

CONSTRUCTION OF RESOURCE-BASED CITY INNOVATION ECOSYSTEM

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Abstract

Based on the viewpoint of innovation ecosystem and regional innovation system, this topic constructs the models of four subsystems: innovation operation (university technology enterprises, industrial enterprises above Designated Size), innovation assistance (intermediary institutions, government), innovation R & D (Research and development institutions, universities) and innovation environment (social, natural, economic and basic environment), study the construction of innovation ecosystem in resource-based cities. Through the empirical analysis of the construction of innovation ecosystem in Xinzhou of China. This paper obtains the key points of Xinzhou in the construction of innovation ecosystem, obtains the weight of model indicators by using statistical software, captures the features of the construction of innovation ecosystem in resource-based cities, and offers a proposal for the development sustainability of resource-based cities.

Keywords : Resource-based city, Innovation ecosystem, Innovative operation, Innovative R&D, Innovation assistance, Innovation environment

Introduction

Resource-based city refers to the natural resources such as coal, metal and oil owned in the region, which are closely related to the survival and development of cities. According to the development degree of resource-based cities and the results of the development and utilization of natural resources, resource-based cities can be divided into two urban modes: "first mining, then city" and "first city, then mining". The essential difference between the two is whether the urban form has existed before the exploitation, development and utilization of the natural resources in the region. The rational development of natural resources is conducive to promoting the sustainable development of resource-based cities.

At present, the effective way to achieve the high-quality development of resource-based cities in China is to build an innovative ecosystem. At present, the innovation ecosystem at regional level and enterprise level are two major types of scholars. The innovation ecosystem at the enterprise level refers to the structure mode of "enterprise-user" composed of integrators, upstream component providers and downstream complementary component providers by participating in the process of innovation activities. Innovation ecosystem at the regional level refers to the ecosystem formed by universities, enterprises, research and development institutions, governments, intermediary agencies and the environment in resource-based cities through the interaction and cooperation of the flow of innovation resources and information.

Theory

Innovation ecosystem is a complex network structure composed of these factors, including enterprises, universities, governments, intermediary agencies, research and development institutions and other factors. Innovation paradigm has undergone several developments, realized the transition from a linear paradigm (innovation paradigm 1.0) to an innovation system (innovation paradigm 2.0), and started entering the ecosystem of innovation

stage (innovation paradigm 3.0). The innovation ecosystem is a symbiotic economic community, among which the various elements influence and depend on each other. As an intermediate force in the innovation ecosystem, the government provides policy support for the development of enterprises, and provides sufficient funds for the transformation of innovation achievements of universities and development and research institutions. On this basis, enterprises have close contact with universities and research and development institutions, and the two sides conduct cooperation in production, learning and research. Intermediaries play an important role in talent, capital, information and other links, and they innovate together with other elements to realize the sustainable development of each elements.

Regional innovation system is an open system with the characteristics of self-organization. In the perspective of the ecosystem of innovation, further development. Regional innovation system is a regional organization system that cooperates, cooperates and operates by geographically interrelated production enterprises, research and development institutions, and local governments, which can effectively promote regional economic growth and make it develop continuously. Regional innovation ecosystem mainly includes three elements, namely the main elements, functional elements and environmental elements. Among them, the environment is the most basic constituent element, which determines the structure, behavior and evolution law of the whole system, and is composed of the system, institutions, government or legal regulation, infrastructure construction and guarantee conditions. Universities, research and development institutions, local governments, intermediary agencies and enterprises in the region are the main bodies. Service innovation, management innovation, system innovation and technological innovation constitute the functional elements. The social interaction between different elements constitutes the organization and spatial structure of the innovation ecosystem, and enhances the regional innovation ability and competitiveness.

By referring to the regional innovation ecosystem and Zhang Aiqin et al. (2021), this paper divides the innovation ecosystem into innovation operation subsystem, innovation research and development subsystem, innovation auxiliary subsystem and innovation environment subsystem. Four subsystems of innovation ecosystem are interrelated and interact with each other (Figure 2.1). The composition of the resource-based urban innovation ecosystem is studied here. The innovation ecosystem construction system including 10 first-level indicators and 10 second-level indicators has been constructed. Taking Xinzhou of Shanxi Province as an example to grasp the characteristics of the innovation ecosystem construction of resource-based city and provide reasonable suggestions for the construction of the innovation ecosystem of resource-based city.

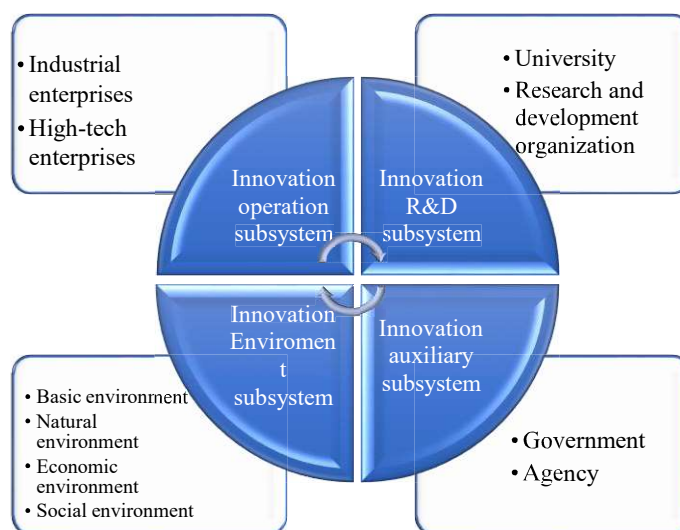


Fig. 1 Composition of resource-based city innovation ecosystem

Construction of the index system for the innovation ecosystem construction of resource-based cities

1) Design of the index system

This paper studies the innovation level of resource-based city innovation ecosystem construction, Building a resource-based city innovation ecosystem construction index, The design of the index system draws on the practice of Zhang Aiqin et al. (2021), According to the composition of the innovation ecosystem, the innovation ecosystem is divided into four first-level indicators: innovation research and development system, innovation operation system, innovation auxiliary system and innovation environment system, Among them, the innovative operation system is respectively reflected by the two second-level indicators of industrial enterprises above designated size and university technology enterprises; The innovation system is reflected by two secondary indicators of universities and research and development institutions; The innovation auxiliary system is reflected by the two secondary indicators of the government and the intermediary agencies; The innovation environment system is reflected by four secondary indicators: economic environment, natural environment, social environment and basic environment. The index system designed in this paper is shown in Table 1

Table 1 Evaluation Index System of Innovation Ecosystem construction

Level 1 indicators	Secondary indicators	Level 3 indicators	unit
Innovate the operation system	Industrial enterprises above designated size	operating receipt (X_1)	100 million
	University technology enterprises	Total exports of high and high-tech products (X_2)	Wan Yuan
Innovate the RESEARCH	colleges and universities	and Number of ordinary institutions of higher learning (X_3)	individual

Level 1 indicators	Secondary indicators	Level 3 indicators	unit
development system	The Agency for Research and Development	Amount of patent license granted (X ₄)	piece
Innovation assistance system	government	Public budget expenditure (X ₅)	100 million
	intermediary organ	Development investment completed amount (X ₆)	Wan Yuan
Innovate the environmental system	Basic environment	Number of public libraries (X ₇)	individual
	natural environment	Crop planting area (X ₈)	A thousand hectares
	economic environment	GDP total sum (X ₉)	100 million
	social environment	Highway line mileage (X ₁₀)	kilometre

Data source and processing

The research object of resource-based city innovation ecosystem construction is Xinzhou city, Shanxi Province. According to the long-term plan of national resource-based city published by China, Xinzhou of Shanxi Province is listed in the list of 262 resource-based cities. Moreover, as the development and utilization of natural resources in Xinzhou is in a stable stage, its leading industry has not yet entered the recession stage, and its resource guarantee ability is strong, which belongs to a mature resource-based city. Therefore, in this paper, the data of Xinzhou from 2012 to 2021 were selected for study. The required data are mainly derived from China National Bureau of Statistics, China Science and Technology Statistical Yearbook, Xinzhou Statistical Yearbook, and Xinzhou National Economic and Social Development Statistical Bulletin, etc. At the same time, because the studied data scale is different, the calculation results will have an error. Therefore, in order to eliminate the influence of magnitude, it is necessary to standardize the selected data before analysis. The formula for the interval-dimensional treatment is shown below. At the same time, the entropy method requires that the data cannot be zero or negative. Therefore, the data to be studied should be non-negatively translated through the SPSS tool.

$$\text{Intervalled dimensional processing} = a + \frac{(b-a)(X-X_{\min})}{X_{\max}-X_{\min}}$$

Xmin represents the minimum value, and Xmax represents the maximum value, with the default a, and b being 1 and 2, respectively

3. Model construction of innovation ecosystem construction in resource-based city

This paper uses the entropy value method (Entropy) to calculate the weight of the construction index, which provides a basis for the importance of the index to the research object. This paper uses the SPSS tool to first analyze the weight of each index according to the weight calculation results, and get the weight analysis matrix through the weight calculation results, and finally summarize the analysis.

Considering the complex influence between various factors, five models are constructed.

1) Take the resource-based city innovation ecosystem as the dependent variable, and take the innovation operation system, innovation research and development system, innovation auxiliary system and innovation environment system as the independent variables to establish models:

The Resource-based City Innovation Ecosystem = a_0 Innovative operation system + b_0 Innovative R & D system + c_0 Innovation auxiliary system + d_0 Innovative environmental system

2) Take the innovative operation system as the dependent variable, with the operating income of industrial enterprises above designated size (X_1) And the total export amount of high-tech products of university technology enterprises (X_2) For the independent variable:

$$\text{Innovation operation system} = a_1 X_1 + b_1 X_2$$

3) Take the innovation research and development system as the dependent variable, with the number of ordinary institutions of higher learning (X_3) And the amount of patent granted (X_4) For the independent variable:

$$\text{Innovative R \& D system} = a_2 X_3 + b_2 X_4$$

4) Take the innovation auxiliary system as the dependent variable, and use the development investment completed by the intermediary agency (X_5) And the government's public budget expenditure (X_6) For the independent variable:

$$\text{Innovation assistance system} = a_3 X_5 + b_3 X_6$$

5) Taking the innovative environmental system as the dependent variable, the number of basic environmental public libraries (X_7). Planting area of natural environment crops (X_8). Total GDP of the economic environment (X_9) And the mileage of social environment (X_{10}) For the independent variable:

$$\text{Innovation Environment system} = a_4 X_7 + b_4 X_8 + c_4 X_9 + d_4 X_{10}$$

In summary, we can get the final index weight model as follows:

$$y = aX_1 + bX_2 + cX_3 + dX_4 + eX_5 + fX_6 + gX_7 + hX_8 + iX_9 + jX_{10}$$

Among them, the coefficient before each index is the weight value of the constructed index, and the weight of each index constructed is calculated and analyzed through the entropy value method, which clarifies the influence degree of the constructed index on the innovation ecosystem of resource-based city.

Describe the statistical results

Describes the sample size, mean value and standard deviation of each analysis item when truly entering the algorithm model. If there are missing values in the data, the sample size at analysis will be smaller than the "number of data rows". Through the analysis, we can get the conclusion that the data is complete and not missing. The mean values or the standard deviation values of each analysis item can be described in Table 2

Table 2 Descriptive statistics

Item	Sample capacity	Average value	Standard deviation
Total exports of high-tech products	10	1.237	0.304
Number of ordinary institutions of higher learning	10	1.600	0.316
Patent authorization	10	1.272	0.295
Public budget expenditure	10	1.473	0.362
Development investment completed amount	10	1.377	0.321
Number of public libraries	10	1.100	0.316
Crop planting area	10	1.723	0.315
GDP total sum	10	1.330	0.321
operating receipt	10	1.262	0.286
Highway line mileage	10	1.628	0.285

2) Weight Calculation Results

Table 3 Weight Calculation Results shows the weight calculation results of the entropy method, and the weight of each index is analyzed according to the results. The entropy value method is used to calculate the weight of 10 items, including the total export value of high-tech products, and the weight between the items is relatively uniform, all around 0.100. Thus, we can get the final model as follows:

$$\text{Resource-based city innovation ecosystem } y = 0.093X_1 + 0.110X_2 + 0.081X_3 + 0.099X_4 + 0.106X_5 + 0.121X_6 + 0.138X_7 + 0.074X_8 + 0.113X_9 + 0.066X_{10}$$

Table 3 Summary of Calculation Weight Results

Item	Information entropy value e	Information utility value d	weight coefficient w
Total exports of high-tech products	0.9893	0.0107	11.02%
Number of ordinary institutions of higher learning	0.9922	0.0078	8.07%
Patent authorization	0.9904	0.0096	9.86%
Public budget expenditure	0.9883	0.0117	12.06%
Development investment completed amount	0.9898	0.0102	10.56%
Number of public libraries	0.9867	0.0133	13.77%
Crop planting area	0.9928	0.0072	7.44%
GDP total sum	0.9891	0.0109	11.27%
operating receipt	0.9910	0.0090	9.33%
Highway line mileage	0.9936	0.0064	6.61%

Suggestions on the construction of innovation ecosystem of resource-based city Accelerate the development of the innovative operation system

Create new new and high-tech products, The production technology of high-tech products is mature technology, high scientific and technological content, high brand added value, and considerable market capacity at home and abroad, which can bring huge economic and social benefits to resource-based cities. We should grasp the inherent development law of new high-tech products, adhere to the basic principles of innovation leading, high-end breakthrough, digital intelligence empowerment, green and low-carbon, create a number of new high-tech products, increase the number and proportion of their exports, and optimize the construction of the innovation ecosystem in resource-based cities.

Cultivate high and new technology enterprises and form industrial clusters, Coal has long occupied a leading position in China's energy for a long time, implementing the cultivation project of high-tech enterprises and accelerating the transformation and upgrading of traditional enterprises. We will accelerate the innovation and guidance of leading enterprises, and focus on cultivating a number of high-tech backbone enterprises with good development prospects, strong core competitiveness and significant driving role. Seize the opportunity of a new round of strategic restructuring and development, cultivate high-tech enterprises into leaders, and support leading enterprises in forming innovation confederations. We will guide enterprises to internationalization, focus on high-tech products, promote mergers and reorganizations, and accelerate the cultivation of a number of top 500 local enterprise groups. We will guide high-tech enterprises to

expand their overseas markets through cooperation and enhance their international competitiveness.

Optimize the supporting construction of the innovation environment

Optimize the construction of public libraries in the basic environment, We will support the full and free opening of libraries, and promote the network construction of digital books in all cities and counties by relying on 5G network construction, big data service system and the application of artificial intelligence. Increase the purchase funds, support the municipal library to purchase the books, expand the scale of the library collection, and support the preservation and maintenance of the library's ancient books, especially the rare books of the ancient books. Consolidate the network foundation of public digital libraries covering resource-based cities, continuously expand the content of digital books, provide more quantity and high-quality digital book resources, and optimize the supporting construction of innovative ecological environment in resource-based cities.

Optimize innovation policies and regulations, The government can set up special funds for resource-based city innovation ecosystem construction projects, support the promotion of key projects and reward related projects; formulate preferential policies of finance and taxation, encourage resource-based city innovation ecosystem construction to set up research and development departments, increase innovation investment, and support scientific and technological innovation enterprises.

Resource-based cities should improve the relevant laws and regulations on innovation, and protect and manage the innovation achievements of resource-based cities. By adopting formal systems, such as the implementation of the innovation achievement registration and certification system, improving the innovation achievement infringement compensation system and other relevant laws and regulations to regulate the behavior of copycat imitators, and extend their time to enter the market. Online and offline approach is adopted to create a good environment for the construction of innovative ecosystem in resource-based cities, and realize the fair and good competition among enterprises in resource-based cities.

We will improve the guarantee system for ensuring innovation and reform

Focus enterprises on scientific and technological breakthroughs and promote the transformation of innovation achievements, Focus on enterprise science and technology, the foothold in the project and enterprises. Centering on the leading advantage industries, relying on the backbone enterprises, with major projects as the support, relying on the projects to increase the efforts to solve the scientific and technological problems of enterprises. To rationally distribute the service platforms for new product research and development, we should attach importance to the dominant position of production, take problems and the sales market as the guidance, and basically build a main position for promoting independent innovation, accelerating the transformation of innovative scientific and technological achievements, and promoting the introduction and training of talents. From the aspects of R & D and development project approval, the current talent introduction policy, data platform improvement, to increase the support for the front-line new product research and development service platform. We will promote the commercialization of innovation achievements.

Attract and cultivate high-level talents needed for regional development, We will implement the project to introduce and cultivate talents to enhance the supporting role of talents. We will improve policies for introducing high-level talents, build an innovation ecosystem in resource-based cities, cultivate multi-level and multi-dimensional talent echelons, and focus on high-level talent brands. We will accelerate the construction of

talent platforms, promote the construction of college student internship bases and entrepreneurship parks, and provide a development platform for all kinds of talents. We will encourage the development of high-level talent headhunters, and build a talent service platform. Establish long-term cooperation with high-end think tanks, and cultivate a number of high-end think tanks with outstanding professional characteristics that serve the whole province. We will attract a large number of high-edge talents with institutional innovation, provide better and more comfortable living conditions for talents with excellent services, and create new advantages in introducing talents with policy innovation.

Give full Play to the power of the government, to optimize the construction of the innovation ecosystem in resource-based cities, we must give full play to the power of the government in the innovation auxiliary system. First of all, optimizing the implementation of policies, systems and plans related to the construction of the innovation ecosystem all need to rely on the strength of the government, enhance the mutual cooperation between the innovation ecosystem systems, give play to the organizational and coordinated role of the government, and the government needs to coordinate the various forces of the city to achieve the goals. Secondly, the government plays a key role in building an innovative ecosystem of resource-based cities. The government strives to create all conditions to promote the project landing; the government should build an open cooperation platform, hold major activities such as Taiyuan Energy Low-carbon Development Forum, expand the city influence; increase the government investment, build a public platform for scientific and technological innovation, promote the integrated development of industry-university-research, increase the proportion of related construction investment in the public budget expenditure, and promote the sustainable development of resource-based city.

Conclusion

This paper combines the viewpoint of innovation ecosystem and regional innovation system, the resource-based city innovation ecosystem is roughly divided into innovation operation system (industrial enterprises above designated size, university technology enterprises), innovation research and development system (universities, research and development institutions), innovation auxiliary system (government, intermediary agencies) and innovation environment system (basic environment, natural environment, economic environment, social environment) and other four aspects of the subsystem.

This paper combines the research results of some scholars and the view of innovation ecosystem, and constructs the index system of resource-based city innovation ecosystem construction. Using entropy analysis, the weights of each indicator were 0.093, 0.110, 0.081, 0.099, 0.106, 0.121, 0.138, 0.074, 0.113, 0.066 respectively.

This paper summarizes and references the experience of resource-based city innovation ecosystem construction, and combined with the empirical research results, from accelerating the development of innovation operation system development, optimize innovation environment construction, perfect innovation reform guarantee system, play innovation auxiliary government power in four aspects to optimize the implementation of the resource-based city innovation ecosystem construction path.

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