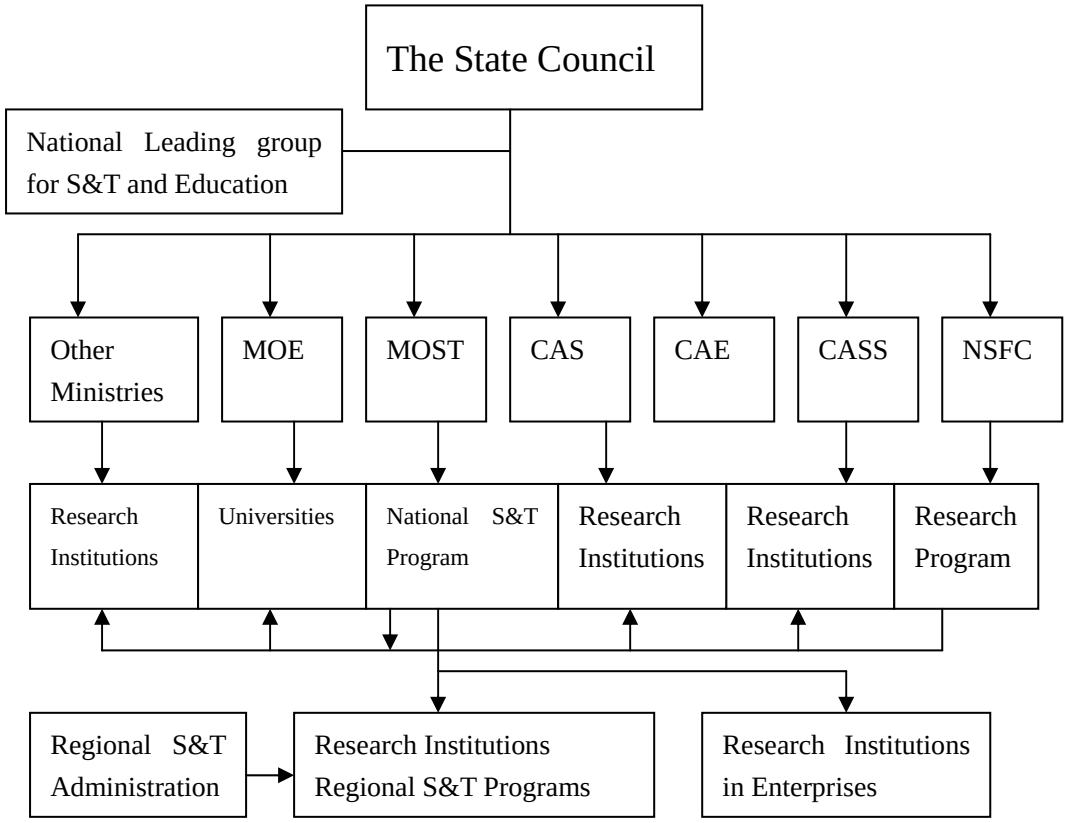
# Contents

# Development of Science & Technology Policy in China

**Mu Rongping**
Institute of Policy & Management, Chinese Academy of Sciences (CAS)
E-mail: mrp@mail.casipm.ac.cn, murp@vip.163.com

## I. Introduction

Since 1980s, China has experienced a change of economic system reform from reforming micro operational mechanism to reforming allocation system for resources, and finally to setting up socialist market economy system in China. Meanwhile, China also has experienced a change of the science & technology system reform (STSR) from extending decision-making power of government-owned research institutions to reforming R&D funding system, gradually to introducing the market mechanism (namely the competition mechanism) into science and technology system. The administration system for Science and technology in China is as following:

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China has made great progresses in science and technology legislation since

1980s, and lots of issued laws and regulations including “Science and Technology Progress Law”, “The Technology Contract Law”, “The Law for Agricultural Technology Diffusion”, “The Law for Dissemination of Science and Technology”, “The Law for Promoting Commercialization of Science and Technology Achievements”, “The Patent Law”, and “The Statute for Computer Software” etc. Besides, China has published lots of policies and measures ranging from priority setting of research fields, science and technology system reform, platform for scientific research, industrialization of science and technology achievements, to promoting the talent mobility and international cooperation so as to increase the supply of science and technology resources, to generate effective demand for science and technology, and to improve innovation environment in favor of the science & technology development and the integration of the S&T and the economy. However, the policy and law system of science and technology in China is still in construction, namely there are still lots of issues in discussion.

The policy and law system of science and technology in China consists of seven parties concerning micro-management of S&T, R&D, S&T achievements, technology market & trade, inspiriting and infrastructure, hi-tech and its industry development, international cooperation.

## II. Quantitative Analysis on the S&T Policy and Law in China

By the end of 2002, the State Council and related ministries issued over 500 pieces of policies concerning science and technology innovation[1]. The roles of science and technology policies and laws have changed a lot during the past two decades, in two directions, namely changing their roles and extending their roles.

### 1. Changing the Role of Policies and Laws for S&T

Tax policies have become the most important measures for government to promote science and technology innovation. Tax policies account for about 25% of total S&T policy and laws issued in the past two decades.

Government, especially central government is changing its role from managing R&D project to making policies & strategies for S&T and providing service and demonstration experiences as socialist marketing economy system in China becomes increasingly more effective than before. Therefore, the role of national S&T programs

[1] Department of Policy and System Reform, MOST: Survey on Laws and Regulations of Technology Innovation, 2003.

in promoting S&T innovation tends to become less important at present although some government sectors used to manage R&D projects. For example, MOST is organizing all government sectors, scholars from research institutes and universities as well as experts from enterprises to make the long term planning for S&T development of China during the period of 2006-2020.

The share of policies concerning “direct S&T input and equipment input” tends to be smaller as the policies related venture capital and government stock become popular. The key measure of S&T policies changes from providing fund to stimulating demands for science and technology innovation.

Policies for talent and education have received increasingly more and more attention from decision-makers, especially the policies attract oversee scholars to serve for domestic S&T development, no matter they join in one of domestic enterprises and research institutions, or just have a short-time on-site visit or bilateral cooperation research in China.

China has gradually improved its intellectual property right (IPR) system by revising related laws and regulations as well as policies, especially the “Patent Strategy” and Standardization Strategy” initiated and implemented by the MOST. The share of incentive policy measures for property right encouragement increases gradually. Evaluation and license as well as standardization play increasingly important role in promoting science and technology innovation.

**2. Function Extension of the S&T Policy and Laws**

The acquisition and export of technology still play very important role in economic development while S&T policies gradually pay more attention to international S&T cooperation and competition

Industrialization and commercialization attract more attention than new product development in the S&T policies, which implies that government pay more attention on industrial development instead of product development, on engineering and marketing as well as market development instead of technology development.

The S&T policies pay increasingly more attention to hi-tech enterprises and foreign invested enterprises as well as large-middle sized enterprises so as to promote science and technology innovation.

## III. Effectiveness of S&T Policy and Laws

### 1. Promoting the Reform of the S&T System

After 20 years incremental reform on operational mechanism with a view to strengthening the linkage between production and research, for example, to decrease government budget for applied R&D institutions gradually so as to force them to survive in the market, and to encourage R&D institutions and university to exploit the economic value of S&T research by setting up their own companies, Chinese Government decides to withdraw from some competitive sectors and take some radical reform measures.

Since 1999, China began to transform government-owned research institutes into enterprises with a view of strengthening national innovation system, especially the capability of technological innovation in enterprises level. In the national level, the first batch of 242 research institutes affiliated to former State Committee for Economic and Trade and the second batch of research institutes affiliated to other Ministries have been transformed into enterprises by the end of 2001.

The transformation of the 242 R&D institutions has very important demonstration effect for transforming other scientific institutions. About 5,000 local government-owned have been transformed into enterprises. Last year, Central government began to transform state-owned public welfare research institutions, but in different way to some extent. For example, the research institutes that providing public goods have been transformed into nonprofit organization with more government budget.

However, the transformed research institutes still play very important role in promoting industrial technology progress. They took over lots of projects of the national science and technology program and provided technology service for enterprises. For example, 242 transformed research institutes receive 676 million yuan RMB by took over the projects of national S&T programs, and profit 1.1 billion yuan RMB with 9.1 billions yuan RMB of sales revenue in 2002[2].

In recent years, enterprises gradually become principal part in the technology innovation. The technological innovation capability of enterprises has been increasingly strengthened according to new results of evaluating 302 technology

[2] Department of Policy & Law and System Reform of MOST: Survey on Reform and Development of Transformed Research Institutes of Technology Development affiliated to Central Government Ministries (1999-2002), July 2003, pp10-12.

development centers of large enterprises[3].

Universities have become significant base for knowledge generation, diffusion, technology innovation as well as commercialization of S&T achievements. Universities account for about 17.5% of total full-time equivalent R&D personnel, while research institutions and large and medium-sized enterprises account for 19.9% and 41.0% of total full-time equivalent R&D personnel in 2002. The universities, research institutions and large and medium-sized enterprises account for 22.4%, 30.1% and 35.8% respectively in 1998, which indicates that more and more R&D personnel concentrate in enterprises[4].

Universities account for 10.1% of total R&D expenditure, independent research institutes[5] account for 27.3%, enterprises account for 61.2% in 2002, the share of the universities and the independent research institutes is 10.4% and 42.5% respectively in 1998, which shows that enterprises have become principal part of innovation.

Chinese Academy of Science (CAS) has significantly strengthened its competitiveness by implementing the "Knowledge Innovation Program". The number of SCI papers published by CAS surpasses Max-Plank Society (MPG) surpassed in 2000, and 4109 units more than MPG in 2003, while the number of SCI papers published by CAS in top twenty journals of each research fields increases faster than that of MPG and CNRS[6], from 20% of MPG and 17% of CNRS in 1998 to 53% of MPG and 52% of CNRS in 2003, which shows that the gap in quality of published papers tends to be smaller. Besides, CAS accounts for more than 50% of published papers by Chinese in ***the Science*** and ***the Nature***, 54% of that in the top twenty journals of each research fields.

## 2. Promoting the Integration of the S&T and the Economy

The technology capabilities in the sectors such as energy sources, resources, raw materials, communication, and machine building have been dramatically improved during past two decades. In recent 10 years, the productivity increased 11942yuan/year . person, the energy consumption /10 thousand GDP decreases 2.69 ton standard coal[7].

[3] These centers are authorized by former state committee for economic and trade, and now by the State Committee for Development and Reform.
[4] National Bureau of Statistics and Ministry of Science and Technology: China Statistical Yearbook 2003, China Statistics Press.
[5] Transformed research institutes are not included.
[6] CNRS means the French National Center for Scientific Research
[7] State Committee for Development and Reform: Report for Implementing the Law for S&T progress 2003.

Mechanism for cooperation between industry, universities and research institutes has gradually established. Enterprises engaged in 90% of all projects of the National S&T Program for Key Technologies R&D. 80% of large enterprises have established cooperation partnership with universities and research institutes.

The transformation of the 242 R&D institutions strengthens the linkage between R&D and production, and the technological innovation capability of enterprises to some extent. The share of scientists and engineers in state-owned independent research institutions decreased from 31.5% of total in China in 1991 to 21.5% in 1999[8]. The share should be much lower than before as soon as all state-owned independent research institutions have been transformed. The fact that the share of R&D persons in state-owned independent research institutions has been gradually decreasing also implies that more and more R&D personnel join in industrial sectors. Enterprises are gradually becoming the principal innovator, and investor in R&D.

The transformation of the 242 R&D institutions is propitious to exploiting human creativity of researchers, and to building up indigenous technological innovation capability in the transformed institutions. On the one hand, the transformed institutions are forced to build up indigenous continual innovation capability due to increasingly drastic market competition so as to develop competitive hi-tech products and to win the competition; on the other hand, the fact that technology and management expertise participate, together with other production factors such as capital labor and land, in distributing the economic returns of the transformed institutions must prompt researcher to exploit new technological resources, and to make full use of them.

The transformation has changed the research model of state-owned independent research institutions from government-oriented or following foreign research organization to market- oriented. Although state-owned independent research institutions are encouraged to run business for about 20 years, but performance of researchers is still evaluated according to academic indicators such as academic papers and experiment results, not the economic value of research results. The purpose for R&D institutions to run business is to make money so as to survive, not to meet the technological demands of enterprises. As soon as these state-owned independent research institutes are transformed into enterprises, to maximize profit,

[8] The Ministry of Science and Technology: China Science and Technology Indicators, kexue jishu wenxian chubanshe (Science & Technology Documents Press): Beijing 2000, p.57.

the nature of enterprises will push transformed independent research institutes to develop what market need and then quickly commercialize them. Besides, the transformation itself also provides many opportunities for the combination of technology and capitals, which enable transformed R&D institutions to enlarge their market share.

### 3. Building up the Indigenous Capability of S&T

As a developing country, China has to face the challenge of further strengthening its infrastructure in science and technology and so as to promote its productivity, innovation capability and social welfare. Besides, China also has to make structural adjustment and institutional reform so as to improve the magnitude and efficiency of S&T inputs, enhance the role of the business sector in R&D and innovation, and foster the diffusion and utilization of technology throughout the economy.

S&T infrastructure has been improved gradually since 1990s. During past ten years, China has put lots of money for big science project, large experiment instruments and S&T documents/data bank. The sharing mechanism for S&T infrastructure has been highly emphasized in S&T policy measures. Besides, Chinese government is making the long term planning for S&T development (2006-2010) with a view of supporting national social, economic development. The first stage of the strategic research for the long term planning ranges from macro strategy research, to key science and technology assignments, and S&T input & policy environments.

The macro strategy research concerns the general strategy for S&T development, the .S&T system reform and national innovation system, while the key science and technology assignments concern the manufacturing, agriculture sectors, the energy, resource and oceanic technology, the transportation and communication and the modern service sectors, cover the issues related to the population and health, the public security, the eco-reconstruction, environment protection and recycling economy, the city development and urbanization, the strategic hi-tech & industrialization, the national defense and the basic science issues. The main purpose for studying the key science and technology assignments is to determine the S&T priority. The S&T input & policy environments concern the equipment and infrastructure for S&T research, the S&T talents, the S&T input and its management, the laws and policy for S&T development, the innovation culture and science popularization, and the regional S&T development.

The expenditure for S&T in China increases steadily since 1998. The expenditure for R&D reaches to128.76 billion yuan RMB in 2002, about 1.23% of GDP[9]. There are 3.22 million S&T personnel in 2002 in China, including 2.17 million scientist and engineers, about 22.7% and 39.8% higher than that in 1995[10].

The sales of new products account for 13.2% of total revenue from the sale of products in 1999, and 16.1% in 2002. The expenditure on purchase of domestic technology in large and medium-sized enterprises of China accounts for 1.63% of expenditure on technical renovation in 1999, 2.88% in 2002, while expenditure on technology absorption accounts for 2.14% of expenditure on technical renovation in 1999, 1.72% in 2002 (see table 1).

Table 1 Major Indicators on Large and Medium-sized Enterprises (100 million yuan)

| | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|
| Expenditure On Technical Renovation | 845.6 | 1132.6 | 1264.8 | 1492.1 |
| Expenditure On Import of Technology | 207.5 | 245.4 | 285.9 | 372.5 |
| Expenditure On Technology Absorption | 18.1 | 18.2 | 19.6 | 25.7 |
| Expenditure On Purchase of Domestic Technology | 13.8 | 26.4 | 36.3 | 42.9 |

China ranks the fifth position in terms of published SCI papers in the world in 2002, and becomes one of countries with advanced spaceflight after the successfully launching of the manned spacecraft “Shenzhou 5” in 2003.

## IV. Problems in Building Environment of S&T Policy & Law

### 1. Lacking of Top-design for S&T Policy and Policy Monitoring System

Science Progress Law needs revising so as to promote its legal position and authority. Some S&T policies need transforming into laws. Lots of S&T policies need adjusting so as to avoid conflicts and overlap each other.

Lacking of effective cooperation mechanism among the people’s Congress, the State Council, the State Committee for Development and Reform, and the Ministry of Science and Technology in S&T policy-making process results in the conflicts between demand and supply for making S&T policies and laws, and in the incomplete S&T policy & law system. Besides, lacking of. foresighted S&T policy research, effective S&T policy evaluation and monitoring system also has negative impact on

[9] MOST and Bureau of Statistics: China S&T Statistics Annual Report 2003, www.sts.org.cn
[10] National Bureau of Statistics and Ministry of Science and Technology: China S&T Statistical Yearbook on Science and Technology 2003, China Statistics Press, p.5

S&T development and social-economic development.

**2. Lacking Effective Support of S&T Policy for National Innovation System**

Lacking of increasing mechanism for public S&T has limited the S&T development while lacking of effective adjusting and priority-setting mechanism for S&T input has decreased the efficiency of S&T input. Besides, lacking of classified guidance for regional S&T enterprises, and special guidance for industrial S&T enterprises as well as agricultural S&T enterprises has weakened the industrial competitiveness.

Lacking of effective inspiriting mechanism and measures to promote enterprises become principal part of technology innovation, and to promote the development of S&T service institutions for public interest has decreased the efficiency of national innovation system.

Lacking of effective mechanism for evaluating and inspiriting S&T talents, and for promoting the mobility S&T talents has negative impact on behavior of scientists and engineers. For example, evaluations of S&T activities and talents at present pay more attention to the quantity of papers than the quality of papers, more attention to the application of patents than the commercialization of research achievements.

Lacking of effective mechanism for deploying public S&T resources has decreased the utilizing efficiency of S&T resources. For example, S&T micro-management sectors usually launch important national S&T program without approval of legal organization, lots of public S&T resources such as big science infrastructures, observations and databanks have not been effectively shared among users.

**3. Lacking Effective S&T Support for Social & Economic Development**

Lacking of effective mechanism in balancing the technology import and the domestic R&D as well as the localization of imported technology has important but negative impact on native technology capability-building, while lacking of legal status hi-tech industrial park and defined ownership of S&T achievements has slowed down the process of industrialization of research achievements.

With the economic development and social change, China has to face a series of problems concerning urbanization, aging population, production safety, public health and information security as well as anti-terror issues. To solve all these problems needs to integrate and develop nature science, engineering technology and social

science, and to establish a monitoring & precaution system and a quick response mechanism for social development crisis.

## V. Future S&T Policy & Law System in Discussion

### 1. The Goal of Building S&T Policy & Law System of China

Now China is revising "The Law for S&T Progress". However, lots of experts suggest establish Chinese S&T Policy System based on "S&T Basic Law" approved by the People's Congress of China, and hope to realize five transformations, namely: from emphasizing policy-making quantity to quality, from policy guidance to institution promotion, from static policy-making to dynamic policy adjusting.

Therefore, the goals for building Chinese S&T policy & law system are to promote positive interaction among innovative parties, to integrate S&T resources and personnel so as to provide institution support for leapfrogging development by 2010, and to establish effective mechanism for policy-making, policy-implementing and policy-monitoring, to ensure an increasing mechanism of .S&T input so as to realize goal of well-off society by 2020.

It is expected that the national expense for R&D reaches 360 billion RMB in 2010 and 900 billion RMB in 2020，R&D／GDP reaches 2.0% and 2.5% respectively. Meanwhile, social investment in S&T reaches 730 billions RMB in 2010 and 1800 billions RMB in 2020.

### 2. Future Eight Tasks for Improving System of S&T Policy & Law in China

There are lots problems to be solved in the process of improving China S&T Policy & Law System. However, I think following eight aspects are major tasks in the future 15-20 years.

#### (1) To Make "S&T Basic Law of PRC"

The most important task in building S&T policy & law system of China is to make "S&T Basic Law" approved by the People's Congress of China so as to assure the ratio of R&D/GDP reach to 2% by 2010 and 2.5% by 2020, to identify the role of government, the market, and the central government and regional government in S&T.

#### (2) To Increase the National Decision-making Level for S&T

It is necessary to increase the national decision-making level for S&T (for example, to the cabinet level) so as to coordinate national interest among different

governmental sectors. Besides, it is also necessary to establish monitoring mechanism and transparence, rational and impartial evaluation mechanism for S&T policy and laws so as to adjust and cancel related policies and laws, and for S&T program so as to increase the efficiency and effectiveness of public investment in S&T.

**(3) To make "The National Strategy for IPR"**

To set up an effective mechanism for formulating, implementing and adjusting the national strategy for IPR by improving IPR laws system and bringing IPR into property right system so as to harmonize related theory and law system. To monitor the implementation of S&T policy & laws so as to support the change from acceptor of "game role" to active participant of making process of "new game roles".

**(4) To make the statute for Sharing S&T Resources**

It is necessary to make the statute for sharing S&T resources so as to establish the mechanism for sharing S&T resources and to increase the effectiveness and efficiency of development and utilization of S&T resources such as large equipments and instruments as well as scientific data & information. license

**(5) To Promote Enterprise Innovation and Internationalization**

It is necessary to improve the innovation policy and to make implementing policy measures for related laws such as the "Promotion Law for Small and Medium Sized Enterprises", and to deepen S&T system reform so as to assure that enterprise be principal part of innovation and investment in innovation, to promote integrated innovation and engineering development in enterprises, and to encourage enterprise become the world leading firms.

**(6) To Make the Statute for Regional Innovation**

It is necessary to make the statute for Regional Innovation so as to promote the development of regional innovation system, especially the national hi-tech industrial development zones and regional agriculture S&T system construction to assure economic development and S&T progress in rural regions.

**(7) To Strengthen the Integration of National S&T Resources**

It is necessary to strengthen the integration of national S&T resources by establishing an effective mechanism for priority setting based on rational S&T policies so as to promote the social and economic development, to strengthen basic research, and to improve environment and social condition for people's survival and development as well as S&T infrastructures. For example, setting up several

consulting committees directly affiliated to the State Council so as to continuingly provide strategic integration of national S&T resources.

**(8) To Ensure the National Security and Sustainable Development**

To establish effective policy system and the foresight, precaution and emergency management system so as to ensure the national security concerning defense, information, bio-technology, technology standards and finance. Meanwhile, to educate hi-level, compound talents with knowledge of S&T, laws, and management so as to promote sustainable economic and social development.

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