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# Study of Government-Industry-Research Integration based on Regional Low-Carbon Innovation System

Yi Jinchao<sup>\*</sup>, Xu Guoquan, Zhao Yuhuan*School of Management and Economics, Beijing Institute of Technology, 5 South Zhongguancun Street, Beijing, 100081, P.R. China*

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## Abstract

Regional innovation system is importance driving force for regional economic development. In modern times, low-carbon economy becomes more and more important and government-industry-research integration plays important role in low-carbon innovation and regional innovation system. This paper focuses on study of govern-industry-research integration based on low-carbon innovation system through analysis of regional low-carbon element, network and system dynamic model. Through above analysis, it helps to clearly understand operational mechanism of such integration in regional low-carbon system.

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*Keywords:* Regional Innovation System; Low Carbon Economy; Government-Industry-Research Integration

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## 1. Literature Review

### 1.1. Regional Innovation System

P. Cooke (1992) initially proposed concept of Regional Innovation System, based on which, he gave some expression of this concept. In 1996, he pointed out that the regional innovation system is a regional organizational system composed by manufacturing enterprises, research institutes, high educational institutes and so on. These institutes not only have division of labor, but also have relationship.<sup>[1]</sup>

When referring to construction and elements of regional innovation system, Lundvall(1992) believed that a regional innovation system should include following elements: enterprises, inter-enterprise relationship, public departments, financial departments, institutional structure and R&D institutes.<sup>[2]</sup> Wiig(1995) thought that generalized regional innovation system should include 5 aspects: ①

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\* Corresponding author. Tel.: 86-13381008773; fax: 86-010-68918679.

E-mail address: [yijinchao8@bit.edu.cn](mailto:yijinchao8@bit.edu.cn).

production group that produce and supply innovative products; ② educational institutes aiming at developing innovative labor source; ③ research institutes focusing on production of innovative knowledge and technology; ④ governmental institutes that will regulate or support innovative activities; ⑤ financial or business produce servicing industries for innovation. [3]

### *1.2. Low-Carbon Economy*

Low-carbon economy was initially proposed in the ENERGY WHITE PAPER, UK(2003), which aimed at fundamentally transferring the United Kingdom into a low-carbon economy country. [4] Based on such concept, Mei Senna (2007) pointed out that the challenge of low-carbon economy that people face with is not from economic or technical aspects, but from political and institutional aspects. [5] ZHANG Kun-min regards that the development model of low-carbon economy is a global revolution related to modes of production, lifestyle and values. [6]

### *1.3. Government-Industry-Research Integration*

The cooperation of industry and research origins from study of innovative theory. R. Rothwell and Rothberg summarized characters of innovation and regarded research institutes as main part of innovation as enterprises. These opinions laid the basis for industry-research integration. [7] Freeman. C(1987) pointed out the concept of national innovative system and stressed the importance of governments in such cooperation. [8]

### *1.4. Regional low-carbon Innovation System*

Regional low-carbon innovation system is new development of regional innovation system. Here we define the regional low-carbon innovation system as follows: a regional low-carbon innovation system is a network system distributed in a specifically geographical area. This network system is consisted with governments(including subsections), research institutes, universities, enterprises, financial institutes, intermediary service institutes regulations and mechanisms that refer to the whole process of production, application, transformation and other related activities about innovative low-carbon knowledge and technology.

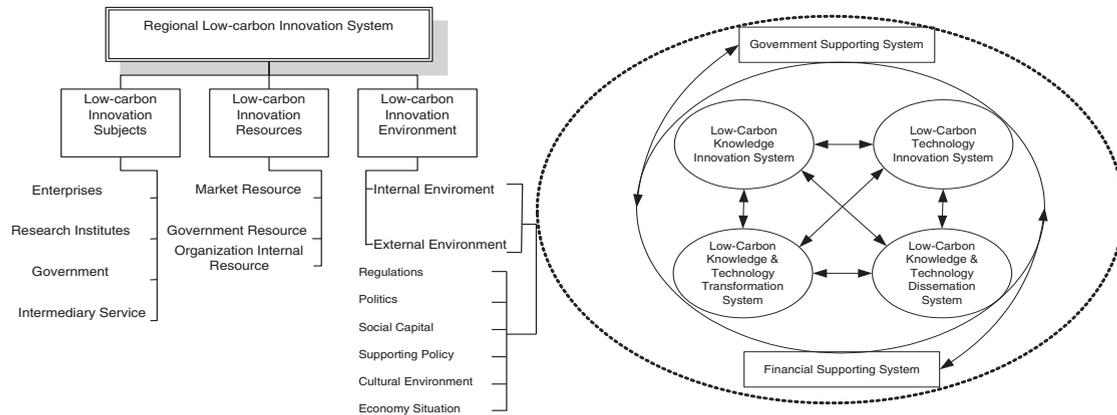
## **2. Analysis of relationship between Government-industry-research Integration and regional low-carbon innovation system.**

In order to analyze the relation between government-industry-research integration and regional low-carbon innovation system, we will prove rationality through analyzing the elements and network structure of regional low-carbon innovation system.

### *2.1. Element Analysis of Regional Low-Carbon Innovation System*

A regional low-carbon innovation system mainly includes following elements: regional low-carbon innovation subject, regional low-carbon innovation resources, regional low-carbon innovation environmental conditions. And figure 1 shows detailed information

Fig. 1. (a)Elements ofRegional Low-carbon Innovation System; (b) Network of Regional Low-carbon Innovation System.



As we can see in figure 1(a), the low-carbon innovation subjects include enterprises, research institutes, governments and intermediary service. In order to realize regional low-carbon innovation and stimulate economic development, these institutes will make use of the current resources.

2.2. Network Analysis of Regional Low-Carbon Innovation System

Table 1. An example of a table

Subsystem	Subsystem Function	Subsystem Characteristics
Low-carbon Knowledge Innovation System	Carrying out basic research, produce low-carbon knowledge, enrich low-carbon knowledge stock	University and other research institute are driving force in such system. Governments afford for most financial support.
Low-carbon Technology Innovation System	Put basic knowledge into practice. Produce new technology, products, patents.	There will be cooperation of enterprises and research institutes. Enterprises show comparative advantage in transferring basic knowledge into practical technology.
Low-carbon Knowledge & Technology Transformation System	Aims at transformation of knowledge and technology.	Such system exists in different forms such as Research Centers and Institutes or research consortia between enterprises and research institutes.
Low-carbon Knowledge & Technology Dissemination System	Be on duty of offering intermediary service for enterprises and research institutes	The intermediary service industry in low-carbon innovation system plays important role. These service institute can be NGO or government-oriented.
Government Supporting System	It creates a great environment through macro regulation, fiscal and monetary policy, property laws, strategic development plans	It mainly depends on governments and their subsections to provide public service for regional low-carbon innovation process. It works as the effective supplement for market resource allocation ability.
Financial Supporting System	Provide the whole process of regional low-carbon innovation with necessary financial support.	Venture capital, commercial banks, investment banks, government policy banks, and low-carbon special funds compose this system.

A regional low-carbon innovation system is a big complex system. Under such big system, there are sub-systems that interrelate and interact with each other. Under the complex system, there will be necessary sub-systems as follows. Low-carbon knowledge innovation system, Low-carbon technology

innovation system is a core sub-system of regional low-carbon innovation system. Low-carbon knowledge & technology transformation system is a sub-system that will be used to transfer basic research knowledge or technology into applied ones. Low-carbon knowledge & technology dissemination system will be responsible for transferring low-carbon knowledge or technology in related institutes for certification, cooperative research or innovation. Government supporting system plays an important role in regional low-carbon innovation system. Finally, there must be financial servicing subsystem to provide process of regional low-carbon innovation with necessary financial support. Figure 1 (b) shows the components of regional low-carbon innovation system. And Table 1 analyzed the characters of each subsystem.

### **3. System Dynamic Analysis of Government-Industry-Research Integration based on Regional Low-Carbon Innovation System**

In this section, we will use system dynamic model to explain the operation mechanism of government-industry-research integration in regional low-carbon innovation system.

#### *3.1. Factors Analysis*

A. Subject Elements. Regional low-carbon innovation process will realize through cooperation of different institutes. The subject includes government, industry, research institutes and intermediary service.

B. Influencing Factors. The function of regional low-carbon innovation system is not simple sum of subsystems, but reflects in interconnection and interaction of different subsystems. Detailed information are shown as follows:

- a. Sense of innovation, including sense of innovation of different institutes.
- b. Benefits and mission orientation. Different institutes have their own missions and benefits orientation in cooperation.
- c. Social Capital. Here, the social capital mainly refers to cooperation history in the past and society integrity degree.
- d. Market factors. Markets factors can be simply divided into market demand and market competition.
- e. Maturity of Low-carbon knowledge/technology.
- g. macro environment..

To sum up, we should know that these factors usually act on institutes and regional low-carbon innovation system at the same time. And there will be positive or negative feedback.

#### *3.2. System Dynamic Model within Subsystem and whole system*

Based on above analysis of various kinds of factors, in this subsection we will construct system dynamic model for subsystems. Here, we will combine low-carbon knowledge innovation system & low-carbon technology innovation system, low-carbon knowledge/technology transformation system & dissemination system and combine financial supporting system and government supporting system, through which we will understand the cooperation of institutes more clearly.

Figure 2(a) shows the operation and institutional cooperation in low-carbon knowledge innovation system. Figure 2(b) explains the operation of low-carbon technology innovation system. Figure 2(c) interprets the operation of low-carbon innovation supporting system. Here the cooperation of institutes reflects in these models.

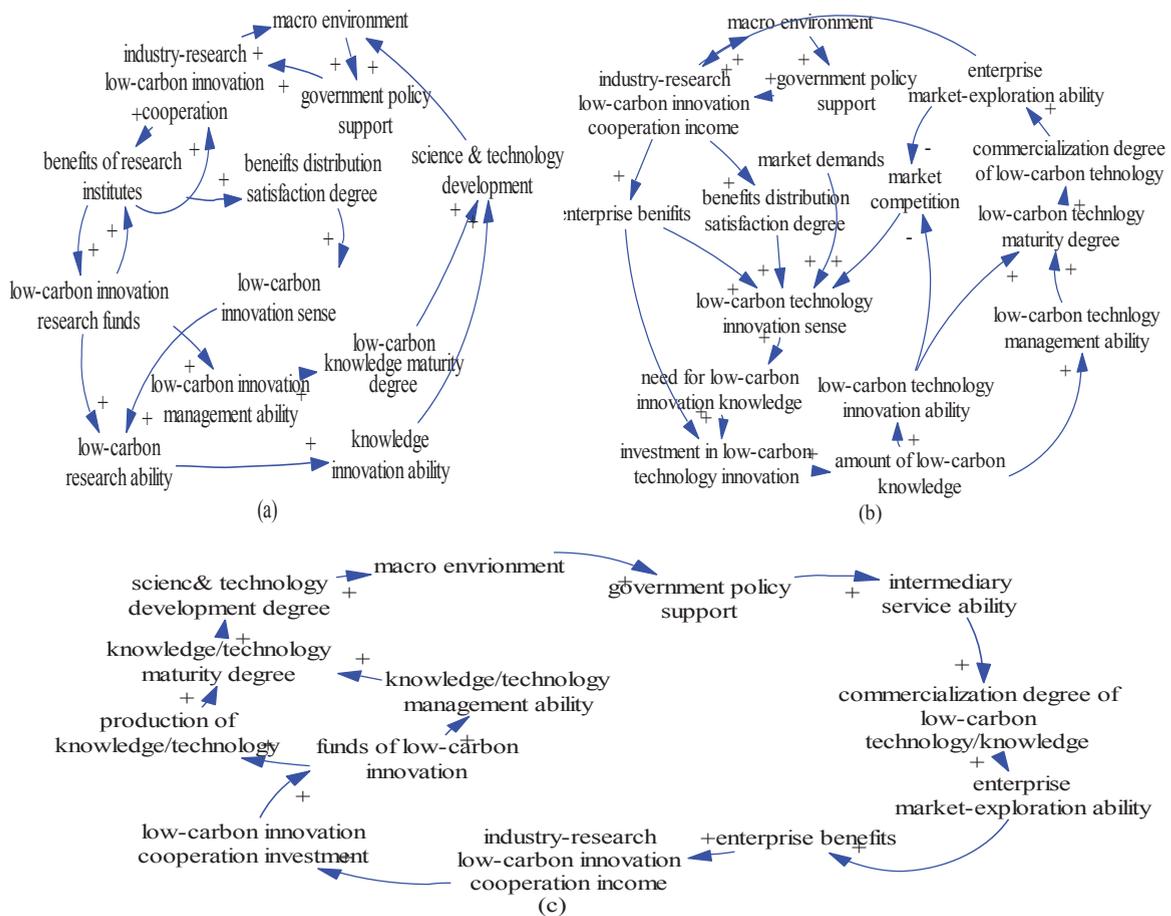


Figure 2 (a) knowledge system; (b) technology system; (c) supporting system

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