The Organization Model of Big Data Innovation Alliance: A Multi-Case Study from the Perspective of Virtual Clusters

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Abstract. The Big Data Innovation Alliance can be understood as a cross-industry and cross-region spatial agglomeration phenomenon based on Big Data. From the two aspects of constituent elements and organizational characteristics, the Big Data Innovation Alliance is found to be a learning organization with a flat management structure. A multi-case study method is used to empirically test the virtual cluster characteristics of the big data innovation alliance organization model using four typical cases, and to analyze its generality and specificity based on the research variables. Several policy implications have been obtained for the big data innovation alliance organization model.

Keywords: Innovation alliance; Virtual cluster; Constituent elements; Organizational characteristics; Multiple case studies.

1. Introduction
In recent years, the Big Data Innovation Alliance has received widespread attention and rapid development, but research on its efficient organization model is still weak. From the perspective of industrial clusters, we believe that the big data innovation alliance can be regarded as a cross-industry and cross-region industrial agglomeration phenomenon based on big data. The characteristics of cross-region, cross-industry and complex systems of big data make the traditional industrial cluster model unable to meet the requirements of big data innovation activities. The virtual cluster breaks the geographical and industry restrictions of traditional clusters on the subject of technological innovation, overcomes the rigidity of the industrial organization formed by the solidification of innovation paths, and better promotes cross-regional and cross-industry integration of resources, technologies, and knowledge. Therefore, the exploration of the organization model of big data innovation alliances based on the perspective of virtual clusters has become a realistic issue. Based on the above assumptions, this article will take a multi-case study approach to conduct an empirical analysis of the organizational model of the Big Data Innovation Alliance. The follow-up arrangement of the paper is as follows: Section 1 defines the research variables of the paper based on the characteristics of the virtual cluster of the Big Data Innovation Alliance; Section 2 introduces the case; Section 3 summarizes the constituent elements of the Big Data Innovation Alliance through case analysis, Organizational characteristics, and analysis of its generality and particularity; Section IV is policy recommendations and research prospects.

2. Theoretical Definition and Variable Definition
Theoretical definition. From the review of the existing literature, few documents organize and study the organization model of the Big Data Innovation Alliance from the perspective of virtual clusters.
However, from the case data we have collected, the existing domestic big data innovation alliance can be abstracted into a virtual cluster-type technology innovation model. For example, the first China Smart Tourism Industry Alliance, the core of which is "Smart Tourism", aims to build an integrated platform for smart tourism planning, investment, construction, operation and service. As another example, the Agricultural Big Data Industry Technology Innovation Alliance uses the "forecast" value of big data to establish an agricultural big data innovation platform. For another example, the China Industrial Big Data Innovation and Development Alliance takes full advantage of Beijing's developed physical geography and information technology to realize data-based, system-level industrial intelligence. In addition, the China Healthcare Big Data Industry Alliance breaks the "geographical concentration" of industrial clusters and achieves cross-industry and cross-region integration of medical big data. There are many similar examples. Due to space limitations, I will not repeat them here.

From the above actual phenomena, it can be seen that these four types of big data innovation alliances that belong to different industries, and their technological innovation activities are undertaken by the government, enterprises, colleges and universities, scientific research institutions, and auxiliary institutions, respectively, at different stages of the innovation chain. The task, each innovation subject is geographically concentrated and decentralized, and forms a continuously operating innovation network through modern information technology, common goals, and good operating mechanisms. This characteristic is consistent with the essential attributes of virtual clusters. Therefore, it can be considered that the characteristics of virtual clusters are common in big data innovation alliances in various industries. Virtual clusters should become a new perspective for studying the organizational model of big data innovation alliances. Based on this, research variables can be defined from the perspective of virtual clusters, and Start an empirical analysis of the organization model of the Big Data Innovation Alliance.

**Variable definitions.** Based on the foregoing analysis, this article selects the following two research variables to conduct an empirical test on the organizational model of the Big Data Innovation Alliance. From the perspective of virtual clusters, the generality and specificity of each research variable are summarized and analyzed.

1. Components. The constituent elements in modern Chinese refer to the indispensable factors that constitute things, and are the basic units that make up the system. In this paper, the constituent elements of the Big Data Innovation Alliance are mainly divided into five types: common goals, membership, operating mechanisms, connection methods, and network protocols.

2. Organizational characteristics. Effective organization features include clear goals, relevant skills, and good communication. This article analyzes the organizational model of the Big Data Innovation Alliance from two aspects: organizational structure and function, and organizational form.

### 3. Case Introduction

The more uniform understanding in academia is that case studies are suitable for studying the question of "how" and "why" [1]. Case selection requires not only greater typicality and extreme situations, but also unique research value [2]. Case studies can be divided into single case studies and multiple case studies [3]. Compared to a single case study, the number of cases required for a multi-case study is generally 4-10, which is more helpful to enhance the internal and external validity and reliability of the study [4]. This article is an exploratory study of the organization model of big data innovation alliances based on the perspective of virtual clusters. The nature of the problem belongs to "how" and "why", which is suitable for the case study method. Considering the validity and universality of the induction theory, the four typical cases in Table 1 are selected as the research objects. The case selection is mainly based on two criteria: first, the provincial, ministerial and industry levels are used as the dividing principle, as much as possible To broadly cover the relevant fields of the big data industry in order to improve the universality of the research conclusions. Second, as far as possible, select a typical big data innovation alliance to improve the relevance and representativeness of the case.
### Table 1. Basic situation of the research case.

| Alliance name                        | Industry scale                                                                 | Public research institute                                                                 | financial institute                                           | Government department                                      | Features                                                                                      |
|--------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| China Smart Tourism Industry Alliance| Provincial and municipal tourism bureaus, scenic spots, enterprises and institutions, financial institutions, etc. | China Tourism Research Institute, Tourism Research Center of Chinese Academy of Social Sciences, Tsinghua University Habitat Environment Information Laboratory, etc. | Cybergroup Investment Group, China Smart Tourism Industry Fund, etc. | Under the guidance of China Smart Tourism Promotion Association | China's first alliance organization with "smart tourism" as its core |
| Agricultural Big Data Industry Technology Innovation Strategic Alliance | Covers 15 provinces, municipalities and autonomous regions in China, and has five branches in North, Shanghai, Guangzhou, Zhengzhou, Lanzhou | Information Institute of Shandong Academy of Agricultural Sciences, Qingdao Agricultural University, Shanghai Key Laboratory of Data Science, Taishan Shennong Zhigu Big Data Industrial Park, etc. | Funds for scientific research projects, self-raised funds by enterprises, government funding, etc. | National Funding Committee, Ministry of Land and Resources, and 6 Shandong Provincial Departments | The first domestic alliance organization in the field of agricultural big data |
| China Healthcare Big Data Industry Alliance | "1 + 7 + X" health and medical big data development plan, build "safe" and "smart" health and medical big data application systems | National Health and Medical Open University, CLP Data Services Co., Ltd., Senyi Intelligence in the field of medical AI responsible for data governance, etc. | CLP Health Industry Fund, Chengdu Hesi Kangjian Investment Co., Ltd., etc. | Chinese Health Information Society co-founded | China's first national industry alliance focusing on medical big data industry and information security |
| China Industrial Big Data Innovation Development Alliance | Intelligent software promotes industrial transformation and upgrading | Beijing University of Aeronautics and Astronautics, including a total of 108 enterprises, federations and associations | Government funds, traditional enterprise funds, scientific research project funds, etc. | Ministry of Industry and Information Technology | Covers the entire industrial chain, the entire process and the industrial life cycle data chain |
Data sources commonly used in case studies include literature, archival records, interviews, direct observations, participatory observations, and physical evidence[5]. The data collection of the case in this article is mainly carried out according to the following steps: in the first stage, studying the relevant industry reports and consulting collection to find out the successful big data innovation alliance organizations; in the second stage, the collected big data innovation alliance cases In addition to reading papers, research reports and other documents, browse Baidu Encyclopedia, Wikipedia and other websites to collect widely required information; in the third stage, use triangle verification to confirm data quality, that is, researchers can use multiple sources of evidence and multiple research methods to reduce The effects of prejudice[6]. In the fourth stage, the verified Big Data Innovation Alliance case fragments are stitched together to obtain a complete case. It should be pointed out that due to the breadth and particularity of the distribution of the cases selected in this article, it is difficult to obtain the cases required for research through direct observation and field interviews. Table 1 is obtained by the author's screening and sorting based on the data collection. For each case in the table, the author obtains case information related to the analysis of this article from more than 2 different data sources (industry dynamic information, official website, news reports, etc.), and continuously expands the data according to the actual situation during the research process. The scope of collection to ensure that the relevant evidence is obtained as comprehensively as possible, so as to ensure the authenticity and objectivity of the data in the case.

4. Case Study

4.1. Generality of the Components of the Big Data Innovation Alliance
The generality of the constituent elements of the Big Data Innovation Alliance refers to its relatively universal nature, which is common to the traditional industry technology innovation alliance. Through analysis, the author believes that the general elements of the constituent elements of the Big Data Innovation Alliance mainly include four aspects.
(1) Technical innovation goals. Goals are the cornerstone of any organization’s existence and the driving force for its activities[7]. Both the Big Data Innovation Alliance and the Traditional Industry Technology Innovation Alliance are guided by a common technological innovation goal, arranging the resources necessary for organizational strategy, and coordinating the economic behaviors of the cooperating parties.
(2) Connection method. As can be seen from the case analysis in Table 1, the Big Data Innovation Alliance, like the traditional industry technology innovation alliance, is not a simple superposition of member units, but forms a network aggregate through specific information communication channels and paths.
(3) Network protocols. From the case analysis in Table 1, the four types of big data innovation alliances belonging to different industries have issued articles of association or signed contracts as binding documents for internal operations, clearly specifying the rights and obligations of member units, and entry and exit conditions.
(4) Operating mechanism. The operation mechanism of the Big Data Innovation Alliance refers to the internal operation mode on which technical innovation activities can be continuously and effectively carried out.
(5) Membership. The composition of the Big Data Innovation Alliance also conforms to the characteristics of the traditional industry technology innovation alliance, which mainly includes enterprises, government organizations, universities and research institutions, and auxiliary institutions such as production and consumption.

4.2. Particularities of the Components of the Big Data Innovation Alliance
Based on the case analysis in Table 1, the author believes that the constituent elements of the Big Data Innovation Alliance mainly reflect its particularity in terms of membership, especially the particularity of the specific functions undertaken by member units.
(1) Enterprise. The enterprise units used to form the Big Data Innovation Alliance must not only consider whether they are leading companies in the big data field or are expected to engage in the big
data industry in the future, but also whether they have heterogeneity and the ability to independently innovate as an entry. Necessary conditions for exiting the Big Data Innovation Alliance.

(2) Government departments. This article believes that government departments should focus on the soundness of laws and regulations in promoting the future development of the Big Data Innovation Alliance, especially on the acceleration of data opening and data privacy protection.

(3) Universities and scientific research institutions. For universities and research institutions in the Big Data Innovation Alliance, the focus of its future development should be on the following two points: First, it is necessary to attach great importance to accumulating and summing up prior knowledge related to big data, and to cultivate the scientific and technological means required for big data innovation All kinds of talents. The second is to train big data talents for enterprises in the form of elites, and realize a virtuous circle of "education in colleges, selection of alliances, and employment of enterprises".

(4) Supporting agencies. In terms of the characteristics of big data itself, auxiliary institutions are more important to help the innovation entities of the big data innovation alliance get complementary cooperation in terms of resource landing, and provide convenient Internet and financial services for alliance units and upstream and downstream enterprises in the industry chain. At the same time, assist the Big Data Innovation Alliance to build a social platform to solve the problem of information asymmetry among innovation subjects.

4.3. Generality of Organizational Characteristics of Big Data Innovation Alliances

(1) Organizational structure. This article believes that the general elements of the organizational structure of the Big Data Innovation Alliance mainly include three types: promoters, corporate brokers, and dynamic enterprise collections.

The sponsor. From the case analysis in Table 1, it is known that the technical standards and regulations represented by the forerunners are binding documents that the Big Data Innovation Alliance must follow in carrying out technological innovation activities.

Corporate Broker. For the case selected in this article, the enterprise broker is equivalent to an intermediary agency within the Big Data Innovation Alliance, and selects the most appropriate business unit from the Big Data Innovation Alliance to form a tight dynamic network alliance according to the technological innovation goals.

Dynamic enterprise collection. Each innovation subject of the Big Data Innovation Alliance is equivalent to one big data dynamic enterprise. In order to realize the technological innovation activities of big data, various resources are quickly connected according to market needs to form a stable and sustainable innovation system.

(2) Organizational structure. From the analysis of the cases in Table 1, it can be seen that each innovation subject of the Big Data Innovation Alliance will spontaneously learn knowledge in order to achieve technological innovation activities, and establish a continuous operation and flatness by reducing management levels and increasing management margins Management structure.

4.4. Special Features of Organizational Features of Big Data Innovation Alliance

The author believes that the particularity of the organizational characteristics of the Big Data Innovation Alliance is mainly reflected in the component of enterprise appraisers. Based on case analysis, this article understands the special features of the big data innovation alliance enterprise appraisers as two points: First, the current evaluation indicators on the processing and use of big data are not sound enough, relevant laws and policies are not perfect, and an independent evaluation agency is needed. Develop relatively standard evaluation criteria. Second, the evaluation agency must not only evaluate the specific contributions of the alliance units, but also evaluate the overall competitiveness of the big data innovation alliance. Therefore, the evaluation agency needs to be undertaken by a leading enterprise in the Big Data Innovation Alliance, or a third-party elite enterprise or even a government department. On the one hand, evaluation agencies need to have irreplaceable technological innovation capabilities. On the other hand, the index system established by the evaluation agency needs to have long-term stability.
5. Policy Recommendations and Research Outlook

5.1. Policy Suggestion
Since the research on the organization model of the Big Data Innovation Alliance is a new thing under the framework of the Industrial Technology Innovation Alliance, there is not much relevant experience for reference. The author believes that the future development of the Big Data Innovation Alliance should mainly consider the following two aspects.

5.2. Enterprise-led and Government-led Parallel
On the one hand, in addition to the need to establish a big data sharing platform in the future development of the Big Data Innovation Alliance, in particular, it is necessary to strengthen the introduction of leading companies with data analysis technology to better integrate and mine data resources in different dimensions. On the other hand, government departments and the Big Data Innovation Alliance themselves need to establish relatively complete laws and regulations to strengthen the understanding of Big Data and the Big Data Innovation Alliance from all walks of life in order to achieve the "benefit for everyone, innovation for everyone" Creative model.

5.3. Both Special and General
The author believes that the future development of the Big Data Innovation Alliance must not only meet the general principles of the Industrial Technology Innovation Alliance in the traditional sense, but also promote the improvement of the big data-based technology innovation system based on the heterogeneity of the field and industry. On the one hand, it shifts from universality to contextualization. Establish big data thinking across the entire population, thereby changing the behavior of innovative subjects. Targeted establishment of behavioral methods suitable for big data-based technological innovation activities is the prerequisite for the stable development of big data innovation alliances. On the other hand, it has shifted from bipolar orientation to organic integration. The future development of the Big Data Innovation Alliance organizational model is the dialectical unification of general and specific elements. While emphasizing the specific elements, the general elements cannot be ignored. First of all, based on the perspective of virtual clusters, the general elements of the two research variables sound constituent elements and organizational characteristics. Secondly, improve the work of big data privacy system, talent training, and innovation platform construction.

5.4. Research Outlook
This article combines the perspective of virtual clusters to conduct an exploratory research on the organizational model of big data innovation alliances, and analyzes the generality and particularity of big data innovation alliances and traditional industry technology innovation alliances from two research variables: constituent elements and organizational characteristics. However, due to the lack of available literature and theories, there may be deficiencies in research depth and breadth. Future research should more fully combine the practical characteristics of the big data industry and the advantages of virtual clusters, and conduct in-depth exploration of its operating mechanism and management methods based on the study of the organizational model of the big data innovation alliance.

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