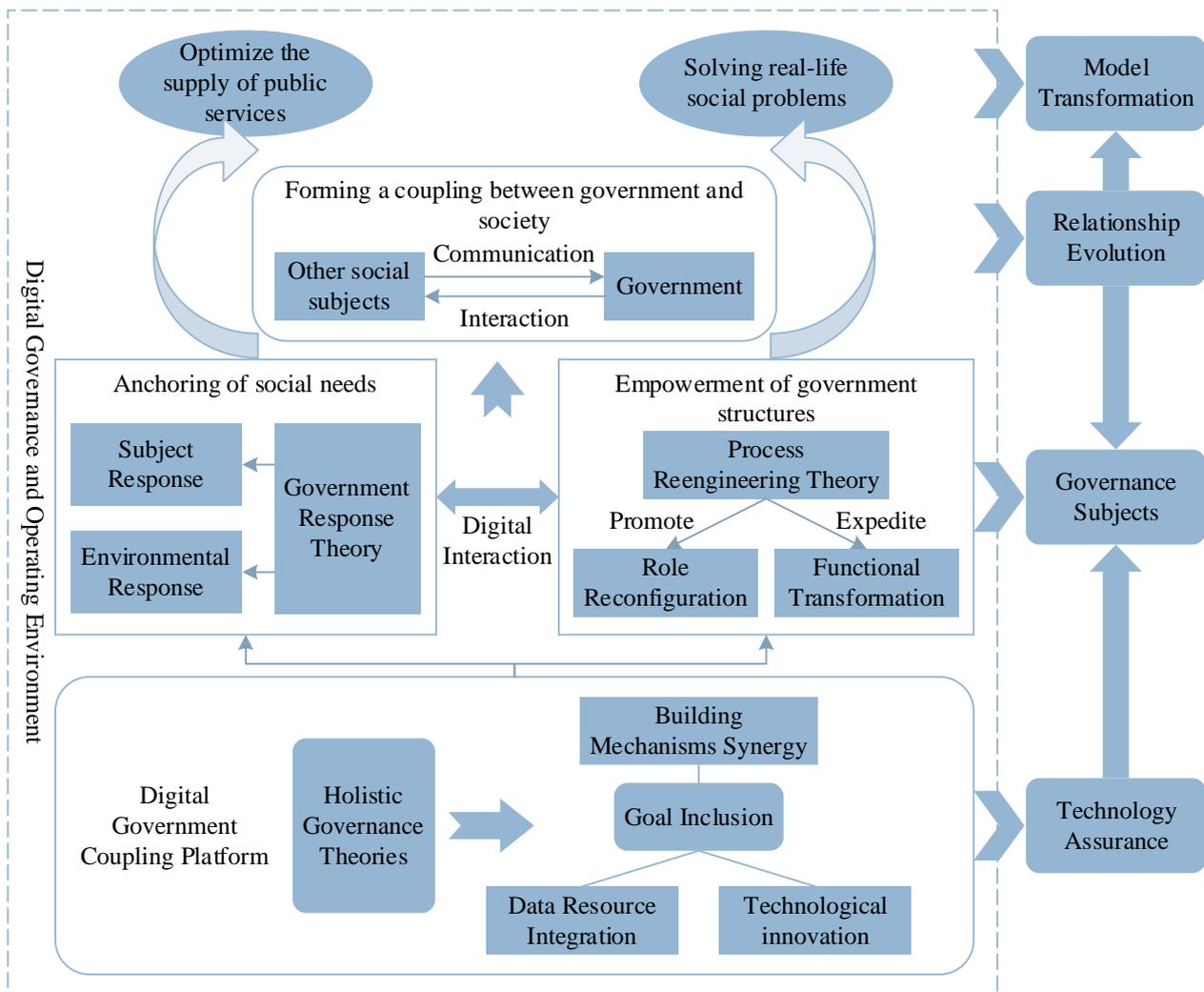
Figure 5. Framework for transforming the governance model driven by smart government building

From the specific path of analyzing framework, we can start from the nature of demand, structure and platform change, respectively, and study the digital smart government construction through three dimensions of change to adapt to today's big data environment and change the interaction relationship between government and society.

3   Digital smart government governance based on blockchain technology

3.1   Blockchain technology

3.1.1   Impact of blockchain on collaborative government governance models

This paper analyzes the impact of blockchain performance on the government's collaborative governance model. The blockchain-based access control model ABAC is chosen as a comparison object, and the same intra-domain access control model that sets the domain to which the accessed object belongs in the government collaborative governance model is ABAC.

Firstly, the response time of the two is theoretically analyzed. The typical access control process in the ABAC model takes the time of:

$$T_{ABAC} = \sum_{i=1}^{8} t_i \tag{1}$$

IMCBAC stores permissions in the form of tokens in the blockchain and the average response time can be improved by the strategy of applying in advance and using tokens several times. The authorization using the token is divided into two cases. The first one is accessing when the user does not have a token. The first time required is to get a token and then access it using the token. The time required is:

$$T_{IMCBAC} = \sum_{i=1}^{10} t_i \tag{2}$$

The other is that the user has been given the token for the object and can access it directly using the token. The time required is:

$$T_{IMCBAC}^{token} = \left(t_{10} + t_8 \right) \tag{3}$$

When a token is used *n* times by a subject, the time reduction compared to ABAC is:

$$T_n = (n-1)\left(\sum_{i=1}^{7} t_i - t_1 - t_{10} \right) + t_8 - t_9 \tag{4}$$

In addition to the guidance, promotion and support of the government, the construction of a blockchain-based government governance system as well as the construction and development of a digital government infrastructure, require the market and other social organizations to play an active role in assisting.

3.1.2   Collaborative governance modeling

1)   Traditional government collaboration model

Under the traditional government collaboration model, the centralized management mode of the database, on the one hand, leads to limited information collaboration content and incomplete information sharing. On the other hand, the links can not realize intelligent convergence, resulting in a serious information lag phenomenon. Therefore, the governments can not get accurate information about the needs of each other, and the government needs to pay additional governance costs.

At this time, the benefits for the government and the people in the society are respectively:

$$\pi_1 = \left(p_1 - c_1 - c_2 \right)q = \left(p_1 - c_1 - c_2 \right)\left(a - bp_2 \right) \tag{5}$$

$$\pi_2 = \left(p_2 - p_1 \right)q = \left(p_2 - p_1 \right)\left(a - bp_2 \right) \tag{6}$$

According to the inverse induction solution method, the optimal solutions for the government and the social population are found separately.

Both sides of the expression for the benefits to the social populace are obtained by simultaneously taking a partial derivation of the management service p_2:

$$\frac{\partial \pi_2}{\partial p_2} = a - 2bp_2 + bp_1 \tag{7}$$

Let $\frac{\partial \pi_2}{\partial p_2} = 0$, then it can be found:

$$p_2 = \frac{a + bp_1}{2b} \tag{8}$$

Substituting Eq. (8) into Eq. (5) and taking the partial derivative of p_1 gives:

$$\frac{\partial \pi_1}{\partial p_1} = \frac{1}{2}\left[a - 2bp_1 + b(c_1 + c_2)\right] \tag{9}$$

Let $\frac{\partial \pi_1}{\partial p_1} = 0$, then it can be found:

$$p_1 = \frac{a + b(c_1 + c_2)}{2b} \tag{10}$$

Substituting Eq. (10) and Eq. (8) into the expressions for the government and the social populace's benefits yields the government's cost of governance as:

$$\pi_1 = \frac{\left[a - b(c_1 + c_2)\right]^2}{8b} \tag{11}$$

2) Blockchain-based Information Collaboration Mode

Under the blockchain-based information collaboration model, the data is jointly managed by all regional governments in the distributed network, and with the application of smart contracts, each link responds intelligently and realizes seamless integration, and the regional governments can obtain all information dynamics of all regions of the country in real-time. As a result, the government and the public can obtain the information they need quickly but accurately, and the government does not need to pay additional governance costs.

At this time, the benefits to the regional government and the public are:

$$\pi_1 = (p_1 - c_1)q = (p_1 - c_1)(a - bp_2 + \alpha) \tag{12}$$

$$\pi_2 = (p_2 - p_1)q = (p_2 - p_1)(a - bp_2 + \alpha) \tag{13}$$

According to the inverse induction solution method, the method is the same as above to derive the optimal governance costs and benefits for the regional government and the people in the society, respectively:

$$p_2 = \frac{a + \alpha + b p_1}{2b} \tag{14}$$

$$p_1 = \frac{a + \alpha + b c_1}{2b} \tag{15}$$

$$\pi_1 = \frac{(a + \alpha - b c_1)^2}{8b} \tag{16}$$

$$\pi_2 = \frac{(a + \alpha - b c_1)^2}{16b} \tag{17}$$

3.2 Construction of digital smart government governance system based on blockchain

Blockchain, on the other hand, can provide a set of democratic operation mechanisms, thus making the hierarchical organizational structure within the government and the government-centered social governance system adjust accordingly to adapt to and meet the modernization of the national governance system and governance capacity.

A government governance system based on blockchain technology constructed in this paper is shown in Figure 6, whose value lies in realizing the multi-engine growth of government services, market coordination and citizen participation. A new structural balance is realized in the government governance system, which can effectively solve many thorny problems the current government governance faces, such as unclear definition of government functions, insufficient public political participation, underutilization of government data and lagging government governance tools.
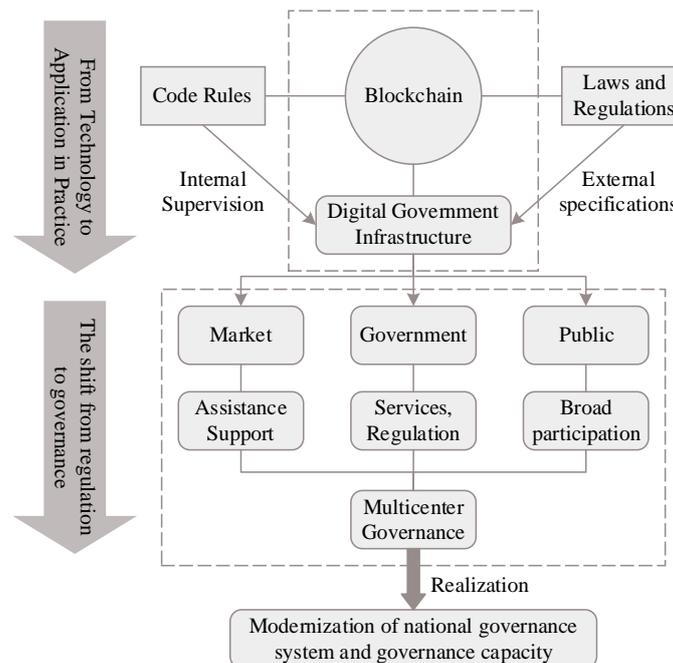
Figure 6. Building a digital smart government governance system based on the blockchain

In this governance system, blockchain will provide technical support for the construction of digital government infrastructure and combine the levels of code rules, laws and regulations to realize digital government's internal regulation and external standardization.

On this basis, government departments will give full play to their service and regulatory functions, market players will actively play their supporting role, and the public will be widely involved in the process to realize the cooperation and common governance of multiple subjects and gradually move towards the goal of modernizing the national governance system and governance capacity.

4 Empirical analysis of the digital smart government information resource sharing model

In order to have an effective understanding of the current government information resource sharing situation, the author has taken the field to conduct questionnaire surveys and observations to understand the situation, which can be very intuitive to find out the actual situation of government information resource sharing. By analyzing the online processing business offered on the government service website, some information about sharing government information resources can be obtained. The distribution and analysis of questionnaire collation leads to identifying corresponding problems that are significant to the study.

4.1 Survey research design

4.1.1 Sample factor data collection

This paper mainly selected three types of departmental employees for the study, specifically government agencies, institutions, and state-owned enterprises. The validity of the information obtained by these departments is higher due to their greater association with government data governance. The selection of work departments is the main focus among these three types of units.

1) Local informatization authorities, such as the Internet Information Office and other departments, the grassroots of the data open wisdom sharing services to determine the local informatization strategy determining the regional informatization process.

2) The Development and Reform Commission and other departments have specific business implementation management departments.

3) The design and planning side of the project, including scientific research institutes and other departments, will provide macro guidance for opening regional government data.

4) Technical teams of research institutes project implementers provide services for government data opening as a third party.

4.1.2 Sample size and sample profile

The questionnaires in this paper were closed questionnaires totaling 1,000, i.e., all questions were answered, and there were no missing values. After screening for questionnaire validity and removing 36 invalid questionnaires, a total of 964 valid questionnaires were gathered. Table 1 displays the basic information of the sample.

Table 1. Sample profile of the questionnaire

Region	Number	Number of frequencies (%)
Beijing	135	14.00
North China (Hebei, Lu, Jin, Henan, Tianjin)	98	10.17
East China (Suzhou, Zhejiang, Shanghai)	109	11.31
Central China (Wan, E, Xiang, Gan)	231	23.96
South China (Guangdong, Min, Qiong)	142	14.73
Southwest China (Yunnan, Guizhou, Sichuan, Tibet, Chongqing)	112	11.62
Northwest (Xinjiang, Qinghai, Gansu, Ningxia, Shaanxi, Inner Mongolia)	89	9.23
Northeast (Hei, Ji, Liao)	48	4.98

4.2   Regularity analysis of influencing factors

4.2.1   Overall model data regression analysis

Based on the data collected from the questionnaire, the regression results of the overall model are shown in Table 2. The results found that the data resources owned by government agencies are not significant in the degree of realization of government data openness and are significant in the degree of realization effectiveness. This indicates that although a large number of high-quality data resources do not significantly contribute to the degree of government data openness, they have a significant positive effect on the provision of information with high accuracy and research value.

Table 2. Overall regression results

Category	Indicators	Estimate	S. E.	C. R.	p
Degree of achievement	Strategic Policy	0.105	0.053	5.385	0.000
	Data Resources	0.134	0.095	1.376	0.052
	Platform Organisation	0.586	0.156	7.181	0.000
	Utilization Effectiveness	-1.213	0.229	-3.155	0.000
	Innovation Assurance	0.114	0.135	4.097	0.000
	Security and Protection	1.256	0.139	8.835	0.000
Achieved validity	Strategic Policy	-0.109	0.063	3.678	0.005
	Data Resources	0.085	0.114	4.385	0.000
	Platform Organisation	0.503	0.173	4.447	0.000
	Utilization Effectiveness	-0.078	0.159	-0.494	0.558
	Innovation Assurance	0.082	0.801	0.993	0.315
	Security and Protection	0.459	0.119	4.409	0.000

The effectiveness of information users' utilization of open data and the innovation guarantee provided by government agencies in the process of realizing open data have a significant impact on the degree of realization of open government data, while they do not have a significant impact on the effectiveness of realization. Figure 7 illustrates the overall path coefficients of each influence factor. Utilization effectiveness has a negative impact on the degree of realization of open government data,

while innovation guarantee significantly impacts the degree of realization of open government data. This may be because it is difficult for government agencies to accurately measure the effectiveness of data utilization by external information users, and inappropriate data openness may hurt government agencies, so the effectiveness of utilization is negatively related to the degree of realization of government data openness.
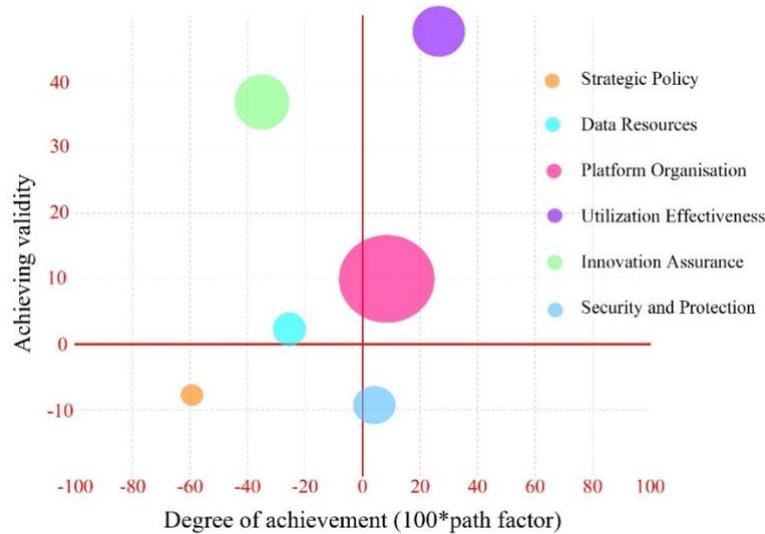

Figure 7. Overall model bubble diagram

### 4.2.2   Comparative analysis of different government agency types

Through the regression results of different types of institutions, as shown in Table 3, it can be found that the regression coefficient of the strategic policy of government agencies on the degree of realization of information sharing is 0.829, the regression coefficient of the platform organization of government agencies on the degree of realization is 0.705, and the regression coefficient of the data resource on the degree of realization is 0.452, which indicates that the strategic policy and platform organization have a significant positive effect on the degree of realization of data openness of government agencies, institutions and state-owned enterprises. A realization degree is important, but data resources can significantly improve the efficiency of data opening by different types of institutions.

Table 3. Results of the analysis of types of government agencies

Category	Government Agencies	Business units	State-owned enterprises
Strategic Policy $\rightarrow$ Level of achievement	0.829	0.415	0.755
Platform organization $\rightarrow$ Level of achievement	0.705	0.386	0.138
Data resources $\rightarrow$ Effectiveness	0.452	0.229	0.625

Figure 8 shows the path coefficients of the influencing factors for government data openness in different types of organizations. From a macro perspective, the positive influence of strategic policies on data openness in government agencies is more obvious, and the promotion of data openness in state-owned enterprises and institutions is relatively limited. The organizational structure and social functions of the three determine this. The degree of understanding and implementation of policies by government agencies is the most thorough among the three, while institutions and state-owned enterprises are under the leadership of the state administrative organs but are still somewhat different

from government agencies in applying and implementing specific policies. Therefore, the positive impact of strategic policies on state-owned enterprises and institutions is relatively small.
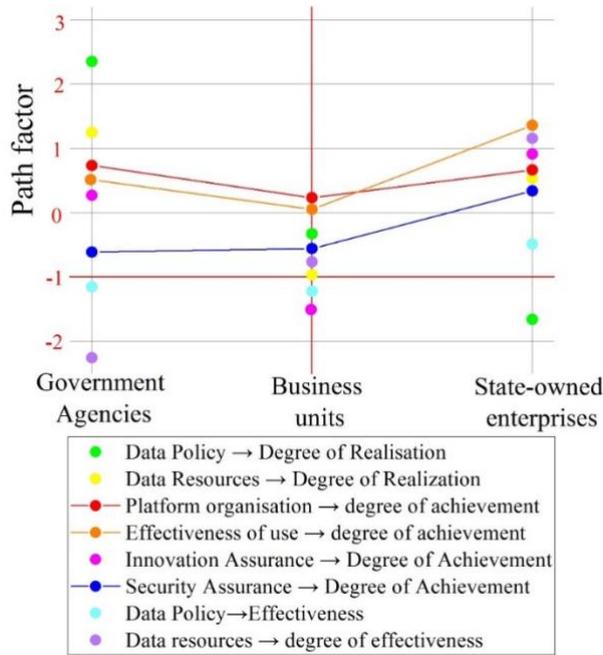
Figure 8. Government data sharing impact path coefficients for different agency types

The platform organization construction can significantly impact the degree of data openness of different institution types, but its positive impact on institutions is limited. This may be because institutions, as organizations providing public services to society, already have complete data sharing and open platforms and more frequent information exchange with the public. On the other hand, grassroots government agencies and local state-owned enterprises have not yet formed the concept of data openness in their work and lack sufficient technical support, so the construction of data sharing and open platforms is lagging. Therefore, enhancing information exchange and platform construction among government agencies and state-owned enterprises can significantly improve the realization of data openness.

5   Conclusion

This paper constructs a collaborative information governance model for blockchain by exploring the collaborative governance model of smart government. The model is co-managed by all district governments in the distributed network, using smart contracts, which ensures that each governance link responds intelligently. Lastly, empirical analysis is used to draw the following conclusions:

1) The digital resources owned by government agencies are not significant in the realization degree of government open sharing $p = 0.125 \geq 0.05$, not significant. In the realization of the effectiveness of $p = 0.02 \leq 0.05$, it is significant. It indicates that it is difficult for government agencies to accurately measure the effectiveness of data utilization by external information users, and inappropriate data openness may negatively impact government agencies.

2) The regression coefficient of the strategic policy of government agencies on the degree of information sharing is 0.829, the regression coefficient of the platform organization of government agencies on the degree of realization is 0.705, and the regression coefficient of

the data resources on the degree of effectiveness of realization is 0.452, which indicates that the strategic policy and the platform organization have a significant positive effect on the degree of realization of data openness in government agencies, institutions and state-owned enterprises.

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