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Research on the Impact of Big Data Capabilities on Government's Smart Service Performance: Empirical Evidence From China

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ABSTRACT The government of China seeks to improve e-government service quality and build a service-oriented government that citizens find satisfactory. To this end, big data is being used as a new tool of government service innovation. However, there is a lack of research on how big data affects the performance of government smart services. This article explores the influence mechanisms of government big data capabilities on the performance of smart service provision, utilizing the carding analysis of relevant literature, published both in China and abroad. To this end, a structural equation model was constructed. Using data from 289 valid questionnaires in Jiangsu, Shandong, Zhejiang, and other provinces and cities in China, the study tests internal mechanisms of big data capabilities and its effect on smart service performance. Following a new definition of government big data capability, the paper divides the capability into three dimensions: big data system capability, big data human capability and big data management capability. The main conclusions are as follows: (1) Big data management capability has a significant positive impact on big data human capability and big data system capability. (2) Big data system capability has a significant positive impact on big data human capability. (3) Big data system capability and big data management capability have a significant positive effect on smart service performance. (4) The impact of big data human capability on smart service performance is not however significant enough to bring about the improvements which the government seeks.

INDEX TERMS Big data system capabilities, big data human capabilities, big data management capabilities, smart service performance, structural equation model.

I. INTRODUCTION

In this era of the Internet's vigorous development, government departments are facing challenges including the diversification, complexity and personalization of public needs in the provision of public services. These challenges restrict the ability of the government to improve its service performance. As a result, how to improve service performance is a key development goal of government organizations, as it involves the cornerstone of government trust. In addition, with the rapid improvement of information technology and the vigorous development of China's smart government construction, big data's value is increasingly prominent. The use

of big data technology can improve the government's operating model, internal decision-making efficiency and information transparency. It promotes more efficient and convenient smart services for the public, and helps to construct a people-satisfactory government [1]–[4]. In the context of the rapid development of information technology, improvement of the government's smart service performance depends on its capability adequately to respond to challenges, especially regarding the government's capability to control big data technologies.

Correct and reliable data enable better decision support, smarter policy making, faster and richer visualizations, and overall improvements to public services, based on better insights into citizen needs [5]. Klievink *et al.* [6] assessed the big data readiness of the public sector via organizational con-

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sistency, organizational maturity and organizational capabilities. The results further demonstrate that big data can be used in the public sector if it is consistent with public sector organizational goals and working methods. As a result, government departments should actively embrace big data technologies. On the one hand, it helps respond to a wide range of public issues in a timely manner at relatively low cost, while improving government's social communication, scientific decision-making, and organizational coordination capabilities. On the other hand, it can help identify the public's differentiated and personalized service needs, and improve public service capabilities, crisis prevention capabilities, and social mobilization capabilities [7], [8]. Finally, government's stock data governance can also improve service efficiency and expand service supply, while the government's incremental data can more accurately reflect social needs and provision of public services [9].

Norris and Reddick [10] pointed out that many government departments had not integrated the introduction of their information technology into service processes transformation and management system upgrading, which results in reduced performance return. According to Fan and Chen's [11] research conclusions, many of the benefits of big data to smart services are based on the government's big data capability. As a result, if the ability of departments to control and use big data is not improved with the advance of the technology, service performance will not achieve desired results. In short, there is an urgent need to explore the composition of the elements of government's big data capabilities, the relationship between the elements, and the factors mechanisms in relation to the performance of government smart services. This would help clarify how to use big data to improve the performance of government smart services in the context of China's current social transformation.

To date, there is limited research on big data capabilities. Studies on the relationship between big data capabilities and government smart service performance are also rare. Joseph and Johnson [12], Feller *et al.* [13], and Ram *et al.* [14] indicated that in the private sector big data could improve decision-making, promote organizational efficiency and effectiveness, lead product innovation, achieve better infrastructure management and lower operating costs, accurately segment customers, ascertain needs precisely, provide targeted and personalized services, and overall improve customer satisfaction. Zheng and Zhou [15] and Cheng and Li [16] discussed the cultivation mechanism of enterprise big data capabilities. Xie *et al.* [17], Ren *et al.* [18] empirically explored big data analysis capabilities, concluding that they were conducive to the improvement of corporate business innovation patterns and collaborative performance. In related research on government departments, scholars have also started to pay attention to the relationship between big data and internet public opinion [19], emergency management [20], security privacy [21], governance [22] and public services [23]. Yan [24], Archenaa and Anita [25] pro-

posed that big data analysis could be used to solve problems involved in social security, urban construction, employment and entrepreneurship, environment and sustainable development, corruption, and so on. Big data can also help realize improved governance and help to build smart cities to facilitate better urban management. However, the current implementation of big data is facing great challenges. If government pays too much attention to big data technology, blindly implements big data schemes, and lacks the introduction and cultivation mechanism of big data talents, then big data will not be able to produce improved results and fulfil its potential value [26]. Big data itself cannot create improved value. A single big data technology cannot be effective without corresponding improvements in personnel for practical operations. Big data talents may not achieve sustainable development without a corresponding management mechanism [27], [28]. Therefore, both the private and public sectors should seek to build and enhance their capabilities to operate and apply big data. Fan and Chen [11] explained that the government's big data capabilities should aim to integrate and construct background data in the cycle of data openness, in order to provide society with a mass of data suitable for easy reuse. Zhu [29] proposed that the government's big data capability is a composite capability that arises from the application of big data technology to its work. It affects the government's ability to acquire, process, and apply data to ensure scientific decision-making and efficient process operation. For the improved performance of big data and smart services, the "Big Data Drives Smart Public Services" is introduced [30]. Big data can alleviate problems such as insufficient public service supply, uneven supply and demand, and "fragmentation" of supply. By using big data, government departments can predict people's demand for services in a more timely manner, improve democratic and scientific decision-making, expand communication channels of service targets to reduce service costs, improve service efficiency, and overall realize public services' diversification, precision and humanization.

Although scholars' research on big data is no longer only conceptual, we do not yet have extensive research on the connotation and measurement of government big data capabilities from a micro perspective. At the same time, the government's smart service construction model is still at an early stage. Performance measurement has not yet achieved a unified framework. This article explores the internal dimensions of big data capabilities and the impact of these dimensions on the performance of government smart services, and seeks to provide a basis for the development of government smart services. Firstly, the article explains the context and potential impact of the government's big data capabilities and smart services, and establishes for both an evaluation index system. Secondly, the article builds a relationship model between government big data capabilities and smart services, and determines the relationship between them. Thirdly, the article explores the internal dimensions of big data capabilities

and their impact on the performance of government smart services, and provides a basis for the development of government smart services.

II. CONCEPT DEFINITION

A. BIG DATA CAPABILITIES

Data has become as important a factor of production as physical assets and human capital. Regarding the concept of big data, the McKinsey Global Institute provided a useful definition: it is a data set large enough to exceed the capabilities of traditional database software tools in terms of acquisition, storage, management, and analysis [31]. It has four characteristics: large volume, fast velocity, diverse data types, and low value. Many scholars summarize these characteristics as “4V”, that is, Volume, Variety, Velocity, Value [32], [33]. At present, scholars aim to realize the potential value of big data through technical research and processing of related data. Chen and Hsieh [5] hold that research on big data should focus on how to use that data and how to transform “a bunch of data” into “big data”. Big data analytics capabilities in healthcare is the ability to acquire, store, process, and analyze large amounts of health data in various forms, while users are provided with meaningful information that enables them to discover business value and insights in a timely manner [34]. Therefore, the government's big data capabilities should not merely indicate the progress in big data technology, but should be a more comprehensive and dynamic concept. Scholars have also begun to distinguish between data, big data, big data analysis capabilities, and big data capabilities. According to McAfee's research [35], we can draw conclusions that big data can be regarded as another expression of “analysis”. And it is an intelligent activity that seeks to extract knowledge from data and turn it into a business advantage. In a word “analysis” is the most important and basic ability of big data. Some scholars even believe that the ability of big data analysis is the same as the ability of big data. However, this view is one-sided. Analysis only gives new insights to the data, while practical application can make it generate new value. According to Fan's research [36], the government's big data capabilities should carry through the entire data life cycle. It needs to consider data acquisition, data analysis, data application, data storage and other processes, as well as data availability, integrity, heterogeneity, data privacy, data law, and data governance. It is clear that the generation, collection, analysis, application, and management of government big data is a complex and dynamic process. The reason why it can play a key role in government departments is that the big data system platform, big data talents and big data management system work collectively. Resource-Based Theory shows that competitive advantage is achieved through the deployment of valuable resources and capabilities. Resource-Based Theory is the main paradigm for evaluating organizational resources, capabilities and organizational performance. The research on IT capabilities is based on this assumption. Big data capa-

bilities are the upgrade of IT capabilities. So, we believe that government big data capabilities are important organizational capabilities for the government to maintain long-term competitiveness and improve service satisfaction. In addition to basic technical concepts, government big data capabilities should also include big data system facilities, big data human skills, and the ability to manage and apply big data. Big data system facilities provide application platforms, big data human capabilities provide technical support, and big data management capabilities coordinate manpower and system facilities, enabling the two to develop harmoniously. Zheng and Zhou [15] also pointed out that the definition of big data capabilities from a technical perspective was often too narrow, ignoring the relationship between technology and corporate history and culture, which has led to the narrow claim of technical determinism. Based on these analyses, the government's big data capability should be defined as the ability to use big data technology and big data management system to quickly obtain, integrate and deeply analyze data on the basis of the government's big data platform, and carry out data prediction and application, so as to promote the government's accurate decision-making and improve the efficiency of government management and service.

Scholars have different opinions on the division of big data capability measurement dimensions. Gupta and George [37] proposed three dimensions of tangible resources, human resources and intangible resources. Kiron *et al.* [38] identified the organizational culture, analysis platform and analysis skills of employees as the core dimensions of big data analysis capabilities. Wamba *et al.* [39] showed the Big Data Analysis Capability Model (BDAC). He analyzed big data capabilities from three dimensions of management capabilities, infrastructure capabilities and human capabilities. Although these classifications are different, scholars have generally paid attention to big data application platforms, big data human capabilities, and big data management capabilities. Combining definitions of government big data capabilities, this article measures government big data capabilities from three aspects: big data system capabilities, big data human capabilities, and big data management capabilities.

1) BIG DATA SYSTEM CAPABILITIES

Big data system capabilities refer to the completeness of the construction of the big data platform in an organization. Compared to the traditional infrastructure, in big data its integrity, diversity and comprehensiveness are emphasized. According to the opinion of Piro *et al.* [40], information and communication technology platforms are widely regarded as the key factors of smart cities. The information-centric platform that he has created can be widely used in e-government and public administration, intelligent transportation systems, public safety, health care and other fields. Du and Zhao [41] put forward suggestions for building a national integrated government big data platform based on the global “government as a platform” development model, involving the trend towards construction experience to promote data integration,

sharing, openness and application, in order to serve the people. Based on the conclusions of Gupta and George [37] and Ren *et al.* [18], this study measures the capabilities of big data systems from the following: big data information communication platform, big data unified business platform, big data online service platform, the big data security guarantee and security assessment system, and big data technology processing platform. The government information communication platform seeks to accelerate interaction, eliminate barriers, and break down information silos; the unified business platform aims to standardize and simplify the service process and improve process operation efficiency; the online service platform is to facilitate the work of the masses and achieve at home "one network for processing"; the security guarantee and security assessment system is to ensure data security, prevent privacy leakage and data crisis; the technical processing platform is used to specifically process multiple types of data to obtain increased value. In sum, the application of big data platforms provides basic equipment guarantees for data decision-making and data applications, which are conducive to improving the value of data.

2) BIG DATA HUMAN CAPABILITIES

Mikalef *et al.* [42] pointed out that most current big data research focuses on infrastructure, intelligence and analysis tools, while lacking attention to, for example, human ability to master big data skills and knowledge. Big data talents are the core resources. The ability of big data systems to generate value requires the role of big data human capabilities. Big data human capabilities refer to the ability of big data talents in an organization to obtain new insights and new values of data through the use of big data technology. Based on the views of scholars such as Wang *et al.* [34], big data human capabilities are divided into big data acquisition and integration capabilities, unstructured data analysis capabilities, big data decision support capabilities, big data prediction capabilities, big data visualization capabilities and big data knowledge and technology learning capabilities. Big data human capability is an indispensable software for government departments to develop and apply big data. Only by combining software and hardware can the value of data be fully realized. Among them, big data acquisition and integration capabilities refer to the ability of government departments to collect, store and clean internal and external data widely and effectively. The scope of data acquisition includes not only intra-sector data integration, but also the realization of cross-regional, cross-level and cross-sector data integration, plus extensive Internet data and integration of external data between countries. Unstructured data analysis capabilities refer to the ability to conduct in-depth analysis of unstructured data, such as images and videos, to arrive at new conclusions and new insights. There is much unstructured data used by government, so it is important to adopt new analytical methods to better understand data. Big data decision support capabilities refer to the ability to provide managers with improved support for more precise decision-making

and actions based on analysis of big data results. Big data decision-making can greatly reduce errors caused by empirical decision-making. Big data prediction capabilities are very important ability in data applications. Predictive analysis through data models can predict future potential problems and provide an early warning, so that data can generate new value. For example, during the 2009 pandemic in the United States, Google obtained timely information through analysis of big data, which provided more valuable information than the Centers for Disease Prevention. It not only predicted the route of influenza transmission, but even predicted where it would spread [43]. Big data visualization capabilities refer to the visual display of data through image technology and other means, making it easier to understand the meaning of the data. Finally, big data knowledge and technology learning capabilities could also be integrated into the big data human capacity. With the remorseless improvement of science and technology, it is only when people have a certain learning ability that they can dynamically improve their ability to control technology. In addition, the development of big data by government departments cannot only rely on big data talents. Existing government staff should also aim to continuously master basic big data knowledge, and make good use of big data to promote their department's work efficiency.

3) BIG DATA MANAGEMENT CAPABILITIES

Big data management capabilities refer to the ability to plan, organize, direct, coordinate and control big data systems and big data personnel. Gupta and George [37] proposed that within a company's big data capabilities, if managers do not have the potential to meet needed new insights, then the organization will not effectively use intelligence gathered from the data. Big data managers' management, operation and application are important in improving data's value. Wamba *et al.* [39] defined big data management capabilities according to four aspects: planning, decision making, coordination, and control. This article uses Wamba's perspective to define and measure big data management capabilities from five aspects of leaders' attention to big data, big data development plans, big data development department responsibility system, policies and regulations for government data, and data-driven organization culture. Among them, the leader's attention to big data is the first step for government departments to apply big data. When Gupta and George [37] developed the big data management and analysis capability scale, the big data analysis manager had an improved understanding of the application of big data as one of the key indicators. Second, the data development plan is conducive to ensuring that big data is developed and promoted continuously in government departments. At present, all government departments in China's provinces are actively promoting the application of big data. For example, in December 2012 Guangdong Province introduced the "Work Plan for the Implementation of Big Data Strategy in Guangdong Province". In July 2013, Shanghai proclaimed the "Shanghai Three-year Action Plan for the Promotion of Big Data Research and Development

(2013-2015)". Third, the big data development department responsibility system encourages each department to perform its responsibilities, while jointly promoting the development of big data. At present, some regions in China attach great importance to the development of big data, and have set up special departments to manage it. For example, in October 2015, the Big Data Development Administration of Guizhou Province was established. It is responsible for data resource management, big data applications, industrial development and so on. Fourth, building data security laws and regulations can prevent information and private data from being leaked or stolen. Security and privacy issues are key issues in the IT era. In the era of big data, the volume of data has increased dramatically. In particular, government departments have more core data. To improve traditional data security technologies, there must be adequate data protection laws and regulations. Finally, the establishment of a data-driven culture is conducive to improving decision-making methods, facilitating the achievement of more precise decision making and helping bring about more refined services. Lavallo *et al.* [44] pointed out that the reasons why big data projects are often ineffective are related to deficiencies of organizational culture, not to data types or lack of technology. Finally, it is obvious that the establishment of a data decision-making culture is of great significance to the operation and potential value of big data.

B. SMART SERVICE PERFORMANCE

The new public service concept has been deeply rooted in the hearts of the people, and governments of all countries aim to build their service-oriented capacities. The concepts of "smart city" and "smart community" have been frequently mentioned, and "smart government" has naturally become the focus of many management scholars. The concept of "wisdom" integrates "service" into new connotation. The New Public Service Theory pays more attention to democratic values and public interests, and emphasizes that the function of the government is to serve rather than steer. Smart services are proposed based on The New Public Service Theory, emphasizing that government services should be more contemporary in the context of the new era. Ma *et al.* [45] claimed that providing smart services to the public is the ultimate goal of a smart government. Algebr *et al.* [46] *et al.* discussed the trend of smart government, and propose that in order to realize the power of data, the integration of government services, seamless service experience, and citizen participation, e-government services must be transformed into smart government services. Wang [47] pointed out that intelligent government service represents a new direction for the development of e-government. The construction of new government management processes, based on perception, evaluation, decision-making, management services and dissemination, is an important component of promoting a service-oriented and transparent government. It aids promotion and formation of a new governance structure where government and citizens are integrated via benign interactions.

Government informatization has gone through several stages of digital government, e-government, and mobile government, before developing into smart government [48]. In general, smart government is a new development stage of e-government, and smart service is a new development direction of electronic public services. Compared with electronic public services, smart services place more emphasis on the openness, intelligence, personalization, and interactivity of services. Openness of services chiefly implies that government departments expand the degree of openness of data and information, enhance the quality of openness of data and information, and allow the public to obtain as much necessary required information as possible. There are many open data movements around the world. Attard *et al.* [49] pointed out that transparency and data reuse are two of their main goals. He believed that there are three main reasons for opening government data: transparency, releasing social and commercial value, and participatory governance. Transparency allows the public and other stakeholders to monitor the legitimacy of government initiatives and their actions. It also enables stakeholders to access, use, reuse, and distribute data. Data information is currently the most competitive resource. The more the government opens data resources, the more the public uses government information to create value, which is conducive to the vitality of data and also to further promote innovation. Intelligent service means that the government uses advanced technology to provide public services conveniently, quickly, and actively through networks, virtualization, and self-service methods. The intelligentization of services reduces the cost of time for the public to obtain services, and can also reduce the pressure on labor costs of government services, while improving service initiative. The intelligentization of service methods requires the application of current advanced technologies. Big data, cloud computing, the Internet of Things, artificial intelligence and other technologies, should ideally work together to achieve improved diversification and intelligence of service methods. Third, smart services emphasize personalization. Guo and Lu [50] pointed out that information overload has become one of the problems hindering the effectiveness of e-government services. Intelligent e-government services with personalized recommendation technology can provide appropriate solutions. Pieterse *et al.* [51] viewed the personalization of electronic services as the adjustment of electronic services to individual users based on specific users and user-related information. Personalization provides a great opportunity for public needs to be met as far as possible. Personalization of services can infer, predict and even influence public behavior, improve communication and service efficiency between the government and the public, and overall increase public satisfaction with government. Personalized service means that the government provides customized services to citizens focused on the Internet, and directly driven and serviced by flexible operations. For example, if a citizen wants to go to a certain place, the intelligent transportation system can recommend multiple alternative routes for him or her to choose according

to traffic conditions and the person's special requirements, and also provide real-time navigation for the citizen; the government service website can provide virtual scene-type services to guide the public; people can customize their own service pages and service methods, according to their own ideas and service needs. Finally, the interactivity of smart services means that government departments and the public can fully communicate and cooperate, and the latter can have an influence in a wider range of government affairs, such as policy making. Linders [52] proposed that in the age of social media, government services are changing from e-government to we-government. The government should treat the public as a partner and expand the role of citizens from "mere passive public service consumption" to a situation where participation in joint decision-making is actively pursued. Citizens could also take more responsibility to obtain greater decisions related to management and decision-making. This author believes that interactive services are mainly manifested in the following aspects: public participation methods should be convenient and diverse, for example, the public can submit ideas and opinions through various platforms such as government WeChat, Weibo, and the Government Affairs Center website; the public can interact with the government in real time during the participation process, and the public and government officials can have an equal dialogue on various issues; the government should also provide timely feedback during public participation, especially public complaints and suggestions, which should be verified and resolved, while processing and results should be announced in a timely manner, the government should also reasonably adopt public ideas and opinions during decision-making. Services are not only about providing products to the public. They also need to focus on the public's service experience and their subject consciousness. Service interactivity is the most complete manifestation of government service quality and must attract more attention. In summary, this article considers that smart services refer to the government as a whole. It involves application of advanced new technologies, with smart portals as the platform, and data decision-making as the core. The aim is to provide open, intelligent, personalized and interactive public services to the public, thereby ultimately improving public service satisfaction.

At present, there is much literature on e-government performance measurement, but relatively little on e-government service performance. Li and Shang [53] listed eight contribution dimensions of e-government service quality: system quality, reliability, security, accessibility, information quality, service capabilities, interactivity, and responsiveness. Fei and Yu [54] used a fuzzy analytic hierarchy process to construct an electronic public service performance evaluation model from three aspects: information disclosure, service maturity and public participation. Yan [55] builded an evaluation index system from four aspects: information, government service, communication feedback and website application. Smart service is a more advanced manifestation of electronic public service. In addition to inheriting all the characteristics of

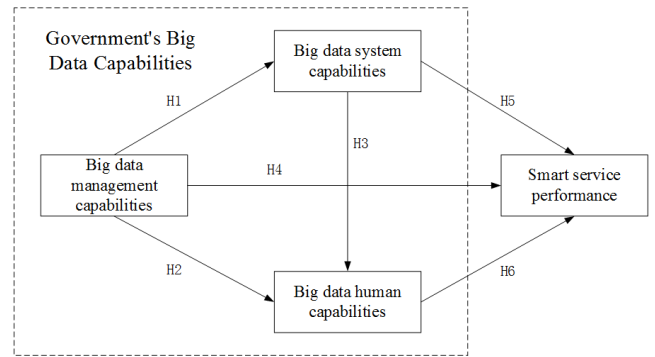


FIGURE 1. Theoretical model diagram.

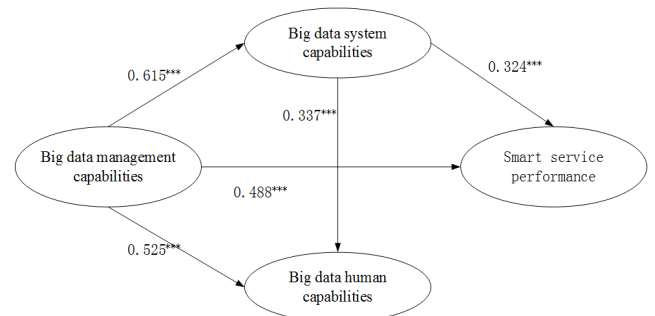


FIGURE 2. Standardized structure model.

electronic public service, it also has more advanced technical and management characteristics. The performance of smart services is the effect that government departments need to provide smart public services to the public. Based on the service orientation, combined with the definition of government smart services and the above analysis, open services, intelligent services, personalized services, and interactive services are considered performance measurement indicators of government smart services.

III. THEORETICAL ASSUMPTIONS AND MODEL BUILDING
 A. BIG DATA MANAGEMENT CAPABILITIES AND BIG DATA SYSTEM CAPABILITIES

The construction and development of big data system platforms cannot be separated from big data management capabilities. Davenport and Patil [56] stated that the goal of big data analytics is to develop an information ecosystem that helps share information, optimize decisions, communicate results, and create new insights for businesses. Shamim *et al.* [57] proposed that solving management challenges related to the use of big data starts with leadership. First, leaders' emphasis on knowledge would have a positive effect on knowledge management in their organization, and leaders' focus on big data would help accelerate the organization's application of big data. Second, government departments should make detailed plans for the positioning, goals, infrastructure, applications, industrial ecology, and security of big data development, which would help government depart-

ments purchase and structure big data systems to achieve greater service value. At present, all provinces and cities in China seek to accelerate the construction of data centers and industrial service platform clusters to promote the joint construction, sharing and interconnection of various government departments. Finally, the construction of a special management department for big data plays an operational and maintenance role in the operation of the system platform. The installation, update, operation, and subsequent maintenance of the platform require professional support from the big data department. In addition, the formulation of laws and regulations related to big data is also a prerequisite for ensuring platform security and data privacy. This is similar to what the scholars of the IT era have demonstrated. IT is not only a technical tool of a department, but also a strategic tool of the enterprise. The enterprise will plan the IT infrastructure at the strategic level. If there are sound IT rules, the implementation of IT infrastructure will be backed by a strong system, and the level of IT infrastructure will be improved accordingly [58]. This perspective once again shows the importance of management to hardware technology. Based on this, this article suggests the following hypothesis:

H1: Big data management capabilities have a significant positive impact on big data system capabilities.

B. BIG DATA MANAGEMENT CAPABILITIES AND BIG DATA HUMAN CAPABILITIES

Shamim *et al.* [57] pointed out that big data management has a positive effect on big data decision-making ability, which in turn affects the quality of decision-making. In this article, the big data decision-making ability is understood to be one of the manifestations of the big data human capabilities. In addition, the establishment of big data management capabilities can help government departments select and equip corresponding talents. By analyzing big data positions and understanding the capabilities required, a department can introduce and deploy talents, which is conducive to matching positions and achieving their best use. For example, by analyzing big data positions, one can make reasonable personnel arrangements for data scientists, data architects, data engineers, data ethics managers, and visualization experts. At the same time, the training of big data knowledge skills is also inseparable from the planning of big data. Big data technology increasingly innovates, and traditional statistical methods are difficult to sustain. On the basis of the introduction of relevant talents, internal key talent training and the improvement of overall data skills should be strengthened. At the same time, by regularly developing big data personnel development plans, training big data personnel and updating big data skills in a timely manner, government personnel can use big data and replace “empirical decisions” with “data decisions” to make data work better. In addition, a data decision culture also has an impact on the behavior of an organization's personnel. Data-driven organizations should develop a culture in which “what we know” replaces “what we think” in order to reduce dependence on intuition and instinct and improve decision-

making science and precision [35]. Based on this, this article suggests the following hypothesis:

H2: Big data management capabilities have a significant positive impact on big data human capabilities.

C. BIG DATA SYSTEM CAPABILITIES AND BIG DATA HUMAN CAPABILITIES

The connectivity of IT infrastructure can link different regions, external suppliers, and people wherever they are physically located. When the organization has good IT hardware and software facilities, its employees can also receive continuous linked training. They would then have the ability to use these IT facilities to solve business problems [59], find business opportunities [60], and enhance organizational learning [61]. First, for big data, the introduction of big data platforms can motivate government personnel to further learn advanced data analysis technologies and knowledge, receive relevant training, familiarize themselves with various application platforms, and master corresponding skills to reduce service time to improve the efficiency of government services. Second, big data systems can promote the exchange and communication of personnel at different levels and between different departments, realize the transfer of information and knowledge, enhance mutual-assisted learning, and improve the level of personnel knowledge and skills. Finally, compared with the previous information technology platform, the big data system platform is more concise and easier to operate, which can separate the staff from the complicated work process and achieve a high level of work efficiency. Zhou [62] proposed that in the era of big data, the deep integration of digital technology and network technology provides new decision-making methods and technical means for acquiring public opinion via the internet, while changing decision-making thinking after an event, predicting in advance the reduction in cost, and helping protect the government's prestige and authority. Based on this, this article suggests the following hypothesis:

H3: Big data system capabilities have a significant positive impact on big data human capabilities.

D. BIG DATA MANAGEMENT CAPABILITIES AND SMART SERVICE PERFORMANCE

Mithas *et al.* [63] advanced information management capabilities as a key and a high-level organizational capability, which can improve performance management capabilities, process management capabilities, and customer management capabilities, thereby improving organizational performance. Xue *et al.* [64] proposed that IT management capability is the only resource to maintain competitive advantage, with a direct role in promoting alliance performance. As far as big data management capabilities are concerned, its enhancement can realize the convenience, efficiency and personalization of services. First, government departments formulate a big data development and construction plan, design basic government service modules and local special service modules, and set up different sections for different groups, such as the elderly,

women, disabled people, farmers, etc., while also providing targeted services to help achieve services' personalization and specialization. It is also possible to further explore "private customization" services by deep mining big data and designing interactive service scenarios. Second, the management department responsible for the development of big data explores how to promote the intelligence of government services through big data and make services more convenient with technology. Third, the use of big data can innovate communication channels and build an interactive platform mechanism between the government and the business (G2B) and between the government and the citizen (G2C), which is conducive to increasing the interaction of stakeholders, improving communications, and further establishing smart government that is fair, just, open and responsive, and works collectively. Finally, data protection policies and regulations play a role in protecting smart services, enabling smart services to advance smoothly and safely. Based on this, this article suggests the following hypothesis:

H4: Big data management capabilities have a significant positive impact on smart service performance

E. BIG DATA SYSTEM CAPABILITIES AND SMART SERVICE PERFORMANCE

The provision of smart services requires the support of big data system platforms. Dai and Bao [65] and others proposed that the construction of Internet government information service platform and convenience service platform can provide more high-quality and efficient online government service, use digital technology to understand citizens' needs, optimize resource allocation, and improve government public service level and promote public participation in governance. Zhang [66] pointed out that building a big data governance platform has four important implications. The first is to simplify administration and decentralization, change government functions. The second is to innovate governance methods and promote scientific decision-making. The third is to grasp market demand and optimize market services. The fourth is to strengthen market supervision and reduce power rent-seeking space. It is proposed that the most intuitive change brought about by big data governance is the transition from management to service. The purpose of building a big data platform is to reduce cost and prevent the waste of time and manpower, and to achieve fast, timely, convenient and intelligent services, aligned with new technologies. For example, the construction of a big data unified information platform is conducive to government information services' comprehensiveness, convenience, and diversification. Via this platform, the public can query the information they receive and related services. Big data-based service websites can make services more intelligent, comprehensive, and personalized. At present, many provinces and cities in China are promoting the construction of government website special services and gradually building brands to distinguish them from other websites, thereby improving services' appropriateness. The application of big data by the government to promote people's

livelihood services can realize large-scale smart transportation, environmental protection, medical treatment, education and tourism. Based on this, this article suggests the following hypothesis:

H5: Big data system capabilities have a significant positive impact on smart service performance.

F. BIG DATA HUMAN CAPABILITIES AND SMART SERVICE PERFORMANCE

Lv *et al.* [67] pointed out that the advanced human capital structure is matched with the upgrading of technological structure to create and improve the innovation environment, and then to upgrade and improve the performance of scientific and technological innovation. The realization of smart services in the government field also requires the protection of big data talents. Big data talents have a technical guarantee role in improving the performance of smart services. Si and Liu [68] pointed out that the application of big data and its technology has brought about a new round of government governance reform and innovation, which has become an important background and condition for smart government governance. The improvement of human data skills training in big data would help improve service efficiency and innovate service methods. For example, data integration skills are conducive to information integration and sharing across regions, hierarchies, and departments. The interoperability of various departments enables high-speed circulation of service information and improves service efficiency. Data analysis skills, especially data mining technology, can generate new data values, thereby providing new construction directions and innovative service methods for urban planning, health-care, etc. Data prediction capabilities can predict traffic congestion and help re-plan routes, predict weather conditions to facilitate improvements to daily life, provide early warning of natural disasters such as earthquakes and tsunamis, to take precautionary measures in advance to reduce disaster costs. In short, by relying on their skills, big data can help realize the rapid supply of services, and innovate service methods, making services more intelligent and personalized. Based on this, this article suggests the following hypothesis:

H6: Big data human capabilities have a significant positive impact on smart service performance.

Based on the above assumptions, the theoretical model constructed in this article is as follows.

IV. RESEARCH METHODS

A. QUESTIONNAIRE DESIGN

This study uses the Likert five-point scale method to design a scale for big data management capabilities, big data system capabilities, big data human capabilities and smart service performance where "1 = strongly disagree, 2 = disagree, 3 = fair, 4 = agree, 5 = strongly agree." The higher the score, the higher the degree of agreement with the question. The questionnaire is divided into two parts: the information section and the questionnaire. The questionnaire measures the

government's big data capabilities and smart service performance. There are 33 questions. Among them, smart services use internal consistency [69] to package smart service performance items in the actual analysis process to form four dimensions of open service, intelligent service, personalized service and interactive service, to perform the following reliability and validity analysis and structural equation model analysis.

B. QUESTIONNAIRE COLLECTION AND DISTRIBUTION

The questionnaire was conducted in two steps. The first step was a preliminary survey, a small sample test. A questionnaire was designed and completed based on previous relevant research results. The questionnaire was discussed with e-government-related experts and government staff. The initial questionnaire was completed after revision and distributed on-site at Gaochun Municipal Government Service Center, Jiangsu Province, China. A total of 50 questionnaires were distributed, 44 questionnaires were returned, and 32 valid questionnaires were collected. The effective rate was 64%. After analyzing the results of the questionnaire pre-test, some unsatisfactory items were deleted, and the questionnaire items were revised and improved based on the interview results to form a formal questionnaire. The second step was the data collection of the formal questionnaire. The survey area in the formal survey was Jiangsu Province, Zhejiang Province, Shanghai Municipality, and Shandong Province, where e-government is developing rapidly. The survey departments are mainly government departments related to the application of big data, such as the traffic management department, the tax department, the Human Resources and Social Security department, the administrative departments for industry and commerce, and the government service centers at various levels where the provinces and cities are surveyed. The survey objects mainly included the staff of administrative agencies, institutions, and government agencies. The distribution time was from April to June 2019. There are two ways to issue field questionnaires and electronic questionnaires through the "Questionnaire Star" platform. A total of 450 were issued. A total of 424 questionnaires were eventually recovered. 135 invalid questionnaires were eliminated. This left 289 valid questionnaires and the effective questionnaire recovery rate was 64.22%.

V. RESULTS

A. RELIABILITY AND VALIDITY

Reliability test. The sample reliability test is the credibility of the questionnaire data. It mainly examines whether the test results are consistent. In social science research, Cronbach's α coefficient is usually used as the measure. Based on this, this study also used the Cronbach's α coefficient to test the reliability of the questionnaire. It is generally believed that Cronbach's α is greater than 0.7, and the scale has high reliability. Using SPSS 22.0 software to statistically analyze the questionnaire data, the results (as shown in Table 2) indi-

TABLE 1. Construct and survey items.

Variable	Dimension	Code	Survey Item	Source of Item		
BDC	BDSC	SC1	We have an open information exchange platform	Gupta[37] Ren[18]		
		SC2	We have an integrated platform for business operations			
		SC3	We have a complete online service platform			
		SC4	We have a data security guarantee and security assessment system			
		SC5	We use professional data processing technology			
	BDHC	HC1	Big data acquisition and integration capabilities	Wang[34] Gupta[37]		
		HC2	Unstructured data analysis capabilities			
		HC3	Big data decision support capabilities			
		HC4	Big data prediction capabilities			
		HC5	Big data visualization capabilities			
BDMC	MC1	MC1	Big data knowledge and technology learning capabilities	Shamima [57] Gupta[37] Akter[70] Tabesh[71]		
		MC2	Leaders are very concerned about big data			
	MC3	MC3	Develop a big data development plan			
		MC4	Organizational Culture of Data Decision big data development department responsibility system			
		MC5	Policies and regulations for managing government data resources			
OS	OS1	OS1	Actively disclose data information	Hu[72] Dong[73]		
		OS2	Data information updated in time			
	OS3	OS3	Data information is accurate and authoritative			
		OS4	Data information is practical			
IS	IS1	IS1	Service innovation	Gouscos[74] Hu[72] Yan[55]		
		IS2	Wide range of services			
		IS3	High service efficiency			
		IS4	Flexible service			
		IS5	Accurate service			
SSP	PS	PS1	Custom service interface and content	Wang[75] Liu[76] Fei[54]		
		PS2	Personalized search and recommendation			
	PS3	PS3	Service with local characteristics			
		PS4	Services for vulnerable groups			
	NS	NS1	NS1		Convenient public participation	
			NS2		Real-time interaction with the public during the participation process	
		NS3	NS2		Timely feedback to respond to participant issues	Gouscos[74] Hu[72]
			NS3		Civic participation influences decision-making	

TABLE 2. Reliability analysis.

	Scale Mean if Item Deleted	Scaled Variance if Item Deleted	Corrected Items -Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
SC					0.894
SC1	14.90	10.496	.675	.885	
SC2	14.90	10.338	.746	.871	
SC3	15.05	9.782	.780	.862	
SC4	14.97	9.621	.755	.868	
SC5	15.20	9.598	.750	.869	
HC					0.922
HC1	16.20	15.119	.710	.917	
HC2	16.03	14.857	.757	.911	
HC3	16.04	14.654	.796	.905	
HC4	16.20	14.105	.838	.899	
HC5	16.17	14.239	.828	.901	
HC6	16.13	14.541	.735	.914	
MC					0.925
MC1	13.54	10.881	.802	.908	
MC2	13.74	10.457	.836	.901	
MC3	13.83	11.542	.740	.920	
MC4	13.79	10.683	.836	.902	
MC5	13.71	10.469	.810	.907	
SSP					0.922
OS	11.0689	4.557	.829	.897	
IS	11.0657	4.404	.856	.887	
PS	11.3604	4.366	.785	.912	
NS	11.2393	4.437	.817	.900	

cate that Cronbach's α coefficient of each variable is above 0.8, and the minimum is 0.894. This shows that the research variables involved have good reliability and are suitable for factor analysis.

Validity test. The sample reliability test seeks to examine the degree of content, which includes content validity and structure validity. As for the content validity, the content validity of the questionnaire is based on the relevant research results at home and abroad as the theoretical basis, and it has been modified and improved by experts in related fields. For structural validity tests, there are mainly convergence validity and disjunction validity tests. This article uses AMOS 21.0 software to determine the convergence validity by using the factor load, combined reliability and AVE value in the confirmatory factor analysis method. In social science research, if the absolute value of the factor load is greater than 0.5, the combined reliability is greater than 0.7, and the AVE value is greater than 0.6, then the scale is typically considered valid. From Table 3, we can see that the factor loadings of the variables involved in this study are above 0.7, the combined reliability is above 0.8, and the AVE values are above 0.6, which shows that each factor has a strong effect on the corresponding latent variable. The explanatory power, that is, the convergence validity is better. In the discriminant validity test, it is generally considered that the square root of the AVE value of each variable is greater than the correlation coefficient between the variables, that indicates the discriminant validity is considered to be high. Table 4 was obtained after analysis and arrangement by SPSS 22.0 and AMOS 21.0. It can be seen in Table 4 that the data on the diagonal of the rectangle, that is, the square root of each variable AVE is

TABLE 3. Validity analysis.

Factors	Index	Factors Loading	R ²	Error	CR	AVE	KMO
BDSC	SC1	0.718	0.516	0.484	0.891	0.620	0.868
	SC2	0.822	0.676	0.324			
	SC3	0.860	0.740	0.260			
	SC4	0.761	0.579	0.421			
	SC5	0.769	0.591	0.409			
BDHC	HC1	0.680	0.462	0.538	0.919	0.655	0.897
	HC2	0.768	0.590	0.410			
	HC3	0.838	0.702	0.298			
	HC4	0.897	0.805	0.195			
	HC5	0.888	0.789	0.211			
	HC6	0.762	0.581	0.419			
BDMC	MC1	0.846	0.716	0.284	0.925	0.712	0.864
	MC2	0.939	0.882	0.118			
	MC3	0.820	0.672	0.328			
	MC4	0.816	0.666	0.334			
	MC5	0.789	0.623	0.377			
SSP	OS	0.938	0.880	0.120	0.944	0.809	0.829
	IS	0.934	0.872	0.128			
	PS	0.846	0.716	0.284			
	NS	0.875	0.766	0.234			

TABLE 4. Descriptive statistics and correlation analysis.

Factors	AVG	SD	BDMC	BDSC	BDHC	SSP
BDMC	3.430	0.814	0.844			
BDSC	3.751	0.779	0.615**	0.787		
BDHC	3.226	0.758	0.733**	0.660**	0.809	
SSP	3.735	0.694	0.706**	0.653**	0.617**	0.899

NOTE: **. THE CORRELATION IS SIGNIFICANT WHEN THE CONFIDENCE (DOUBLE TEST) IS 0.01. THE DATA ON THE DIAGONAL OF THE RECTANGLE IS THE SQUARE ROOT OF EACH VARIABLE AVE.

greater than the correlation coefficient between the variables. This indicates that the scale has good discriminative validity. In short, the sample has good validity and the quality of the questionnaire is high, and further research can be carried out.

B. PATH ANALYSIS AND HYPOTHESIS TESTING

Model fitting and evaluation. The fit test is to test the prediction models that have been made, and compare their prediction results with the actual occurrence. This article mainly uses the AMOS 21.0 software to test the fit of the three measurement models of big data system capabilities, big data human capabilities, and big data management capabilities, as well as the fit test of the big data capability and smart service performance structural equation model. Select 9 indicators such as RMR, RMSEA, GFI, AGFI, NFI, RFI for inspection. It can be seen from Table 5 that the fitting indices of the three measurement models of big data system capabilities, big data human capabilities, and smart service performance meet the requirements. Except for the RMSEA value, the rest of the big data management capabilities meet the requirements. It is therefore considered that the overall fit of the measurement model in this article is better. In addition, the related indexes of the government's big data capability

TABLE 5. Summary table of model fitting.

	<i>RM</i> <i>R</i>	<i>RMS</i> <i>EA</i>	<i>G</i> <i>FI</i>	<i>AG</i> <i>FI</i>	<i>NFI</i>	<i>RFI</i>	<i>IFI</i>	<i>TLI</i>	<i>CFI</i>
<i>Adaptive value</i>	<	<	>	>	>	>	>	>	>
	0.05	0.08	0.9	0.8	0.9	0.9	0.9	0.9	0.9
<i>BDSC</i>	0.01	0.07	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	6	2	86	49	88	69	93	81	93
<i>BDH</i>	0.01	0.06	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	4	4	83	48	88	74	93	86	93
<i>BDM</i>	0.02	0.14	0.9	0.8	0.9	0.9	0.9	0.9	0.9
	1	5	66	74	75	37	78	46	78
<i>SSP</i>	0.02	0.07	0.9	0.8	0.9	0.9	0.9	0.9	0.9
	7	2	00	59	49	36	69	61	68
<i>model</i>	0.01	0.07	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	2	7	76	25	85	64	90	77	90

and smart service performance structure model constructed also met the requirements, and the model fits well.

Hypothesis testing. In this article, AMOS 21.0 software was used for hypothesis testing. Hypothesis testing was mainly used to verify the hypotheses proposed in this article. P value was mainly used to test the significance of the relationship between variables. It can be seen from table 6 that other hypotheses (H1, H2, H3, H4 and H5) have been verified, except that H6 has not been verified due to the insignificant P value. First, the standardized path coefficient from big data management capabilities to big data system capabilities is 0.615 ($P < 0.001$), indicating that big data management capabilities have a significant positive impact on big data system capabilities. Second, the standardized path coefficient from big data management capabilities to big data manpower capabilities is 0.525 ($P < 0.001$), indicating that big data management capabilities have a significant positive impact on big data manpower capabilities. Third, the standardized path coefficient from big data system capabilities to big data human capabilities is 0.337 ($P < 0.001$), indicating that big data system capabilities have a significant positive impact on big data human capabilities. Fourth, the standardized path coefficient from big data management capabilities to smart service performance is 0.488 ($P < 0.001$), indicating that big data management capabilities have a significant positive impact on smart service performance. Fifth, the standardized path coefficient of big data system capabilities to smart service performance is 0.324 ($P < 0.001$), showing that the big data system capabilities to smart service performance has a significant positive impact. Sixth, the standardized path coefficient of big data human capabilities on smart service performance is 0.084 ($P = 0.181$), whose P value does not reach a significant level, indicating that the influence of big data human capabilities on smart service performance is not significant. The details are shown in table 6, and the standardized path diagram is shown in figure 2.

VI. CONCLUSION AND FUTURE WORK

The research explores the impact path of government big data capabilities on smart service performance, and explores the relationship between the dimensions of government big

TABLE 6. Hypothesis testing data of structural mode.

<i>H</i>	<i>Path</i>	<i>Standardized Estimate</i>	<i>S.E.</i>	<i>C.R.</i>	<i>P</i>	<i>Result</i>
<i>H1</i>	<i>BDS</i> <- <i>BDM</i> <i>C</i> - <i>C</i>	.615	.044	13.22	<0.001	Supported
<i>H2</i>	<i>BDH</i> <- <i>BDM</i> <i>C</i> - <i>C</i>	.525	.044	11.22	<0.001	Supported
<i>H3</i>	<i>BDH</i> <- <i>BDS</i> <i>C</i> - <i>C</i>	.337	.046	7.207	<0.001	Supported
<i>H4</i>	<i>SSP</i> <- <i>BDM</i> - <i>C</i>	.488	.048	7.895	<0.001	Supported
<i>H5</i>	<i>SSP</i> <- <i>BDS</i> - <i>C</i>	.324	.046	5.751	<0.001	Supported
<i>H6</i>	<i>SSP</i> <- <i>BDH</i> - <i>C</i>	.084	.052	1.338	0.181	Unsupported

data capabilities, and builds a conceptual model between big data system capabilities, big data human capabilities, big data management capabilities, and smart service performance. This model is empirically analyzed through 289 valid samples, and the following research conclusions and inspirations are obtained.

Firstly, big data management capabilities have a significant promotion effect on big data system capabilities, big data human capabilities, and smart services. This shows the importance of a robust plan for the research and development, introduction and application of big data platforms, and the necessity of a certain plan for the introduction and training of corresponding talents, conducive to the gradual application of big data in government departments and the progressive promotion of digital decision-making and the building of a smart government. In addition, a department's big data organization capability is also very important. Establishing a big data department to cooperate well with other departments and embed big data technology in its business operations can play a full effect in the big data system platform. At present, many provincial, municipal, or district governments in China have set up functional departments related to big data, such as the Big Data Development Administration established by Guizhou Province, which is a department-level big data management department directly under the provincial government. It has built the first provincial government data gathering, sharing, and open Guizhou system platform on the cloud, set up the world's first big data exchange, and has taken the lead in formulating local regulations for the development and application of big data. This makes the development of big data in Guizhou provincial government departments in the forefront of such efforts in China [77]. In addition, it is necessary to establish big data-related laws and to clarify the responsibilities and rights of managers and users in the process of data collection, collation, analysis, and

sharing [78]. This is appropriate to ensure the reasonable and standardized use of data security. At the same time, it is also necessary to strengthen the soft management of data, starting from the organizational culture, and to integrate the thinking of data decision-making into the daily work of government workers, thereby improving the accuracy of services. In short, development of a big data development plan, implementation of a big data division of labor management system, formulation of laws and regulations on the application of big data, and promotion of a data-driven organizational culture are of great significance for the innovation of data platforms, the training of data talents and the improvement of smart services.

Secondly big data system capabilities have a significant promotion effect on big data human capabilities and smart services. At present, the construction of big data system capabilities is particularly important. Ma *et al.* [79] points out that data governance through government's big data platform provides an exploratory solution path to break the fragmented management system and achieve cross-system and departmental data sharing. However, at present, the phenomenon of "information islands" and "knowledge islands" between government departments still exists. In addition, there is sometimes a response from government personnel that because they are not sure whether the impact of data opening is good or bad, then they will not directly open government data. This idea of avoiding risks also makes data integration difficult. But once the big data sharing platform is opened, it would produce huge benefits. It is imperative to replace traditional information systems with big data systems. In addition, the development of big data platforms will also promote the improvement of human capacity in big data. Before the development of the platform, corresponding big data planners are required to plan for this development. After the establishment of the big data platform, big data analysts are required to perform data processing and analysis. Big data platform also requires corresponding talents. Therefore, improving the capabilities of big data systems will have a certain significance for the introduction of big data talents and the improvement of skills. In addition, government services must not only be more efficient, but also be "smarter". Many departments are now exploring smart services. The development of big data system capabilities has provided a hard platform support for the smartness of government services. According to related reports, more than 87% of Sichuan-level service matters can be handled online. Not only that, Sichuan Government Affairs Service Network has provided 8 online real-name authentication channels such as "face recognition" and established complete online government service identity authentication system. "Handheld Office" and "Fingertip Office" services are also common [80]. Government departments should make improved use of data, establish a big data integrated government service platform, and innovate service methods so that the public can enjoy improved services at home. In short, the deployment of multi-level, cross-sectoral, multi-functional big data system

platforms would have positive significance for human skills upgrading and government service innovation.

Thirdly, the impact of big data human capabilities on smart service performance is not insignificant. It is generally believed that the improvement of human capacity in big data would improve the performance of smart services, but it has not been verified in this article for the following reasons. The first is because the number of big data talents within the government is small. The second is the lack of big data skills among government personnel. The third is the shortage of talents and skills lag in the government caused by the outsourcing of big data services. At present, the number of big data talents in China is still relatively small compared to other talents, and most of the data talents exist in corporate organizations, and in government organizations they are relatively scarce. The "2018 Global Big Data Development Analysis Report" points out that although China's big data industry has the highest proportion of talents in the world, China's big data industry talents still have a large gap. China's big data industry-related talents account for 0.23% of China's total employed population. Internal government workers generally lack big data skills and are not familiar with big data operating systems. The government has begun to focus on computer skills training in e-government services. However, it is the era of big data. Most employees of government departments are not familiar with how to operate and use big data technologies. At the same time, because big data skills have a certain professional nature, it requires a systematic training, which requires a certain time and cycle. As a result, many current government personnel have not yet mastered data analysis skills, which limits the impact of big data human capabilities on the performance of smart services. Finally, in China, the government could outsource a large amount of business to the private sector, thereby reducing material and labor costs. At present, government outsourcing is widely used. Contract outsourcing is to separate the roles of producers and regulators through contractual mechanisms. The government and the market work together to improve the performance of public service supply. However, there are also some problems with public service outsourcing at present, such as disorderly market competition, abuse of public power, lack of government supervision, public opposition, corruption and the poor quality of public services [81]. In the field of government information technology services, Zhang and Wang [82] points out that although government website information service outsourcing can alleviate financial pressure and improve the problem of insufficient government technology, there are several problems. For example, the pressures of government and partners on capital and cost recovery, high information customization fees, increased contract management and supervision costs, and risk of marginalization of government website information management. Specific to the field of e-government projects and service outsourcing, due to the incomplete e-government management system and the lack of unified standards and norms, service requirements and the operation and maintenance of information-based assets

are difficult to guarantee, and the boundaries between government and enterprises is blurred due to upgrades, transformations, and function expansion. Government departments rely often too much on the technology of the contractor to limit the importance of the government's IT department. The technical level and comprehensive ability of IT personnel has declined, and organizational learning and innovation abilities have been neglected [83], [84]. Especially nowadays, big data technology has high professionalism, and big data construction service outsourcing has emerged. The related problems of big data service outsourcing restrict the realization of smart public services. The first problem is the lack of big data talents in government departments due to service outsourcing, so that the human capacity of big data does not have a significant impact on the performance of government smart services. The second is that outsourcing of big data may cause government departments to rely too heavily on contractors and cause their internal staff to underestimate learning big data skills and fail to master relevant knowledge and capabilities, which leads to only insignificant impact on the performance of smart services. Third, the big data platform is difficult to meet the needs of a department's work. Many questions make it difficult for government departments to apply the platform for effective operations and also affect the performance of smart services. For example, a contractor's information service would not be continuously optimized, the contractor would refuse to deal with after-sales problems, and the contractor would be unable to meet the system update requirements. Therefore, government departments need to consider how to attract big data talents such as big data engineers and data analysts to work in government departments, how to train talents with big data skills, how to prevent the "outflow" of big data talents, and how to ensure that government outsourcing services can maximize the value of their services.

Based on the relevant results of academic research and the above conclusions, studying the relationship between big data capabilities and government smart service not only has certain guiding significance for the further development and construction of various elements of government big data, but also involves certain theoretical developments for the construction of smart government and the improvement and development of smart services. The future direction of such research is mainly reflected in the following aspects. (1) The performance of smart services is currently analyzed as a general concept. In the future, the impact of government big data capabilities on different aspects of smart services should be explored to further study the relationship between different variables, thereby promoting service convenience and smartness. (2) This study is a sample survey of government staff in several eastern regions, such as Jiangsu, Zhejiang, and Shandong provinces. There is still an imbalance between the development of the eastern and western regions in the administrative region in China. At the same time, the difference in the types of departments also limits the promotion of the research conclusions. Future research could further

expand the geographical scope of the research object and the research department, so that the research conclusions are more universal.

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