Development Level of Digital Government: A Qualitative Comparative Analysis of Fuzzy Sets Based on 31 Provincial Capital Cities in China

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Abstract. The onset of the information era has accelerated the transformation of digital governance, establishing it as a critical component in the modernization of governance frameworks and capabilities worldwide. Despite considerable advancements in the field of digital government, regional disparities in development remain pronounced, emphasizing the necessity for a coordinated and effective approach. This study employs a qualitative comparative analysis (QCA) of fuzzy sets to assess 31 provincial capitals in China, aiming to discern the digital governance ecosystems that promote the development of digital governments. It is grounded in the TOE framework, which examines the dynamics among technological, organizational, and environmental factors. The results provide empirical insights into the architecture of digital governance, offering a detailed comprehension of performance levels and recommending specific policy directions to enhance digital government progression.

Keywords: Digital Governance; Qualitative Comparative Analysis; TOE Framework.

1. Introduction

Under the wave of the information age, digital government construction has become an important engine to promote the modernization of the national governance system and governance capacity. The China Digital Government Development Index 2022 shows that the current digital government still has the problem of uneven development among regions, and emphasizes that building a synergistic and efficient digital government performance capability system is the ultimate goal of digital government construction. Under the guidance of the national strategy, local governments have actively launched digital government construction programs, and have made a series of remarkable achievements in practice. However, at the same time of rapid development, the problem of "unbalanced and insufficient" development of digital government construction around the world has gradually come to the fore. This paper selects 31 provincial capital cities in China and conducts a comprehensive case study by combining inductive case analysis and fuzzy set qualitative comparative analysis (fsQCA) to explore the types of digital governance ecologies that can improve the development level of digital government, so as to provide empirical references for the construction of digital government.

2. Literature Review and Research Framework

2.1 Literature review

The famous contemporary sociologist Manuel Castel first put forward the idea of building a digital government, believing that the governmental governance system also needs to change and innovate with the development of the network society. Subsequently, many countries have introduced numerous policies to promote the digital transformation process and build a digital government, such as the UK's "Government Digital Strategy", South Korea's "Smart Government Program", Japan's "i-Japan Transformation Strategy" and so on. Japan Transformation Strategy" and so on. In China, some scholars trace the development of the concept of digital government and

define the concept of digital government as the digital era, i.e., the emerging digital governance system constructed by the joint influence of two mechanisms, namely, technology-enabled government and society (Zhao Jinxu et al., 2022). Currently, the relevant research on the factors influencing the development level of digital government involves a number of important indicators, reflecting the impact of digital transformation on government governance and social development from different perspectives. Based on the TOE framework, the influencing factors on the performance of China's provincial digital government construction were analyzed from three dimensions: technology, organization and environment, and it was found that the technical management capability was the most critical influence on the construction of digital government institutional system (Guo Gaojing et al., 2022). Using the fsQCA method, a path analysis of provincial government health code application cases was conducted, and it was found that the application of digital governance in provincial governments is influenced by a combination of technological, organizational and environmental factors (Li Yue et al., 2020).

Digital governance theory is a new public management theory spawned by the combination of governance theory and Internet digital technology, emphasizing the importance of changes in management systems based on information technology as well as changes in the methods of interaction between the government and the public (Dunleavy et al., 2006). As a governance orientation in the digital era, digital governance theory centers on guiding public sector reform through three ideas, including reintegration, digital change, and demand-based holism, so as to provide citizens with faster and more accurate public services. Established studies have mainly categorized the connotation of digital governance into two layers: one is "governance with digital technology", which focuses on the use of digital technological means to internally improve the effectiveness of government management and externally enhance government transparency and public service (Zheng Lei, 2021). For example, Xu Xiaolin and Zhou Lixin (2004) point out that digital governance is the use of e-technology to streamline government administration and simplify the process of dealing with affairs, and to increase the degree of democratization in the interaction between the government and the civil society, the government and the economy and society as represented by enterprises, and in the internal operation of the government. The second is "governance of digital technologies" or "governance in a digital society", which emphasizes that digital governance is not only about digital changes in government itself. Research under this connotation will take a more open perspective to examine the interaction relationship among multiple subjects such as government, enterprise, and society in the form of information society (Jiakai, 2020), and emphasize adapting to and even promoting the digital transformation of the whole society through the change of governance system and governance capacity (Bao Jing and Jiakai, 2019).

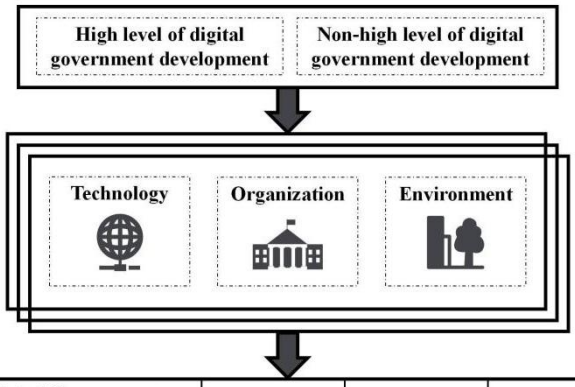
As a qualitative comparative analysis method, the QCA method can effectively reveal the generation and change of complex social phenomena under different conditions by comparing and configuring cases. In the field of digital government and digital governance, the QCA method can effectively analyze the impact of multiple conditional variables on the level of digital government development, reveal the dynamic role mechanism of digital government development and digital governance ecology, and explore the complex causal relationships in digital government and digital governance. Existing studies have explored and demonstrated numerous key factors affecting digital government development and confirmed some types of factor linkages, providing the factor set and framework foundation for this study. However, existing studies have either focused on the macro data of 31 provinces across the country, which is comprehensive but lacks granularity, or included samples from as many as 233 municipalities, which is too broad a scope and may lead to a loss of focus and depth in the research results. Therefore, based on previous studies, this study will seek to strike a balance between the two by selecting the capital cities of China's 31 provinces to ensure that the scope of the study is broad enough to capture the core policy and practice dynamics of each province, while fully ensuring the precision and representativeness of the data. By focusing on the provincial capital cities, this study will analyze the influencing factors of the development level of

digital government more accurately, and put forward more targeted and operational policy recommendations and practical guidance to enrich and expand the existing research.

2.2 Research Framework

In 1990, Tornatzky summarized a TOE (Technology-Organization-Environment) analytical framework applicable to multifactorial technology application situations based on the results of the technology acceptance model and the diffusion of innovations theory, which classifies the factors affecting the application of technology in an organization into three categories, namely, technology, organization, and environment. The TOE framework serves as a The TOE framework, as a meso-theoretical framework for examining the context of innovative technology application, provides an analytical framework for studying the adoption of technology and diffusion of innovation in various types of organizations. In recent years, many scholars have studied the mechanism of transformation of scientific and technological achievements in China based on the TOE framework, which has been widely applied to the influencing factors of the transformation of scientific and technological achievements in different organizations, the evaluation of scientific and technological achievements transformation performance and optimization paths and other related aspects. Based on the TOE framework, this study elaborates the influencing factors of China's digital government development level into three aspects: technology, organization, and environment.

Technological factors correspond to the use of digital means and information and communication technologies; organizational factors relate to the organizational structure, management processes and personnel capacity of government agencies; and environmental factors include the policy, social and economic environments. The development of digital government requires the support of technology, and is also affected and constrained by organizational capacity and environmental factors, all of which are important factors affecting the development level of digital government. First, technology plays a leading and supporting role in the development of digital government. The continuous innovation and application of digital technology has provided government agencies with more efficient and convenient tools and means to promote the informatization and intelligence of government management. At the same time, the development of technology also requires government organizations to continuously improve their technical application capabilities and innovation awareness to meet the development needs of the information age. Secondly, organizations play a central role in the development of digital government. Factors such as the organizational structure, management process, and personnel capacity of government agencies directly affect the development effect of digital government. Finally, the environment plays an important role in promoting the development of digital government. The policy environment, social environment, economic environment and other factors provide external conditions and opportunities for the development of digital government. Government organizations need to pay close attention to changes in the external environment and adjust their development strategies and action plans in a timely manner to adapt to the changes and needs of the external environment.



Digital Government Development Model	Technology	Organization	Environment
Technology-driven	1	0	0
Organization-leading	0	1	0
Environment-responsive	0	0	1
Good digital governance	1	1	1

Fig. 1. Potential grouping effects of the TOE framework on digital government development

3. Research Design

3.1 Methodology

3.1.1 Fuzzy set qualitative comparative analysis method (fsQCA)

QCA is a case-study oriented theory collection research method proposed by Charles C. Ragin in 1987, which transcends the boundaries between qualitative and quantitative methods, treats cases as conditional groupings, and through in-depth qualitative description and categorization of the cases, it can reveal the complex causal relationship between the conditional groupings and the results, and then reveal the logic and laws behind the complex social phenomena. logic and law behind complex social phenomena.

At first, Larkin combined Boolean algebra and set theory to develop Crisp Set Qualitative Comparative Analysis (csQCA) for dealing with dichotomous variables. 2000, Larkin introduced fuzzy sets into qualitative comparative analysis on the basis of this approach, and proposed Fuzzy Set Qualitative Comparative Analysis (fsQCA). In comparison, fsQCA breaks through the restriction of dichotomous variables and pays more attention to the vagueness and continuity of the data, which enables the researcher to analyze the case in a more detailed and in-depth manner.

The literature review shows that the fsQCA method is increasingly favored by academics, but its use in the study of factors influencing the level of digital government development is relatively small. Meanwhile, in the context of digital government capacity building becoming a focus of both theory and practice, the results of the research on its influencing factors are still controversial in the academic world, which provides the necessity for this study to use fsQCA method to explore the main factors affecting the development level of digital government.

3.1.2 Case study approach

In terms of the number of research objects, this study selects 4 municipalities directly under the central government in China, as well as the capital cities of 22 provinces and 5 autonomous regions across the country, totaling 31 cases as research objects, constituting a comprehensive and in-depth multi-case study framework.

In terms of research function, through the refined analysis of each case, this study forms a comprehensive and deep understanding of the research object as a whole, in order to systematically dig out the core influencing factors and their generating mechanisms in the performance of digital government construction in the capital cities and municipalities of each province and municipality. This research orientation aims to provide useful references and insights for digital government

construction through the close integration of theory and practice, so this study focuses on exploratory and empirical research.

After careful screening and repeated examination, the cases in this study are selected based on the following three points. First, the cases selected for this study cover the eastern, middle and western regions of the country, and the administrative levels are municipalities or provincial capitals, which are more representative and at the same time reflect the practice differences between regions. Second, this study technically satisfies the methodological requirements of a smaller sample of QCA, while the cases themselves conform to the conditional structure of multiple concurrency of causality, and satisfy the requirements of homogeneity and diversity among the cases. Third, practically, the data of this study mainly comes from the "China Digital Government Development Index Report (2022)" published by the team of Data Governance Research Center of Tsinghua University, and the relevant data are available and authoritative.

3.2 Variable selection and Description

3.2.1 Outcome variable

At present, a number of scholars have constructed a wide variety of digital government evaluation systems and evaluation reports, but limited to the availability of data and subjectivity of individual research, these indicators are often relatively simplified, and it is difficult to reflect the overall picture of the development of local digital government.

In contrast, the digital government evaluation indicators constructed by academic research institutions are more accurate and systematic, and the measured data are richer and more objective. The researchers found that the Data Governance Research Center of Tsinghua University's China Digital Government Development Index is rich in data, combining high accessibility and strong consistency. The Data Governance Research Center at Tsinghua University is the first specialized data governance research institute in China, which has long been concerned with the practice of digital government construction in China and has published the Research Report on China's Digital Government Development for many years in a row, which is authoritative, scientific, comprehensive, and systematic in the field of examining the development of digital government. Guo Lei (2021) point out that e-government is one of the most easily perceived orientations of digital government by the public, and thus the report's index of the level of digital government development exists as a proxy variable for digital government in a representable and reasonable manner.

In summary, this study draws on Liu Mengyan's (2023) research to use the digital government development index measured by the Data Governance Research Center of Tsinghua University's China Digital Government Development Index as an outcome variable to more comprehensively measure the integrated level of local governments in digital technology application and information management.

3.2.2 Condition variable

Based on the TOE theoretical framework, this study summarizes the factors affecting the level of local digital government development into three dimensions: technology, organization and environment. Reference is made to the "2022 China Digital Government Development Index Report" and the Ministry of Industry and Information Technology of the People's Republic of China's publication on Internet business income and cell phone penetration rate. Six secondary condition variables are selected: technical conditions, governance capacity, organization, institutional system, governance effect, and competitive pressure.

1) Technological condition

The technology conditions cover a wide range of emerging digital technologies such as big data and artificial intelligence, which all have high application value in the digital transformation of the government. Based on this characteristic, this study selects Internet business revenue and cell phone penetration rate, each weighted by 50% to constitute a proxy variable for technological conditions.

The Internet, as the technological foundation of digital government transformation, provides rich data resources and technical means for digital governance. Adopting Internet service revenue as a tertiary variable can avoid the characteristic of diverse technological conditions and comprehensively measure the level of regional technological conditions from the overall perspective. At the same time, digital governance involves the collection, transmission and processing of massive amounts of information, and the selection of cell phone penetration rate as one of the weighted variables can effectively represent the differences between communication technologies in various regions. The Internet business revenue and cell phone penetration rate selected for this study are from the public statistical analysis data released by the Ministry of Industry and Information Technology in 2022, which are both authoritative and available.

2) Governance capacity

Governance capacity, as a secondary variable under the "organization" dimension, focuses on specific indicators such as the quality of platform management, the degree of data openness and the effectiveness of government services. Among them, the quality of platform management is measured by the construction quality and standardization of government portals and city brains. The degree of data openness is represented by the construction of local data centers and the degree of sharing of data resources. Reflecting the effectiveness of government services with the feedback evaluation of the digital government platform's citizen-friendly services and commercial services. The intensity of government services is measured by the frequency of interaction between local governments and the public using digital technology.

3) Organizational structure

The organizational institution dimension is a key link in assessing the participating subjects of digital government development. Under China's unique institutional structure, party and government agencies and social organizations share the organizational task of digital governance, and thus this study's exploration of the organizational variables is divided into two categories according to the participating subjects. One is an assessment of party and government institutions, including various offices and departments such as e-government offices, smart city offices, etc., while covering some of the leading groups and websites of management departments set up to promote the development of digital government; the other focuses on the development status of social organizations such as industry associations and industry alliances that specialize in the field of digital technology.

4) Institutional system

The institutional system is the rule base for the development of digital government, which is examined from the aspects of digital government policy and digital ecological policy, respectively. The former focuses on the construction of policies and regulations to improve the level of government management and public service with digital technology, including the general policy of digital government and the promulgation of policies in various aspects such as data management and data security. The latter focuses on the construction of policies and regulations to promote the development of digital technology, digital industry and digital society, including policies on the development of digital economy, smart city, artificial intelligence and big data.

5) Effectiveness of governance

The measurement of the variables of governance effectiveness focuses on reflecting the people's feedback perspective of digital government development and probes the people's satisfaction and sense of access. This includes the popularity of digital public services, the effectiveness of citizens' daily use of digital public services and the overall satisfaction of the public with the level of digital government development.

6) Competitive pressure

From the perspective of government competition, whether it is due to the attributes of local governments themselves as "politicians" (2020, Sun Kai and Zhang Lei), or considering the mechanism of local officials' promotion championships (2007, Zhou Li'an), which creates competitive relationships between governments at the same level, the competitive pressure of local governments is an important factor that cannot be ignored when they develop a digital government. The competitive pressure of local governments is an influential factor that cannot be ignored in the development of digital government. Therefore, in this paper, the average value of digital government development in neighboring regions of the same administrative level is used as an indicator of competitive pressure. Considering the vertical administrative hierarchy of China's administrative system, municipalities take the average value of the digital government development index of their neighboring provinces, and the remaining provincial capitals take the average value of the digital government development index of their provinces.

3.3 Calibration rule

Drawing on established research, the group calibrated all city data uniformly. The 5% quartile, 50% quartile, and 95% quartile were set as three anchor points, namely, completely unaffiliated, midpoint, and completely affiliated, using the direct calibration method. The specific calibration rules for the variables are shown in Table 1.

Table 1. Variable Calibration Rules

Variable type	Variable		Full affiliation	Mid point	Completely unaffiliated
Outcome variable	Level of digital government development		76.7	65.8	41.5
Condition variable	Technological condition	Internet business revenue	3248.4	529.9	16.2
		Communications penetration	138.3	118.3	106.3
	Governance capacity		13	11	9
	Organizational structure		15	13.75	10.63
	Institutional system		35.34	34.01	29
	Effectiveness of governance		18.01	14.71	9.91
	Competitive pressure		77.67	73.82	60.25

4. Analysis

4.1 Empirical research

Table 2. Results of the analysis of the necessary conditions

Condition variable	**High level of digital government development**		**Non-high level of digital government development**	
	Consistency	**Coverage**	**Consistency**	**Coverage**
High Technological condition	0.819014	0.861600	0.607895	0.654523
Non-high Technological condition	0.671598	0.625959	0.871459	0.831314
High Governance capacity	0.737909	0.710136	0.593764	0.584836
Non-high Governance capacity	0.568600	0.577624	0.705711	0.733749
High Organizational	0.732403	0.737589	0.568613	0.586089

structure				
Non-high Organizational structure	0.589000	0.571557	0.745414	0.740327
High Institutional system	0.849001	0.789208	0.633824	0.603022
Non-high Institutional system	0.572945	0.604550	0.778440	0.840672
High Effectiveness of governance	0.749586	0.812491	0.563460	0.625090
Non-high Effectiveness of governance	0.654117	0.594161	0.830978	0.772538
High Competitive pressure	0.802097	0.797862	0.593602	0.604336
Non-high Competitive pressure	0.602236	0.591484	0.801452	0.805630

Necessary condition analysis is a test of the necessity of a single condition in an outcome. It concentrates on answering the question, "Is there some condition that necessarily exists when the outcome occurs?" This question. When the level of consistency is greater than 0.9, the condition can be initially determined to be necessary for the outcome to occur. The results of the analysis in Table 2 show that the consistency of all conditions is below the critical value of 0.9, there are no necessary antecedent conditions for high and non-high levels of digital government development, and the grouping of antecedent conditions needs to be further analyzed.

Table 3. Grouping configurations of factors influencing the level of digital government development

N=31	**High level of digital government development**					**Non-high level of digital government development**	
Configuration	Environment-responsive	Technology-driven		Organization-leading		Slow-developing	Less-effective
Condition variable	H1	H2a	H2b	H3a	H3b	N1	N2
Technological condition	⊗	•	•	●	●	⊗	⊗
Governance capacity		●	●	•		⊗	●
Organization structure	●	⊗	●	•	●	⊗	
Institutional system	⊗		⊗	●	●	⊗	⊗

Effectiveness of governance	●	●	●		●		⊗
Competitive pressure	●	•	⊗	•	•	⊗	⊗
Consistency	0.9688	0.951717	0.984034	0.937964	0.954162	0.953104	0.957292
Raw Coverage	0.340941	0.364858	0.245339	0.486002	0.509587	0.53092	0.337817
Unique Coverage	0.0428913	0.145757	0.0056724	0.0575532	0.034532	0.28583	0.0927271
Overall solution consistency	0.914605					0.945878	
Overall solution coverage	0.762788					0.623647	

Note: ● Large black circles indicate the presence of a core condition, • Small black circles indicate the presence of a peripheral condition; ⊗ Large circles with "x" indicate the absence of a core condition, ⊗ Small circles with "x" indicate the absence of a peripheral condition.

Using fsQCA software, the researchers came up with a total of seven groupings. Based on the similarities and differences between the different groupings, the groupings were rationalized and finally summarized into five groups: environment-responsive, technology-driven, organization-leading, slow-developing, and less-effective. In the following study, we will further analyze the cases based on the cities included in each group, in order to explore the generation path of digital governance.

4.2 Case Study

4.2.1 H1 Environment-responsive: Nanjing

The environment-responsive type corresponds to the H1 histogram path configuration in Table 3. In this configuration, even if the local government's technical conditions and institutional system are relatively weak, it can still be motivated by the competitive pressure brought by the environment, which will promote the construction of sound organizations and institutions, the effectiveness of governance, and ultimately achieve a high level of construction of the local digital government. Nanjing is a typical representative of the H1 environmentally responsive path. It has a long history and rich culture, and its geographic location determines that environmental factors have a profound impact on it.In 2022, Nanjing ranked second in Jiangsu Province in terms of total GDP with 16,355

billion yuan. Suzhou, on the other hand, has a GDP of more than 2.3 trillion yuan, making it the only prefecture-level city in Jiangsu with a GDP of more than 20,000 billion yuan. As an ordinary prefecture-level city, Suzhou's strong level of economic development puts great competitive pressure on Nanjing, which is the capital city of the province. In response to the digital governance work, Nanjing has issued the "Work Program for Accelerating Urban Digital Governance", "Interim Measures for Nanjing Municipal Governmental Data Management" and other planning methods, which provide specific operational procedures and technical specifications for sharing and opening of governmental data. Located in the Yangtze River Delta region, which has the most active economic development, the highest degree of openness, and the strongest innovation capacity in China, the high level of government and relatively low level of economic development have provided Nanjing with a constant development momentum for local government construction, which in turn contributes to its status as an environmentally responsive city with high digital government construction.

4.2.2 H2a Technology-driven: Fuzhou

Fuzhou corresponds to the H2a grouping path configuration in Table 3. In this configuration, the local government is driven by the development of digital technology, the development of high governance capacity and governance effect, with the auxiliary incentive role of competitive pressure, to make up for the shortcomings of the organizational setup, and ultimately reach a high level of construction of the local digital government. Fuzhou's digital development can be traced back to 2000, in the CPC Fujian Provincial Party Committee Sixth Twelfth Plenary Session, "Digital Fujian" was written into the program proposal of Fujian. As the capital city of Fujian Province, Fuzhou has laid the foundation for its technology-driven digital government development path. In 2020, Fuzhou's first batch of 175 key projects with a total investment of 230 billion yuan have already begun construction of 122 projects, and completed the construction of 7 new projects such as the National Science and Technology Center (NSTC) and the Shuangchuang Fuzhou Demonstration Base (SBFDB). By the end of 2020, a total of 5,300 5G base stations had been constructed in Fuzhou, accounting for 1/3 of the total number in the province. In 2021, the added value of the digital economy in Fujian province reached 2.3 trillion yuan, continuing to be at the forefront of the country in terms of scale and level (2023, He Jun'an and Chai Shun). By building up a basic support system for government affairs and forming three major government affairs processing methods, namely 12345 service platform, e-Fuzhou APP and Administrative Citizen Service Center, we have achieved excellent results in smart city and digital government applications.

4.2.3 H2b Technology-driven: Beijing

Beijing corresponds to the H2b grouping path configuration in Table 3. It is driven by a high level of digital technology, which develops a high level of governance capacity. It has sound governance institutions and good governance effects. It bridges the relative deficiencies in the two dimensions of the institutional system and competitive pressures. Ultimately, it achieves a high level of construction of the local digital government. As the capital city, Beijing has an advantage in digital technology development that is difficult to be matched by other cities due to its special administrative level. In July 2021, the General Office of the Beijing Municipal Committee of the Communist Party of China (CPC) and the General Office of the Beijing Municipal People's Government (BMG) issued a notice. The notice is on "Beijing Municipality's Implementation Plan for Accelerating the Construction of a Benchmark City for the Global Digital Economy". It proposes to build a "Beijing Model" for China's digital economy development and a global digital economy development model. It also proposes to build a "Beijing benchmark" for the development of the global digital economy and to accelerate the construction of a benchmark city for the global digital economy. In terms of technological drive, Beijing has a sense of forward development. It has advanced the layout of quantum technology, 6G technology, algorithmic innovation, and blockchain

technology. Beijing has strengthened the construction of the digital government. It has comprehensively built a modernized governance system characterized by digitization.

4.2.4 H3a Organization-leading: Shanghai

The representative city in the H3a configuration is Shanghai, China. With high technological conditions and a high institutional system as core conditions, and high governance capacity, high organizational institutions, and high competitive pressures as peripheral conditions, high-level digital government governance can be achieved. Since after 2018, Shanghai has been continuously strengthening the transformation of government form and guiding the transformation of the entire social governance system. In terms of technological infrastructure, Shanghai, leveraging its status as a center for technological innovation, has actively introduced and developed cutting-edge technologies such as artificial intelligence, big data analysis, and cloud computing. The application of these technologies has not only improved the efficiency of government operations but also enhanced the quality of government services. For example, through intelligent data analysis systems, the Shanghai municipal government can conduct real-time analysis of a large amount of urban operation data, effectively supporting decision-making for urban management and public services. In terms of cloud computing, the Shanghai government has promoted the use of leading domestic cloud service platforms to support massive data storage needs and complex data processing tasks. Government departments, through these cloud platforms, can achieve elastic scaling of resources and optimization of cost-effectiveness, while ensuring the continuity and security of services. In terms of governance capacity and organizational institutions, the Shanghai government has established specialized digital management agencies, such as the Shanghai Municipal Data Resource Administration, to uniformly lead and coordinate the city's digital efforts. This centralized management not only promotes the opening and sharing of government data but also regulates the development of the digital economy and enhances the government's decision-making data support capabilities. At the same time, the Shanghai municipal government has advanced the electronic processing of government services and established an integrated platform for services from various departments—the Shanghai Municipal.

4.2.5 H3b Organization-leading: Hangzhou

High technological conditions, organizational structure, institutional system, and governance effects are core conditions for achieving high-level digital government governance, with high competitive pressure serving as a peripheral condition. Hangzhou represents the H3b configuration, where technological conditions play a pivotal role in the rapid development of its digital government. As a cradle of e-commerce and a hub for technological innovation in China, Hangzhou is home to high-tech giants like Alibaba and NetEase. These companies not only fuel local economic growth but also provide robust technical support for government digitization. The Hangzhou government has leveraged its edge in big data, cloud computing, and AI to innovate, exemplified by projects like the "City Brain", which enable efficient data processing and urban management optimization. The institutional system and organizational structure are closely aligned, ensuring effective policy implementation and technological integration, propelling the modernization of government services and the intelligence of urban management. Policies such as the "Hangzhou Digital Economy Development Fourteenth-Five Plan" and the "Hangzhou Smart City Construction Management Measures" provide a clear roadmap and regulatory framework for digital transformation, with a focus on data security and privacy. The establishment of the Smart City Development Bureau in Hangzhou has facilitated the integration and management of digital resources, fostering inter-departmental information sharing and breaking down information silos. The government's collaboration with local tech companies, especially Alibaba, extends beyond technical support to include organizational synergy. This partnership ensures the swift and effective implementation of smart city solutions like Alibaba's "City Brain," enhancing administrative efficiency and service quality. To adapt to digital transformation, Hangzhou has also emphasized enhancing the digital skills and innovation capabilities of civil servants through regular training.

Competitive pressure, particularly in comparison with neighboring cities like Shanghai and Suzhou, has been a significant driver in Hangzhou's digital government development. This competition has spurred Hangzhou to continuously improve its digital capabilities, optimize government services, and maintain a leading position in national smart city construction, meeting citizens' needs and improving their quality of life.

4.2.6 N1 Slow-developing: Lhasa

Besides the aforementioned high-level digital government development paths, China's overall digital government construction still faces regional disparities, leading to a "hierarchical pattern" in local government digital development. The slow development type corresponds to the N1 configuration in Table 4. In this type, except for governance effects, which show no significant correlation with local digital development levels, the overall poor performance across other dimensions results in a lower level of local digital government construction. Lhasa is a typical representative of the N1 slow development path. Lhasa, located in an inland plateau region with unique geographical conditions, has relatively lagging infrastructure, including insufficient network coverage and unstable electricity supply, which hinders the smooth development of digital technology and restricts digital government construction. Additionally, as a remote area, Lhasa struggles to attract talent and faces a brain drain, leading to a shortage of specialized personnel in digital government operations, and consequently, lower levels of digital governance capacity and organizational structure. As a less developed region, Lhasa's relatively low economic level and limited fiscal revenue also constrain digital government development. In terms of e-government platform construction, Lhasa's platform suffers from an imbalance in public participation, low levels of engagement, subpar construction standards, and low operational efficiency (Shen yang, 2022). Moreover, there are issues with the operation and maintenance of Lhasa's two government websites, with a lack of timely updates and maintenance post-construction, and due to design flaws, there is minimal interaction between the government and the public, leading to low governance effectiveness assessments from the public. In contrast to the current situation, remote areas like Lhasa urgently need to strengthen digital government construction to reduce or eliminate the administrative burdens on the public, such as the need to physically visit government offices, to truly achieve convenience, benefits, and service for the people. Furthermore, as digital government becomes a crucial pathway for modernizing government governance in China, Lhasa, as an important city in the western region, holds significant importance for advancing the country's digital government development and governance modernization.

4.2.7 N2 Less-effective: Nanning

The Ineffective Performance type corresponds to the N2 configuration in Table 3. Local governments have relatively prominent governance capabilities, but there are deficiencies in all other dimensions, ultimately leading to a lower level of local digital government construction. Nanning is a typical representative of the N2 Ineffective Performance path. It located in the southern part of China and serving as the capital of the Guangxi Zhuang Autonomous Region, has achieved certain results in the construction of a digital government. The city has actively pursued the digital transformation of government affairs, formulating standards such as the "Nanning City Government Information Resource Catalogue Standard" and the "Nanning City Data Assets Registration Management System Management Measures," aiming to further regulate the management of government information systems and data resources. It has also promoted the "Internet + Government Services" model, creating a city-level public service mobile application platform called the "Love Nanning APP".

These measures have made Nanning's governance capabilities a prominent core condition. However, despite the proliferation of various platforms, there are shortcomings in the institutional system and actual governance effectiveness. Research has indicated that Nanning's e-government platform has issues with slow response times and low response quality (Wu dan, 2022), and due to traditional passive response and administrative processing, public feedback is not satisfactory,

suggesting that the governance effectiveness of the local digital government needs improvement. Additionally, similar to Lhasa, Nanning has a relatively small number of high-end scientific and technological institutions, and the local cultivation of digital technology talent is limited. The technological conditions have become a bottleneck issue for Nanning's development of a digital government, leading to difficulties in the effective utilization of government information resources and hindering the city's digital transformation. This results in a development predicament where there is governance capability, but the overall level is low.

5. Discussion

Our thorough examination of digital government development across the provincial capitals of China unveils a complex interplay of factors influencing digital governance. The application of the fsQCA method has adeptly uncovered multiple causal pathways, underscoring the importance of technology, organizational structures, and environmental contexts in determining outcomes in digital governance. The distinct configurations identified—namely, environment-responsive, technology-driven, and organization-leading—offer a refined view on the diverse approaches to achieving superior digital government development. Case studies from cities such as Nanjing, Fuzhou, Beijing, Shanghai, and Hangzhou illustrate the variety of strategies and the critical role of contextual factors in digital governance. In contrast, the challenges observed in slower-developing cities like Lhasa and Nanning highlight the difficulties faced by areas with less advantageous conditions. These findings are crucial for policymakers aiming to customize digital government strategies to their specific regional circumstances. Moreover, this study emphasizes the necessity for a balanced approach to digital governance, where technological advancements are supported by strong organizational frameworks and adaptive environmental policies. The lack of a universal model for digital government development reinforces the importance of regional specificity in devising effective digital governance strategies. In summary, this research enriches the digital governance literature by providing an in-depth analysis of the factors influencing the development of digital governments. It presents a strategic guide for policymakers navigating the complexities of digital transformation, stressing the need for a comprehensive and context-aware approach. Furthermore, this study sets the stage for future inquiries into the long-term effects of digital governance and the opportunities for inter-regional learning and collaboration.

Acknowledgments

This research was funded by the "College Students' Innovation and Entrepreneurship Training Program" at Soochow University in 2023, a national-level project titled "Working Together with a United Heart, Building a City Together: Research on the Participation of New Business Models and New Employment Groups in Social Governance through Digital Empowerment". The project number is [202310285011Z].

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