Research on Innovative Development and Utilization Services for Data from Open Government Data Platforms (Postprint)

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Abstract

[Purpose/Significance] This study analyzes the service functions of government data open platforms in the innovative development and utilization of data, to assist relevant departments in better grasping the priorities for future planning, construction, management, and service delivery. [Method/Process] From the perspectives of both service methods and characteristics, this research conducts an investigation and analytical study on the current status of innovative development and utilization services for government open data across 32 local-level government data open platforms in China. [Results/Conclusion] A total of 23 platforms have already actively engaged in the innovative development and utilization of government open data, providing the public with diverse and comprehensive services for conducting innovative development and utilization of government open data, including targeted datasets, application development services, and tool downloads. In future service processes, it is essential to formulate actionable policies and regulations, accelerate the integration and interoperability of massive government open data, emphasize the practical implementation of development and utilization outcomes, and focus on user needs analysis and participation.

Full Text

Preamble

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Abstract

[**Purpose/Significance**] This paper analyzes the service functions of government data open platforms in the innovative development and utilization of data, helping relevant departments better grasp the priorities for future planning, construction, management, and service delivery.

[**Method/Process**] From two perspectives—service models and service characteristics—this study investigates and analyzes the current state of innovative development and utilization services for government open data across 32 local-level government data open platforms in China.

[**Result/Conclusion**] A total of 23 platforms have actively engaged in the innovative development and utilization of government open data, providing diverse and comprehensive services to the public, including targeted data provision, application development services, and tool downloads. In future service processes, it is necessary to formulate actionable policies and regulations, accelerate the integration and interoperability of massive government open data, focus on the implementation of development and utilization outcomes, and emphasize user needs analysis and participation.

Keywords: government data, data open, innovation and entrepreneurship, development and utilization, service model
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1. Introduction

As human society enters the era of big data, government departments, possessing vast public data resources, have transitioned from information disclosure to data openness. Due to their special nature and functional requirements, government departments produce or control large volumes of data resources, making them the largest producers, collectors, users, and publishers of data. Promoting data openness, sharing, and innovative development and utilization to fully tap the value of government data has become an important measure for improving government management and service efficiency, fostering social innovation and economic growth, and enhancing sustainable development and people' s living standards.

In August 2015, the State Council issued the "Action Outline for Promoting Big Data Development," which clearly required promoting resource integration and accelerating the openness and sharing of government data. The outline mandated the establishment of a unified national government data open platform by the end of 2018, taking the lead in opening public data resources in key areas such as credit, transportation, healthcare, employment, social security, geogra-

phy, culture, education, science and technology, resources, agriculture, environment, safety supervision, finance, quality, statistics, meteorology, oceanography, and enterprise registration and supervision. This initiative aims to drive public participation in value-added and public-interest development and innovative applications of big data, fully releasing data dividends and stimulating mass entrepreneurship and innovation.

The issuance of the Action Outline has made building government data open platforms a major national strategy in China, and has also set clear requirements for the role these platforms should play in driving public engagement in value-added, public-interest development and innovative applications of big data, tapping and releasing the value of government open data, and promoting social innovation.

2. Government Data Openness and Innovative Utilization

2.1 Government Data Openness

Regarding the concept of government data, both the Open Knowledge Foundation and the Organisation for Economic Co-operation and Development (OECD) define it from two aspects: (1) Government data refers to data produced or collected by governments or government-controlled entities; (2) Such data can be freely used, reused, and redistributed by anyone. Domestic scholars Li Xurong and Xu Huanliang argue that "government data is a general term for all data resources generated within government or externally but affecting social activities, public affairs, and the general public." A. M. Espinar defines government data openness in "Open Government Data: Setting the Scene" as "the release of raw public domain information for use and reuse in open formats and under non-restrictive licenses." Wu Min views government data openness as both a philosophical concept and a practical implementation, referring to the storage and organization of Web data from different sources and types according to public-specific needs and certain Internet protocols, ultimately achieving openness and sharing of government data in cyberspace to maximize data acquisition and reuse.

An OECD report from 2010 states that government data openness can generate three types of value: economic, social, and political. It creates a favorable environment for big data industry development, promotes economic growth, facilitates social innovation, improves citizens' quality of life, enhances government public service levels, and increases government transparency and citizen participation. Huang Ruhua et al. systematically analyzed the value of open government data from both basic values and sub-values built upon them, identifying political, social, economic, and technological values as the fundamental values.

Government data itself has no value; it only gains value when it creates public value. The European Commission describes the open data value chain: after data is opened, it will be analyzed and processed to provide valuable informa-

tion or visual presentations, promoting the formation of new data products or data services. Xia Yikun divides the value realization process of open data into three stages—raw material production and supply, core data product development, and comprehensive development—based on information product evolution patterns and information lifecycle theory, covering all aspects of the open data process including data aggregation, conversion, concentration, and application development. Value realization at each stage mainly relies on innovation in data utilization methods, means, and tools, gradually enriching the connotation of the open data industry value chain and continuously extending its length through content value-added and development of derivative data service products such as software, thereby progressively enhancing utilization benefits and value. Zheng Lei argues that government data is an indispensable and important component of big data, with high value for value-added development and innovative application. In the process of creating data value, the roles of government, data users, the general public, and the external environment are all indispensable, jointly determining the ultimate effect of open data and constituting an ecosystem.

2.2 Innovative Utilization of Government Open Data

Acquiring, mining, and utilizing the economic, social, and political value of government open data requires, on the one hand, promoting data fusion and sharing among government departments to achieve internal utilization of government open data, optimize departmental business capabilities, improve decision-making levels and government transparency, facilitate democratic decision-making, and realize political and social value. On the other hand, it requires orienting toward social needs, promoting the complete, raw, timely, accessible, machine-processable, non-discriminatory, non-proprietary, and license-free opening of government data to the public, meeting the reuse needs of social organizations and enterprises for further processing and provision to users or for their own use for commercial or non-commercial purposes, creating economic and social value, and making people' s production and lives more efficient and convenient.

In the big data era, government agencies possess massive data resources of great value. Moreover, government open data has the characteristic of not being consumed by the ideas and innovations it inspires; on the contrary, it provides an endless source for innovative applications. Therefore, opening government data means not only promoting data fusion and sharing among government departments and opening to society according to social needs, but also providing a series of analytical tools and platform services to facilitate the public and enterprises in analyzing, mining, and acquiring deeper and more effective value from government data resources through basic data alone or through combining basic data with other data, developing various innovative applications, solutions, or derivative data service products to promote economic and social development, assist smart city construction, and improve people' s living standards.

Open government data can promote the repetitive and innovative development and utilization of government data. Therefore, data utilization, reuse, and innovative utilization are three levels of value generation, with innovative utilization being the core. The opening, integration, and analysis of government data, as well as development and innovative utilization based on them, can discover new knowledge and create new value. The ultimate goal of government data openness is to release the value of government data resources through openness, sharing, and development and utilization, enabling government departments to work more efficiently and transparently, promoting economic development and social innovation, and improving citizens' quality of life.

2.3 Typical Foreign Cases in Promoting Innovative Development and Utilization of Government Open Data

Developed countries attach great importance to building the government data ecosystem, establishing good public-private partnerships with private sectors and civil society organizations in terms of organization, mechanism, and activities. They have formed three multi-party participation models with orderly division of labor and win-win cooperation—government-led, enterprise-led, and citizen-led—adopting various measures such as improving policy and regulatory systems, creating an environment for innovative development and utilization, holding innovative application contests, and perfecting organizational structures to continuously promote innovative development and utilization of government open data, achieving excellent results that provide good references for China. Specific cases are shown in Table 1 .

3. Data Innovative Development and Utilization Services of China' s Government Data Open Platforms

3.1 Service Forms

This study employed web-based investigation to conduct a comprehensive survey of 32 local-level government data open platforms (excluding Hong Kong, Macao, and Taiwan) that have been built in China, focusing on practical operation and effectiveness analysis of platform functions for application development, online tools, and data provision. The investigation found that 23 platforms have actively engaged in the development and utilization of government open data, providing diversified and comprehensive services for the public to develop and utilize government open data, including providing targeted data for government open data innovation application competitions, API services, APP software, developer services, and data monitoring and analysis tool downloads. These services facilitate users in obtaining government data and conducting development and utilization. Table 2 presents a detailed display of the data innovative development and utilization service forms of the 23 surveyed government data open platforms.

3.1.1 Application Development Services As a public resource, government open data is characterized by non-discrimination, non-exclusivity, and license-free usage, meaning anyone can develop and utilize it. Government agencies also encourage public participation in the development and utilization of government open data by providing various services and conveniences. Currently, software developers have played a central role in revealing the value of government data by building mobile and Web applications or APPs that enable users to access and interact with data and information through mobile devices or networks. To help software developers better develop applications, government data open platforms have established sections such as "Application Programming Interface (API)," "Developer Center," "Development Services," "Developer Community," "APP," "Application Achievement Submission," and "User Help,"providing platform services including massive data downloads, application programming interfaces, recommended development methods and processes, detailed developer documentation, and downloads of commonly used development tools, as well as self-services for developer registration, application creation, service application, application promotion, review and release, and application management.

An Application Programming Interface (API) is a set of definitions, programs, and protocols, and is currently a widely used method for websites to provide data for user calls. This Internet-based application is becoming increasingly popular, with more sites opening their resources to developers for calling. The provision of external API calls enhances content relevance between sites, while these open platforms bring greater value to users, developers, and small and medium-sized websites. For government data open platforms, API services are interfaces provided to users for developing and utilizing data, and their quantity reflects the platform' s data developability. For government agencies, unified external interfaces enable full lifecycle management of government open data from generation and collection to openness, sharing, updating, maintenance, and acquisition and utilization, ensuring the originality, authenticity, integrity, readability, openness, and security of government data. For ordinary data demand users, it provides browsing, retrieval, and download services for government data, allowing users to interact with data open platforms through APIs to obtain needed government data according to their selection criteria or actual needs. For software developers, it enables real-time and efficient calling of massive government open data suitable for application development needs through parameters, thereby developing APP applications based on government open data for public use.

With the development of mobile Internet and APP software development technology, mobile APPs have become an important way for public sectors to release the latest data information and for users to obtain and utilize information instantly. Government data open platforms provide functions for introducing and downloading links for government open data acquisition and utilization APPs, while also supporting user evaluation of APPs. These APPs are developed by software developers based on massive government open data, can be real-time

linked to massive government open data, are generally classified according to the fields or themes of the connected government data, and are mostly closely related to public transportation, work and study, and leisure and entertainment. They are powerful and convenient to use. APPs can integrate data from different sources or allow users to view data on interactive maps, helping users utilize government data conveniently and effectively. Meanwhile, APP promotion and download usage also enable the public to more deeply appreciate the functions and practical effects brought by government open data. Therefore, the development and external release of APP software not only promotes the repetitive use and utilization of government data but also effectively encourages the public to actively carry out further innovation and creation in government open data applications.

Through application development services, enterprises and the public can become software developers based on massive data or by using service interfaces to obtain data in real time, develop mobile applications in data application fields of their interest, or connect to external applications and conveniently utilize platforms to promote applications.

3.1.2 Online Tool Services (1) Data Analysis Tools. Data analysis is the foundational link in data innovation application. Analyzing raw data helps fully mine the value of government data. Government data open platforms provide various data analysis tools to help users conduct preliminary management and visual analysis of data.

The Beijing Government Data Resources Network has set up a "Tools" section, introducing 15 tools to users, including Hadoop, RapidMiner, Solr, and Tableau, which support data-intensive distributed application frameworks, data analysis, data search, and data visualization, to facilitate users in obtaining and processing government data. Government data open platforms in Guangzhou, Harbin, Foshan, Jinan, Nanping, and Menjiang have set up "Data Graph" sections and provide "Graph" or "Association Service" options for each piece of data, pointing to data graphs. The Guiyang Government Data Open Platform has set up "Thematic Graph" and "Global Graph" columns on its homepage and provides a "Resource Graph" option for each piece of data, offering multiple data graph visualization options to visualize the constituent elements of datasets and the relationships between datasets. Government data open platforms in Guangzhou, Shenzhen, Qingdao, Foshan, Harbin, Jinan, Nanping, and Ningbo Haishu District provide options such as "Data Analysis," "Data Chart Visualization," "Data Initialization," "Data Management," "Data Model," or "Description Information" on the detail page of each piece of data, supporting preliminary management and visual analysis of data.

(2) Data Openness and Utilization Monitoring Tools. Monitoring the openness, sharing, acquisition, and utilization of government data helps platform managers and users analyze the situation of government data openness, sharing, acquisition, and utilization, providing a basis for further optimizing

government data openness and utilization, ultimately improving service methods and enhancing the quality of government data openness and sharing.

The Guiyang Government Data Open Platform provides a powerful data monitoring tool—the Openness Index—including functional sections such as platform access source tracing, access frequency, attention heat word cloud, user registration type analysis, platform access history, data rating statistics, data openness statistics, demand classification ratio, data update statistics, resource format ratio, TOP10 department data, TOP10 data downloads, and TOP10 API calls, conducting comprehensive analysis of government data openness and utilization. Government data open platforms in Beijing, Guangzhou, Qingdao, Jinan, and Foshan Shunde District have set up "Website Statistics," "Service Statistics," and "Data Statistics" sections to conduct statistical analysis on government data openness statistics, access statistics, download statistics, and rating statistics. Platforms in Foshan, Harbin, Nanping, and Menjiang have set up "Data Services," "Data Index," or "Data Analysis" sections to display the data openness and usage of various government departments on the platform, the completeness of current departmental data, and the ranking of associated datasets based on tag values from three perspectives: departmental openness index, thematic openness index, and tag openness index. Shanghai provides a data overview in the "Interactive Communication" section, visually displaying the fields, types, and departmental distribution of open data, as well as download and access situations.

In addition to the two types of tools mentioned above, the Harbin Government Data Open Platform provides six online tools in the "Data Tools" section under "Data Services," including encryption/decryption, MathML editing and testing, and jQuery plugins, offering online services such as data encryption and decryption, QR code generation, compression, CSV to HTML table conversion, jQuery plugin demonstration, and online editing of MathML, LaTeX, and mathematical formulas, as well as image generation.

3.1.3 Targeted Data Services for Innovation Application Competitions

After opening data, to promote its development and utilization, government departments at home and abroad have successively held various high-prize competitions for developing innovative applications or solutions using government open data as "raw materials," attracting the public to participate in the development and utilization of government open data to achieve data utilization goals. Government open data innovation application competitions can comprehensively integrate technology, creativity, and business models, allowing the public to participate in open data development based on their professional fields and industry backgrounds, discovering value with unique insights and innovative thinking, and mining the "gold mine" of value in open data.

(1) Shanghai Open Data Innovation Application Competition (SODA). The Shanghai Open Data Innovation Application Competition has become a brand series event in the field of open data innovation application

nationwide. Adhering to the concept of open innovation and taking data openness as the entry point, SODA adopts the model of "data crowdfunding and application crowdsourcing," oriented by social needs and social hot spots and pain points, providing government data resources to all sectors of society. Through government platform building, government-enterprise cooperation, and public participation, it relies on the power of the whole society to form a complete value system serving data openers, product developers, and application demanders, stimulating innovative data applications and promoting the in-depth development and value-added utilization of government data resources. The 2015 SODA competition, themed "Urban Transportation," opened 24 transportation datasets through the Shanghai Government Data Service Network; the 2016 competition, themed "Urban Safety," opened a total of 29 competition-specific datasets exceeding 2TB; the 2017 competition, themed "Urban Governance," opened a total of 23 competition-specific datasets.

(2) China Graduate Student Smart City Technology and Creative Design Competition. Since its first edition in 2014, the China Graduate Student Smart City Technology and Creative Design Competition has been held for four sessions. With the concept of "creativity inspires wisdom, innovation drives development," the competition focuses on the theme of smart cities, stimulating graduate students' innovative consciousness, improving their innovation and practical abilities, and cultivating innovative talents for the nation, society, and enterprises. The Beijing Government Data Resources Network has set up a "Targeted Data" section and a "Previous Activities" section to provide data for the China Graduate Student Smart City Technology and Creative Design Competition and conduct related introductions.

(3) National University Data-Driven Innovation Research Competition. The first National University Data-Driven Innovation Research Competition was held from December 2017 to March 2018, aiming to encourage students from various disciplines to conduct innovative research based on data and promote the preservation and sharing of research data. To support participants in designing their works, relevant Beijing government departments provided two types of thematic data—targeted open and fully open—through the Beijing Government Data Resources Network for participants to download and use.

Additionally, the Beijing Information Resources Management Center hosted the "Beijing Government Data Resources Network Application Creativity Competition" in 2014. With the theme of "Government Data Openness, Big Data Innovative Application" and using data resources opened on the Beijing Government Data Resources Network as the main data source, the competition aimed to further enhance understanding and usage of government data among all sectors of society, promote interactive communication between government departments and enterprises, institutions, and individuals, and promote the Beijing Government Data Resources Network on a larger scale. The Shanghai Library held the "Shanghai Library 2016 Open Data Application Development Competition" with genealogy as the theme in 2016, opening its collection of genealogy litera-

ture information and content information for participants to use. The Guiyang Traffic Management Bureau and other departments held the "Traffic Accident Cause Analysis Competition" in 2016, with the Guiyang Traffic Management Bureau opening vehicle management data, traffic violation information, traffic accident data, traffic weather conditions data, tidal road traffic management, and traffic flow data as targeted competition data.

3.2 Optimization Strategies

Based on the above discussion of data development and utilization service models of government data open platforms, it is evident that government departments attach great importance to the openness, sharing, and reuse of government data, providing numerous services and conveniences for users to obtain government open data and conduct openness and utilization. However, problems still exist, such as the absence of specialized policies and regulations guiding the innovative development and utilization of government data, the multi-source heterogeneous nature of government data, and the lack of significant results from development and utilization. Inspired by typical foreign cases promoting innovative development and utilization of government open data, this paper argues that optimizing the data innovative development and utilization services of local government data open platforms requires efforts in the following aspects:

3.2.1 Formulating Actionable Policies and Regulations Releasing the value of government open data is a systematic project. Technically, it involves data collection, fusion, processing, analysis, and result presentation. In terms of policies and regulations, it involves sharing mechanisms, open policies, management models, transaction rules, and safeguard measures. In terms of actors, it requires joint participation and efforts from government, enterprises, research institutions, and individuals. Therefore, with the deepening development of government data openness and innovative development and utilization, optimizing the data development and utilization services of government data open platforms inevitably requires providing development directions through policy issuance and providing a solid guarantee through the formulation and implementation of relevant laws and regulations. Currently, China has not yet formulated specialized national policies for guiding the innovative development and utilization of government data and releasing data value. There is an urgent need to formulate actionable policies and regulations at the national level, while local levels need to formulate specific local administrative regulations and action plans under the guidance of the national policy and regulatory system.

3.2.2 Accelerating the Integration and Interoperability of Massive Government Open Data On the one hand, government data open platforms have massive public data as resource support; on the other hand, the development and utilization of government data require massive data resources as a foundation. However, there is currently a certain mismatch between government data openness and innovative development and utilization, mainly due

to the segmented organizational structure of government departments at all levels and the multi-source heterogeneous nature of government data. Therefore, government data open platforms should provide multiple formats for opening government data, continuously optimize the organization and management of government open data, provide multiple choices of data retrieval methods and channels, support calling specific data resources through APIs, and promote links to massive data resources, enabling massive data resources to be developed and utilized and providing massive data resource support for society to carry out government data development and utilization. At the same time, all departments should launch a "data integration and interoperability" campaign, implement government data resource integration plans, accelerate the construction of government data sharing platforms, strengthen horizontal integration and management of data resources among government departments, strengthen data exchange and information communication with relevant national institutions, eliminate "information silos" and "data chimneys," and actively promote interconnection and sharing of government department data.

3.2.3 Focusing on the Implementation of Development and Utilization Outcomes The ultimate purpose of government data openness is to release the value of government data resources through openness, sharing, and development and utilization, enabling government departments to work more efficiently and transparently, promoting economic development and social innovation, and improving citizens' quality of life. In this process, the implementation of development outcomes is particularly critical. If development outcomes remain only at the level of application models or solutions, the value of government data still cannot be released, and government transparency, economic development, social innovation, and improvement of citizens' quality of life can only become empty talk. Therefore, in specific practice, the data development and utilization services of government data open platforms should aim to release the value of government data, striving to achieve implementation of development outcomes and produce actual effects. Government data open platforms should further provide diversified and comprehensive services for the public and enterprises to carry out innovative development and utilization of government open data. Innovation application competitions should actively implement the spirit of open cooperation, bringing enterprises, universities, and civil institutions into the local big data ecosystem construction, introducing investment institutions to provide investment docking and incubation support for excellent projects, promoting result transformation, accelerating project incubation and implementation, and achieving the trinity goal of open data, innovative applications, and incubation implementation, truly demonstrating the substantive role of open data in promoting business innovation and economic transformation and development.

3.2.4 Emphasizing User Needs Analysis and Participation The data innovative development and utilization services of government open data plat-

forms strongly emphasize user needs analysis and participation. On the one hand, it emphasizes user-centered, needs-oriented approaches, conducting research and analysis on user and market needs for government open data development and utilization through various analytical tools and channels. On the other hand, it emphasizes openness and public nature, valuing public participation and interaction, striving to simplify public online consultation and participation processes, introducing media cooperation, establishing public participation and feedback mechanisms, and improving user experience.

In terms of user needs analysis, some government data open platforms provide openness index tools or set up "Website Statistics" sections, which help platform managers and users analyze government data openness, sharing, acquisition, and utilization situations, providing a basis for further optimizing government data openness and utilization methods and improving government data openness and sharing quality. In terms of user participation and feedback, for ordinary data demanders, providing functions such as data sharing, data application and customization, information exchange, and user personalized services not only provides users with various services with local characteristics and user personalization, improving user experience, but also emphasizes strengthening public consultation, stimulating the "collective wisdom" of the public and the vitality of innovation and entrepreneurship, and supporting and encouraging the public to participate in platform construction and optimization and the development and utilization of government open data.

Through these measures, an efficient public participation and feedback mechanism is established to ensure that public data requests and consultations can receive the fastest response, prioritizing the opening of data resources most urgently needed by the public, improving platform service efficiency and user satisfaction. For application developers, the construction of "Interactive Communication" sections is emphasized, with information release, chat and exchange, information sharing, and question feedback sections set up to facilitate information sharing and exchange feedback among application developers.

4. Conclusion

Entering the big data era, opening government data to society and fully mining, developing, and utilizing government open data has become an important measure for improving government management and service efficiency, promoting social innovation and economic growth, and enhancing sustainable development and people' s living standards. With the issuance of the "Action Outline for Promoting Big Data Development," building government data open platforms has become an important national strategy in China. Government data open platforms have also begun to actively engage in driving public participation in value-added, public-interest development and innovative applications of big data, tapping and releasing the value of government open data, and promoting social innovation. Government data open platforms have provided services for the public to develop and utilize government open data, including targeted

data for government open data innovation application competitions, API services, APP services, developer services, and data analysis and monitoring tool downloads, providing conveniences for users to obtain government data and conduct openness and utilization. In future service processes, it is necessary to formulate actionable policies and regulations, accelerate the integration and interoperability of massive government open data, focus on the implementation of development and utilization outcomes, and emphasize user needs analysis and participation, so that the data innovative development and utilization functions of government data open platforms can be better leveraged, more effectively tapping and utilizing the enormous value of government open data, effectively meeting the needs of "mass entrepreneurship and innovation," promoting economic growth and social sustainable development, and continuously improving people' s living standards.

References

[1] Notice of the State Council on Issuing the Action Outline for Promoting Big Data Development [EB/OL]. [2017-12-10]. http://www.gov.cn/zhengce/content/2015-09/05/content_{10137}.htm.

[2] Wei Junchao, Wei Haiyan. Current Status and Characteristics of Foreign Government Data Openness and Implications for China [J]. Library Journal, 2016(11): 23-29.

[3] Li Xurong, Xu Huanliang. Government Information Resource Management and Development [M]. Beijing: Peking University Press, 2005.

[4] ESPINAR A M. Open government data: setting the scene[R]. Gijón: W3C Spain Office/CTIC, 2012.

[5] Wu Min. Application and Implications of Open Data in UK and US Governments [J]. Library and Information Service, 2012(1): 127-130.

[6] OECD. ANNEX B. Reaping the benefits of cloud computing, Web2.0 and open data: OECD country experiences[J]. Sourceoecd science & information technology, 2010(14): 172-185.

[7] Huang Ruhua, He Naidong, Li Baiyang. Construction of the Value System of China' s Open Government Data [J]. Library and Information Service, 2017, 61(20): 6-11.

[8] European commission. Elements of a data value chain strategy[EB/OL]. [2017-12-10]. https://ec.europe.eu/digitalagenda/en/news/elements-data-value-chain-strategy.

[9] Xia Yikun. Industrial Characteristics and Value Chain Analysis of Open Data Development and Utilization [J]. E-Government, 2016(10): 41-50.

[10] Zheng Lei. Value Creation Mechanism of Open Government Data: An Ecosystem Perspective [J]. E-Government, 2015(7): 2-7.

[11] Zheng Lei, Lv Wenzeng. Research on the Output and Effect of Public Data Openness—A Case Study of Shanghai Open Data Innovation Application Competition [J]. E-Government, 2017(9): 2-10.

[12] Zhou Zhifeng. Countermeasure Analysis for Promoting Development and Utilization of Government Open Data from the Perspective of Innovation and Entrepreneurship [J]. Journal of Intelligence, 2017, 36(6): 141-147.

[13] Shen Jing, Hu Guangwei. Research on the Value Generation Mechanism of Government Data Openness from the Perspective of Stakeholders [J]. Journal of Intelligence, 2016, 35(12): 92-97.

[14] Huang Ruhua, Wang Chunying. Investigation and Analysis of the Current Status of China' s Government Data Open Platforms [J]. Information Studies: Theory & Application, 2016(7): 50-55.

[15] The 8 principles of open government data[EB/OL]. [2017-12-10]. https://OpengovData.org/.

[16] Wu Gang, Zeng Liying. Comparative Study on the Construction of Government Open Data Platforms at Home and Abroad [J]. Information and Documentation Services, 2016(6): 75-79.

[17] Shanghai Open Data Innovation Application Competition Awards 950,000 Yuan Announced Today [EB/OL]. [2017-12-10]. http://www.sheitc.gov.cn/zxxx/672473.htm.

[18] Hong Xuehai, Fan Lingjun, Hong Xiaonan, et al. Government Big Data Openness and Market-oriented Utilization in Smart City Construction [J]. Big Data Research, 2016(3): 17-26.

Note: Figure translations are in progress. See original paper for figures.