Postprint: Research on a Cross-Boundary Integration-Based Model for Government Data Open Sharing

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Abstract

[Purpose/Significance] This study aims to explore the intrinsic mechanisms and models of government data openness and sharing, thereby promoting data flow and deep mining, releasing greater data dividends, creating greater public value, and providing reference for government data management. [Methods/Process] Employing research methods such as questionnaire surveys and in-depth interviews, measurement scales were designed and empirical analysis was conducted. Upon verifying the relationships among relevant variables, a multi-party collaborative government data openness and sharing model based on cross-boundary integration was constructed and elaborated. [Results/Conclusions] There exists a significant correlation among platforms, data, mechanisms, and performance outputs. At the current stage, the unified government data openness and sharing platform should be enhanced, government data management based on the entire data lifecycle should be innovated, and cross-boundary data integration should be realized, laying a foundation for promoting government data openness and sharing and “data-driven” development.

Full Text

Preamble

Research on a Cross-Boundary Integration Model for Government Data Opening and Sharing

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Abstract

[**Purpose/Significance**] This study aims to explore the internal mechanisms and patterns of government data opening and sharing to promote data flow and deep mining, release greater data dividends, create greater public value, and provide references for government data management. [**Method/Process**] Using questionnaire surveys, in-depth interviews, and other research methods, we designed measurement scales and conducted empirical analysis. Based on verification of the relationships among relevant variables, we constructed a multi-party collaborative model for government data opening and sharing based on cross-boundary integration and elaborated on this model. [**Result/Conclusion**] There exists a significant correlation among platform, data, mechanism, and performance output. At the current stage, efforts should focus on improving the unified government data opening and sharing platform, innovating government data management based on the full data lifecycle, and achieving cross-boundary data integration to lay the foundation for promoting government data opening and sharing and "data-driven" development.

Keywords: government data; cross-boundary integration; open and sharing; model

Introduction

With the development of new-generation information technology, big data is integrating into economic and social development at an unprecedented speed, breadth, and depth, bringing reconstruction to production organization methods and social production factors, significantly improving economic operation levels and efficiency, stimulating business model innovation and new business format growth, and becoming a new driver for creating new momentum and promoting economic transformation. Big data also plays a vital role in enhancing government governance capabilities. Currently, China's big data development faces challenges such as inconsistent data format specifications, insufficient data openness and liquidity, imperfect data ownership systems, and relatively lagging data governance, which constrain the implementation of the "Cyber Power" and "Digital China" strategies in the new era. The government possesses vast amounts of data resources but still faces the "information silo" problem. Therefore, exploring a government data opening and sharing model based on cross-boundary integration to release more data dividends represents an important research topic worthy of in-depth investigation.

This paper defines "cross-boundary integration" (trans-boundary integration) as the process of crossing boundaries created by differences in organization, industry, institution, language, and culture, opening up to each other, accessing each other's data, information, and knowledge, and developing and utilizing them. Government data opening and sharing (open & share government data) refers to the process of opening massive amounts of raw data held by government departments to society in "machine-readable" form through data platforms, making it

easily accessible, obtainable, usable, transformable, and shareable for the public. Its basic model includes not only one-way government data transfer but also two-way opening and reciprocal development across departments, organizations, and boundaries. Its scope covers non-confidential public domains such as credit, education, healthcare, sanitation, employment, social security, science and technology, transportation, quality, statistics, and enterprise registration and supervision. Its purpose is to break boundary barriers that hinder data flow, drive society to conduct value-added and public welfare data development activities through data interconnectivity, and achieve data-driven development.

Promoting economic and social development through government data opening and sharing has become a global trend receiving increasing attention. The United States issued the Open Government Directive in 2009, defining principles for government data opening and establishing and operating the Data.Gov platform. The United Kingdom, Canada, France, Norway, Australia, South Korea, Singapore, and other countries have also established government data opening platforms. China's government data opening and sharing started relatively late; Shanghai first launched the "Shanghai Government Data Service Network" trial operation in 2012, followed by Beijing, Guangdong, Wuhan, Guizhou, and other localities. In August 2015, the State Council issued the "Outline for Promoting Big Data Development," proposing to accelerate government data opening and sharing, promote resource integration, and enhance governance capabilities. In July 2016, the "National Informatization Development Strategy Outline" proposed building a unified, standardized, interconnected, and secure national data opening system.

1. Literature Review and Research Hypotheses

Current domestic and international scholars have conducted extensive research on the organizational management, platform construction, and policy frameworks of government data opening and sharing. The following reviews the objectives, influencing factors, and methods of government data opening and sharing.

1.1 Cross-Boundary Integration: The Goal of Government Data Opening and Sharing

Cross-boundary is a common concept in organizational theory research. It can provide organizations with diversified knowledge sources, enable data and information resource interaction with the outside world, and obtain sustainable competitive advantages, but it also creates certain obstacles for inter-organizational data opening, knowledge transfer, and resource sharing. In different contexts, cross-boundary integration and data information opening and sharing interact with each other, ultimately helping to promote innovation. For example, Ge Baoshan et al. proposed that achieving cross-organizational data opening and mutual learning can generate novel ideas; T.H. Malik proposed the concept of

crossing institutional barriers; E.H. Hwang et al. proposed crossing geographical and social class differences; and K.L. Lepik proposed that cross-border exchanges help promote data information opening and sharing, knowledge transfer, and cross-boundary integration.

Cross-boundary integration is the driving force and important goal of government data opening and sharing, contributing to data mining and performance output at government, enterprise, and social levels. First, government policy-making and governance capability improvement require data opening and sharing across departments, between government and enterprises, and between government and society. By building high-level data interaction platforms and releasing datasets of certain scale, governments can more accurately grasp public needs and ensure more transparent decision-making based on sufficient data and facts, thereby better fulfilling administrative functions. For example, data opening in credit, transportation, healthcare, meteorology, education, and employment can not only facilitate public daily life but also improve government decision-making precision and work efficiency. Second, enterprise development has an increasing demand for data, requiring acquisition and integration of large amounts of external data to obtain continuous information and technical support and enhance innovation momentum. Third, the UK has proposed the concept of "data rights," viewing it as a basic right of modern citizens in the information society, requiring governments to regularly publish datasets according to certain standards and allow public application and use. Public awareness of the right to know is continuously increasing, and data information opening and sharing can narrow the information gap between the public and government, enhance social participation in government decision-making and social governance, and promote transparent government and democratic politics. Only through government data opening and sharing can the people effectively exercise their supervisory rights and ensure public power operates in the sunshine. Additionally, data opening and sharing can drive data development and utilization, further tap innovation potential, promote industry division of labor in data statistics, storage, cleaning, processing, mining, and utilization, and promote big data analysis and related information industry development to achieve greater public interest and social value.

1.2 Boundary Obstacles: Influencing Factors of Government Data Opening and Sharing

Boundary obstacles refer to the organizational, institutional, technical, and environmental constraints that government data opening and sharing face due to boundary differences among different departments, organizations, and individuals, which are not conducive to data flow and integration development at government, enterprise, and social levels. In terms of organizational obstacles, different organizations usually have different thinking modes, which often create barriers to communication, knowledge transfer, and even goal conflicts. P.R. Carlile proposed that cross-boundary knowledge has three attributes: dif-

ference, dependence, and novelty. Difference drives organizations to acquire and share knowledge from each other; dependence refers to the matching between different knowledge, which is the condition for cooperative development of common knowledge; novelty often reduces the role of common knowledge and increases organizations' need to identify unknown knowledge. A.L. Dain and V. Merminod pointed out that cross-boundary opening and sharing need to address three aspects: knowledge transfer across syntactic boundaries, knowledge translation across semantic boundaries, and knowledge transformation across application boundaries. G.Z. Felipe et al., through empirical analysis of different participants' views on government data opening, found that government officials, public sector practitioners, politicians, and international organizations typically have far more power over data opening than donors, ICT suppliers, social activists, and scholars, but with opposite interests.

In terms of institutional obstacles, W.N. Dunn proposed that policy is an important factor affecting government data opening and sharing. Data collection and problem definition are the starting points of policy argumentation. Policy information generated and transformed in the political environment constitutes the arguments controlled by policy analysts to solve public problems. In terms of technical obstacles, S. Dawes et al. proposed that the degree of public access to government data, completeness, priority, timeliness, convenience of physical and electronic access, machine readability, and licensing to place data in the public domain are important factors affecting government data opening. In terms of environmental obstacles, T.T. Nguyen proposed that cultural dislocation between organizations in different social cultures creates boundary challenges for knowledge flow and inter-organizational learning, and knowledge transfer and absorption from different social cultures face great difficulties. Cultural differences can even lead to organizational conflicts, affecting cross-boundary knowledge exchange. K. Janssen proposed that ignoring the value of data to others is a major challenge for government data opening.

1.3 Breaking Boundaries: Methods for Government Data Opening and Sharing

Breaking boundary obstacles, promoting government data opening and sharing, and driving data mining and performance output at government, enterprise, and social levels mainly explore methods from three aspects: platform, data, and mechanism. Regarding "platform," the emphasis is on what models and carriers data opening and sharing should have, which are the basic conditions for realizing government data opening and sharing. Jiang Nan proposed a government cloud service model based on linked data and analyzed the model's construction principles, operation mechanisms, and hierarchical content. Cui Hongming et al. analyzed the implications of New York City's data opening plan for Chinese government from the perspectives of terminals, platforms, and utilization methods. Zhou Junjie conducted research on data opening scope, opening sequence, platform functions, and user experience from a demand-oriented perspective,

drawing on US experience.

Regarding "data," the emphasis is on standardizing and unifying data quality, type, format, and other standards, which are the basic elements for realizing government data opening and sharing. A. Zuidervijk et al. proposed standards for government data opening principles, quantity, type, format, metadata provision, target groups, utilization types, technical support, data quality, and non-open data types. J.C. Bertot proposed a basic framework for government data opening composed of data privacy, reuse, accuracy, accessibility, archiving and preservation, supervision, platform and architecture, standards, and cross-departmental data sharing systems. N. Veljkovic et al. proposed an indicator system for government data opening, including basic datasets, data openness, transparency, subject participation, and collaboration.

Regarding "mechanism," the emphasis is on organizational management methods and supporting measures for government data opening and sharing and cross-boundary integration, which are important guarantees for realizing government data opening and sharing. Data resource sharing depends on effective knowledge sharing management activities and a cooperative, trusting, and motivating cultural atmosphere. T.M. Harrison et al. analyzed government data opening from an "ecosystem" perspective, proposing to build a social system of interdependence among actors, organizations, infrastructure, and symbolic resources. D.S. Sayogo et al. analyzed three aspects affecting the degree of government data opening: government data opening principle indicators, data control capabilities, and user participation capabilities. Huang Simian proposed policy recommendations such as improving the regulatory system, promoting data opening platform construction, promoting marketization of government data production, and improving the assessment and evaluation system. Additionally, some experts and scholars have proposed management countermeasures such as policy environment analysis, top-level design, data opening legislation, system improvement, guarantee mechanism construction, data security, personal privacy protection, and government data opening ecosystem construction.

Based on the above literature review, this paper proposes the following hypotheses:

H1a: Government data opening and sharing platform construction is positively correlated with government, enterprise, and social data mining performance output.

H1b: Data quality standards, collection organization, and safety supervision are positively correlated with government, enterprise, and social data mining performance output.

H1c: Cross-boundary integration opening and sharing mechanisms are positively correlated with government, enterprise, and social data mining performance output.

H2a: Cross-boundary integration opening and sharing mechanisms positively

moderate the impact of government data opening and sharing platform construction on government, enterprise, and social data mining performance output.

H2b: Cross-boundary integration opening and sharing mechanisms positively moderate the impact of data quality standards, collection organization, and safety supervision on government, enterprise, and social data mining performance output.

Based on the above, this paper constructs a conceptual model as shown in Figure 1 [Figure 1: see original paper].

2. Research Design and Results Analysis

2.1 Research Methods and Process

This study adopted structured questionnaire surveys, in-depth interviews, and expert consultation methods to collect first-hand data and information from government departments, enterprises, universities, research institutes, and the public to comprehensively reflect the current situation and main expectations of government data opening and sharing. Relevant academic literature was searched through CNKI, while policy texts, reports, news, and public comments on government data opening and sharing were searched through search engines and government official websites. The research process followed steps of problem perception, problem search, problem definition, and problem clarification to conduct in-depth material analysis and problem construction.

The questionnaire survey aimed to understand relevant groups' cognition, expectations, and suggestions on government data opening and sharing to address the "information silo" problem. Survey respondents were mainly distributed in Beijing, Tianjin, Shandong, Jilin, and other provinces and municipalities, with occupations including civil servants, scientific and technical personnel, teachers, graduate students, enterprise R&D technicians, and legal workers, covering senior, intermediate, junior, and operational positions. The questionnaire design included 27 questions on opening and sharing attitudes and behaviors, opening and sharing data and platforms, operation mechanisms and supporting conditions, and data development and application, as well as respondents' personal characteristic information. From August to September 2017, 200 questionnaires were distributed, and 178 valid questionnaires were collected. Sample information was analyzed through quantitative statistical analysis and qualitative research. SPSS 22.0 software was used to test the consistency, stability, and reliability of data results through internal consistency analysis to determine whether the scale design was reasonable. Principal component analysis was used for exploratory factor analysis, AMOS 7.0 software and structural equation modeling were used for confirmatory factor analysis, chi-square tests were used to discriminate variable test validity, and hierarchical regression analysis was used to verify relevant hypotheses, thus laying the foundation for model construction.

For interviews, 13 representative individuals were selected as interviewees to discuss the necessity, existing problems, methods, and countermeasures of government data opening and sharing, with an average interview duration of about 43 minutes. Combined with expert consultation in the data management field, interview content was systematically organized, coded, and modeled.

2.2 Variable Measurement Index System

Referring to measurement indicators proposed by domestic and foreign scholars and combining some interview and expert consultation content, we designed a variable measurement index system for government data opening and sharing to analyze its internal mechanism. As shown in Table 1 , the relevant variable measurement index system is divided into three observation dimensions (first-level indicators), 12 variable profiles (second-level indicators), and 27 relevant variable measurement items (third-level indicators). A 5-point Likert scale was used to assign values to each variable, followed by statistical analysis and refinement to further analyze the relationship between explained and explanatory variables.

2.3 Reliability and Validity Test

Before hypothesis verification, we tested the internal consistency reliability, convergent validity, and discriminant validity of the measurement model using Cronbach's coefficient to ensure the adequacy and appropriateness of each multi-item scale in measuring specific concepts. Table 2 presents the results of exploratory factor analysis for all variables, showing that all factor loadings and reliability values are above 0.7, meeting acceptable levels recommended by relevant research and indicating good reliability and internal consistency of the scale.

2.4 Simple Correlation Analysis

Pearson correlation analysis was used to test variables in the model. As shown in Table 3 , according to relevant criteria, platform (government data opening and sharing platform construction), data (data quality standards, collection organization, safety supervision), mechanism (cross-boundary integration opening and sharing mechanism), and performance output (government, enterprise, and social data mining performance output) all show significant positive correlations at the 0.01 level, preliminarily indicating that the conceptual model and research hypotheses are reasonable.

2.5 Hypothesis Verification and Results Analysis

Multiple linear regression analysis was used to test the relationships among platform, data, mechanism, and performance output. Hierarchical regression analysis results show that the non-standardized regression coefficients of platform, data, and mechanism corresponding to performance output are 0.34, 0.21, and 0.29 respectively, with significance p-values all less than 0.01, indicating

that these variables have significant positive impacts on performance output, supporting original hypotheses H1a, H1b, and H1c. “Platform” is the primary factor affecting data opening and sharing. The effectiveness and efficiency of data opening and sharing are first affected by organizational boundaries. A unified government data opening and sharing platform is the basic condition for promoting data cross-boundary opening and sharing.

Second, data value increases with data convergence and interconnection. Data scale and correlation impose a series of requirements on data quality standards, types, quantity, and security, such as maintaining originality, integrity, timeliness, machine readability, accessibility, non-exclusivity, non-discrimination, and license-free characteristics. Government data sources include different levels of government departments and business systems, covering numerous fields such as economy, transportation, medical care, education, credit, and environment, with diverse and complex data formats, metadata, or descriptions. Large amounts of data remain in paper form in archives without digitization, objectively making interconnectivity between different datasets difficult. For example, currently data opened via API lacks semantic support and has many usage limitations, while web-based portals only have browsing and retrieval functions, with insufficient cross-referencing among multi-source data, making it difficult to achieve intelligent and automated big data analysis and deep mining. Therefore, we should strengthen data quality standard management, data collection organization, and data safety supervision to eliminate or reduce technical barriers for free data flow.

Under the moderating effect of cross-boundary integration opening and sharing mechanisms, the non-standardized regression coefficients of platform and data corresponding to performance output are 0.41 and 0.37 respectively, with significance p-values less than 0.05, indicating that the impact of these two explanatory variables is significantly enhanced under the moderating variable, showing a stronger positive correlation with performance output, thus supporting original hypotheses H2a and H2b. This also reflects that the moderating effect of mechanism is relatively significant. Therefore, cross-boundary integration opening and sharing mechanisms should be integrated into all aspects of government data opening and sharing platform construction and data quality standard management, data collection organization, and data safety supervision. Cross-boundary integration opening and sharing mechanisms mainly originate from policies and institutional regulations and behavioral patterns under the influence of sharing culture and attitudes. Policy is the key factor in government data opening and sharing, which cannot be achieved without government promotion. Globally, government data opening is invariably driven by national top-level design with national policy as the fundamental guide. Without clear policy decisions, government data opening and sharing cannot be discussed. Institutions and legal systems are also indispensable factors. China’s current government data opening and sharing mainly relies on the “Regulations on Open Government Information,” which plays a guiding role in implementing government information disclosure. However, due to its low legislative level, it has no

universal legal effect on government data opening, making it difficult to support the target demands of government data opening and sharing, and needs further improvement in specifying open data types, data security, business secrets, and personal privacy. From data opening, cooperation, acquisition, and utilization to forming valuable datasets, each link including storage, cleaning, analysis, mining, processing, and utilization requires corresponding regulations, institutions, and technical standards.

Moreover, under the influence of different social cultures, organizational cultures, thinking modes, and values, the lack of common ground in inter-organizational or personnel communication creates ambiguity and complexity regarding cross-organizational knowledge and information resources, posing obstacles to data information opening and sharing. From the government perspective, data disclosure may expose confidential information and imperfections in government work, potentially negatively affecting state secret protection, social security and stability, and government credibility. Therefore, governments often avoid data disclosure on the grounds of "confidentiality" or "inappropriateness for disclosure." Some departments fail to truly recognize the importance of data opening and, considering departmental interests, treat their data as exclusive "family assets" and "heirlooms" unwilling to open and share. Government departments' conservative tendencies toward data opening make cross-boundary integration difficult to initiate, let alone advance. Some staff adopt a "the less trouble the better" and "not my business" attitude, being conservative and lacking initiative in data opening and sharing. If government staff's mindsets are not properly aligned, mandatory implementation of government data disclosure usually results in inefficient outcomes that hinder progress. Additionally, inconsistent development levels across industries, localities, and regions also affect dataset effectiveness. Citizen information freedom rights, personal privacy, intellectual property rights, and public participation are also important influencing factors. These consciousness and environmental factors concern whether data opening can be smoothly realized and further affect the smooth progress of cross-boundary integration.

3. Government Data Opening and Sharing Model Construction

Based on the above research and combined with the practical background and application needs of government data opening and sharing, we designed a multi-party collaborative model for government data opening and sharing based on cross-boundary integration (Figure 2 [Figure 2: see original paper]) to grasp the internal mechanism of government data opening and sharing. The model is divided into three stages: data opening and sharing, data development and utilization, and innovation performance output, with "platform" and "data" as two key components, and "mechanism" acting on all aspects of "platform" and "data" and the entire process of data flow operation. Unlike traditional models where subjects in data and knowledge transfer typically have a one-way

provider-receiver relationship, in this cross-boundary integration-based model, different subjects have an interactive, co-construction, and sharing relationship, focusing on multi-party interaction and data flow effectiveness by integrating "mechanism" into the two key components of "platform" and "data."

3.1 Open Sharing Data Platform and Its Operation Path

A unified government data opening and sharing platform is an important basic condition for government data opening and sharing. In recent years, China has continuously increased its promotion of government data opening and sharing with remarkable results, but the degree of opening and sharing still lags behind some developed countries. Achieving government data opening and sharing begins with platform construction. Currently, efforts should focus on overcoming boundary obstacles caused by differences in organization, institution, technology, and environment, gradually eliminating information barriers, integrating existing network platform resources at all levels and departments, and establishing a unified government data opening and sharing platform (see Stage I in Figure 2). Specifically, we can unify the data platform in terms of content, technology, and management, improve the government system's co-construction and sharing database, form several comprehensive government data processing centers to undertake inter-governmental network resource connectivity and matching functions, and make them effective data resource distribution centers. Simultaneously, according to public data needs, ensure consistency in data opening standards across different departments, establish a public-oriented government data opening and sharing platform to facilitate basic operations such as query, application, upload, and inquiry on a unified network platform (Figure 3 [Figure 3: see original paper]), and gradually enhance public participation through incentive measures.

In the platform construction stage, we should ensure data standardization early on, reflecting refined and interactive basic characteristics to create conditions for breaking boundaries and reshaping, which requires: unifying data caliber to ensure data standardization, accuracy, and consistency, achieving interconnectivity among multiple different databases; facilitating public access and query, continuously innovating personalized data services; strengthening backend platform management to ensure high-quality and efficient government data operation throughout the process; improving government data openness and interactivity, strengthening technical cooperation with specialized third parties in non-confidential fields for efficient utilization of government data resources, while emphasizing public participation and continuous optimization.

3.2 Open Sharing Data Management Model

Data and its metadata are the basic elements of government data opening and sharing, important content affecting government data management, data opening and flow, data rights realization, data ownership relations, and public participation. At the current stage, due to relatively low government data open-

ing degree in China and the diverse and complex characteristics of data types, formats, sources, and distribution fields, to reduce the difficulty of data publication and improve the efficiency of government data opening and sharing, we should mobilize the enthusiasm of multi-party collaborative participation and co-construction, build multi-party co-construction and sharing databases with government, third-party, and public participation, and form a unified data development and utilization mechanism integrating data acquisition and utilization, development and mining, and data value-added that interacts positively with support systems (data technology, intermediary services) and external knowledge (see Stage II in Figure 2). Data management based on the full lifecycle is the entire process of government data opening and sharing, mainly divided into three interacting data operation modules: data publication and maintenance, data organization and management, and data acquisition and utilization. These jointly support the operation of the government open sharing data platform, forming a multi-party participatory open sharing data management model (Figure 4 [Figure 4: see original paper]), promoting data mining, innovation output, and transformation application to further meet the data needs of different subjects including government, enterprises, universities, research institutes, and the public (see Stage III in Figure 2).

In the open sharing data management model, the three data operation modules have the following main division of tasks: The data publication and maintenance module is dominated by government agencies to standardize unified metadata vocabulary description, undertake government data management functions, collect, manage, use, occupy, and publish data according to prescribed procedures, and support data browsing, retrieval, and download services; The data organization and management module should encourage third-party institutions, open communities, and research institutions to actively participate in data organization, standardization, transformation, and association to continuously optimize and improve data quality; The data acquisition and utilization module directly faces the public, providing data services such as semantic retrieval, association query, data preview, and interactive analysis. Additionally, the main functions, required supporting technologies, and tools for each module are shown in Table 4 .

4. Conclusion and Outlook

This study addresses the practical conditions and application needs of government data opening and sharing, comprehensively utilizing structured questionnaire surveys, in-depth interviews, and expert consultation methods to design relevant variable measurement indicators. Through quantitative statistical analysis and qualitative research, we analyzed the mechanism of action among variables and designed a multi-party collaborative model for government data opening and sharing based on cross-boundary integration.

(1) There exists significant correlation among “platform,” “data,” “mechanism,” and “performance output.” “Platform” is the primary factor af-

fecting data opening and sharing. The effectiveness and efficiency of data opening and sharing are first affected by organizational boundaries. A unified government data opening and sharing platform is the basic condition for promoting data cross-boundary opening and sharing. "Data" quality standards, collection organization, and safety supervision are the basic elements promoting free data flow. "Mechanism" is an important guarantee for government data opening and sharing, running through the entire process of data quality standard management, collection organization, and safety supervision.

(2) Combining the practical background and application needs of government data opening and sharing, constructing a multi-party collaborative model for government data opening and sharing based on cross-boundary integration helps provide theoretical and methodological references for planning and constructing government data opening and sharing platforms, promoting data opening and sharing, development and utilization, and performance output. At the current stage, China should improve the unified government data opening and sharing platform, innovate government data management based on the full data lifecycle, achieve cross-boundary data integration, and lay the foundation for promoting government data opening and sharing and "data-driven" development.

Government data opening and sharing issues have certain complexity. Some long-accumulated problems in the government information disclosure process, such as personal privacy protection, conflicting target demands, and low public participation, have not been properly resolved. Additionally, government data opening faces challenges such as data security, network security, and system security, further increasing the difficulty. How to effectively prevent security risks from government data opening and sharing, reduce technology's negativity and risk uncertainty, while designing scientific and reasonable data management models and operation guarantee mechanisms to promote free data flow, development and utilization, and innovative application, form a government-industry-university-research-application multi-party linked data industry ecosystem, and achieve "data-driven" economic and social development requires in-depth follow-up research.

References

[1] STENSAKER IG, GOODERHAM PN. Designing global leadership development programmes that promote social capital and knowledge sharing[J]. European journal of international management, 2015, 9(4): 442.

[2] State Council. Notice on Issuing the "Outline for Promoting Big Data Development"[EB/OL]. [2017-04-18]. http://www.gov.cn/zhengce/content/2015-09/05/content_{10137}.htm.

[3] General Office of the CPC Central Committee, General Office of the State Council. "National Informatization Development Strategy

Outline"[EB/OL]. [2017-09-18]. http://news.xinhuanet.com/fortune/2016-07/27/c_{1119291902}.htm.

[4] TORTORIELLO M, KRACKHARDT D. Activating cross-boundary knowledge: the role of Simmelian ties in the generation of innovations[J]. Academy of management journal, 2010, 53(1): 167-181.

[5] GE Baoshan, SHENG Fan, LI Jun. Research on knowledge sharing model and operation mechanism of cross-boundary entrepreneurship[J]. Library and information service, 2016, 60(14): 24-31.

[6] MALIK TH. National institutional differences and cross-border university-industry knowledge transfer[J]. Research policy, 2013, 42(3): 776-787.

[7] HWANG EH, SINGH PV, ARGOTE L. Knowledge sharing in online communities: learning to cross geographic and hierarchical boundaries[J]. Organization science, 2015, 26(6): 1593-1611.

[8] LEPIKK L, KRIGUL M. Challenges in knowledge sharing for innovation in cross-border context[J]. Dissertations & theses, 2014, 5(4): 332-343.

[9] HM GOVERNMENT. The coalition: our programme for government[R]. Cabinet Office, 2010.

[10] CARLILE PR. Transferring, translating, and transforming: an integrative framework for managing knowledge across boundaries[J]. Organization science, 2004, 15(5): 555-568.

[11] DAIN M AL, MERMINOD V. A knowledge sharing framework for black, grey and white box supplier configurations in new product development[J]. Technovation, 2014, 34(11): 688-701.

[12] FELIPE GZ, RICHARD H. The multiple meanings of open government data: understanding different stakeholders and their perspectives[J]. Government information quarterly, 2015, 32(4): 441-451.

[13] Dunn. Introduction to public policy analysis[M]. Translated by XIE Ming, DU Zifang, et al. 2nd ed. Beijing: China Renmin University Press, 2010: 119-162.

[14] DAWES S, VELJKOVIC N, PARKHIMOVICH O. Planning and designing open government data programs: an ecosystem approach[J]. Government information quarterly, 2016, 33(1): 15-27.

[15] NGUYEN TT. Knowledge transfer across dissimilar cultures[J]. Journal of knowledge management, 2013, 17(1): 29-46.

[16] AHAMMAD MF, TARBA SY, LIU Y, et al. Knowledge transfer and cross-border acquisition performance: the impact of cultural distance and employee retention[J]. Cancer, 2016, 86(8): 1455-1462.

[17] JANSSEN K. The influence of the PSI directive on open government data: an overview of recent developments[J]. Government information quarterly, 2011,

28(4): 446-456.

[18] JIANG Nan. Research on government cloud service model based on linked data[D]. Wuhan: Central China Normal University, 2015.

[19] CUI Hongming, BAI Wenlin. Analysis of New York City data opening plan and its implications for China's government information disclosure[J]. Information studies: theory & application, 2014(5): 140-144.

[20] ZHOU Junjie. Demand-oriented research on Chinese government data opening[J]. E-government, 2014(12): 61-67.

[21] ZUIDERWIJK A, JANSSEN M. Open data policies, their implementation and impact: a framework for comparison[J]. Government information quarterly, 2014, 31(1): 17-29.

[22] BERTOT JC, CHOI H. Big data and e-government: issues, policies, and recommendations[C]// Proceedings of the 14th annual international conference on digital government research. New York: ACM, 2013: 1-10.

[23] VELJKOVIC N, BOGDANOVIC DINIC S, STOIMENOV L. Benchmarking open government: an open data perspective[J]. Government information quarterly, 2014, 31(2): 278-290.

[24] LEPIKK L, KRIGUL M. Challenges in knowledge sharing for innovation in cross-border context[J]. Dissertations & theses, 2014, 5(4): 332-343.

[25] HARRISON TM, PARDO TA, COOK M. Creating open government ecosystems: a research and development agenda[J]. Future Internet, 2012, 4(7/8): 900-928.

[26] SAYOGO DS, PARDO TA, COOK M. A framework for benchmarking open government data efforts[C]// Proceedings of the 2014 47th Hawaii international conference on system sciences. Piscataway: IEEE, 2014: 1896-1905.

[27] HUANG Simian, ZHANG Yanhua. Research on current problems and countermeasures of Chinese government data opening platform construction: taking Beijing and Shanghai government data opening websites as examples[J]. China management informationization, 2015(14): 175-177.

[28] MA Haiqun, WANG Hongshuai. SLEPT analysis and strategic deployment of China's government open data strategy[J]. Information science, 2016, 34(3): 3-8.

[29] Research Group of China Administration Society. Research on top-level design of China's government data opening[J]. Chinese public administration, 2016(11): 6-12.

[30] ZHANG Yijing. Global practice from information disclosure to data opening: concurrent discussion on sustainable development of Shanghai's construction of "government data service network"[J]. Information studies: theory & application, 2016(9): 25-29.

[31] XIA Yi, DING Nian. Impact of open government data development on government information activities[J]. Information studies: theory & application, 2015(12): 1-6.

[32] YUE Lixin, LIU Wenyun. Research on construction of guarantee mechanism for China's government data opening[J]. Library and information service, 2016, 60(19): 40-48.

[33] SUN Yanming, ZHAO Shukuan, WANG Long, et al. Research on science and technology resource sharing mechanism from collaborative innovation perspective[J]. Science and technology management research, 2017, 37(13): 1-8.

[34] WANG Bengang, MA Haiqun. Policy analysis of open data security issues[J]. Information studies: theory & application, 2016(9): 25-29.

[35] ZHANG Xiaojuan, WANG Wenqiang, TANG Changle. Research on policies and regulations of government data opening and personal privacy protection in China and the US[J]. Information studies: theory & application, 2016, 39(1): 38-43.

[36] DILIA. Research on personal data protection in deep opening of government data[J]. Library, 2016(6): 54-58, 64.

[37] GU Tiejun, XIA Yuan, XU Kewei. Exploration of Shanghai municipal government's sustainable development from information disclosure to data opening: based on practical investigation of 49 government department websites and Shanghai government data service network[J]. E-government, 2015(9): 14-21.

Author Contributions:
Zhang Fujun: Determined research methods, organized questionnaire surveys and interviews.
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Zhao Shukuan: Proposed research ideas, determined research framework, guided and revised the paper.
Li Xia: Collected literature, collected and processed data.

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