

Research of Construction of Sci-tech Innovation Platform in Anhui Province in China

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Abstract

In the age featured with Big Data, Anhui Province has made great progress in scientific and technological innovation. As a result, there appear new features and new requests of sci-tech management. This article, from the perspective of Big Data, basing on the realistic condition of sci-tech innovation platform's construction in Anhui province in China, has discussed how to build a better platform. We has creatively proposed the construction principle, which is three-elements-driving (Big Data, Internet of Things and Cloud Computing) and the four-in-one constructing subjects of system and mechanism, innovative service, industry cultivation and technology research and development, and has provided strategic suggestions on how to guarantee the platform's smooth running from three respects of system and mechanism, fund source and environment. At last, it has analyzed and studied the platform's effective operation.

Key words: Big Data, Anhui Province, sci-tech innovation platform

The Eighteenth CPC National Congress had proposed that the implementation of innovation-driven development strategy and emphasis on sci-tech innovation are important strategies to improve social productive forces and strengthen our comprehensive national power. These are significant developmental strategies made by the Party Central Committee, basing on the overall situation, taking the whole world into consideration and focusing on the key problems. The Central Committee of the Communist Party of China and the State Council had issued *National Innovation- Driven Development Strategy Outline*^[1] in May 2016, which had emphasized again that innovation-driven development strategy should be placed at the key position of national development.

On the other hand, as the joint of coastal developed areas and the west area, Anhui province in China has become the first stop of industry and technology's gradient transfer. Its capital, Hefei City, has become one of the four science and education bases in China, with advantage of scientific and technological innovation. In the recent years, with the proposal of One Belt One Road strategy, the construction of Shanghai scientific and technological innovation center and the development of Yangtze River Economic Zone, Anhui Province has always been actively grasping these historical opportunities, speeding up sci-tech innovation, enriching human resources, enlarging the number of sci-tech organizations and intermediaries, increasing research input and trying to get more obvious results.

Shih Chi said when it's time to take and you don't, you will be blamed; when it's time to act and you don't, you will be troubled. Under this historical background, it's a necessary step to construct a sci-tech innovation service platform, on which we can integrate various resources to support innovation activities. That will be of great significance to accomplish the first goal of *National Innovation-Driven Development Strategy Outline*, becoming an innovative country in 2020.

1. Literature Review

Construction of sci-tech innovation management platform is a complex big project, on which many scholars have done research. Oversea study mainly focuses on some certain platforms from one of the layers of industry, enterprise and product. Johnson and Ravipreet^[2] have proposed that innovation platform could improve enterprises' cooperation and learning ability, so that the learning actives based on platform could make enterprises' interrelationship more effective, stable and efficient. Nicolas and Kara^[3] discussed the process of consumer commodity companies making use of this platform to create potential ideas and how to decrease innovation risks, and pointed out that innovation platform is the driver and foundation of enterprise innovation. Throughout literature reading, we've never found any foreign scholar doing systematical research on platforms. If we begin platform's construction on a large scale without straightening out platform's structure and operating mechanism, various platforms' functions could be so conflicting that the whole structure could become a mess and platforms' functions could not be played out.

Scholars in China have also done research on regional innovation platform construction. Huang Huiling^[4] has analyzed the real problems in construction of sci-tech innovation platform in Xiamen City in Guangdong

Province in China, designed assessment index system, come up with an overall construction plan and suggestions on innovation mechanisms. Lixiao and Zhu Xinghua^[5] have concluded the accomplishments Zhejiang Province in China has achieved and proposed some suggestions of depending on industry, facing society, task object location and following market rules and so on. Shen Qifeng and Qi Linhua^[6] have cited the example of Agricultural Science Institution in Jiangxi Province in China, analyzed the real requirements faced the agricultural development in Jiangxi Province, presented the basic framework of agricultural sci-tech innovation in Jiangxi Province and proposed countermeasures and suggestions on how to improve it.

Though scholars in China have realized the importance and necessity of research on innovation platform, they have done little research on platform structure as well as development law, and even less research on innovation platform construction under the historical background of Big Data. Besides, though it's right to learn from other provinces, Anhui Province has its own special features, especially under the historical background of Big Data. Therefore, it's of great theoretical significance and practical value to make in-depth exploration on how to construct a sci-tech innovation platform in Anhui Province, especially about construction rules and subjects, taking into account of the new accomplishments Anhui has done in the era of Big Data.

2. The present condition of sci-tech innovation platform construction in Anhui Province

2.1 *The connotation and functions of regional sci-tech innovation platform.*

Regional sci-tech innovation platform is a supporting system of managing sci-tech innovation activities in this region, which can integrate innovation elements and resources. It includes material system, information system, institutional system and specialized talents.

The platform has many functions from different aspects of governments, industry, schools, research laboratory and so on.

2.1.1 The platform can provide decision basis of policy making for government, participate in formulation of industry standards, and hold various-level national or international exhibitions and intercommunications.

2.1.2 The platform can provide technical service for local enterprises; accept enterprises' entrust to promote generalization and exchange of regional sci-tech innovation products. Meanwhile, accumulate and analyze dynamic data of industry development, provide consultation and remote diagnosis and promote communication between industries and enterprises.

2.1.3 The platform can cultivate innovative talents and give guidance to universities and colleges on how to optimize teaching resources and cultivate talents according to different requirements of various innovation bodies.

2.1.4 The platform lead universities and colleges go out and share resources, strengthen cooperation with other innovation bodies and conduct R&D collaboratively on the key and new-frontier technology.

2.1.5 The platform can make use of its advantage of resource integration and provide financial support to innovation talents after absorbing research fund from different channels.

Therefore, regional sci-tech innovation platform can meet various needs from various aspects, will become a big platform of managing and supporting sci-tech innovation and play a great role in it.

2.2 The present condition of construction of regional sci-tech innovation platform in Anhui Province

2.2.1 The accomplishments on platform's construction

We have already set up the initial platform based on a servicer network called Technology Passes Out, supporting innovation from the perspective of service. We have constructed one provincial center, nine municipal centers, many innovation service stations, and cultivated 300 intermediary service institutions and owned an innovation group which consists of 1000 technology brokers. Aiming at innovation bodies' actual requests, we have created out a service process of Double Closed Circulation, that is innovation bodies put forward requests, platform accepts requests, provide online and offline service and evaluate its performance from different channels. There are one-stop service windows in Hefei, Wuhu and Bengbu cities in Anhui Province, accepting enterprises' and colleges' and individuals' innovation requests through phone, network or on-the-spot communication. The platform will take reaction within 24 hours, assigning the work to corresponding behind-the-scenes backers respectively. Service staff and innovation carriers provide aid. Meanwhile, through tracking, accepting complaints and performance assessment and other various ways, the platform will supervise the whole process ^[7].

Currently Department of Science and Technology of Anhui province has put forward a great goal of constructing five projects and establishing a big innovation platform with regional characteristic, in which the five projects are industry R&D cooperation, elements exchange cooperation, achievement transformation cooperation, intermediary services cooperation and resource share cooperation. Anhui province has made great accomplishment on the basis of the existing platform, with its various R&D indexes ranking first among the five provinces of central region in China, see Table 1.

Table 1: The R&D status of the large and medium-sized industrial enterprises in Provinces of central china

(2014) unit: %

indexes provinces	the proportion of enterprises with R&D activities in all enterprises	the proportion of R&D personnel in all staff	the proportion of enterprises with R&D department in all enterprises	the proportion of R&D fund in all income from main business	the proportion of the income brought by new products sale in all products
Anhui	40.77	5.68	35.29	1.03	21.17
Hubei	27.80	4.79	14.01	1.19	17.58
Hunan	29.76	4.31	17.70	1.35	29.33
Henan	22.21	3.22	14.42	0.66	10.93
Shanxi	13.02	2.48	9.53	0.82	6.04
Jiangxi	21.79	2.37	15.76	0.56	8.45

2. 2.2 The existing problems of platform's construction

(1) The capability of promoting enterprise' R&D and improving industrial performance needs to be enhanced.

R & D ability within enterprises is limited. Laboratories supported by enterprises only occupy a small proportion of all laboratories. In all industries of provincial level or higher, enterprises with R&D department only occupy 14.51%; enterprises with R&D activities only occupy 16.59%. Economic benefits brought by R&D should have been increased; industrialization should have been improved. Like what we see in Table 1, as to the proportion of the income brought by new products sale in all products, Anhui 21.17%, lower than Hubei 29.33%^[8]. Industries' self-dependent innovation has been restricted; therefore, platform's promoting ability needs to be enhanced.

(2) The ability of resource sharing, information exchange and tackling key problems jointly needs to be improved.

Currently, in Anhui province, each platform is still doing things in its own way. This situation should be changed, in which we should reinforce commutation and cooperation more intensely and have the composition force of resource sharing, information exchange, advantage complementation and tackling problems jointly. On the one hand, we construct the high-level big platform; on the other hand, we perfect joint-use mechanism, accelerating cooperation between small platforms within the big platform. R&D institutions, colleges and universities and enterprises should know their own roles clearly in platform's construction and self-dependent innovation activities, working together in a more competitive, cooperative and win-win atmosphere.

(3) The current existing sci-tech innovation platform couldn't meet the demand of Big Data.

With the breakout of the third information technological revolution featured with Internet of Things, human society has undergone enormous changes, transforming from the binary pattern of *human society—physical world* to ternary pattern of *human society—information space—physical world*. Any object could become data origin, data size being enlarged enormously. According to Internet Data Center, global data has been increased with the rate of about 59% annually, the growth trend following new Moore's law—the global data size doubles every two years and will become 35ZB in 2020^[9]. Therefore, human society has developed into the age of Big Data. Big Data resources become the basis of innovation activities and will play a great role in sci-tech innovation.

Currently there is no clear definition of Big Data in the academic world, but people agree that the data size, complexity and producing speed have all surpassed the existing data form, so traditional technological methods can by no means handle it. As a result, sci-tech management has many new characteristics: the enlargement of experimental data's size and complexity, the increase of demand of equipment, the diversity of scientific subjects and individuality of demand of scientific research. The platform we've already set up could not satisfy the new demands brought by the age of Bid Data, which means we should construct regional innovation platform with Big Data characteristic as soon as possible.

3. The construction of sci-tech innovation platform in Anhui Province

3.1 Three Elements driving constructing principles of Big Data, Internet of Things and Cloud Computing

As what mentioned above, we need a creative model of sci-tech management in the age of Big Data to tackle new problems arising in this time, which means we need to reinforce regional sci-tech innovation platform's construction and make it work more smoothly to gain maximum benefits with minimum cost. We should take into consideration the new characteristics of sci-tech management of the age of Big Data, make use of Internet of Things, Cloud Computing and other modern technologies and build a regional sci-tech innovation platform system which can cover the whole province, can run through the whole innovation process and provide all-round service on the basis of the current existing platform.

3.1.1 Internet of Things is the source of Big Data.

Internet of Things means a network in which any commodity can conduct information exchange through RFID, GPS, QR code, laser scanning and other information tests and equipment identifications via Internet. As for sci-tech innovation, Internet of Things can do intelligent identification and effective management on innovation's material basis, system and mechanism and personnel information. There are three layers in Internet of Things, see Table 2:

Table 2. framework features of Internet of Things

network framework of Internet of Things	characteristics
perception layer	comprehensive perception
network layer	reliable transmission
framework layer	intelligent processing

Internet of Things' feature of connecting any object and its three-layer technology especially perception layer (RFID, GPS, QR code, laser scanning and sensor technology), make any object can send data, generating the enormous amount of data and its diversity. Internet of Things is the input source of Big Data ^[10].

3.1.2 Cloud Computing is the application platform of Big Data.

Google 101 proposed Cloud Computing for the first time, regarding Cloud Computing as the process mode of large-scale computing, through organizing all kinds of information and transferring all kinds of ICT resources flexibly. The fundamental of Cloud Computing is to distribute computing into a large number of computers, making application system can obtain computing ability, storage space and software maintenance as needed, making enterprises can visit computers or storage systems to obtain resources as needed. Cloud Computing has become the supercomputing mode of mobile internet and Internet of Things, can integrate data resource and computing resource of sci-tech innovation in a great extent and will become the commercial realization of computer science conception.

In the early phase of its development, because of Internet of Things' extreme complexity and its high implementation cost, it hasn't been put into practice until Cloud Computing coming into being. We set up Cloud Computing platform, connect three layers of Internet of Things, integrate small fragments of innovation in various regions into bigger fragments and integrate these bigger fragments into biggest part, even integrate with other industries' information and into a more comprehensive one^[11].

3.1.3 Internet of Things, Cloud Computing and Big data have a common impact on sci-tech innovation model.

If we say Internet of Things provide the source of data and Cloud Computing provide the storage mode and access channels, then Big Data provides support to decisions made on data application. Big data is the real soul, as the common growing trend of the three. Therefore, the Internet of Things' large-scale popularization, Cloud Computing technical process and Big Data's collection and share have a common impact on sci-tech innovation platform construction. Big Data, Internet of Things and Cloud Computing will become new principles of platform construction. The platform under Big Data background has to be a big platform on the basis of Internet of Things, Cloud Computing and Big data's interaction and mutual support, see Chart 1:

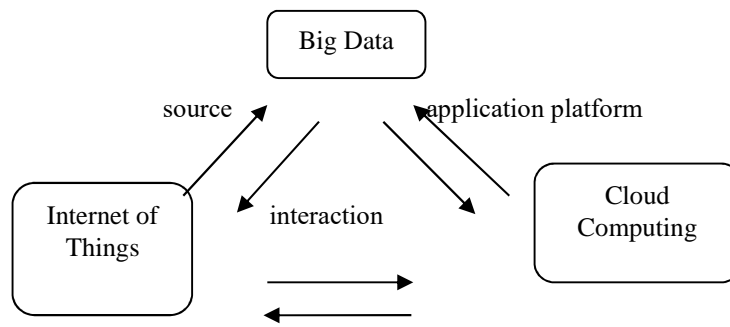
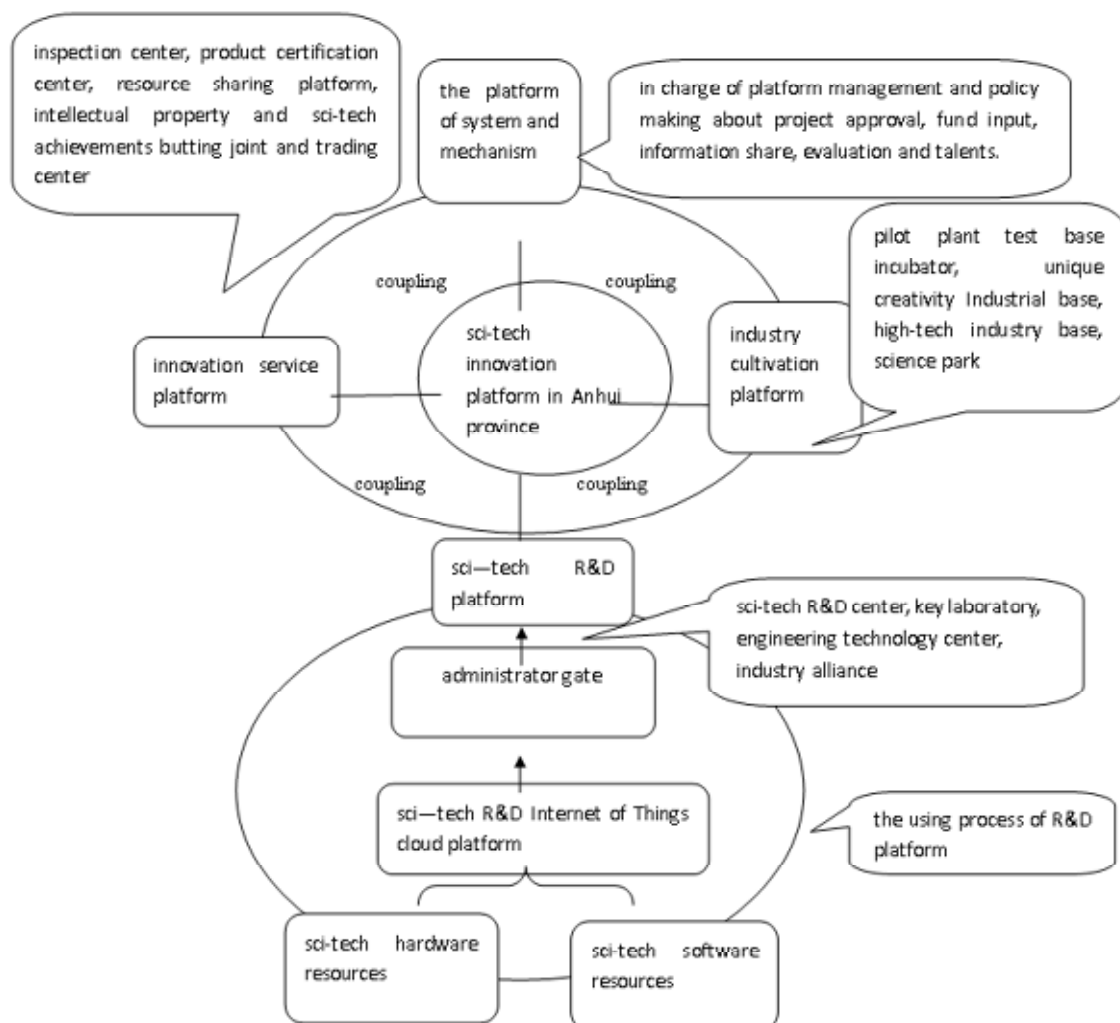


Chart 1: the approach of the platform's practice

3.2 Four-in-one construction subjects of system and mechanism, innovation service, industry cultivation and sci-tech R&D.

In order to suit the new requests of sci-tech innovation under the background of Big Data, we can refer to the three-elements-driving mode of Big Data, Internet of Things and Cloud Computing, construct a multi-element and establish a four-in-one big platform from four separate perspectives of system and mechanism, innovation service, industry cultivation and sci-tech R&D. As what mentioned in Chart 2, the emphasis is sci-tech R&D.



3.2.1 The platform of system and mechanism

The platform of system and mechanism provides policy guarantee to sci-tech innovation platform construction and management. This platform consider the long-term development of the entire sci-tech management system, formulate reasonable developing route, design and build regulations and policy system, create good environment of stimulating innovation, heightening its vitality, promoting its strength, improving economic performance, and promote the healthy development of the entire platform^[12].

3.2.2 The Innovation service platform

The innovation service platform is the backstage supporter of the whole innovation, integrate trans-department and trans-disciplinary resources, provide services including expectation, high-tech products export authentication, engineering talents cultivation and so on. This platform helps to realize basic resources sharing and provide basic support to social innovation.

3.2.3 Industry cultivation platform

The industry cultivation platform is the cradle of cultivating promising and strategic industries, aiming at industrialization, and combing scientific payoffs and industries and promoting the acknowledgement, popularization and application of the scientific payoffs. The platform will provide more opportunities for sci-tech personnel and industry to communicate with each other, which can not only let sci-tech innovation make real productivity, but also make the industry's requests heard by sci-tech circle. Meanwhile, the platform can introduce and breed some small enterprises which have real innovation ability, promoting emerging industry, forerunner industry cluster and the high-end oriented industry^[13].

3.2.4 Sci-tech R&D platform

Sci-tech R&D platform is the core of the entire innovation platform, is also the priority among priorities of sci-tech management. Under the background of Big Data, in order to meet the new requests of this age, we need to make use of Internet of Things and Cloud Computing to establish an Internet of Things cloud platform of sci-tech R&D. On the one hand, from the perspective of sci-tech personnel, through this platform, personnel can approach to data they needed, without wasting energy on obtaining sci-tech resources, and focus on research and development itself. On the other hand, from the perspective of sci-tech management, we can conduct all kinds of sci-tech resources integrating management, avoiding repeated collection of data, reducing the R&D cost and improving the service efficiency of sci-tech resources.

There are three procedures of the use of sci-tech R&D platform. At first, sci-tech management personnel construct sci-tech Internet of Things cloud environment and take charge of system maintenance and upgrade. Then, R&D personnel log on the Internet of Things Cloud and select services they need (data, equipment and analysis software, etc.) At last, Internet of Things cloud provides services to users and charge fees.

4. The operation guarantee of sci-tech innovation platform in Anhui Province

A set of measures is needed to guarantee the platform's smooth running.

4.1 systems and mechanisms

4.1.1 Collaborative innovation mechanism in the decision-making management layer

The decision-making management layer of this platform is local governments at different levels and their functional departments. The management layer, seeing from the perspective of overall development, aiming at collaborative innovation, should distribute rationally and cultivate scientifically innovative subjects. There are three modes of its spatial distribution: balanced distribution, dotted distribution and dot + axle distribution. According to the economic development level, industry distribution mode and sci-tech innovation features, dot distribution mode has been adopted currently. In the future, balanced distribution mode will be adopted gradually and promote the innovation development in Anhui Province comprehensively.

4.1.2 laws and regulations

In order to create a multi-element and multi-level big platform, first, joint conference system should be established in order to make all parties' requests heard. Second, laws and regulations, policy mechanism and incentive method concerning scientific and technological finance service system should be established and perfected in order to guarantee it's running from the height of policy making. Third, policies about the commercialization of research findings should be perfected, and with clear property rights, R&D personnel can be more stimulated. Fourth, as to revenue tax and land use, more favorable measures should be given to provide practical convenience.

4.1.3 Mechanism of polarized radiation-like and web-like development

We should concentrate on establishing dominant platform, like property rights exchange markets; making use of dominant platform's radiating effect to promote the platform's development in this region. Meanwhile, pay attention to platforms' development in different cities, establish four-in-one networking information platform, share resources and achieve common development.

4.2 Fund resource

4.2.1 Multiple investment lead by government

Our goal is multiple investment mode lead by government. There is still a long way to go to achieve this goal. We need to probe, analyze and construct different financing modes, including fund and venture investment, to deploy social capital into innovation through playing the role of government-lead venture capital fund.

4.2.2 Deploy social capital through market operation

In order to encourage social capital to participate in platform construction, on the one hand, multi-channel investment and financing mechanism should be established, relevant departments should communicate with investors, discuss on development prospects and industrialization prospects and other problems, and make

investors relieved to invest. On the other hand, through perfecting stimulating mechanism, investors' interests are guaranteed, investors' enthusiasm is improved, and social capital is deeply employed to participate in innovation platform's construction and operation.

4.3 Forming complete set environment

4.3.1 Boost innovation culture and promote development through culture construction

In cities in Anhui Province, we should cultivate a cultural atmosphere in which people like to participate in innovation. Culture is a big power, in which individuals, enterprises and society will see innovation as a necessity. Culture is beneficial for sci-tech R&D, research findings' commercialization and sci-tech enterprises' development. Different cities should cultivate innovation cultures with their own characteristics according to their own characteristics. Plus, in order to promote material and spiritual civilization grow harmoniously, concrete and material awards are needed to stimulate innovation culture's construction.

4.3.2 Talents team construction, get productivity out from technology.

In order to make platform run smoothly, talents team with high quality need to be built. Colleges and universities, scientific research institutions, R&D departments within enterprises should become the main force of specialized talents group with both specialized knowledge and team spirit. Meanwhile, introduce excellent talents and perfect stimulating mechanism and distributing mechanism. Technology will be appraised as capital stock in order to retain talents and translate technology into productivity.

4.3.3 Reinforce performance evaluation construction and assess development scientifically

Performance evaluation mechanism will be quite useful in talents team construction. On the one hand, evaluation index should be established, including four sub-platforms' system and structure, the number and distribution, specific situation of construction, management and collaboration, economic interaction between platform and other subjects within the region, translation from major achievements in scientific research into productivity. On the other hand, establish evaluation index's weight and construct evaluation mode rationally.

4.3.4 Reinforce international communication; enlarge scope of platform's services

On the basis of platform's construction, platforms' international communication and cooperation should be emphasized; the strategic cooperation between different subjects within platforms and with other countries especially developed countries should be reinforced. The platform should be integrated into global innovation network. The more requests platform will face, the larger the scope of platform's services will become. Service chain, fund chain and innovation chain will be integrated organically.

5. The effective evaluation of sci-tech innovation platform in Anhui Province

In order to evaluate platform's operation effect, indicator system of platform's evaluation should be established. This evaluation indicator system is a kind of measurement, which can inspect the management

which has been done before, balance the platform's operation, find out problems and improve its efficiency through solving these problems. As the reference of governments' subsidies in the future and policy of science and technology, the evaluation result of the platform, can make the limited sci-tech resources be distributed more rationally and improve its utilization efficiency^{[16][17]}.

5.1 Development environment evaluation

Platform's development will be influenced by its living environment. The better the environment, the faster the platform develop. Therefore, three second-level indexes--economic development environment, science and technology environment and information basis environment—will be selected to measure development environment. Economic development environment will determine the platform's overall development, science and technology environment will influence platform's development with pertinence, information basis environment will be the modernized ways of its development.

5.2 Resource utilization evaluation

All sci-tech innovation platforms will face some problems, such as the limited resources, low utilization efficiency and bad communication between institutions. Therefore, resource is the basis of platform's construction and development. Two second-leveled indexes—resources share and resources integration—will be selected evaluate the entire platform's resource situation. Resource share is the precondition of resources' mutual exchange and resource integration is the reflection of the organic treatment and full utilization of resources in Anhui Province.

5.3 Service quality evaluation

According to the principle of platform construction, the platform will provide innovation service to enterprises, colleges and universities, scientific research institutions and sci-tech personnel from the four perspectives of mechanism, R&D, industry cultivation and innovation service. In order to evaluate the visible economic benefits and invisible social benefits, we set the second-level indexes from three aspects of R&D service, other services and social benefits^[20].

5.4 Operation management evaluation

Operation management of the platform is the guarantee of platform's development. In order to strengthen the standardization construction of platform management construction, the second-level indexes include basic infrastructure, management system and personnel matching. Basic infrastructure is the material basis of platform's operation; management system is the key factor of making sure the smoothness and the effectiveness of platform's operation, and talents are the key of competitiveness, having a direct impact on the service the platform provides and platform's developing direction.

5.5 Development potential evaluation

Evaluation of platform's development potential must face the future. Platform's development are restrained by supply-demand relationship, market's demand is the inner driver of its development while government's support is the external guarantee.

According to the overall objective of platform's construction, platform's development's influential factors and functional orientation taken into consideration, and also considering platform's operation management acting as a guarantee to platform's development, we set up our evaluation indicator system from five perspectives of development environment, resources usage, service quality, operation management and development potential. The set of indexes will estimate the platform's development, check efficiently the platform's sound development and provide important references for governments of different levels in Anhui Province to evaluate its own performance and help make policies.

6. Conclusion

Throughout the history of mankind's progress and the rise and fall of Chinese nation, we see the revolutionary breakthrough of science and technology is inseparable to the development of society. In May, 2016, Committee of Communist Party of china and the State Council issued *Innovation-driven development strategy outline* of China, which pointed out innovation-driven development is the key of the nation's fortune. To bring about a great rejuvenation of the Chinese, we should make full use of this powerful leverage of science and technology, which will be the ultimate revolution.

Sci-tech management is inseparable to sci-tech innovation, which is a key influential factor of national development. With the arrival of the age of Big Data, sci-tech innovation management of China will have new characteristics and new demands, with which Anhui province is no exception. The existing sci-tech innovation platform has made a great difference in promoting the commercialization of research findings and accelerating innovative development, which helps Anhui a lot in the great dream of starting from carrying on industry transfer, taking on scientific and technological innovation as driver and participating in Yangtse River Delta Region. However, with the development of Big Data, Cloud Computing and Internet of Things, sci-tech management of this age must make progress with the sci-tech progress, therefore, the existing information management platform must keep up with the development of this age.

On the basis of the development of sci-tech management platform in Anhui Province, we proposed the three-elements-driving principle of Big Data, Internet of Things and Cloud Computing and the four-in-one constructing subjects of system and mechanism, innovative service, industry cultivation and tech-research and development, especially the proposition of "Internet of Things Cloud Platform supporting scientific and technological research and development", constructing multi-element and open science and technology management platform. Then, we have studied the platform's operation guarantee from three aspects of

mechanism, fund resource and environment. Finally, we've set up evaluation indexes system from five aspects of development environment, resource usage, service quality, operation management and development potential and use it to evaluate the platform.

In conclusion, our platform is the effective measure to promote science and technology innovation in Anhui Province, which will play a great role in accelerating scientific and technological progress and innovation development in Anhui Province and promoting the constant, stable and fast development of economic development in Anhui Province.

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