ISSN: 0379-5462
IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association
Vol. 30, E4, 2018, pp.451-461

Research on An Innovative Urban Gas Industry Supervision Method with Big Data

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Abstract: *The paper first offers a general review on the development of urban gas industry. Then it outlines the industry characteristics, regulatory approach, and regulatory content of the urban gas industry. It proposes the architecture of urban gas industry supervision platform based on the ideas of "Big Data", and explains the component, feature, mechanism of this platform. This paper also gives the safeguard mechanism to construct the "Urban Gas Industry Supervision Platform", and the further research in future.*

Key words: Big data; Urban Gas; Industry Supervision

1. Introduction

The scientific and technological revolution and industrial transformation represented by big data, cloud computing, Internet of Things and artificial intelligence have developed rapidly. It accelerates the integration, adjustment and development of various elements, resources, industries and markets. New models and new formats of digital economy, network economy, sharing economy and mass fund-raising have emerged in endlessly. It has profoundly changed the existing way of production, organization and life. This series of changes put forward new requirements and challenges to government supervision. Government supervision needs to embrace new technologies, new ways and explore new mechanisms to better meet the needs of development and change.

The 19th National Congress of CPC proposed that we should change the functions of the government, deepen the simplification and decentralization of government power, innovate the way of supervision, enhance the credibility and execution of the government, and build a service-oriented government with the people's satisfaction. In January 2017, the State Council issued the "Market Supervision Plan for 13th Five-Year ", pointing out that it is necessary to adapt to the new trend of scientific and technological revolution and industrial transformation, to meet the objective requirements of the market, and to give full play to the role of new technology in market supervision. Using big data to promote supervision innovation, relying on the Internet and Big Data to create a platform for market supervision, and promote "Internet + Supervision" to improve the level of the intelligent market supervision [1].

At present, the state is constantly strengthening supervision innovation to promote social equity and justice. Firstly, we should implement impartial supervision, promote the reform of government supervision system, accelerate the construction of supervision system, coordinate with credit supervision and intelligent supervision, strengthen the construction of social credit system, give full play to the role of national credit information sharing platform, promote the implementation of joint incentives for keeping faith and joint punishment for breaking faith. Using the Big Data, Cloud Computing, Internet of Things and other information technologies to establish and improve the market main body credit records, industry blacklist system and market exit mechanism. Secondly, we should promote comprehensive supervision, constantly establish and improve inter-departmental and inter-regional law enforcement response and cooperation mechanisms, realize the interconnection of illegal clues, the interchange of supervision standards and the recognition of treatment results, eliminate supervision blind spots and reduce law enforcement costs, strengthen industry self-discipline, encourage the public to participate in market supervision and play the role of media supervision. We should give full play to the role of social forces in strengthening market supervision.

Therefore, in the current situation of deepening the modernization of national governance system and governance capacity, it is necessary to improve the government supervision based on big data. The application of big data will become an important basis and strong support for government supervision, innovation of service mode, improvement of supervision level and participation in macroeconomic management.

On the basis of reviewing the latest development of government supervision theory, this paper takes gas industry as an example to study new ideas and new models of industry supervision under the background of big data. This paper analyzes the main characteristics of the gas industry and the major challenges facing the industry supervision, fully integrates the concept of big data technology with the theory of industry supervision, and combines the characteristics of the gas industry, puts forward the framework of the gas industry supervision platform based on big data, discusses the functions and characteristics of the platform. And from the aspects of law, standards, organization and so on, the mechanism of large data supervision platform is discussed.

2. Related Literature Review and Development Practice

2.1. Research on Government Regulation Theory

According to the relevant literature, most of the existing supervision can be classified into economic supervision, anti-monopoly supervision and social supervision. According to the type, it also can be divided into internal supervision and external supervision. According to the process, it can be divided into pre-supervision, in-process supervision and post-event supervision. From the perspective of mechanism, it can be divided into access supervision, price supervision and exit supervision.

The goal of government supervision is to correct market failure, maintain effective competition, and reduce social transaction costs and operating costs. Its main features include the following aspects: Firstly, the government does not directly intervene in the economic process, but uses policy tools to regulate it. Secondly, the government is the referee of the market economy, not the athlete. Thirdly, the relationship between government and industry is relatively independent. In addition, the operation of government regulators is different from the traditional legislative, judicial and administrative institutions, with a stronger independence, speciality and scientificity. Finally, the government should gradually open up the domestic market and treat the foreign industrial competitors as the national treatment [2].

With the development of globalization and internet economy, the global economy has become more closely linked. All kinds of new things also promote the further development of market regulation. E-government and other information service methods are also used in regulation. In this process, collaborative regulation, responsive regulation, voluntary regulation, smart regulation and other regulatory models have emerged in theory and practice. It enriches the original single mode of regulation and emphasizes the role of other subjects [3].

Liu Peng summarized up the new features of China's market regulation reform and innovation since 2013. The first one is to simplify supervision, lower the threshold of market access, relax and simplify prior supervision, and promote the optimization of market competition efficiency. The next one is efficient supervision. The key is to strengthen in-process supervision and post-event supervision. Thirdly, it is necessary to reinforce the cooperative supervision, which include emphasizing the coordination and cooperation among departments, strengthening information interconnection and sharing, improving the credit supervision mechanism, and improving the efficiency of supervision; Fourthly, by participating in supervision and management, self-restraint and honest management of market participants through the self-discipline of industry organizations and the supervision of market specialized service organizations can be promoted [4].

Xie Di and Liu Jiali, according to the experience and facts, put forward that the government supervision system of urban public utilities should be further reformed in accordance with the requirements of "systematicness, integrity and cooperativity". The focus of the reform is to beyond the paradigm of "supervision subject-supervision means-supervision object". And according to the regulatory mechanism, regulatory system and regulatory system reform linkage and organic coordination, the step of reform is launched. Some facts that have already happened can support the above judgment [5].

Yang Binglin proposed to construct a new paradigm of cooperative supervision between government and non-governmental organizations by drawing the theory of responsive regulation which has aroused wide public concern in recent years. This paradigm requires us to establish a new concept named "big supervision", and from the aspect of multi-party cooperation mechanism, self-regulation of industry and enterprise, third-party supervision, hierarchical supervision and other aspects to promote the construction of China's regulatory governance system [6].

Li Yu and Zhou Hongmei pointed out that the development of big data technology provides necessary technical support for innovative market supervision mode. It is a new challenge and opportunity for market supervision departments to construct intelligent supervision based on big data to better serve the market supervision [7].

2.2. The Application of Big Data in Government Regulation

The traditional way of supervision mainly based on administrative orders lacking two-way communication and interaction between the supervisor and the supervised. It has the characteristics of being independent of each other. The lack of cooperation within the government makes it difficult to adapt to the rapid changes of the market. Market supervision must pay more attention to the integration and innovation of system, mechanism and technology in order to realize the leap-forward development of supervision ability. Big data, as another subversive technological in IT industry after Internet, Internet of Things, Mobile Computing and Cloud Computing, is redefining the processes and way of social management and national strategic decision-making, enterprise management decision-making, organizational business processes, and individual decision-making. Big data has been widely used in government public management, medical services, retail, manufacturing, and personal location services, and has generated tremendous social value and industrial space [8].

The emergence of big data is not only a material phenomenon, but also a discourse phenomenon, which will bring about profound changes in superstructure, administrative institutions and regulatory deployment [9]. Through data integration and analysis, it will play a strong role in promoting the efficiency of government supervision, reducing the cost of governance, and strengthening the government's governance capacity. Analyzing and processing complex data will be able to deliver the right information to the right people in the right form at the right time [10]. The developed countries combine the internet with big data and government service platform, and create the "Internet + Big Data + Government" platform, which provides software and hardware support for the application to promote government governance [11].

In March 2012, the Science and Technology Policy Office of White House released the "Big Data Research and Development Plan" to establish a "Senior Guidance Group of Big Data". The program aims to enhance the federal government's ability to collect large amounts of data, analyze and extract information, and enhance its ability to predict socio-economic development by collecting massive and complex digital data [12].

In 2013, the UK released the Strategic Plan for the Development of Data Capability to gradually open up data on urban transport, health care, climate and other aspects, to share big data information with the public, and to encourage non-governmental organizations and individuals to participate in the development of government big data [13].

In November 2013, Brazil's Rio de Janeiro won the title of "World's Best Smart City" at the 3rd International Exposition of Smart Cities. This city's operation and management center is a data platform for early warning of natural disasters, weather forecast, emergency rescue, real-time traffic monitoring, civil defense, security, accident response including water, electricity, gas and so on. Since it was put into operation in 2010, it has successfully dealt with the emergency events related to disasters and accidents in Rio City, and played an important role in emergency rescue work [14].

On August 31, 2015, the State Council of China issued the Outline of Action for Promoting the Development of Big Data, proposing to create a new model of social governance with precise governance and multi-party cooperation.

The government should take big data as an important means to enhance the governance capability, through efficient collection, integration and deepening the application of government data and social data, to enhance the level of government decision-making and risk prevention, to improve the accuracy and effectiveness of social governance, to support the transition from pre-approval to ex-post supervision, and to promote the combination of government supervision and social supervision, effectively organizing social forces to participate in social governance [15].

In conclusion, in recent years, the theory of industry supervision has developed in improving the efficiency of supervision and the reform of supervision. The application of big data to promote industry supervision has also been involved, but the relevant research is basically in the stage of policy recommendations. The specific application of big data is scattered in individual fields, especially the application from the industry regulatory theory to the implementation of large data platform in detail is rare. Based on the technical and economic characteristics of gas industry, this paper discusses the innovation of supervision mode under big data, and makes a thorough study on the overall thinking, model design, platform framework and operation guarantee mechanism from the industry supervision concept to the realization of large data platform, hoping to be beneficial to the promotion of industry supervision ability.

3. Characteristics and Challenges of Gas Industry Regulation

3.1. Industry Development Status

Gas refers to the gaseous fuels and meets certain requirements, including natural gas, liquefied petroleum gas and artificial gas and so on [16].

In recent years, with the acceleration of urbanization, the deepening of air pollution control and the improvement of people's living standards, gas has been widely used in many fields, such as residential life, industry, power generation, transportation, distributed energy and so on. Gas plays an increasingly prominent role in optimizing energy structure, improving urban environment, accelerating urban modernization and improving people's living standards, and has become an indispensable important energy for urban development. Gas transmission and distribution system has become an important part of urban infrastructure construction and an important symbol of urban modernization.

With the completion and commissioning of major projects such as the national West-to-East Gas Transmission Project, Air Landing Project, LNG Project, and the continuous introduction of natural gas network construction planning, the construction of urban gas infrastructure in China has entered a climax of investment, the application of gas in China has gradually matured, and consumption has increased rapidly year by year. With the rapid development of China's urban gas market, the continuous expansion of the gas population and the rapid growth of the total gas consumption, the urban gas industry has maintained a relatively rapid development speed on the whole, and the industry competition has become increasingly fierce. According to statistics, the total urban natural gas supply in China has increased from 24.477 billion cubic meters in 2006 to 117.172 billion cubic meters in 2016, an increase of 4.7 times in 10 years; the urban natural gas population has increased from 83.19 million in 2006 to 30.8557 million in 2016, an increase of 3.7 times in 10 years [17].

At present, the gas industry actively embraces the technological changes such as the Internet, big data, and so on. Business and services in the gas field are constantly emerging. The diversification of market forms, the modernization of business methods, the intensification of market competition, the concealment of illegal acts, and the pressure of safety production are becoming increasingly prominent. The long-term, complex and arduous nature of market supervision is constantly increasing.

- With the acceleration of urbanization, energy structure optimization, air pollution prevention and control, China's urban gas construction is fast, covering a wide range of areas, especially gradually from the city to the countryside, gas pipeline network extends to thousands of households, gas facilities throughout everywhere, forming a complex gas pipeline network.
- With the accelerating of gas market reform in China and the diversification of gas market subjects, various kinds of gas suppliers, such as state-owned enterprises, state-owned holding enterprises, private enterprises and mixed ownership enterprises have emerged. It covers gas-related consultation planning,

engineering design, exploration and exploitation, transportation allocation, pipeline network operation and terminals sales.

- Gas as a clean and environmental protection of high-quality energy, has been widely used in enterprise production and residential life. First, it has a wide range of uses, including gas power generation, refrigeration, heating, chemical, textile, chemical fiber, residential life and other fields; second, it has a large number of users, involving industrial users, commercial users, residential users and others.

3.2. Main Characteristics of the Industry

a. Natural Monopoly

The production and supply of gas mainly include production, transmission, distribution and utilization. Through complex gas transportation network, the source of production is closely linked with the gas terminal. Gas pipeline network and related facilities have characteristics such as long investment return period, high fixed cost and huge sunk costs. In economics, scale economies refer to the economic phenomenon that the proportion of output increase is greater than that of input. Scope economies mean that the cost of producing several products at the same time is less than that of producing them separately. For the gas industry, with the increase of gas transmission, the fixed cost per unit will be reduced, which will make the average price decrease. In addition, because of the difference of gas demand and gas consumption among different users, different gas supply can be provided for different users on the premise of a certain total gas transmission. This will make the total cost of serving a variety of users less than the sum of service costs for a single user.

Therefore, for the whole industry, it has the characteristics of network economy, scale economy and scope economy, its cost function is additive and has strong natural monopoly characteristics, so the government should implement strict regulations to ensure the orderly and effective operation of the gas market.

b. Social Public Welfare

Gas has become a necessity for residents' daily life, and gas facilities have become an important infrastructure for urban construction. Gas industry is closely related to people's life, and its foundation and lifeline in the national economy have already become prominent.

Gas can provide an important basic energy for people's production and living, which directly affects the public welfare of social members. The goal of public welfare requires that enterprises should take into account both social and enterprise benefits, and ensure that the public can obtain public services include good quality, adequate quantity and preferential prices. The commonweal of gas is embodied in that urban residents need stable, high-quality, affordable, and generally acceptable gas supply services. However, the industry of monopoly is difficult to meet the goal of public welfare automatically. In order to maximize profits, enterprises can provide inferior products and services at higher prices and relatively lower quantities relying on their monopoly position easily.

Therefore, the government must regulate the quantity, quality and price of the products and services it provides, improve the transparency of the industry and strengthen social supervision in order to better meet the needs of the public interest.

c. Production Safety

As gas belongs to flammable and explosive gases, it is easy to cause fire, explosion, poisoning and other accidents in the process of production, transportation with a little carelessness. It will cause incalculable loss to society.

Due to historical reasons, some underground gas pipelines have been operated for a long time, and lack of effective technical means and strict management standards during the initial construction, resulting in unclear pipeline positioning, inadequate construction about anti-corrosion protection, and high hidden dangers of pipeline damage and leakage. At the same time, with the acceleration of urbanization process, gas pipeline network and power, water, sewage, communications and other types of underground pipelines crisscross, gas pipeline land and other construction land are often occupied by each other, further increasing the probability of safety accidents. In addition, individual illegal construction, private construction and other problems are more serious. The construction of roads, buildings and pipelines is frequent in urban construction, and the destruction of gas pipelines often occurs.

Therefore, the safety of gas production is a major event to ensure the safety of people's lives and health. It is necessary for government construction, emergency response, quality supervision, fire control and other departments to carry out coordinated supervision and management of gas industry in terms of regulations, structural establishment, staffing, responsibility for education and training, safety management, capital investment, material guarantee, accident report and emergency rescue, so as to promote standardization, institutionalization, normalization and transparency of industry safety supervision and management. It will promote the safety of gas industry to a new level.

d. Regulatory Collaboration

At present, China's gas regulatory functions are distributed in many government departments. According to the regulations published by the State Council on the regulation of urban gas management, the competent department of construction under the State Council shall be responsible for the nationwide gas management. The gas management department of the local people's governments shall be responsible for the gas management within their respective administrative areas. The Ministry of Housing and Urban Rural Development of People's Republic of China is the national

competent department of the city gas industry, The Provincial Department of Housing and Urban Rural Development is the government department responsible for the provincial gas industry [16].

At the same time, China's gas industry regulation also involves many related departments as shown in Table 1.

Table 1. Supervision Departments and Responsibilities of China's Gas Industry

No	Department	Responsibility
1	Natural resources department	Responsible for managing the exploration and exploitation of natural gas resources and implementing the production license.
2	Development and reform department	To be responsible for formulating medium-term and long-term natural gas development plans, formulating and implementing industrial policies and regulations, formulating natural gas prices and adjustment mechanisms, and supervising the selling prices of natural gas stations and transmission prices of long-distance pipelines; In the process of examining and approving the pipeline construction projects with corresponding limits, the Development and Reform Commissions at all levels will take into account the opinions of relevant environment departments, natural resources departments and urban planning departments. The determination and adjustment of the selling price of urban gas shall be put forward by the operating enterprises and shall be implemented after being examined and approved by the regional Development and Reform Commission or the price department.
3	Urban and rural construction department	The gas administrative departments of the local people's governments shall be responsible for the gas management within their respective administrative areas. In accordance with the division of responsibilities stipulated by the people's government, the departments of security supervision and public security (fire control supervision) shall be jointly responsible for the supervision and administration of urban gas safety in their respective administrative areas. According to the authorization of the government, responsible for the specific implementation of the franchise of the municipal public utilities in the local area.
4	Safety production supervision and management department	In accordance with the division of responsibilities stipulated by the government, it shall be jointly responsible with the departments of urban construction and public security for the supervision and administration of urban gas safety in their respective administrative areas.
5	Fire management department	In accordance with the division of responsibilities stipulated by the government, it shall be jointly responsible with the departments of urban construction and safety supervision for the supervision and administration of urban gas safety in their respective administrative areas.
6	Transportation management department	In accordance with the relevant laws and administrative regulations on road transportation and waterway transportation, the gas enterprises transported by road, waterway and railway shall be supervised by means of transport permits and operation supervision.
7	Quality and Technology Supervision Department	To be responsible for supervision and management of gas quality and metering, and to be responsible for the safety supervision of gas-related special equipment.
8	Gas Industry Association	Establish self-discipline mechanism for the industry, formulate standards of conduct and service in accordance with the law, safeguard the rights and interests of gas operators and users, and urge gas operators to operate in accordance with the law, be honest and trustworthy and exercise strict self-discipline.

The technical and economic characteristics of the industry and China's current national regulatory system determine the supervision of specific industries (such as gas industry), multi-sector collaborative supervision model will exist for a long time in the future.

Therefore, how to break through the barriers of communication between the relevant regulatory departments, strengthen efficient coordination and cooperation between departments, in order to achieve rapid response to market changes, scientific research and judgment, timely response, flexible disposal, will be a key problem to be solved through the innovation of regulatory methods in the future.

3.3. Challenges of Existing Regulatory Mode

a. Challenges of Traditional Regulation

Under the traditional industry supervision mode, it is difficult to realize the closed-loop supervision because each supervision department chooses the direct supervision mode and relies on a single administrative order to implement the

supervision. The supervisory departments have equal status and no affliction with each other. The supervisory departments may consider the scope of their supervision more, and it is difficult to achieve synergy. Although related communication and coordination mechanisms have been established, they are often manifested in the balance and coordination of interests between departments, and information communication and collaborative supervision are still relatively limited. The top-level design of industry supervision needs to be improved, and the lack of consistency of action among the regulatory departments is an important reason for the above situation. This makes the industry regulation lack linkage, regulatory blind spots, high regulatory costs. And regulatory effectiveness needs to be improved.

b. Challenges of Existing Information Infrastructure

All kinds of data needed for gas industry supervision are still isolated and are widely scattered in government departments, gas enterprises, gas users' own information systems and mobile devices. And more and more data have not yet been perceived and discovered. Although most government departments carry out the construction of relevant professional supervision information system in combination with supervision needs, the information sharing and data synergy between departments are still not smooth. Although gas enterprises are also actively promoting enterprise information construction and Internet applications, but most of them are based on the needs of their own enterprises, only to meet their own marketing, management and production operation management needs. A great number of users have generally realized the internet connection, but the gas-related information service which meets the users' own needs is obviously insufficient. Therefore, the problem of gas industry supervision generally exists such as supervision data interoperability, regulatory information asymmetry, regulatory behavior is not coordinated, unrealistic regulatory methods, regulatory efficiency is difficult to improve, synergetic supervision is difficult.

4. Innovation of Supervision Mode in Gas Industry

Big data is a new revolutionary information technology based on data. In the process of data mining, it can drive the innovation of concept, mode, technology and application practice [18]. The choice of regulatory tools plays a key role in decision making. Compared with traditional regulatory tools, information tools have unique functional advantages. Its use can not only promote fair trade, promote the self-discipline of trading subjects, promote the implementation of regulatory systems, but also can reduce costs [19].

Big data technology has become an important tool for innovative regulation and transformation of regulatory. The application of big data in the field of government reform, daily management and public service is an inevitable requirement for the implementation of innovation and development. It is of great significance for speeding up the transformation of government functions and enhancing the government's modern governance capability, especially for deepening the simplification of government and decentralization of power and the optimization of service [20].

4.1. General Thinking of Supervision Mode Innovation

Big data technology can promote regulatory process reengineering, change the traditional regulatory mode, achieve interactive, multi-dimensional, network-based collaborative governance. By integrating regulatory measures into service behavior, the real-time, human-oriented and service-oriented supervision of supervision can be enhanced.

Taking the gas industry as an example, the general idea of its supervision is: with the aid of big data platform and the goal of open and sharing of data resources, by integrating the practice of the gas industry, modern supervision concepts and the gas supervision process, merging the multi-dimensional data of all parties, changing the way of industry supervision, promoting the enhancement of supervision capacity, we can provide support and service for business development, decisions, industry service and public communication.

- Through data integration, break through the data barriers of relevant government departments, realize the sharing of regulatory information, simplify the government regulatory process, and effectively promote regulatory coordination.
- Through the monitoring of massive multi-dimensional data, to achieve full coverage of the regulatory scope, to realize the regulatory process coherent and change the traditional random sample supervision into innovative overall sample supervision.
- Through the interaction of large data platforms, it can promote the participation of all parties, realize the real-time interaction between supervisory subjects and supervisory objects, respond to market changes quickly and respond to social concerns in a timely manner.
- Through the in-depth mining and analysis of supervision data, the forecast and early warning of supervision process can be realized, supervision problems can be found early, prevented and solved in time, and problems can be solved early.

4.2. Strengthen the Top-Level Design of Industry Regulation

It should deepen the reform of industry regulation in accordance with the requirements of "integrity, systematicness and synergy". Through leading by the competent departments of the industry, combing with the relevant regulatory departments,

focusing on the development of the industry, clearing industry regulatory tasks, detailing industry regulatory processes, refining the division of industry supervision, improve the industry regulatory mechanism, decomposing regulatory tasks, dividing regulatory responsibilities, strengthening industry regulatory cooperation, finally, the industry-wide supervision can be formed.

a. Top-level Design from Regulatory Content

From the aspects include urban gas development planning and emergency protection, gas management and service, the utilization of gas, the protection of gas facilities, gas safety accident prevention and treatment, this paper refines the decomposition of supervision tasks, divides the supervision responsibilities of departments, improves the supervision operation process, and distinguishes the supervision boundary and the supervision interaction and form the data interaction forms.

b. Top-level Design from Regulatory Mechanism

In the aspect of price supervision, the government departments, gas enterprises, industrial and commercial users, resident users and others involved in price supervision should be clarified, and the procedures and rules of price supervision should be improved. In the aspect of supply supervision, we should focus on the implementation of the gas source plan and its implementation, improve the regulation of gas source control, and strengthen the communication mechanism with gas producers. In terms of business license access, we should optimize the existing examination and approval process, strengthen the integration of examination and approval data of relevant government departments, such as industry and commerce, taxation, safety supervision and quality inspection, consider the public participation in the examination and approval, and improve the business license access mechanism.

4.3. Industry Regulation Model under Big Data

We should break the rigid traditional thinking mode of supervision and build a new mode of industry supervision with process, digitization, coordination and grid. Relying on the big data platform and taking the supervision workflow as the main work, solidifying the industry supervisory process, realizing the whole online supervision, task assignment, task execution, information feedback, plan deviation comparison and performance evaluation. Real time interaction and dynamic sharing online are realized among different levels and departments.

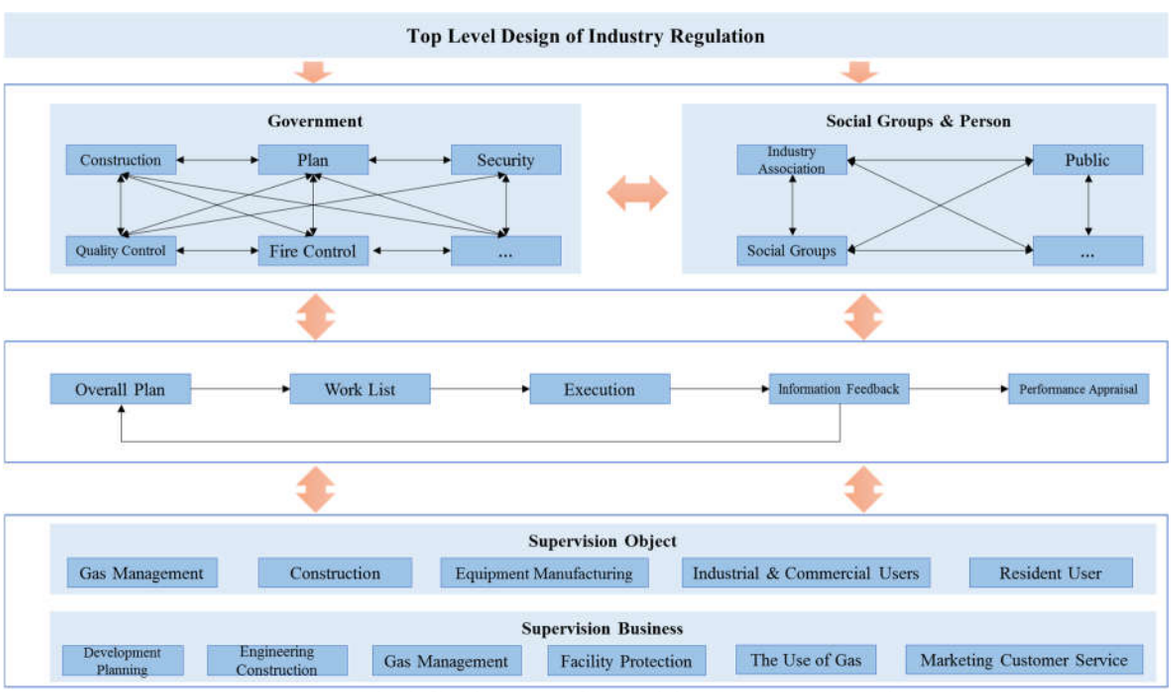

Fig.1 Gas industry Supervision Model under Big Data

Through the application and innovation of big data in industry supervision, the supervisory departments should jointly formulate supervision plans, execute the supervision task, realize the supervision and execution on-line, share feedback information in real time, realize the traceability of supervision responsibility and supervision behavior, and effectively make up for the traditional supervision methods according to the requirements of the top-level design of industry supervision. Through the following functions, we can significantly enhance the level of supervision in the industry.

a. Urban Gas Development Plan and Emergency Support

With the help of big data platform, the data related to industry development need to be collected to assist gas development planning. It is necessary to collect data of gas engineering construction process, and enhance the quality of completion and acceptance of gas projects. It also should strengthen the dynamic monitoring of the total amount of gas source data and demand-side consumption data of gas suppliers to improve the gas emergency support capability, and ensure that the supply of residential gas will be given priority after the emergencies such as serious shortage of gas supply or supply interruption.

b. Gas Management and Service

With the help of big data platform, the supervision of the gas market should be strengthened. And the enterprises to engage in gas business activities should be supervised in accordance with the permitted business scope, business category, time limit and scale. By integrating the supervision data of relevant departments, realizing the visualization of gas safety production supervision, price supervision, quality supervision and measurement supervision, standardizing the gas market, the gas service level can be improved.

c. The Utilization of Gas

With the help of big data platform, gas enterprises and users can be monitored by collecting data. The supervision rules include safety gas rules, using qualified gas burning appliances and cylinders, and payment of gas fees before the deadline. It is also need to supervise and control the production and sales units of gas burning appliances, and to provide qualified products and related installation and maintenance services

d. Protection of Gas Facilities

Through the big data platform, it can help to solidify the relevant national standards and regulations, integrate public safety and gas enterprise video surveillance, third-party construction, public report and other data. It can realize real-time perception of gas facilities on-site dynamic, to achieve gas facilities monitoring and protection. First, it should supervise gas operators to set up gas protection devices and safety warning signs in accordance with national standards, and conduct regular inspection, testing and maintenance. Second, it should supervise the third party and prohibit the construction endangering the safety of gas facilities. Third, it is to supervise the relevant enterprise engaged in laying pipelines, digging and drilling, which may affect the safety of gas facilities. Fourth, it should supervise the construction, expansion and reconstruction of projects.

e. Prevention and Treatment of Gas Safety Accidents

Through the big data platform, it can support the gas accident prevention system, timely discovery of gas safety incidents or gas safety incidents hidden dangers, promote gas management departments, gas operators, public security organs and other relevant departments to quickly coordinate the handling of accidents, start gas safety incidents emergency plans, organize emergency management.

5. Construction of Gas Industry Supervision Platform Based on Big Data

At present, with the deepening of the gas industry supervision system, it is urgent to support the supervision system by means of information technology. Constructing the gas industry supervision platform has become the realistic demand of the government supervision department. In addition, the government regulatory departments, gas enterprises, social organizations, public individuals and other individuals have a considerable data base and technical conditions. Therefore, building a regulatory platform for gas industry based on big data will become an inevitable choice.

5.1. Architecture Design

This paper divides the big data supervision platform into three parts: supervision application layer, data resource layer and technology platform layer. The specific contents of each part are as follows.

a. Supervisory Application Layer

Supervisory application layer is a deep integration of modern supervisory ideas and big data technology. It can achieve process monitoring, real-time warning, intelligent analysis of the operation of the industry, and effectively promote transparent supervision, collaborative supervision, efficient supervision and comprehensive supervision based on big data resources. The supervisory application layer is based on the core business of the industry. Taking the gas industry as an example, it covers the development and construction of the industry, gas quantity guarantee, gas management and service, the utilization of gas, gas facilities protection, accident prevention and treatment, rights and interests protection and law enforcement and so on.

On this basis, micro-applications with high reliability, service and flexibility are provided for government supervisors, supervisors and the public. Users of all platforms can customize data requirements, obtain data information and develop data applications. The application framework is shown in Figure 2.

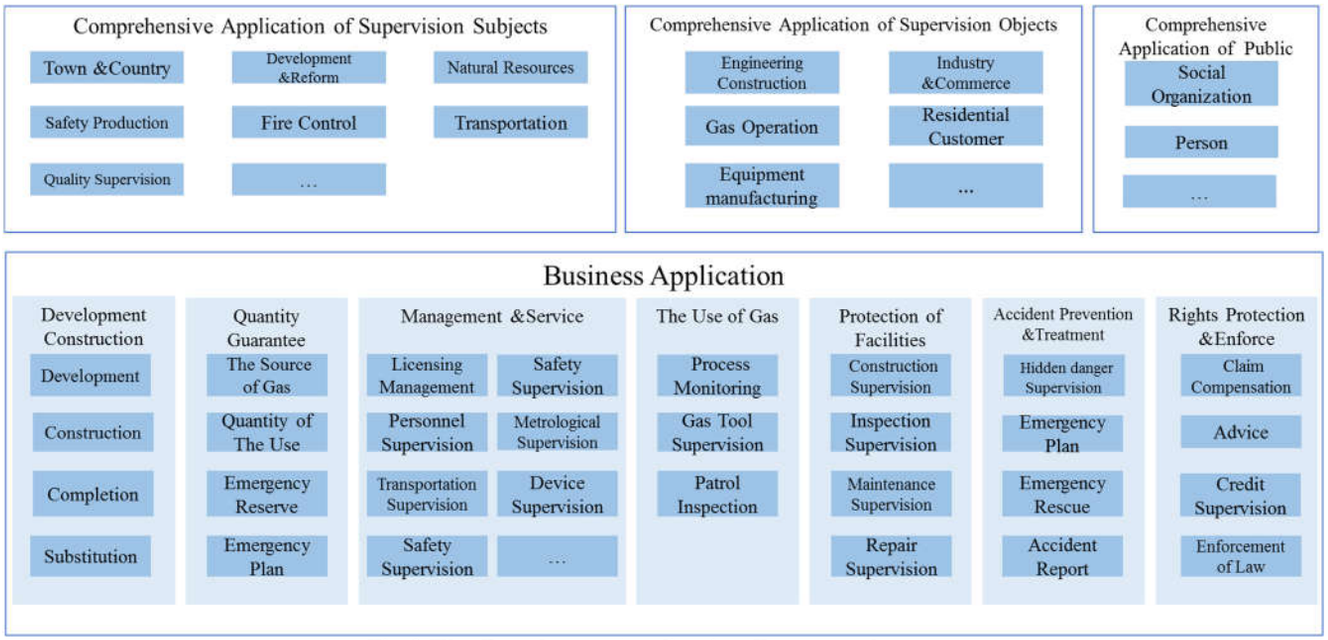

Fig.2 The Regulatory Application Framework

b. Data Resource Layer

The key technology of big data regulatory platform can realize data resource interconnection, integration, interaction and real-time sharing. The primary function of the big data platform is to obtain, transmit, store and process all kinds of data scattered among government departments, enterprises, social organizations and the public in a timely and effective manner, effectively correlate the original isolated and scattered data, and form a complete, orderly, modeled and systematic number of supervision. It can rapidly support regulatory application. This paper divides the large data resources of industry supervision into supervision data, business data and basic service data. Supervision data is the data produced by government supervision, which involves permit access, industrial and commercial registration, tax registration, safety production, credit management and so on. Business data is mainly the data involved in the industry, such as development planning, engineering construction, pipe network operation, equipment and facilities and so on. Basic service data refers to geographic information, weather and meteorological data, hydrological and water conservancy data, video surveillance and so on. It mainly provides support and services for the application of industry supervision. The data resource layer architecture is shown in Figure 3.

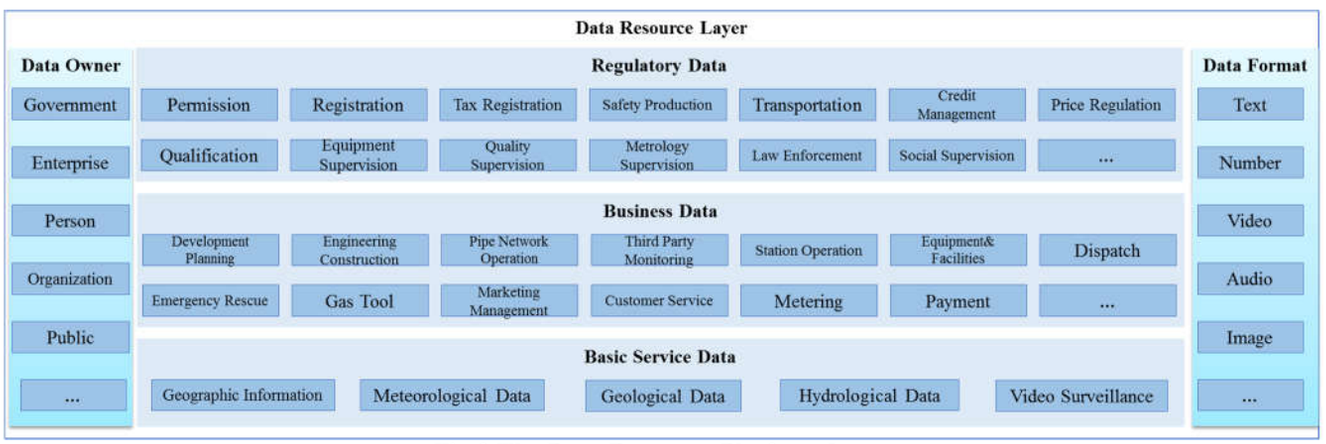

Fig.3 The Data Resource Platform Layer

c. Technology Platform Level

Relying on the new technologies such as cloud computing, Internet of Things and mobile interconnection, a large data technology platform with cross-department, cross-platform and cross-domain is constructed to support data collection, data flow, data mining and data analysis under industry supervision. The technology platform layer is divided into basic resource cloud platform, data source access, data resource storage, data algorithm model, data application service. The basic resource cloud platform can provide the basic support for data computation, storage and network transmission. Data source provides multi-channel data access services to achieve timely and accurate data access on demand. Data resource storage implements mass storage of real-time data, structured data, unstructured data and geospatial data. Data Algorithms Model provides services for data mining, machine learning, pattern recognition, image and video recognition, clustering analysis and other big

data services. Data application services provide unified data standard specification, data model, identity authentication, mobile applications, data integration and other services. The technology platform layer are shown in Figure 4.

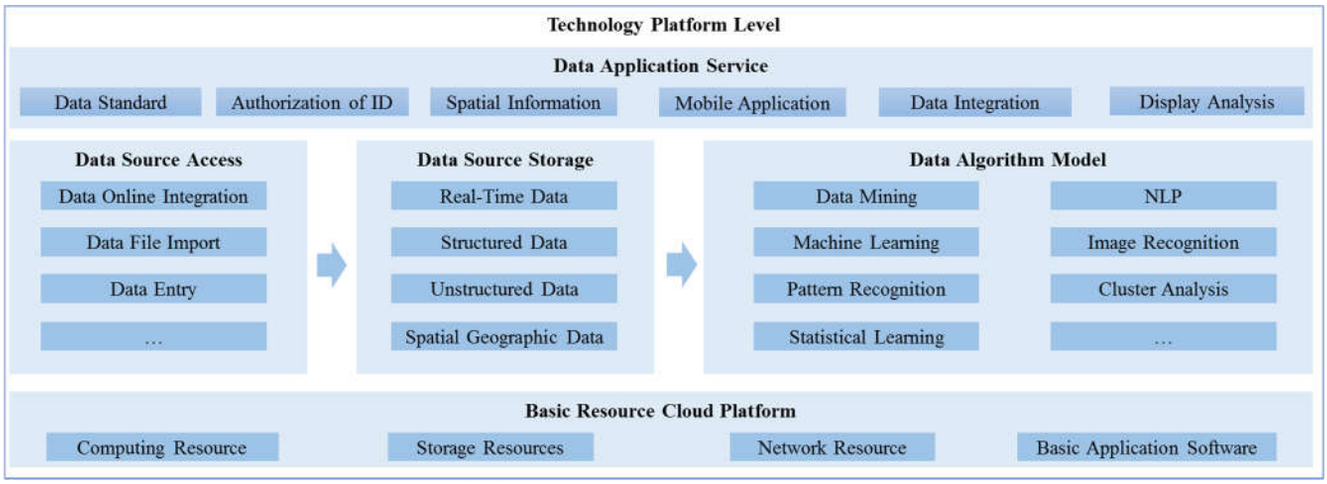

Fig.4 The Technology Platform Layer

5.2. Operation and Guarantee Mechanism

a. Legal Guarantee

From the aspect of data sources of big data monitoring platform, it involves public data sources, social data sources, business data sources and personal data sources. Public data and social data are related to the information security of the state and society, business data is related to business secrets, personal data is related to personal privacy protection, there is no clear law and regulations to make a clear definition of this. In the big data age, the law has no single principle to balance the competitive interests of individuals, businesses and society [21]. Therefore, the usual practice is "law without authorization is prohibited", which will restrict the promotion of the big data platform. It is necessary to further accelerate legislation, remove some legal constraints, and avoid some management risks.

b. Standard and Specification

The integration of various data must exist in varying degrees of standards, format, dimensions, granularity and other difficulty. Therefore, data standards for regulating the quality of regulatory data applications, improving regulatory efficiency will play an important role. Establishing a perfect supervision data system is not only the requirement to improve the quality of standardization work, but also the requirement of the development of government supervision in the age of big data. Therefore, it is necessary to construct a data standardization management system to form a set of data standards and unified information codes according to the requirements of industry supervision.

c. Organizational Guarantee

The effective operation of government's big data platform needs a continuous, stable and reliable organizational guarantee. It should rely on a special organization, big data supervision service center, to collect, screen, store, clean, transform, analyze and integrate all the data in real time and comprehensively, so as to provide timely, accurate and reliable support for the supervision application and realize the accurate, effective and scientific government supervision.

d. Operation Guarantee

Big data supervision platform mainly relies on data transmission of supervision participants. Timely, accurate and efficient data transfer is the main technology. Barriers of data circulation occur frequently due to the conflicts of interest and self-protection tendencies among data owners. Therefore, it is necessary to establish the supervision and restriction mechanism of data circulation. First, we should make it clear from the supervision system and implement the responsibility of the supervised object.

The next, it is should strengthen the monitoring and control of the operation of the system, and timely discover the incomplete data, inaccurate problems need to be supervised and solved. Finally, it should ensure timely and accurate transmission of data, and ensure strong support for supervision.

6. Summary and Prospect

The implementation of regulatory innovation through big data platform will effectively extend the scope of supervision, change the way of supervision, enrich the content of supervision, reduce the blind area of supervision, solve the problems that were difficult to be managed in the past. It will certainly effectively promote the efficiency of supervision, effectively maintain market order, and better promote fairness and justice in society.

In the process of using big data to innovate the way of government supervision, there must be various games in the process of data supply and data utilization. Therefore, the innovation supervision is also a process of gradual and gradual deepening. On the one hand, it is necessary to strengthen the effective supply of data on time, quality and quantity so as to ensure the smooth and orderly operation of big data platforms and support effective supervision. On the other hand, with the help of big data platform, timely exploration should be made to provide valuable services for the supervised objects, so that the supervised objects are not only the dedication, but also the beneficiaries and the participants of supervision.

References

1. The State Council. Notice of the State Council on Issuing the "market supervision plan for 13th Five-Year". http://www.gov.cn/zhengce/content/2017-01/23/content_5162572.htm, 2017, 01, 23.
2. Liu Peng. Western Regulatory Theory: Literature Review and Theoretical Clean-up. Chinese Administrative Management, 2009(9).
3. Yu Jianxing, Zhu xinyi. The market supervision function of the government in the era of "Internet +" and its implementation. Chinese Administrative Management, 2017(6).
4. Liu Peng. Reform of China's Market Economy Regulatory System: Development Context and Realistic Challenges. Chinese Administrative Management, 2017(11).
5. Xie Di, Liu Jiali. New Ideas on the Reform of Government Supervision System for Urban Public Utilities -- from the Perspective of Empirical Facts. Industrial Organization Review, 2013(3).
6. Yang Binglin. Research on Theoretical Paradigm and Implementation Path of Regulatory Governance System -- Inspiration from Responsive Regulatory Theory. Chinese Administrative Management, 2014(6).
7. Li Yu, Zhou Hongmei. Data Driven Smart Supervision. Research on China's market regulation, 2016(10).
8. Xu Zongben, Feng Zhiyan, Guo Xunhua, Zeng Dajun, Chen Guoqing. Big data driven frontiers in management and decision making. Manage the world, 2014(11).
9. L Baruh, M Popescu.Bigdata analytics and the limits of privacy self-management. New Media & Society, 2015(1).
10. Ritu Agarwal, Vasant Dhar.Editorial-Big Data, Data Science, and Analytics: The Opportunity and Challenge for IS Research. Information Systems Research, 2014, 25(3).
11. Chen Chaobing. The Main Practice and Reference of Developed Countries to Promote Government Governance by Internet and Big Data. Research on Socialism with Chinese Characteristics, 2017(6).
12. Editorial department. Big data strategy and action of major countries in the worldp. Information security in China, 2015(5).
13. Su Yun, Ren Yuanyuan. Construction and perfection of government information disclosure system under the background of big data-- Concurrently on the frontier development of transparent government practices abroad and Its Enlightenment to China. Books and information, 2016(2).
14. Yuan Fang. Research on the Path of Improving Government Governance Capability with Big Data. Journal of Hebei Normal University (Philosophy and Social Sciences Edition), 2015(6).
15. The State Council. Notice of the State Council on Issuing the Action Plan for Promoting the Development of Big Data (No. 2015 [50]) [EB\OL]. http://www.gov.cn/zhengce/content/2015-09/05/content_10137.htm, 2015.8.31.
16. The State Council. Regulations on Urban Gas Management［EB/OL］.
17. http://www.gov.cn/zwgk/2010-11/25/content_1753480.htm, 2010.11.19.
18. National Bureau of statistics. National Bureau of statistics / annual data / energy / urban energy products supply EB/OL.
19. http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A070C&sj=2016.
20. Zhao Yong, Lin Hui, Shen Yushi. Big data Revolution -- Theory, Mode and Technological Innovation[M]. Electronics Industry Press, 2014.
21. Ying Feihu, Tu Yongqian. Information Tools in Public Regulation. Chinese Social Sciences. 2010(4).
22. Gao Xiaoping. Big data and government reform and innovation. Guangming Daily, 2016,12,21(13).
23. H Ekbia, M Mattioli, I Kouper, G Arave, A Ghazinejad. Big data, bigger dilemmas: A critical review. Journal of the Association for Information Science & Technology, 2015, 66 (8).