Classification of the Industrial Technology Research Institute Based on Functional Localization

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ABSTRACT

The Industrial Technology Research Institute is playing a more and more important role in China's innovation system; some provinces and cities also actively explore to establish the Industrial Technology Research Institute in the region. Many researchers and policy makers have put intensive attention to the Industrial Technology Research Institute. But its features, functions and classification are still not clear. According to the deep investigation and analysis of the Industrial Technology Research Institute of Guangdong, this article is makes a comparative analysis on the typical of the Industrial Technology Research Institute of China, sums up the characteristics and function, and puts forward the classification based on function.

INTRODUCTION

In order to improve the industrial competitiveness, some countries and regions devote to constructing the national innovation system, and use the appropriate policy tool to process the institution implementation, establishes the industry (Industry) Technology Research Institute is one of the typical organizational mechanism. For example, American National Institute of Standards and Technology (NIST), Japan National Institute of Advanced Industrial Science and Technology (AIST), The Netherlands Organization for Applied Scientific Research (TNO), The Australia Commonwealth Scientific and Industrial Research Organization (CSIRO), and Korea Advanced Institute of Science and Technology (KIST), etc., are mostly a result of organizational construction based on such policy objective. Industrial Technology Research Institute of Taiwan, which is developing well, becomes the objective of various countries to study and to emulate. Under the objective of constructing the national innovation system and processing the development of driven by innovation,

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Industry technology research institutes are developing rapidly in economically developed area in our country, such as “Pearl River Delta” and “Yangtze River Delta” established a large number of Industrial Technology Research Institute. While some of the Industrial Technology Research Institute has made remarkable achievements, such as the Research Institute of Tsinghua University in Shenzhen etc. But there are also many industrial technology research institute’s functional orientation is unclear, research’s end results are ineffectiveness, and even some of the industrial technology research institute became a mere formality and make the operation more difficult. Therefore, there is an urgent need that conduct in-depth studies for such new innovative carrier of Industrial Technology Research Institute for the reality of our country, such as Feature positioning, Characteristics, operational mechanism, revenue model, and basis for selection etc., summary the regularity and pervasive nature to draw lessons for the construction and development of the industrial technology research institute.

Previous studies of domestic and foreign scholars consist some relatively mature industrial technology research institutes analyzed and lessons learned, compare the industrial organization and operation system of typical industrial technology research institute and discuss the importance of industrial technology research institute of the national innovation ability in the region and country. For example, Shiqin Tai, Yiyan Hung, Chiung-Wen Hsu, Min Leng, and Yunlong Ding etc. respectively summed up the successful experience of Taiwan’s Industrial Technology Research Institute. [1] - [5]; Guanghui Zheng, Jiejun Zhang, Wei Li etc. respectively conducted a study on the Japanese industry operating mechanism of science and technology [6] - [8]; Lv Zhu etc. analyzed and compared the organization modes of industrial generic technology R&D institute in United States, Japan, Austria, the Netherlands and other countries [9]; Joe Hwi, based on national innovation perspective, give the research about industrial technology research institute role [10]; Zhijian Lin conducted a study about the operation mode for government-led industrial technology research institute [11]; Yue Yang classify China’s industrial technology research institute based on support organization and construction bodies[12]; Shouwen Wang research the performance evaluation system of industrial technology research institute, and provides the performance evaluation model [13]; Xijin Wu’s research highlights the public industrial technology research institute play an important role on development of new strategic industries, and also believe the successful of Taiwan’s technology research institute lies in its clearly position and focused business area[14]; As the successful of the university industrial technology research institute in practice, some scholars specifically studied for the domestic successful cases, and believe one of the major directions of combining the technology and economics is the universities and research institutions based on their technical capacity to the right business model for commercial development, such as Shenzhen Research Institute of Tsinghua University[15]; Zhaoquan Jian etc. used the example of South China University of ITRI as example, proposed that the key points to make up the gap of innovation is university institute of advanced industrial Science and technology.

But in the case of existing literature, domestic and foreign scholars’ research points of industrial technology research institute (ITRI) are dispersed. In particularly the lack of researches on some important primary issues of ITRI, for instance, Feature Positioning, Characteristics, Classification researches etc. Thus leading to the lack of support for the theoretical researches and practical operation on ITRI. This article will try to make up the gap of this aspect.
THE ORIGIN AND BASIC MEANING OF INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE (ITRI)

In the true sense, the ITRI first appeared in Taiwan, China. In 1970s, Taiwan industries dominated by small and medium enterprise. Because of limited R&D Resources, short of innovation competence, unable to afford the risk of innovation for a long-term etc., establish the Industrial Technology Research Institute (hereinafter refereed to ITRI). During the development of more than 40 years, the ITRI promoting the establish of Taiwan’s emerging scientific and technological enterprises. In the Hsinchu area, Taiwan formed a high-tech industrial clusters which has made outstanding contributions on the development of Taiwan’s high-tech industry. This new innovation by ITRI in Taiwan carrier play a significant role in the stimulation. Germany, Australia, Japan, Korea, Denmark, Hong Kong and other countries and regions, has established a research, development, and service institution, like Taiwan ITRI. These institute achieve good results in the aggregate innovation resources to support the development of high-tech industries, cultivate new industries, leading and driving regional economic development and so on.

Regard to the definition of the Industrial, Technology Research Institute, Min Leng etc. positing it as a very special public R&D institution, is distinct from government, universities, enterprises,” the fourth power of innovation” [4]. Yunlong Ding believe the institute mainly research on common technology, key technology, and is committed to promoting the industrialization of innovative technologies and upgrading the industrial structure level [17]. Jianqiang Li believe the institute is an effective form of general technology research and development [18]. We believe that the ITRI is a new carrier which engaged in the research and development of technology, technology services, and the transformation of science and technology innovation. This stage, our industrial technology research institute is generally led by the government and relying on one or more objective organization which are built by college and enterprises or only government. The institute shoulder the different responsibility compared with college and other creative carrier (such as National Key Laboratory, engineering technology center, enterprise technology center, etc.), which are mainly focused on the regional development strategic emerging industries or leading high-tech industry with technical research and development, technology transferring and technology services. Practice shows that ITRI had a positive impact and play an important role on the development of emerging technologies, the formation of new industries, gathering the innovation resources, accelerate technology transfer and diffusion, promote regional economic development, promote industrial restructuring and upgrading, help small and medium enterprises to upgrade its technology, technical services, and other aspects. The Shenzhen Institute of Tsinghua University, Shenzhen Research Institute of Chinese Academy of Science and other advanced technologies, etc. where the effect is significant and influence is bigger.

THE FUNCTIONAL CHARACTERISTICS ANALYSIS OF THE GUANGDONG PROVINCE INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE (ITRI)

Guangdong Province is a springboard, cooperated with some domestic universities and research institutions from 1990s, and established the ITRI which has a
strong representation in our country. This acritical make the comparative analysis based on a typical 28 Guangdong Industrial Technology Research Institute’s research, in conjunction with other domestic representative of ITRI, summary some common characteristics and laws of China’s ITRI.

The Main Characteristics of Guangdong Province Industrial Technology Research Institute (ITRI)

Broadly speaking, China’s ITRI belongs to many kinds of the many new and innovative carrier. Compared with national key laboratory, enterprise technology centers, engineering centers, technology innovation and strategic alliances, technology parks and other innovative carriers, it has own characteristics. According to the research for the 28 ITRI in Guangdong province, the main features of ITRI can be summarized as following aspects.

(1) Government play an important role on the establishment and development of ITRI, not only the main part of investing, but also the main support of operating expenses. These 28 ITRI set up by the local government-led investment.

(2) The college and research institutes involved in the formation would not be restricted by its own location. On the one hand, attract famous university from other regions, research institutes to set up in the local area, such as Shenzhen Institute of Tsinghua University, Chinese Academy of sciences Shenzhen Institute of Advanced Technology, etc. settled in Shenzhen. On the other hand, rely on local well-known university or research institutes to set up. For example, SYSU Huadu Industrial Science and Technology, Jinan university Shaoguan Research Institute, Institute of Dongguan—Sun Yat-Sen University etc.

(3) In industrial upgrading and development of new industries as the main target, both ITRI for multiple integrated industry, but also ITRI for a single industry. For instance, Shenzhen Institute of Tsinghua University, Chinese Academy of Sciences Shenzhen Institute of Advanced Technology Research Institute is facing a number of areas of comprehensive industry, and more are facing to single industry, such as Guangdong HUST Industrial Technology Research Institute, Guangzhou Institute of Biomedicine and health, Chinese Academy of sciences, Institute of Electronic and information Engineering in Dongguan UESTC, South China Household Electric Appliances Research Institute, Light industry Shantou Equipment Research Institute.

(4) Project construction is generally completed by joint stock company and holding company, the company’s earnings will be better develop institutes. As RITS has initiated investment, construction 18 companies go public in SME board and GEM board. Chinese Academy of Sciences Shenzhen Institute of advanced technology research and development were provided the support by Angel Investors, Venture Capital, and private equipment investments.

(5) The revenue structure is significantly different. The income of 28 ITRI consists of three main parts, which are competitive contract revenue, various government funding of R&D, the income from providing benefits of public services. Competitive contract revenue reflects the ITRI’s market competitive advantage, the main income of Shenzhen Institute of Tsinghua University is competitive contract revenue. Few ITRI undertake part of responsibility of government’s public service function, the main income is proving benefits of public services, such as ITRI, Chinese Academy of Foshan, Zhongshan equipment manufacturing Industry Research Institute, Sun Yat-sen Institute of Huizhou, Guangdong South China consumer
The remaining 22 ITRI revenue comes mainly from various government R&D funding various projects for funding. But with the extent of establishment time, the income from competitive contract revenues showing growth.

**The Basic Function of the Guangdong Province Institute of Technology Industry Analysis and Classification**

According to the survey analysis and induction summary, these functions of ITRI can be described as follows:

1. Develop the research of new technology and high-tech, launched the technological achievement which have independent intellectual property rights, market-oriented scientific.

2. Promoting technology transfer and diffusion, make the technological achievement develop to technology enterprise

3. Develop technical research and technical services to solve technical problems in surrounding areas. Provide the information exchange platform for enterprises to develop information service

4. Promote upgrading of traditional industries, establish new industries

5. Develop technical research, innovation and entrepreneurship high-level person

6. Develop competition for advanced technology research and technology, to provide technical reserves for the development of new industries

7. The obligation for upgrading local enterprises and industrial services

Through comparative analysis, we find that the vast majority of industrial Technology Research Institute will have many basic functions. As further above the basic functions to be classified, which can be simply classified into three functions: provide public technical services, the transfer from technical achievements to application development, and technical studies prior to competition (to carry out basic research and new technologies), see Table 1.

**TABLE 1. FUNCTIONAL CLASSIFICATION OF INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE.**

<table>
<thead>
<tr>
<th>Function description</th>
<th>Function classification</th>
<th>Typical representation</th>
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<tbody>
<tr>
<td>Technical research and technical services to solve technical problems surrounding areas and areas where providing information exchange platform for enterprises to provide information services;</td>
<td>Public technology service oriented</td>
<td>Chinese Academy of Foshan; Zhongshan equipment manufacturing Industry Research Institute; Huizhou Research Institute of Sun Yat-sen University Guangdong South China consumer electronics Research Institute; Shantou light Industrial equipment Research Institute, etc.</td>
</tr>
<tr>
<td>Develop technology research and development, entrepreneurship and management high-level personnel;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrading services for local business and industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promoting technology transfer and diffusion, converting technological achievements to</td>
<td>Application technology</td>
<td>Shenzhen Research Institute of Tsinghua University</td>
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</tbody>
</table>
technology and science business. Promote the upgrading of traditional industries and formatting new industries.

| Development and achievement conversion oriented | Guangdong HUST Industrial Technology Research Institute |
|                                                | Institute of Electronic and information Engineering in Dongguan UESTC |
|                                                | Guangzhou Institute of Biomedicine and health, Chinese Academy of sciences, etc. |

Carry out research and development of emerging technologies and high-tech developments, launched with independent intellectual property rights, market-oriented scientific and technological achievements; Competing for advanced technology research and technology, to provide technical reserves for the development of new industries.

| Competing for advanced technology research oriented | Shenzhen Institutes of Advanced Technology Chinese Academy of Sciences, etc. |

DOMESTIC INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE (ITRI) CLASSIFICATION BASED ON FUNCTIONAL ORIENTATION AND ANALYSIS OF THE ADVANTAGES AND DISADVANTAGES OF ITRI

Domestic Industrial Technology Research Institute (ITRI) Classification Based on Functional Orientation

For the classification of domestic ITRI, some articles are divided into three categories—government oriented, universities and research institutes oriented and business oriented. But with little analysis, it is not difficult to find that at the present stage of China, the quantity of business oriented ITRI is very small, even if some companies have research institutes alike institutes, the institutes only serve for their own company. This situation is very different from ITRI, which has discussed in this article; and the numbers of ITRIs solely established by universities and Institutes of Technology is relatively very small, most of these ITRIs are established with local governments. As the result, the universality of classification methods, which mentioned above are insufficient and cannot reveal the internal mechanism of ITRI, also contributes nothing to the further studies of ITRI.

Therefore, according to the research analysis of 28 ITRIs in Guangdong province, the author proposed a different angle. In accordance with the functional orientation to classify ITRI, which can give us three categories of ITRI as following: public technology service oriented, application technology development and achievement conversion oriented and Competing for advanced technology research oriented (basic research oriented). In accordance with the functions to classify ITRI not only can contribute to declare the development goal of ITRI, to maximize the performance of ITRI and to achieve optimal use of resources. But also makes the assessments and managements from government to ITRI to be more targeted. The basic connotation, function orientation and characteristics of the three categories of ITRI are as shown in the Table 2.
TABLE 2. THE CONNOTATION AND FEATURES OF THREE CATEGORIES OF ITRI.

<table>
<thead>
<tr>
<th>Category</th>
<th>Public technology service oriented</th>
<th>Application technology development and achievement conversion oriented</th>
<th>Competing for advanced technology research oriented</th>
</tr>
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<tbody>
<tr>
<td>Formation method</td>
<td>Founded by government</td>
<td>Established by government and universities or Institutes of Technology</td>
<td>Established by government and universities or Institutes of Technology</td>
</tr>
<tr>
<td>Income resource</td>
<td>Various government financial support, government services and other institutional grants</td>
<td>Income from Competitive contract, or from applications for various research projects funds</td>
<td>Investments from local government and large businesses, or from applications for various research projects funds</td>
</tr>
<tr>
<td>Function Orientation</td>
<td>Function extension of government, mainly for integration and innovation resources, building an innovative network, scientific and technological services for companies in the same region</td>
<td>For application technology development and scientific and technological achievements conversion, promote same region industrial restructuring and upgrading, technical problem solving for medium size and small size same region companies and establish high-tech companies</td>
<td>Combined with strategic emerging industry focus on the development of local intends to carry out the key technology, common technology researches and industrialization</td>
</tr>
<tr>
<td>Area of involvement</td>
<td>Single area</td>
<td>Single area or multiple area</td>
<td>Single area or multiple area</td>
</tr>
<tr>
<td>Research and development strength</td>
<td>Relatively weak</td>
<td>Relatively strong</td>
<td>Strong</td>
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Although the three categories classification has made for domestic ITRIs, but some aspects need to be pointed out that at the present stage, the functional orientation of some ITRIs might be based on one category and also give consideration to other categories’ some features. For instance, the Institute of Advanced Industrial Technology of Shanghai Jiao Tong University has been using competition for advanced technology has its main functional orientation, but has given the consideration to some functions of public technology service. And at the beginning of the formations of some other ITRIs, these ITRIs fail to plan their functional orientation clearly, which causes the functional orientation becomes fuzzy or across different categories.
Analysis of the Advantages and Disadvantages of ITRI

PUBLIC TECHNOLOGY SERVICE ORIENTED

(1) Advantages: Capable of promoting the technological innovation and technical services in its region, and through the construction of innovation, it can effectively help medium size and small size companies to improve technology capability. The quantity of financial supports requirements is relatively small and the requirements of members are not too high.

(2) Disadvantages: Lack of complete technical research and development team, which is difficult to carry out substantial technology or products development.

APPLICATION TECHNOLOGY DEVELOPMENT AND ACHIEVEMENT CONVERSION ORIENTED

(1) Advantages: Has its own development team; can effectively solve the same region technical innovation and technical service problems for medium size and small size companies. It is capable to develop new technologies and new products, promoting the upgrading and restructuring for regional industrial. Promoting the technological achievements’ rapid conversion, and contributes to produce high-tech companies.

(2) Disadvantage: The need for sufficient projects funding to support, the need for large office spaces for development and research, consisting of relatively more staff.

COMPETING FOR ADVANCED TECHNOLOGY RESEARCH ORIENTED

(1) Advantages: Promotes the developments of regional or even national industrial, and capable of gathering high-level research and development personnel. If it can break through the key technology and common technology, it will contribute the future formation of new industrial clusters.

(2) Disadvantages: Has to have long-term and large funding supports. Has to have high-level research team to positively support, and require the region to have relatively large technical resources and solid economic strength.

ACKNOWLEDGEMENT


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