Triple Helix of Innovation: Case Study of City Dalian and DUT

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Abstract

Indigenous innovation is a crucial task for the Chinese economic development. Innovation system is the network and interplay of academic and production institutions in which production, distribution and use of new knowledge and technology take place. The Triple Helix (T-H) approach is used for the investigation of Government, Industry, Academia interactions. T-H is formed by these three institutional spheres which are increasingly working together, with a spiral pattern of linkages. Each institutional sphere can not completely instead of others although wish to substitute them, and the best way is complementary each other. In the overlap areas of the triple-helix model, there are enough spaces for the complementation. The overlap area implies that it has the possibility of collaboration with it. The question is how to set up some joint institutions, which we can call them "interface organizations" to organize and coordinate the activities and interactions between these institutions. Case study of city Dalian and Dalian University of Technology offers some preliminary experiences. The problems of knowledge flow in T-H are also discussed.

Keywords: Innovation, Triple-helix Model, Interface Organization, Knowledge Flow

1 Introduction

In the recent years, the Chinese economy grows rapidly. In the year 2006, the industrial output ranks 4 in the world, only lower than US, Japan and Germany. The products of electric fan, VCD, recorder, telephone, micro-motor, tractor, cement, sewing machine, container, port machine occupy over 50% of the world. Now about 30% of the consumer products in the world are made in China. In the year 2005, the output value of construction in China amounts 3,450 billion RMB, with about 20% annual increasing during the period 1995-2005.

But now the economy confronts with some constraints for the further development. Shortage of natural resources and over consumption (see below) are becoming constraints for the sustainable development.

SCARCED RESOURCE
PER CAPITA % OF WORLD AVERAGE

CULT. LAND	42%
WATER	27%
FOREST	20%
MINERAL	58%
COAL	53%
PETROLEUM	11%
NATURAL GAS	3%
IRON ORE	71%

OVER CONSUMPTION
GDP OF CHINA / GDP OF THE WORLD =4%
THE COMSUMPTION % OF THE WORLD

PETRO	7.4%
COAL	31%
IRON ORE	30%
STEEL	21%
CEMENT	40%

Another constraint is lack of core technology and advanced manufacturing equipments. Now,

70％of numerical control machines

85％of IC manufacturing equipments

95％of modern medical equipments

100% of optical fiber manufacturing equipments are imported.

Chinese firms must pay more for the imported technology and resource/environment cost, and get poor little from the labor. In order to overcome these difficulties, Chinese Government takes measures to promote change of economic growth mode and adjustment of economic structure.

Since the science and technology become the primary productive force and powerful driving force for sustained economic and social development, the key factors of a country's competitiveness are now identified as capability for innovation and the industrialization of high technology. The Government worked out important strategic decisions on constructing the National Innovation System (NIS). NIS is the network and interplay of academic and production institutions in which production, distribution and use of new knowledge and technology take place.

2 Triple-Helix Model of Innovation

Innovation contributors include governments, enterprises and research institutions. They were increasingly penetrating into each other although they had different targets.

The "triple helix" model can be used to investigate the relations and interactions between institutions.

The Triple Helix approach was first introduced by Etkowitz and Leydesdorf [1]. "Triple helix" is formed by three institutional spheres (Government, Industry, Academia) which are increasingly working together, with a spiral pattern of linkages (Figure 1), emerging at various stages of the innovation process.

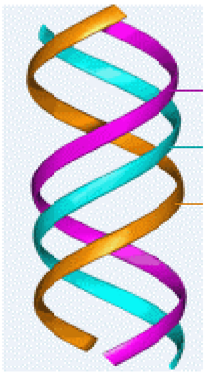

Figure. 1

In Previous Chinese command economy system, the government controlling and incorporating industry and academia, expects to coordinate industry and academia toward a common development goal. Both the industry and academic institutions are not the independent bodies, and there were only a few collaborations. In free market economy, research institutions and enterprises have become independent bodies to engage in market activities. Academia, industry, and government are supposed to work more or less independently of each other.

The different helices have recently been moving in a common direction to stimulate both competition and collaboration. There is movement toward a model where the three institutional spheres will overlap, with each sometimes taking the role of the others (Figure. 2).

Etzkowitz, Webster, & Healy [2] have pointed out the primary role of the university in relation to industry is through its educational activities that prepare graduates for industrial employment. The second academic focus of relations with industry builds upon the development of scientific research capabilities and the transfer to industry of economically relevant knowledge.

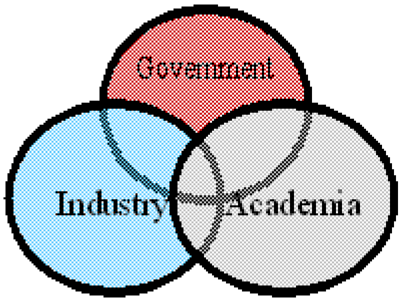

Figure. 2

Thirdly, the production of knowledge, either as an extension of basic research or by solving problems presented by industry, has been institutionalized through the creation of a series of boundary-spanning mechanisms. In the previous years, Chinese universities started up some university-run-enterprises (URE). It can be implied in the diagram as Figure.3.

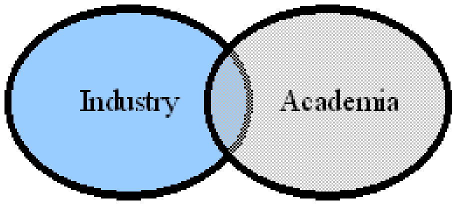

Figure. 3

But only a few got success and most of them failed, since they are not competent in marketing and there are also some ownership issues. Recently the Government no longer encourages the further development of URE and separated them from universities.Chinese government hopes the industry plays the main role in the innovation, and wished the industry set up their internal innovation institutions, but most of enterprises had not enough manpower（especially the talent） and fund for it. They wish to import innovation results from outside. Although some of them wish to set up their own, questions are raised about what should be located within the firm, among firms, or between firms and other types of institutions, such as universities and government laboratories.

Government plays an increasingly more important role not only in providing a regulatory environment, but also in encouraging innovation and developing the innovative capacities of firms within the national, and in some cases regional concentrations. Some Chinese local government eagerly wanted to start up some high-tech enterprises and directly invested to set up some firms. But most of them also failed since there are also some issues of ownership and governance.

All of these reveal that each institutional sphere can not completely instead of others although wish to substitute them, and the best way is complementary each other.In the overlap areas of the triple-helix model, there are enough spaces for the complementation. The overlap area implies that one actor wish to play the role of another, but it is non-efficient. Moreover it has the possibility of collaboration with it.

3 Interface Organization (City Dalian and DUT Cases)

The question is how to set up some joint institutions, which we can call them "interface organizations" to organize and coordinate the activities and interactions between these institutions.

There are two kinds of "Interface organizations": The first one is third party type, like incubator, consulting organization, etc. The advantages are its neutrality, specialty, etc; disadvantages are far from business. The second one is Joint organization type, the typical examples are joint R&D center, joint Engineering Center, etc. The advantages are business centered, profit-sharing. The disadvantages are non-special in intermediary.

A case of city Dalian and Dalian University of Technology offers some preliminary experiences.

Dalian is a coastal open city in the northeast part of China. It is also an industrial city, with traditional manufacturing and petro-chemical industries. It has attracted a large number of foreign investors and is a choice place for high-tech industries. The modernization of the existing and development of high-tech industries need technological innovation (especially the indigenous).

There are over 22 Universities and Colleges, and many Research Institutes in the city. The municipal government hopes these institutes pursue their scientific research by responding to requirement of the market and put its scientific and technological achievements into the market through certain transformations.The Municipal Government has set up 5 platforms:

R&D platform
Incubation platform
Commercialization platform
Consulting platform
Venture capital platform

Dalian Hi-Tech Industrial Park (Figure. 4) as a national Industrial Park was founded in 1991 by the Municipal government and approved by the State Council, in which there are:

Software Park as software and BPO export base.
DD Port (Digital and DNA) for high-tech incubation.
Overseas Students Park for the entrepreneurship of overseas students.

Figure. 4

There are 30 incubators in Dalian. Most of them are "Private-investment and Government-support" and financed partly by Municipal government. 650 SME have been "graduated" and 1658 new products were developed with output 3.14 billion RMB in 2005. A new concept "Re-incubation" was put forward and under experiment in the high-tech park.There are two types of organizations for the collaboration between industry and academia. In the case of Dalian, there are two typical examples:

1. Dalian University of Technology (DUT), there are two Joint Engineering Research Centers in its campus as the interface to enterprises: One with Shenyang Blower Works Group to solve the design and manufacturing problems. Another with Liaohe Oil field for the development of construction technique and petroleum processing. Every year the firms offer 20 and 30 million RMB respectively for the joint R&D projects (Figure.5).

Figure. 5

2. GONA Numerical Control system Company,

a numerical-control equipment manufacturer. More efforts are made in the innovation work. In GONA, there are (Figure. 6):

An Engineering Research Center of NC (jointly with DUT).

Two joint laboratories (with Tsinghua Universities and Harbin Institute of Technology)

Post-doctoral Program in Digital Control Eng

Pilot production and test line.

Figure. 6

For the interactions between government and university, in DUT there is a National Engineering Research Center of Ship-building and 4 National Key Laboratories financed by the Central Government:

Coastal and Offshore Engineering,

Fine Chemical Engineering, Material

Surface Modification

Structural Analysis for Industrial Equipment.

In these organizations, the R&D projects come from the national plan of S&T development but mainly according to the needs of industry.

4 Knowledge Absorption and Learning Innovation

The essential feature of innovation is knowledge integration and creation**.** The function of system of innovation is production, diffusion and use of new and economically useful knowledge to value-creation. Firms invest in own R&D not only for innovation at present stage, but also for the enhancement of the learning and absorptive capability [3].

In the past days the role that R&D plays in learning and knowledge absorption has received little attention. Many economists have assumed that technological knowledge which is in the public domain is a public good. Like a radio signal, its effects are thought to be costless and at least small relative to the cost of creating new knowledge [3].

In fact, the investment in R&D is not only for new product and process innovation, moreover, is to develop and maintain the broader capabilities to assimilate and exploit externally knowledge.

There are two kinds of knowledge: explicit and tacit.

One of the important factors in the learning, absorption and innovation is the crucial effects of tacit knowledge.Recently scholars of knowledge management in different countries pay more attention to the tacit knowledge and its role in the innovation process. They often quote the famous philosopher, M. Polanyi's words: "we can know more than we can tell".More than 2000 years before, in a textbook for explanation of "Yi Ching (易经, Theory of Change) " said :"Writing could not fully describe what the people want to say; speech could not express what the people want to think."[4]The main problem in knowledge and learning in innovation processes is examine and implementation of knowledge (both explicit and tacit) flow between innovation actors.

Knowledge flows in the learning process include the following forms (Table 1).

(1) Selection of interfacing mode:

There are many possibilities for the selection.

•Criteria for the selection

1. Proximity:
Geographical proximity:
Marginal cost of transmitting tacit knowledge rises with distances.
Cognitive proximity
Organizational proximity
Social proximity
Institutional proximity
2. Complementation:
Technological
Assets (tangible and intangible)
Marketing
3. Capability of integration :
Integration of multi-disciplinary expertise
explicit and tacit knowledge
technology and business
networks
4. Non-technical:
local policy
intellectual properties rights

(2)Evaluating the success of I-A-G collaboration

The success factors of I-A-G collaboration are:

1. Creativity of the joint team
2. Inter-disciplinary knowledge exchange
3. Speed of response to new technology and market
4. Capability of technology transfer
5. Organizational learning

Table 1. Knowledge flows in the learning process

Learning mode	int. / ext.	explicit	tacit
Learning by doing	int.	less	most
Learning by using	int.	less	most
Learning through training	int. / ext.	more	more
Learning from interaction of user/producer	int. / ext.	less	most
Learning from interaction between workers	int.	more	more
Learning from spillover	ext.	less	most
Learning from sci.develop.	ext.	most	less
Learning from history and foreign experiences	ext.	most	less
Learning based on integration	int. / ext.	more	more

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