

Factor Analysis and Construction of Resource-Based Cities' IUR Cooperative Collaborative Innovation System*

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Resource-based cities are often faced with the dilemma which cannot be sustainable development after depletion of resources, so how to achieve sustainable development of resource-based cities becomes the focus of scholars. Based on the definition of the concept related to the resource-based cities' industry-university-research (IUR) collaborative innovation system, the paper analyzes the two main factors of innovation entity and innovation environment of the resource-based cities IUR collaborative innovation system. The innovation entities include enterprises, universities, research institutes, government, intermediary agencies of science and technology, and financial institutions. The factors of innovative environment include the environment of policy and legal, the level of development which represents regional pillar industries and high-tech industries and the perfection degree of resource-based cities' cooperative innovation platform construction. Finally, this paper builds a resource-based cities IUR collaboration innovation system model. In this model, each party entity, in the context of low-carbon economy, are in the environment that policy, law, and regional pillar industries and high-tech industries growing fast, they also make collaborative innovation.

Keywords: industry-university-research (IUR), collaborative innovation, resource-based city, elements

The development of resource-based cities often relies on the energy and abundant resources in the region, and the establishment of industrial form is also dependent on the rapid development of large-scale energy sources, but along with the process of energy and resource-based cities' development, the city need think earlier and plan in advance about some situations, e.g., the continued deterioration of the natural environment, the excessive development of energy, the bottle neck issues connected with the economic which has developed to a certain stage. Therefore, the research of resource-based cities' industry-university-research (IUR) collaborative innovation system can enhance the source of innovation and provide a strong motivation for achieving the

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objective of resource-based cities' sustainable development.

The Concept of Resource-Based Cities' IUR Collaborative Innovation System

The system of resource-based cities' IUR collaborative innovation means that under the background of the low-carbon economy, resource-based cities' enterprises, universities and scientific research centers depend on the local pillar industries or high-tech industries, with the support of local government, the help of the assisted agencies, such as intermediary platform, financial firms, the market-oriented system makes the innovative thinking as a guide, according to their own development needs to find a partner, it integrates with their own advantages to carry out technical innovation activities, and upholds the low-carbon concept to complete the process of "research and development (R&D), design, production, and sales", and ultimately achieves the goal of using minimal energy consumption and lowest environment cost to obtain the maximum benefits of the science and technology, economy, and environment. After achieving their desired results, they continue with the original partners or re-look for new partners to complete a new round of cooperation, and even form a long-term strategic alliance, so as to form a virtuous circle cooperation innovation system, which can enhance the resource-based cities' innovation capacity, reduce carbon emissions by resource-based cities, and promote the low-carbon development of resource-based cities.

Factor Analysis of the Resource-Based Cities' IUR Collaborative Innovation System

The Elements of Innovation Entity

The entity elements of resource-based cities' cooperative innovation mainly refer to the entity that is involved in the collaborative innovation process, is enterprises, universities, and scientific research centers, government and assisted entities, such as science and technology agencies and financial institutions.

Enterprises are the core entity of the regional IUR cooperative innovation. Long-term development of enterprises needs relying on continuous technological innovation. Enterprises solve their weak technology problems through cooperation, especially the larger enterprise. The stronger the absorptive capacity is, the more active the IUR cooperative innovation activities are. The dominant position of enterprises is demonstrated by the following aspects: First, companies will be involved in all phases of IUR cooperative innovation. Enterprises are the ones who are at the helm of the industry direction. They select project through the market, determine which kind of technology they need; then seek partners and invest funds; monitor project progress; achieve technological transformation; complete a series of innovation activities, such as business activities. Meanwhile, enterprises determine the IUR cooperative mode to a great extent. Based on its own strength, combined with the reality of the situation, they will choose technology transfer, commissioned research and development, joint research, internal integration, building a base, building entity and class platform (IUR alliances and Technology Park) and other models. Second, enterprises are mainly responsible for cooperative innovation risks. In collaborative innovation process, companies have to face a series of risks, such as financial risk, technology risk, market risk, and environmental risk. Third, businesses are the leaders who turn scientific and technological achievements into actual economic benefits, and they are basically responsible for the production, energy, and other inputs. Fourth, after obtaining the benefits of cooperative innovation, enterprises have a larger initiative in the profit distribution, and thus how to carry out the two sides or multi profit distribution reasonably and properly so as to improve cooperative satisfaction in universities and scientific research centers without compromising their own interests, is largely determined by the enterprises.

Universities and scientific research institutes are the science and technology body of regional cooperative innovation. Universities and scientific research institutes are the sources of technological innovation, they have a strong sense of innovation, focusing on the progressiveness and originality of the creation. This spirit of exploration ensures technological innovation activity from the source. Universities and scientific institutes have sizable facilities and a strong team of professionals, they are equipped with professional knowledge, powerful science and technology, and great research results. They have an absolute advantage in hardware and software facilities and they are able to provide strong technical support for cooperation. In addition, many resource-based cities are currently carrying out economic restructuring to achieve sustainable development, and the key to economic transformation is to carry out scientific and technological innovation and to encourage the source of innovation constantly. Therefore, the economic restructure of resource-based cities will set off a new round of cooperation climax, making the main role of universities and research institutes become increasingly prominent.

Government is the body boot of regional cooperative innovation. IUR collaborative innovation is a market behavior, but the reason why the government joins into it as a body has three reasons: First, the government can guide enterprises to focus on basic research and the source of innovation through preferential policies. Most of enterprises that are affected by pursuing the maximizing interests, do not want to invest a great deal of time and money for research and development, always tending to improve technology in the process of cooperative. In the long run, it will affect the entire region to enhance innovation capability. However, the government's financial compensation will inspire the innovative power of enterprises. Second, the government guides universities and research institutes to get actively involved in cooperative innovation through funds support, institutional norms, and other ways. On one hand, universities and research institutes are lack of funds in R&D investment, but the support of government funding can guarantee the R&D funding of universities and research institutes; on the other hand, the appraisal standards of universities and research institutes are not uniform for science and technology personnel performance, and this may affect the initiative of innovative of the scientists, therefore the relevant government departments through policy guidance allow scientists to play its due role. Third, the government, through management, supervision, and other ways, protects the efficient operation of the cooperative. Cooperative parties often face difficulties in many aspects, for example, policy, markets, funds, and mechanism, and government intervention can alleviate these contradictions and problems.

Financial institutions are the main source of innovation entity financing. Innovation requires a lot of funds investment, every stage of IUR cooperation requires funding to support, so each entity is in need of financing when they are the lack of funding. Especially for enterprises, as we all know, the actual technological innovation activities of enterprises need a lot of money to support, but the enterprises' funds are often limited, then almost all enterprises need loans from financial institutions, therefore, the financial institutions have a great effect on the development of the enterprise. As our country's market-oriented interest rate, financial institutions have autonomy, which makes enterprises prevail, while this makes SMEs (small and medium-sized enterprises) increase the pressure of loans, facing financing difficulties, this impacts on funds investments of technological innovation. Because both the financial institution and private capital will consider the borrower's credit, strength, and other occasions, when lending, so this makes the entity which is lack of credit and strength, raise funds difficultly and impact seriously on innovation activities. In addition, even if somebody has the ability to finance, but when face of higher lending rates, they will be cautious, which affects some innovation

project selection and decision-making. In summary, the financing problem that the financial institutions face the innovation entities affect on cooperation innovation behavior to varying degrees.

Technology agencies become the service of every IUR party. Currently, each regional technology agency is extremely diverse, including the productivity promotion center, technology incubators, technology property right trading service center, technology consulting, assessment agencies, etc. They mainly provide technical advice, technology diffusion, achievements transfer, innovation decision-making, personnel training, and other services. The industry side and the university-research side will seek help from technology agency according to their specific circumstances. For example, enterprises can seek technology agency for help in a short time and find the right research staff to resolve difficulties in the event of technical difficulties; likewise, after obtaining the technological achievements, universities or research institutions are able to let technology agency to find buyer for them. So, the function of technology agency's diversified services can provide powerful support services for every IUR party.

The Factors of Innovative Environment

The environment factors of resource-based cities' IUR collaborative innovation mainly include policy and legal environment, the level of development which represents resource-based cities' pillar industries and high-tech industries, the perfection degree of resource-based cities' cooperative innovation platform construction.

Policy and legal environment. Policy and legal environment has a significant impact on resource-based cities' cooperative innovation. If the government of a resource-based city attaches great importance to the IUR collaboration cooperative innovation, it will increase the support of the industry side and the university-research side, then it will give guidance on policy and support in the funding, which can make a good environment for the industry side and university-research side to dare to do and be committed to cooperation innovation actively. On the contrary, it will hit the both sides' innovation enthusiasm, so as to affect the environment of all the regions. In addition, laws and regulations will have a greater impact on IUR cooperation. Such as the "People's Republic of China Science and Technology Progress Law", "People's Republic of China to Promote Scientific and Technological Achievements Into Law" and other laws, "Interim Provisions on SMEs Technology Innovation Fund", "National Industrial Technology Policy" and other regulations are reflecting the country's importance of innovation activities. At the same time, it should be pointed out that in the current background of low-carbon economy, resource-based cities' activities are subject to "National Environmental Quality Standards", "National Emission Standards", "National Environmental Promotion Industries Standards", and other relevant environmental laws and regulations, if some innovation activities have a larger effect on the environment, they could have been ordered to stop.

The level of development which represents regional pillar industries and high-tech industries. Currently, the pillar industries and high-tech industry of developing areas can stimulate new economic growth point, and it has become the consensus of every region. Pillar industries have a strong ripple effect and linkage effect, and they promote the growth of many industries so as to affect the economic structure of the region. The longer the life cycle of the pillar industries are, the more far-reaching the impact on regional economic development has, and only do the technological innovation assimilate into pillar industries, are various sectors and departments linked together, the life cycle of the pillar industries is extended. From this point of view, the significance of IUR collaborative innovation is extremely great. High-tech industry is an industry that has knowledge and technology, the industrial development is better, it is more able to play its role of radiation and

leading and it also can bring more economic and social benefits. In recent years, a number of resource-based cities establish high-tech industrial development zone, set up scientific and technological innovation demonstration base, strategic IUR alliances, these measures have greatly promoted the development of high-tech industries. Through developing high-tech industry, regional economy has been developed and the damage to the environment has been reduced. Therefore, the development of resource-based cities' pillar industries and high-tech industries will lead to innovation activities more active and make the development of trans-department IUR cooperation more vigorous.

The perfection degree of resource-based cities' cooperative innovation platform construction. Cooperative innovation platform is a non-profit organization, it provides services for public through various forms, such as building cooperative platform, providing information integration services, exploring effective cooperative models and methods, tracking and monitoring the progress of cooperative projects, evaluating and assessing scientific and technological achievements, promoting scientific and technological achievements to transfer and industrial to upgrade, push forward to construct cooperative fund, etc. Currently, the better construction of platform is nationwide "China Cooperative Promoting Association" and regional "Guangdong Provincial Cooperative Promoting Association", etc., they have achieved good results since its inception. Other regions also built the networks or entity innovation platform, but it is more dispersed and has less influence, so it is difficult to play the role of bridge and link effectively. Therefore, the perfection degree cooperative innovation platform construction directly affects the activity of the resource-based cities' cooperative innovation behavior as well as the cooperative effect of innovative entities.

The Construction of Resource-Based Cities' IUR Collaborative Innovation System

According to the entity and environment factors analysis of resource-based cities' IUR collaborative innovation system main elements and environmental factors, combined with the meaning of this system, we can find the IUR collaborative innovation activity is a process of co-operation, it need the innovation entity invest a lot of manpower, material, and financial resources to acquire scientific and technological, economic, and environmental benefits. Thus, we can build resource-based cities' IUR collaborative innovation system, as shown below.

In this conceptual model, each party entity, in the context of low-carbon economy, is in the environment that policy, law, and regional pillar industries and high-tech industries growing fast, they also make collaborative innovation. Enterprises, universities, and research institutes, with the guidance of the government and the help of assisted agencies, establish cooperative relations through discussion and consultation, and implement the IUR cooperation project. In the course of project implementation, every party entity needs to be based on the actual situation to invest manpower, material, and financial resources, certainly, for carrying out the smooth and efficient cooperation and innovation, they also need the funding support of financial institutions, the coordination of technology agencies and the help of the innovation platform, and finally, in the multi-party joint efforts, they obtain cooperative innovation output. These outputs not only include economic output and technological achievements, but also involve ecological benefits.

Conclusions

In order to achieve sustainable development, resource-based cities must optimize IUR collaborative innovation overall. Based on the connotation and factors analysis of this system, we build the model of

resource-based cities' IUR collaborative innovation system. Through this system model, we can build the IUR collaborative innovation platform, cooperate with government, enterprises, and research institutions fully, reduce transaction costs of development and achievements transfer; and in the development and collaboration process, use universities' role on research and development, combine personnel training with enterprises' research investment, and take a development road of independent training leader; and in the downstream of resource-based industries higher value-added, give full play to the characteristics of enterprises, concentrate on the superior resources, integrate the value of the industry fully, lead the new transformation and development of industry in the new; while further reduce energy's dependence of industrial and urban development, complete scientific and sustainable development.

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