

# Research and Thinking on the Application of Big Data in Budget Performance Management

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## Abstract

At present, the budget performance reform has become a breakthrough in the profound reform of government governance, and is an inevitable requirement for further promoting the modernization of the national governance system and governance capacity. Big data technology can improve the quality of budget performance management from four ways: the scientific review of budget performance objectives, the accuracy of performance evaluation, the online real-time monitoring of performance operation and the visualization of performance information. Some local financial departments in China have explored the introduction of big data in the aspects of pre-performance review, database construction, performance operation and target monitoring to carry out budget performance management. Improving the legislation on "budget performance management + big data", promoting the interconnection of cross-departmental data, comprehensively applying multiple data analysis methods, and establishing a composite talent training mechanism are the directions for further improving the quality of budget performance management with big data technology.

## Keywords

Big data; Budget performance; Management of government budget.

## 1. Introduction

Big data is the product of the continuous development of information and communication technology, and it is a massive, high-growth and diverse and powerful information asset that needs new processing modes to have stronger decision-making power, insight and discovery power and process optimization ability. In 2012, the word big data was mentioned more and more. People used it to describe and define the massive data generated in the era of information explosion, and named the related technological development and innovation. The great impact of big data on government management reform has also quickly attracted the attention of academic circles. Overall, big data will transform the government into a data government and a smart government. With the help of big data, it has become the consensus of governments to enhance the ability to serve citizens and deal with potential challenges.

Since 2015, big data has become China's national strategy. In 2015, the State Council promulgated the "Action Program for Promoting Big Data Development", which clarified the overall goal of big data development and the main tasks of the government. In the field of budget performance management, in September 2018, the Central Committee of the Communist Party of China and the State Council issued the Opinions on Full Implementation of Budget Performance Management, which proposed to innovate evaluation methods, base on multi-dimensional perspectives and multiple data, and rely on big data analysis technology to improve the objectivity and accuracy of performance evaluation results. The Fourth Plenary Session of the 19th CPC Central Committee emphasized that it is necessary to establish and

improve the institutional rules for administrative management by using the Internet, big data, artificial intelligence and other technical means.

Comprehensive budget performance management is a result-oriented, comprehensive, whole-process and full-coverage budget management model, which involves all budget composition systems. Its essence is an institutional innovation in the field of public management and a concrete embodiment of the government's concept of development and performance. With the advent of the era of big data, the budget activities of relevant government departments have become increasingly complex. Building a budget performance evaluation system based on big data thinking and technology and improving the budget performance management level have gradually become the basic trend of budget reform. By introducing big data thinking and technologies such as multiple data collection, data modelling and analysis of fusion and correlation, and dynamic and intuitive data display, we can analyse the expenditure structure and use efficiency of the financial budget, clarify the comprehensive financial revenue and expenditure details of various departments, and provide a basis for formulating scientific performance objectives, reasonable performance evaluation system and high-quality performance evaluation report; It can also prevent budget execution deviation better, faster and more timely, reduce budget supervision cost and improve performance monitoring efficiency. At the same time, the application of big data technology can promote the whole process, all-round and full coverage of budget performance management, thus promoting the optimal allocation of financial resources, making performance evaluation results better applied to practice and forming a benign closed loop of budget performance management. Therefore, the impact of big data and its technology on improving the quality of budget performance management, and the practical exploration and enlightenment of using big data to carry out budget performance management are worthy of in-depth study.

## 2. Literature Review

Scholars have studied the role of big data in budget performance management.

First of all, big data can solve the problems existing in traditional budget performance management, and improve the quality of budget performance management by improving the public recognition ability and participation level of budget performance management, the scientific analysis of performance data and the data collaboration between departments. Lavertu (2016) believes that wide disclosure of financial data and performance information can help external participants to monitor and evaluate public plans, so that external actors can better understand the effectiveness of performance indicators and policy priorities. Li Shufang et al. (2018) believe that information asymmetry restricts the efficiency of budget performance management, but the use of big data can help reduce the information asymmetry between financial departments and budget departments. On this basis, Wang Yinmei et al. (2016) pointed out that the information of various activities in the budget process should be integrated to realize data opening and sharing, and all-round three-dimensional supervision should be built through real-time monitoring to improve the accuracy and effectiveness of government budget supervision. Yan You et al. (2019) pointed out that exploring the application of financial big data in the field of budget performance management can effectively solve the problems that budget performance management has not yet achieved in all aspects and full coverage, poor objectivity and large workload of financial personnel in budget units.

Second, big data has changed the way budget performance has been evaluated. For example, O'Malley (2014) believes that big data, especially the rapid collection and sharing of various kinds of data, has changed the previous input-centric performance evaluation method to focus on output and results. Morgeson (2014) also holds the same view and points out that some national and local governments have begun to use big data to shift the evaluation focus from

internal performance indicators to citizen-centred performance indicators. Rogge (2017) points out that the applications and capabilities of big data are also expected to be increasingly used in management models of organizations and public services, where government and department heads can use performance panels with large amounts of data to assess and compare cost-efficiency issues across agencies. Ma Caicen et al. (2019) believe that in the process of building the framework of budget performance evaluation indicators, big data technology is applied to improve the scientific rationality of index design from many aspects such as system construction, data disclosure and technology expansion, and a budget performance indicator database that can be horizontally compared and continuously optimized is generated to further classify, compare and analyse the indicators.

### **3. International and Domestic Practices of Using Big Data to Improve Budget Performance Management**

#### **3.1. International practice of using big data to improve budget performance management**

In the field of budget performance management, the data-driven concept first emerged in the New York City Police Department in 1994. However, at present, the application of big data in the field of budget performance management in various countries is more confined to data disclosure and data sharing. It is mainly reflected in the following aspects:

First, in terms of the data sources of budget performance, countries have begun to get rid of the traditional single data source from the competent authorities, and explore multiple evaluation methods such as multi-source performance evaluation, peer review, self-evaluation and subordinate evaluation of the competent system. In particular, multi-source performance evaluation and peer review have received great attention, and diverse data sources provide more useful information. The UK's performance data source platform has received a great deal of attention for peer review of government services, and the diversity of data sources provides more useful information. The UK's performance data Source platform provides an integrated database for finding the performance data of government services, including 776 government department service data panels, 54 network information data panels and 15 other data panels, providing data information including the completion rate of government services, administrative costs and public satisfaction.

Second, at the big data technology innovation level of budget performance management, USDA's FY2020 Annual Performance Plan and FY2018 Performance Report show that USDA has worked with the Office of American Innovation (OAI) on technology innovation, and in its first phase of work, Five key areas of contact centre, customer experience, data analytics, cloud extraction, and infrastructure optimization were identified and analysed to accelerate the transformation of the Department of Agriculture into a data - and customer-centric department. In 2016, the state of California launched OpenGov Budget Builder, the world's first integrated cloud solution for public sector budgeting, reporting, and open data, using an integrated platform to prepare budgets, intelligently-analyse performance metrics, and broadly inform government officials and citizens. This enables data-based decision making.

Third, in terms of the disclosure of performance reports, the transparency of performance information and the public feedback on the use of government budgets, the disclosure of performance results has become one of the tasks that all departments in most countries need to complete every year, and 12 OECD member countries have begun to use information and communication technology in performance information reports. The UK's Performance Platform requires all public sector services to measure four key performance indicators, including transaction costs, public satisfaction, completion rate and digital usage, and upload them to the performance platform for public disclosure. In the United States, the Government

performance Platform (performance-gov) also provides visual data disclosure, providing additional data through interactive panels that allow operators to view performance metrics and key data sets in novel ways. The USAspending.gov website details the revenue, expenditure and use of fiscal funds for nearly 2,000 federal accounts in 25 government departments.

In general, the concept of big data-driven budget performance management has been deepened in various countries, and the evaluation results are obtained through the analysis of quantitative data and quantitative indicators to optimize the process of budget decision-making. However, there is still a lack of practical efforts to explore the integration of this emerging technology into budget performance management, and although some public sectors have begun to collaborate with technology companies on technological innovation, the concrete results are still not significant.

### **3.2. Domestic practice of using big data to improve budget performance management**

Some local financial departments in China have also carried out the exploration of using big data to help budget performance management, and gained certain experience. Its main approach is to open up the information islands within the financial sector, between financial and budget units, and between financial and government departments, establish a comprehensive financial data centre and a database covering the whole process of budget declaration, review, implementation and performance evaluation, and conduct pre-performance evaluation of capital declaration, online real-time performance operation monitoring and early warning, and accurate evaluation of fiscal expenditure performance based on big data. The quantitative and accurate macro and micro analysis and prediction are carried out to provide first-hand scientific basis for financial operation monitoring and government decision-making.

#### **3.2.1. Establish a special fund management information system based on big data to conduct pre-evaluation of budget declarations**

Selecting the implementation unit of the financial special fund project with good reputation and qualification, and preventing fraud, embezzlement of financial funds and repeated declaration of projects are the prerequisite for achieving the performance target of funds and improving the efficiency of funds.

In order to meet this premise, some local financial departments have established a special fund management information system based on big data, and have used big data technology to strictly check the fund declaration link, move the threshold of performance management forward, and consolidate the foundation of prior performance review. For example, the financial department of Chongqing has also established a corporate credit "joint collection system" to effectively identify the "problem" enterprises that declare financial funds projects and make good quality declarations of funds. The system covers non-public economic organizations such as enterprises, individual industrial and commercial households and intermediaries used in the city, and collects tens of millions of pieces of enterprise credit information, including basic information such as enterprise identity, tax registration qualification level, excellent information about enterprises, and bad information about enterprises. For example, enterprises violate laws and regulations, pay and tax arrears, banks' non-performing loans and accept various administrative penalties. Jinhua City of Zhejiang Province has also established an "information management system for enterprise-related financial subsidy funds", which screens according to policies, years, enterprises and competent authorities, and queries the financial subsidies of various departments in each year, including policy basis, project overview and subsidy amount, providing a reliable and convenient platform for financial departments to grasp historical data. From the technical level, we can effectively resolve the problem of repeated financial subsidies for enterprises.

### **3.2.2. Rely on the financial business data platform to monitor and track the budget performance targets and project implementation process**

The implementation of real-time automatic performance monitoring and tracking for the operation of financial funds projects, timely detection and feedback of problems in the process of project implementation, and urging the project unit to correct them in time are important measures to ensure the realization of project performance objectives and improve project performance.

In order to realize the automatic real-time monitoring of the operation of many financial fund projects and save human and material resources, local financial departments have established an online performance monitoring system based on performance database to identify and feedback performance problems in a timely manner. For example, Foshan Municipal Finance Bureau, relying on the integrated public finance management platform, developed an internal performance monitoring system and an external network system to promote the integration of internal and external performance monitoring. In terms of internal performance monitoring, make full use of the advantages of the integrated platform, define the monitoring rules, and play the online automatic warning function. Automatic early warning of performance monitoring takes the realization degree of the quarterly fund use plan of the project as the trigger point of automatic early warning. When the quarterly fund expenditure rate of the project fails to reach the fund expenditure rate set by the unit when applying for the project, the financial integration platform will automatically issue an early warning to the unit to realize the internal automatic dynamic monitoring of the project performance progress and improve the efficiency of performance monitoring. In terms of external performance monitoring, the internal monitoring data of the integrated platform will be synchronized to the performance monitoring external network system. Experts can log in to the performance monitoring external network system through the Internet, carry out professional monitoring quickly and in real time, and feedback the monitoring opinions to the financial department and budget unit in a timely manner.

### **3.2.3. Integrate internal and cross-departmental business data of the financial department and establish a database covering the whole process of budgeting**

Each business department within the financial department retains data such as project database, budget preparation and implementation, fund use and supervision, performance objectives and evaluation results, etc. However, these data are mastered by different business departments or developed with different technical standards, so there are data fragmentation or data islands to a certain extent, which is not conducive to the comprehensive use of data.

In order to realize the data sharing and comprehensive application within the financial department, and to link all aspects of budget declaration, review, implementation and performance evaluation with data, some local financial departments have formed a unified financial information system database by integrating the data of various business departments within the department. For example, Xiamen, Fujian Province, through the construction of financial information system big data, collects the business data of the financial department, realizes the comparative analysis and intelligent retrieval of data, and tracks the progress of key project performance targets. The system collects the financial budget revenue and the final accounts of the departments over the years, can query the financial revenue and expenditure situation over the years at any time and reflect the financial revenue and expenditure situation in real time, and carry out comparative analysis of various departments and units. The system comprehensively grasps the allocation and use of financial funds, provides data reference for financial budgets and final accounts, and controls the implementation progress of key project performance targets in real time.

In the establishment of cross-departmental databases, some local governments have tried to integrate data from other government departments related to finance to form a comprehensive

financial data centre to achieve all-round monitoring and analysis of financial fund income and expenditure. A typical example is the establishment of a comprehensive financial data centre in Beijing and the construction of a comprehensive financial resources management model with scientific and systematic analysis. In order to integrate the financial revenue data, enterprise information, financial policies, statistical standards and other data scattered in various government departments, Beijing Municipal Bureau of Finance officially launched the construction of Beijing Municipal Financial Comprehensive Data Centre in 2013, integrating the data of state tax, local tax, industry and commerce, People's Bank of China, statistics and other departments to form four databases: enterprise database, income database, policy database and standard database. Information sharing across municipal departments, districts and counties is realized, and on this basis, four major functions of income operation monitoring, income forecasting and early warning, macro decision support and investment benefit analysis are realized.

#### **4. The Basic Path of Big Data Application to Improve the Quality of Budget Performance Management**

Budget performance management is a closed cycle process, including performance objective review, performance operation monitoring, performance evaluation and result application. Among them, the objectivity and diversity of big data, its analysis and mining, identification and comparison, correlation and graph analysis, and visualization technology can effectively improve the quality of budget performance management.

##### **4.1. Big data analysis and mining technology can effectively improve budget performance targets**

Scientific and reasonable examination of budget performance targets is the starting point of budget performance management. However, due to the lack of appropriate standards, the audit of budget performance targets mainly relies on the experience of budget audit staff or experts. The sample survey on the financial performance evaluation departments of cities and counties in Guangdong Province (The questionnaire respondents of this report are the staff of the performance evaluation departments of the financial departments of cities and counties in Guangdong Province, and a total of 34 counties and cities were surveyed in September 2018. In order to avoid redundancy, we will not repeat it below, collectively referred to as "survey findings"), up to 94% of the respondents believe that the lack of standards is the main obstacle to the review of budget performance objectives, and 76% of the respondents find it difficult to judge the rationality of budget funds through performance objectives in their work. The emergence of big data text analysis, machine learning and data mining technologies helps to solve this age-old problem. First of all, big data Python automatic text analysis technology can carry out text analysis on the declaration materials of budget performance targets over the years, and rely on machine learning to automatically cluster and classify the declared funds. Secondly, through the numerical comparison and time trend analysis of the performance targets of the same kind or even the same budget funds over the years, the evolution trend of the targets is estimated and predicted, and the calculation method of the forecast target value is formed, so as to determine the performance target value based on historical analysis and provide a scientific reference standard for the evaluation of the performance target. Thirdly, using the neural network learning method, the relationship between the performance objective and the budget amount of similar budget funds over the years is deeply explored, and the calculation method of the relationship between the two is obtained. By adding factors such as price, the budget amount based on a certain performance objective can be predicted, providing a scientific basis for determining the budget fund limit.

#### **4.2. Big data identification and comparison technology helps to realize online real-time performance operation monitoring and early warning feedback**

Performance operation monitoring is an important part of performance management. However, the survey found that 65% of the respondents still said that their units did not carry out performance operation monitoring, and 71% of the respondents thought that it was difficult to implement real-time online monitoring, which was the main problem encountered in performance operation monitoring. Big data identification and comparison technology based on performance operation standard database can realize online real-time monitoring and early warning feedback of performance operation. First, collect the performance standards of each time node of performance operation, form a database of performance operation time limit and standards, and set comparison items and comparison values. Secondly, a database of real-time performance operation results is formed by automatic capture or manual entry, and data information flow instructions are sent to the result database for comparison and difference detection according to comparison items and comparison values, the time limit of the database and performance standards, and signalling information flow instructions are sent based on the comparison results, so as to realize performance detection and early warning. This method can be used not only for performance monitoring and early warning, but also for abnormal data identification and screening. For example, in order to verify the authenticity of the materials of people applying for subsistence allowances, Chongqing has integrated 16 categories of data on household registration, motor vehicles, employment, insurance, housing, deposits, securities, individual industrial and commercial households, tax payment and provident fund from departments and institutions such as civil affairs, public security, human resources and social security, land and housing management, finance, insurance, industry and commerce, taxation and housing provident fund management. All these information are networked. After data analysis, comparison items and comparison values are set. Any factors that do not meet the application conditions will be displayed immediately by the system, so that the minimum living allowance application can be screened from all directions to ensure the authenticity of the minimum living allowance application. In order to improve the government's IT performance, the Office of Management and Budget (OMB) in the United States issued a tool-Portfoliostat in the early investment stage of federal IT projects, and matched it with a "MAX collection tool"-MAX.gov website to collect and automatically analyse the data of various departments. These data include not only the investment, cost and implementation progress of the project, but also a series of data information sets directly or indirectly related to the project, such as user demand and service optimization, which realizes the effective evaluation of the maturity of IT project asset management process and eliminates the problem of repeated construction between departments.

#### **4.3. Objectivity and diversity of big data effectively improve the accuracy of performance evaluation**

The traditional performance evaluation mainly adopts the method of submitting performance data by the evaluated unit, combining expert sampling field survey with satisfaction survey, which inevitably has the problems of poor comprehensiveness and authenticity of data, and it is difficult to conduct in-depth comparative analysis of performance. The survey found that more than 60% of the respondents think it is difficult to compare and analyse the performance vertically and horizontally, and more than 70% of the respondents think that the performance evaluation lacks evaluation standards. The reason is that the data collected by most existing performance evaluation methods are small and subjective, which not only needs to be improved in authenticity and authority, but also makes it difficult to make horizontal and vertical comparisons and correlation analysis. The objectivity and diversity of big data can meet the requirements of performance evaluation for data authenticity and correlation analysis.

First of all, the objectivity of big data can effectively improve the authenticity of data and accurately identify performance. The objectivity of big data means that big data automatically keeps and records data. For example, the data generated by the use of mobile phones, the Internet, the Internet of Things and social media are all objective and true big data, and are not affected by human subjective factors. Using these big data for performance evaluation can effectively ensure the authenticity of the data. For example, the performance evaluation of poverty alleviation funds can truly evaluate the performance of poverty alleviation by using the objective data of telephone communication between residents in poverty-stricken areas and economically developed areas. Because of the active economy and the increase of residents' income, it will inevitably lead to the increase of residents' telephone calls. For another example, the performance evaluation of tourism special funds can truly reflect the number of passengers by using thermal imaging data or signalling data of mobile phone position displacement in scenic spots. For another example, in order to evaluate the performance of bus route optimization subsidized by the government, it is necessary to collect bus route and passenger travel trajectory data for matching and comparison, including bus passenger flow information such as total passenger flow, line passenger flow, cross-section passenger flow, station passenger flow, and temporal and spatial distribution of passenger flow, as well as residents' travel characteristics such as average bus trips, distribution of starting and ending points, average transfer times, travel time consumption characteristics and travel distance characteristics, so as to evaluate the performance of bus route optimization more accurately.

Secondly, the diversity of big data can be analysed by correlation analysis of influencing factors and "portrait" analysis of maps. Big data is diversified data, including not only traditional data forms mastered by various large organizations, but also original, semi-structured and unstructured data from web pages, Internet log files (including clickstream data), Internet of Things, mobile phone usage, search index, social media forums and active and passive sensor data. The comprehensive application of these diversified data can effectively carry out the correlation analysis of influencing factors and the "portrait" analysis of people, institutions or projects. For example, the performance of the medical insurance fund to avoid poverty caused by illness is evaluated and analysed by big data, and a big data warehouse is established by collecting diversified data of residents' population, medical care, social security and provident fund and related businesses. By correlation analysis of these data, we can explore the influence of demographic characteristics on medical care and social security, as well as the influence of medical health level, expenditure and demographic characteristics on poverty, and then use demographic characteristics, physical health level, medical treatment, medical expenditure, medical insurance participation, social security participation, provident fund expenditure and other indicators to "portrait" each resident and analyse the time series change trend, so as to identify and analyse the influencing factors of residents' medical insurance participation, and avoid residents' illness-related medical insurance.

#### **4.4. Data visualization technology makes the quantity, performance and geographical distribution of financial funds clear at a glance**

The traditional information reflecting the amount of financial funds, regional investment and performance is Excel data and Word format, and it is difficult for financial performance managers to intuitively find the structure and relationship. Big data visualization technology can solve this problem. Financial data can be visualized by integrating geographic coordinate vectors and using GIS system software. This function makes the investment and performance of departmental budget funds and financial special funds very intuitive, which greatly facilitates the allocation, supervision and evaluation of budget funds. In this regard, Portland, Oregon, USA has made fruitful exploration. The city's budget management implements the departmental budget map strategy, which requires budget units to visualize the expenditure and



performance of financial funds on the GIS carrier, so as to realize the "one map" of the amount of funds, regional structure and performance, so as to optimize the budget allocation and improve the performance of funds. For example, in the fiscal year of 2016-2017, the performance goal of the Transportation Bureau is to maintain 80% of the roads in the busy sections in a "good" or "good" state, and less than 2% in a "poor" state; 70% of local roads are in a "good" or "better" state, and less than 11% are "poor". At present, 50% of roads in busy sections are in a "good" or "better" state, and 43% of roads in local sections are in a "good" or "better" state. The Traffic Bureau uses GIS to visualize the road status of each local area, and the road status of each area is clear at a glance, which points out the direction for the investment of financial funds. In the management of special financial funds, in order to optimize the investment of the special funds for "Prospering Portland", Portland City used GIS to visualize the investment of the special funds for five years (2012-2017), visually showing the regional distribution of the special funds invested in the past five years and the per capita amount of funds obtained in different regions, providing a basis for optimizing the future fund allocation.

## **5. Thoughts on Further Improving the Quality of Budget Performance Management with Big Data Technology**

Although big data has created conditions for the full implementation of budget performance management, China is not fully prepared for the big data revolution and "+big data" in all fields, and there is still much room for improvement in terms of legal protection, awareness and the specific implementation ability of big data technology.

### **5.1. Improve legislation to provide strong support for "budget performance management + big data"**

Since 2005, China has formulated the Measures for the Administration of Performance Evaluation of Budget Expenditures of Central Departments (Trial Implementation), the Notice of the Ministry of Finance on Further Promoting the pilot work of Performance Evaluation of budget items of Central Departments, the Interim Measures for the Administration of Performance Evaluation of Financial Expenditures, and the Opinions on the Comprehensive Implementation of Budget Performance Management and other policy documents to promote the development of budget performance management. Local governments have also responded positively by issuing a series of local regulations. The basic institutional framework of budget performance management in our country has been formed. In 2015, with the release of the Outline and the subsequent establishment of provincial data governance institutions and the exploration of big data, the development of big data entered a stage of rapid advancement. However, whether it is for the development of budget performance management or big data, China has not yet introduced relevant laws to ensure its implementation, let alone laws and regulations supporting "budget performance management + big data". Therefore, although big data has great potential in the field of budget performance, due to the lack of legal protection, "budget performance management + big data" can only be a "weak fat man", with "form" but not "quality".

The introduction of big data in the field of budget performance management is a profound change to the traditional budget and budget performance management model, and can effectively promote the transformation of China from the current passive "I want to have performance" budget performance management model to the active "I want to have performance". But first, we must establish and improve the relevant legal system, and rely on the pilot to supplement and improve. The realization of government data opening is a strong guarantee for the use of big data for budget performance management. Starting from the legal principle of data opening, a series of laws and regulations should be issued to strengthen the connection among relevant laws and regulations such as government information opening,

secrecy law and archives Law, and provide a set of feasible mandatory provisions to promote the establishment of an open government information platform. To achieve the integration of government, department, enterprise, public and other multi-party data, to provide a basic guarantee for "budget performance management + big data". In addition, strengthening legislation should be based on protecting data security, severely punishing hackers who maliciously steal and attack big data systems, and removing "worries" for "budget performance management + big data". The introduction of big data in the field of budget performance management cannot be done overnight, we should start from the pilot, through the "budget performance management + big data" pilot, find out the possible problems, and can be implemented nationwide when it is fully feasible.

## **5.2. To break the "information island", data interconnection is the key to improve the quality of budget performance management with big data**

Chinese people lack the sense of ownership of the financial budget performance management, and tend to passively look at the issue of government information disclosure, and lack effective supervision of the content of government information disclosure. While government functional departments regard the large amount of information and data they have as "departmental assets", it is difficult to coordinate the budget and budget performance management related interest subjects. On the other hand, even if the data can be shared, because the data of different departments is stored in different places, the data management and transaction rules are still incomplete, the format is not the same, and the integration is difficult, and the phenomenon of "information island" and "information chimney" persists.

Data interconnection requires breaking through the pattern of departmental-level segmentation and closure of data, realizing cross-departmental database sharing, enabling automatic, real-time and online cross-departmental performance data collection, screening, review, conversion, integration and storage, using multidimensional analysis models to help users analyse business data from multiple angles, and forming a visual interface. Show the correlation between performance data, automatically generate performance target review results, performance operation monitoring results and performance evaluation results. At present, the phenomenon of "information island" in our country is mainly caused by the problems of "dare not open", "can not open", "unwilling to open" and "unable to open" in data opening. Therefore, the relevant government departments should speed up the improvement of the supporting system of data opening to solve the problem of data "dare not open"; Establish a complete data resource collection, management, processing, development and utilization system to solve the problem of "unopenable" data; Make use of the compulsory law to break the data monopoly and solve the problem of "unwilling to open" data; Strengthen the construction and maintenance of data opening websites, unify government data disclosure standards, and solve the problem of "not open" data.

In order to promote data connectivity, provinces (autonomous regions and municipalities) can make full use of the opportunity of digital government construction to integrate government data resources such as development and reform, industry and commerce, taxation, finance, transportation, customs, finance, education and health, realize the interactive sharing of data resources among departments and industries, and promote the integration of financial data resources among provinces (autonomous regions and municipalities). To realize data sharing and interactive use, enhance data aggregation, exchange, and service capabilities, and promote cross-level, cross-regional, and cross-departmental sharing and exchange of government data resources and collaborative application. Within the financial system, build or improve the time series database of the performance target value, realized value and standard value of the financial fund project, realize the interconnection of data across regions, levels and government departments, and establish data cooperation with the Internet, mobile providers and large

organizations, so as to realize the integration of vertical and horizontal, internal and external performance data. It lays a good data foundation for the high-quality analysis of performance information.

### **5.3. The multivariate analysis method of data is the incision of big data to improve the quality of budget performance management**

After establishing a more reliable and sufficient data foundation, the comprehensive use of appropriate data analysis methods is the starting point to improve the quality of budget performance management. For measurement, statistics, classification and correlation analysis of performance data, it is necessary to comprehensively apply multiple methods including data clustering, classification, outliers, visualization, descriptive statistical analysis, regression analysis, similarity matching, frequent item sets and so on.

Data clustering refers to dividing data into some aggregate classes according to the intrinsic nature of the data. The elements in each aggregate class have the same characteristics as far as possible, and the characteristics of different aggregate classes differ as much as possible, such as clustering by amount and performance level. Data classification refers to dividing data objects into different parts and types according to certain characteristics, and then further analysing and mining the essence of things. For example, through the technology of machine learning and automatic text analysis, the fund performance target is automatically classified, and the scientific rationality of the goal setting is judged according to the historical value of the performance target, the completed value of the previous year, the situation of other regions and other factors, so as to provide a scientific basis for the review of the budget performance target and improve the efficiency and quality of the review. Data heterogeneity is the setting of certain algorithms to mine and identify abnormal data. Data visualization refers to the conversion of data or analysis results into graphs. Statistical analysis of data description refers to the simple description of performance data by means of average value, frequency, proportion, etc. Regression analysis refers to the use of linear or nonlinear regression methods to explore the factors affecting performance and their directions and coefficients. Similarity matching is a method to calculate the degree of similarity between two pieces of data, which is usually measured as a percentage. The similar matching algorithm can be used to match the target in the target review stage, match the target with the actual value in the performance evaluation stage, and match the actual value in different regions or project implementation units. Frequent item set refers to the set of items that occur frequently in a case. For example, frequent item set can be used to explore the high-frequency characteristics associated with high performance projects and the concentration of capital investment. In order to reveal the causal relationship between input, output and effect, data analysis methods such as differential analysis, propensity value matching and synthetic control can also be comprehensively used. In short, big data technology provides a variety of means for data analysis, and analysts can make flexible choices according to the needs of budget performance management.

### **5.4. Improve the training mechanism for big data talents and cultivate interdisciplinary talents**

The construction of big data platform is inseparable from the cultivation and accumulation of talents, and the application of big data to budget performance evaluation requires a large number of compound talents. Budget performance evaluation is a relatively complex task. To complete it successfully, relevant government personnel should not only understand the overall framework and process of budget performance evaluation operation, but also master other processes. For example, the determination of performance objectives, the determination of performance indicators and the application of performance evaluation results and so on. Big data talents not only need to have basic mathematics, statistics and other knowledge, but also master the deep mining technology and visualization technology of big data technology.

At present, there is a big gap in the primary, intermediate and senior talents of big data in China, and the talents of technology development are also very scarce. Short-term talent needs can be through government departments at all levels and financial departments through bidding and other ways to introduce foreign aid technical support, but far-reaching consideration should actively try to each department's own data technology hardware construction and training of related talents, so as to contribute to the long-term development of budget performance evaluation. The long-term development of big data technology and budget performance evaluation needs compound talents with budget performance evaluation management and big data related knowledge, but our country still needs to improve the training and requirements of compound talents. On the one hand, the training of compound talents of big data should rely on the corresponding courses of colleges and universities and the help of government industry, and on the other hand, the use of online courses and software for learning. In addition, it is also necessary to mobilize the enthusiasm of the government and relevant departments, improve the big data technology of government staff through the training of relevant government personnel, and enhance the application ability of big data technology.

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