Exploring Big Data Applications for Public Resource Transaction

To cite this article: Yu Hong Zhao and Yi Huan Huang 2018 J. Phys.: Conf. Ser. 1087 032010

View the article online for updates and enhancements.
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Abstract. This paper starts with the importance of public resource transaction, enumerates the current situation of large data application in the field of public resource transaction, analyzes the significance and function of big data application in this field, gives the big data application prospect of public resource transaction, proposes the general framework and technology overview of large data application based on public resource transaction management, and points out that the public resource transaction based on big data is the future direction of development.

1. Introduction
Public resources transactions involves a wide range, which covers the construction bidding, government procurement, the state-owned property rights transactions, land and mining rights trading, public hospital medicines and medical supplies procurement, the auction of the judiciary confiscated the goods, the state confiscated goods auction and auction of state funded transaction etc. It has the characteristics of wide coverage, trading volume, extensive social influences, public, service and government behavior dominating. In 2015, the national public resource trading platform to achieve the transaction amount of more than 20 trillion yuan. Moreover, In 2016, the total size of the transaction exceeded 23 trillion yuan. According to the national public resources trading platform website statistics, by the end of July, the total amount of various types of public resources transactions in 2017 has reached 26,514 cases. (The distribution ratio is shown in figure 1). In order to encourage the realization of electronic bidding, promotes public service platform for the market to exchange and share information, the State Council and the National Development and Reform Commission (NDRC) has issued the document of 《Electronic tendering and bidding measures》, 《Integration to Establish Bidding a Unified Platform for the Work of Public Resources Trading Program》. A system of public resources trading platform in the country to form the unified rules, open and transparent efficient service and supervision norms, the basic realization of the whole process of public resources trading electronically, paving the way for big data applications of public resources transactions. This is aimed at the nationwide formation of a unified system of unified rules, open and transparent, efficient service, supervision and supervision of the public resources trading platform system, the basic realization of the whole process of public resource transactions, for public resources transactions paved the way for big data applications.
2. The Application of Electronic Resources and the Development of Big Data in Public Source Transactions [1]

The public resource trading organizations in various cities have carried out the research and practice of big data application successively. By the end of 2016, Guizhou public resources trading big data application service platform formally launched, which became the country's first major data application platform in the field of public resource trading. Guizhou Public Resource Trading Center connects the 31 trading platform systems in the province, and it achieved the goal of "One network coverage, one rule lead, One database of experts sharing, One general certificate of the province", which creates a new pattern of public resources trading by Internet plus. On the basis of platform interconnection, the provincial public resource trading center not only brings all kinds of massive transaction data generated by all levels of public resource trading platform together, but also exchanges regulatory data of relevant industry authorities. Guizhou Public Resources Trading Center integrates big data resources of social enterprises, forming a trans-regional, cross-sectoral, inter-departmental, cross-time, cross-data sources of Guizhou public resource trading data center. It provides reliable data sources for big data applications.

Nanjing Public Resource Trading center uses big data technology to build "trading eye" module. According to the platform in the construction of engineering transactions set up dozens of monitoring points, and adopts the "red light, yellow light, blue light" way, in order to alert the illegal, abnormal behavior, process abnormalities and other abnormal transactions. Since the "transaction eye" module is enabled, it found hundreds of suspected illegal acts, and transferred to the administrative regulatory authorities surround and colluded bidding nearly 70 cases. Big data analysis has achieved great success.

According to the characteristics of the field, business types and characteristics, Guangzhou Public Resource Trading Center has realized the design of specialization, individuation and standardization. As the most common digital trading platform in the field of public resource transactions, it has focused on the standardization of processes, data collection and application standardization, and has made important contributions to the research of big data applications.

In June 2017, more than ten national research institutions and local public resource trading
institutions to jointly build the "China Public Resource Exchange Big Data Innovation Committee in Inner Mongolia. Thus, guide and advance the deep integration of big data analysis technology with public resource trading platform. At the same time, it also promote the sharing of data resources opening, development and application, to play the use of big data analysis in the transaction supervision, economic development prediction, decision-making assessment and other aspects. It indicates that the big data application of public resource transactions enters the regional joint phase.

3. The Role and Significance of Big Data in Public Resource Trading

3.1. Providing scientific basis for decision-making
The big data of public resource transaction is characterized by large amount of data, many types, fast updating and government leading. The government has a natural advantage in data acquisition and management. At the same time, the government is more likely to benefit from big data applications to improve government decision-making.

First of all, big data analysis can quickly process complex, multi-source and heterogeneous data into valuable knowledge with decision value. In the decision-making process, the data indicator is set, the association relationship is established, and the relevant data information of the targeted knowledge is quickly acquired. This is to support the management decision-making based on scientific, and improve the quality of decision-making. Such as Beijing, Hunan and other places in land resources and management of mineral resource usufructs, the implementation of "smart land" project to big data as the core of the intelligent information system to build digital, information, network-based big data decision-making platform. They carry out the "smart land" project, and build a big data decision platform based on digitization, informatization and networking, with big data as the core of the information, intelligent systems. It provides accurate and fast information service for the administrative approval of land and resources management, the use right transaction, the monitoring and supervision, and the auxiliary decision-making.

Secondly, big data can enable management to obtain more extensive, real-time and accurate information. For example, in the government emergency procurement, big data analysis will provide a scientific basis for rapid decision-making under high uncertainty and high time pressure. Through big data analysis, we will be able to find similar conditions, projects, implementation plans and market reference prices in the past as well as in various regions. It helps to analyze the market situation scientifically and rationally, thus completing the entire procurement process more efficiently and at a lower cost.

In the end, big data applications can provide a cost price index for businesses and management regularly, guide the bidding organizations to predict more reasonable project construction price, time limit and risk analysis.

3.2. Promoting Government Information Disclosure
To promote big data applications, the state has introduced policies. For example, in 2013, the General Office of the State Council issued the 《Key work arrangement of the current government information》. The report asked to strengthen the administrative examination and approval, the financial budget and final accounts and "the three public expenses ", affordable housing information and other nine key areas of government information publicity. "Regulation on the Implementation of the Government Procurement Law of the People's Republic of China" emphasizes the disclosure of information, expanding the scope and content of information disclosure, and emphasizing the response time of information disclosure. In addition, the state has also introduced a series of government information sharing, unifying public resource transactions and other provisions.

In the aspect of government procurement, big data technology has led to a broader range of purchases. On one hand, combined with "Internet of things (LoT)" technology, big data can be used to analyze the use of buses, office consumption and so on, so as to support the approval of government procurement decisions; On the other hand, through the information disclosure of government
procurement activities, big data is beneficial to full-scale multi-dimensional data mining. Discover abnormal behavior in time, and can also be carried out in the government procurement of illegal rent-seeking behavior of social supervision.

3.3. Promoting the Electronic Trading
Application of big data promotes the implementation of electronic transactions. With the big data technology appears, Electronic resources transaction isolated business system constraints, from the traditional electronic platform and system operation of the transaction business information operation, towards to the big data analysis, Internet thinking change. It makes the transaction presents intelligent decision-making and precision service changes, closer to the nature of electronic network transactions.

In addition to, big data systems provide effective help for electronic process optimization. In the management of bid bond, some Public Resource Trading Centers have carried out the online bidding deposit refund management system. Electronic margin management ensures the correctness, confidentiality, security, timeliness and convenience of funds transactions. Through data analysis and statistics of the bid bond, it can optimize the bidding agency personnel work flow, reduce the short time surge burden caused by the bid bond of different projects due to the same time over bidding, improve the accuracy of relevant business content, at the same time, avoiding the related problems caused by the failure of timely payment of the bid bond and the receipt of the bid bond.

3.4. Help Construction of Credit System
Using big data systems to establish dynamic bidding project information database, the content of which can include the basic information of bidders, tenderers and other related aspects and the basic information of bidding projects. Includes: scale, nature, administrative region, risk preference, enterprise relationship, historical performance and other aspects. It also includes the registered capital of enterprises, business scope, qualification level, ownership form, place of registration, historical bid information. Through data mining, we can build the bidding enterprise performance integrity level, and incorporated into subsequent bidding review link. This provides a more scientific basis for project review, while also reducing the cost of regulatory correction. Moreover, reducing the possibility of winning the negative credit enterprises, increasing the cost of breach of contract, and promoting the enterprises to improve their own level of honesty.

Such as Guangzhou public resources trading center jointly launched the "Guangzhou credit index", the evaluation index covering bidders, buyers, bidders, suppliers, bidding agents and evaluation experts, and other market subject. The evaluation includes social credit, bidding credit, cross industry, cross regional credit and market subject mutual evaluation.

3.5. Warning Abnormal Trading Phenomenon and Improve Supervision
In the process of public resource transactions, there will be a variety of problems, such as the surround, colluded and accompanying bidding, have no specific scoring of judges, the transaction results questioned, abnormal offer (unbalanced or below the cost price). According to the Big data analysis, it plays an active supporting role in technology and reduces the cost of supervision. For example, we can check the IP address and its frequency. When more than three bidders are found to use the same IP address, it can be regarded as having a correlation with the surround-bidding and accompanying-bidding. Through the multidimensional analysis of the IP address of bid enterprise, bid winner, bid winning number, bid evaluation expert, agency, qualification examination method and bidding method, we can find the correlation between the parties involved in the transaction, and find the causal link. Through the statistical analysis of offer rule in a certain period of the bidding enterprises, we can find the rigging colluding correlation [2]. A typical case in Guizhou [5] fully illustrates its utility. Thus, big data analysis can be found in a timely manner to participate in violations of the parties involved in the transaction, to provide reference for supervision and management of the transaction.
4. Problems in Big data Application and Its Solution

4.1. Data Sharing
Big data applications rely on massive data sharing. (For the Public resources trading institutions,) The big data sources involved in the public resource trading body include the vast majority of government information such as finance, taxation, industry and commerce, public security, judicial, quality supervision, health, education, statistics, transportation, land resources and government. It also includes banking, telecommunications, postal services, express delivery, social credit agencies, Internet information, industry alliances, the enterprise data resources.

How to realize massive data sharing is the urgent problem to solve.

The first is policy driven [3]. The state has adopted many policies in the context of big data, such as the "National Construction Market Supervision Integrity Information System Basic Database Data Standard (Trial)", "Promote the Platform for Big Data Development " and "Interim Measures for the Administration of Government Information Resources Sharing ". The construction of a unified open platform for national government data provides the basis for the application of public resources trading big data applications.

This requires government departments to come forward, sort out the information scattered in the department to form a directory of government information resources sharing, and through a unified regional data sharing exchange platform for the collection, integration, management and sharing. The government also signed big data cooperation agreements with some key sectors of the industry to achieve complementary advantages and data sharing, so as to use social forces to jointly carry out big data analysis. It can also sign strategic cooperation agreements with telecom operators and Internet companies, to build a pool of data resources. The aim is to integrate data from multiple sources and to conduct big data analysis together.

4.2. Standardization of Trade Links and Processes
Public resources have wide range of transactions and numerous means. A variety of transaction types lead to different trading rules, various means of trading, complex trading links and processes of public resources. It is an effective means to solve the problem of diversity and heterogeneity by adopting standardized management means and standardizing transaction links and processes.

The use of standardized transaction links and processes can effectively reduce data heterogeneity, which facilitates big data analysis, learning and knowledge discovery.

It also needs to be unified acceptance of registration. When the project is admitted, the market subject samples the standardized transaction acceptance system, then automatically collects, sorts and transfers the input data. At the same time the standardization of information dissemination, in accordance with the requirements of the project unified in the designated media information release. After the completion of the project, a unified transaction witnessed. The measures also include the use of the transaction witness system, the uniform issue of the witness document, and the transaction information automatically entered into the electronic information system to complete the transaction data start and end process.

The uniform operation of different types of transactions can be realized by adopting unified field, unified electronic platform, standardized process and whole process synchronous monitoring. Using electronic platform can avoid the impact of human error probability. The purpose is to standardize each link and make it possible to participate in, supervise each other and save the whole process. This increases the cost of surround-bidding, colluded-bidding and human action corruption, and forms a new electronic, standardized, informative public resource trading mechanism.

4.3. Social Division of Labor
Public resource trading faces all aspects of society, involving many departments, industries, enterprises and individuals. The application of big data promotes the ability and level of public resource transaction, and also needs the support from all sides of the society. For example, in the area
of data resources, public resources need to cooperate with government agencies, banks, credit rating agencies, network operators, and communications operators. At the same time, the amount of public resources transactions is huge, and it is also a data resource that cannot be ignored for all big data applications. So cooperation means win-win.

Besides, the public resources trading are inadequate for big data applications professionals. In addition to understanding public resources trading systems, and information technology, complex talent with comprehensive knowledge of mathematics, statistics and machine learning is also needed. It is difficult for people with single skills to catch up with the rapid development of application, and must start with social division of labor. In data analysis and processing, cooperation with professional institutes, schools and network operators is needed, to build big data, basic research and secure reliable big data technology system at the same time. Public resources trading data related research internet, data warehouse, data source pool, distributed system architecture, distributed computing, data mining, deep learning, data analysis, data visualization, information security and privacy protection and other key technology areas. It needs to be based on big data, basic research, public resources, big data applications, big data products and solutions. We should jointly establish the public resources ecological system of big data of the linkage of politics, production, education and research.

5. Public Resource Transaction Big data Application Architecture [4]

Big data applications are not a simple Internet search and cloud computing, it need a series of technical means to support. In general, the overall architecture of public resource transaction data application includes data source collection, data storage center, computing and analysis center and service center. The overall architecture details are shown below in Figure 2.

**Figure 2** The overall architecture of big data applications for public resource transactions

1) Data Source Collection

Data source collection mainly relies on the public resources trading institutions, relies on the digital, network, intelligent trading platform, relies on video surveillance monitoring platform, relies on existing public resource transactions laws, regulations and processes. Data source collection can also collect part of the transaction-related social resource data sources, such as enterprise database, network
operator data center, credit database, government data resources.

2) Data Center
The information platform of public resource trading institutions at all levels is regarded as the data center node. Construction of public resource trading at provincial level data center requires provincial units, by using Hadoop (distributed file management and computing architecture) architecture. This can provide access, storage, calculation and analysis services for the provincial and municipal public resource transaction data, and provide data for analysis, decision and real-time collection applications. The integrated information service platform of provinces will be combined, to achieve information collection electronization, standardization and automation. And gradually distributed application support platform or cloud service architecture is constructed. It will support business applications in terms of business and data characteristics.

The national unified public resource trading platform, which is regarded as the national data warehouse and data storage and processing service organization, realizes national data sharing and regional data sharing.

3) Calculation and Analysis
The distributed operation engine and cooperative computing function can be realized by using Hive (Hadoop data warehouse mapping table tool), and the distributed running cluster environment can be set up. It also needs to develop heterogeneous information processing and computing service architecture and software based on text, image, video, audio, GIS geographic information, financial information, credit information, network public opinion information. We can also use multidimensional computing services such as cloud computing, memory computing, batch computing, and query computing. We also use Mahout (data clustering, classification calculation) technology, data mining technology, to form a self-service analysis tool set to improve the ability, and search related resources quickly. Building big data platform also requires deep learning technology. According to the transaction process, the mathematical model is refined to form a big data knowledge system, in order to realize the knowledge discovery of KDD for public resource transactions. It is more convenient for big data mining, analysis and application. The KDD process is shown in Figure 3 below:

![Figure 3 Public resource transaction knowledge discovery process](image)

4) Data Service
On the platform of public resource transaction, network method is used to provide service for big data application. Including self-service search, statistical forecasting, calculation analysis, auxiliary decision-making and data visualization management services. Among them, management services include data source management, security authority control, data caching, computing task specification, management, resource allocation, and so on. In addition, we should integrate GIS, geographic information and all kinds of images, graphics, audio, video and text display software. This can form a big data visualization component library and support visual application services.

6. Conclusion
The public resource transaction is a comprehensive public welfare planned activity with wide
distribution, huge scale, great people's livelihood, numerous forms of transaction and complicated situation. A single approach is far from meeting the needs of its rapid development. The application of big data solves the problem of heterogeneous, complex, universal and mass information processing. Big data has not only gone deep into all areas of public resource trading, but has also been a key tool for resolving future intelligence trading and evolving trading needs. Country, governments at all levels and related trading institutions, supervision agencies are increasingly concerned about the application of big data practice. Future public resource transactions must be carried out around big data applications. This requires public resources, trading institutions, economic research units, information research units, Internet operators and other institutions to jointly promote the achievement.

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