Basic Research and the Development of Strategic Emerging Industries

Following the 2008 global financial crisis, many governments have given priority to emerging industries with comparative advantages and adjusted their plans for S&T development. In China, the national authorities quickly adopted policy measures to maintain economic growth, boost domestic demand and carry out economic restructuring, leading to a package program for smooth and rapid economic growth. In September 2010, the State Council decided to accelerate the fostering and development of strategic emerging industries.

History shows that the rise of S&T industries often depends on breakthroughs in industry-oriented basic research. To probe into issues in this regard, a consultative taskforce on basic research and the development of emerging industries was set up by the CAS Academic Divisions in April 2009. On the basis of in-depth investigations, the team, consisting of more than 30 academicians and other scholars, completed a report on the subject in late 2012. The following is brief summary of this report.

1. Making Correct Selection of Key Technology

Many cases in history demonstrate that industry-oriented basic research is very important for the development of S&T enterprises. For instance, thanks to its many years of exploration into the application of semiconductors, Bell Lab invented the first point-contact transistor in 1947, kicking off the semiconductor industry. Continuous research into miniaturization helped Kilby to invent the first working integrated circuit in 1958, ushering in the new age of information technology.

China's basic research has long been weak, and has made little contribution to industrial growth. China's strategic emerging industries will not have the resources for innovation and prospects for continuous development unless increased support is made available for industry-oriented basic research. Over the past 30 years, since China adopted its reform and opening-up policy in the late 1970s, China has grown into a large manufacturing country by taking advantage of its huge domestic market, cheap labor and fairly relaxed export regulations. However, these advantages are diminishing as a result of the shrinking international market following the global financial crisis in 2008, the European sovereign debt crisis in 2010 and S&P lowering the US's sovereign long-term credit rating in 2011. As a consequence, China is now facing challenges strikingly similar to those once faced by Japan. Japan's experience and lessons are therefore of great potential value for us in addressing the situation.

The selection of key technologies and strategic emerging industries has an important bearing on China's socioeconomic growth and national security. Making the good choice will enable leapfrog development, otherwise we will lose opportunities.

2. Strengthen Basic Research by "Restructuring" R&D Investment in Strategic Emerging Industries

Recent years have witnessed the rapid growth of government spending on basic research. However, due to the orientation of the management and evaluation system, many S&T workers have paid too much attention to publishing papers, applying for awards, professional title assessment and rank advancement. Furthermore, duplicated and scattered investment in science and technology with few useful results has weakened the national ability to make breakthroughs in strategic and key areas. Without a dramatic reform in the allocation of R&D spending, it is difficult to channel the increased funding into the development of a technological innovation system which is market-oriented, making enterprises the main player and with industry-university-research institute collaboration as a major feature. In comparison with developed countries, China has to deal with the following problems in the structure of R&D expenditure.

Out-of-Proportion Basic Research Funding

Funding for basic research as a percentage of total

R&D expenditure in China has stayed at no more than 5% for many years, which is much lower than the average of innovative countries (16%). Funding for basic research, applied research and experimental development in China is in the ratio of 1:2.7:17.6, which is very different from the ratios in innovative countries, for instance, 1:1.3:3.5 in the US, 1:1.6:1.6 in France, 1:1.7:5.1 in Japan and 1:1.3:4.3 in the ROK.

Inadequate R&D Intensity with Structural Flaws

The year 2008 saw lower than 2% R&D intensity (the ratio of expenditure on research and development to prime operating revenue) of China's main manufacturing industries (namely, special equipment, pharmaceuticals, general equipment, electric machinery and materials, transportation equipment, rubber products, telecommunication equipment, computers and other electronic equipment, meter, instrument & cultural products, office equipment, and synthetic fibers). But in advanced countries, the figure generally ranges between 3% and 5%, and between 10% and 20% for high-tech companies. The R&D spending level of China's high-tech industries is fairly low. For instance, in 2007, its high-technology industry expenditure on R&D as a percentage of value added was only 25.8% while the figure was more than 40% in the UK, the US and France, 58.8% in the ROK and 72.3% in China's Taiwan. At present, R&D spending in Chinese enterprises is mostly used for experimental development for technology introduction and improvement, with very limited input into basic research. In developed countries, however, funding for basic research is largely provided by enterprises. For instance, in 1995, 25.3% of the investment in basic research in the US was made by enterprises. The figure in the ROK was nearly 50%, which might explain the rise of its giant enterprises such as Samsung, LG and Hyundai.

3. The Key for the Translation from Basic Research to Industrialization: Keeping the Market and New Industries in Mind

Finding ways to promote the translation of basic research discoveries into applied, commercialized or even industrialized outcomes, has been a constant challenge worldwide. To achieve this objective in China, national planning has long been the main tool, which has proven inefficient and often reduces S&T enterprises into OEMs. Over the past decade, with the increasing investment in basic research and improving S&T policy and market environment, there have been some successful business stories for basic research teams aiming at emerging industries. One example is the establishment of China's first OLED mass production line, which is attributable to a basic research project launched in 1996 by Prof. QIU Yong from Tsinghua University. From its beginning, the project was aimed at developing key technologies with patent rights and accomplishing industrialization.

4. To Integrate S&T with the Economy, Industrial Parks should be Built to Promote the Industrialization of Basic Research Findings

A divorce between S&T progress and economic development has haunted China for a long time. In particular, it is extremely difficult to translate basic research findings into industrialized products. Solving the problem completely requires more powerful promotion and guarantees from the national government. It would be advisable to establish industrial parks to integrate basic and applied research with industrial incubation. There are many S&T industrial bases in developed countries, such as the US, Germany and Japan. Although there are also many S&T parks in China's mainland, they have much room for improvement in terms of concept design, institutional development and accessory services. In this regard, we could learn from the success of Taiwan. Over the past 40 years, its impressive industrial development in semiconductors and flat displays is largely attributable to the Industrial Technology Research Institute and Hsinchu Science and Industrial Park.

5. Recommendations for Promoting Priority Emerging Industries and Relevant Basic Research

The Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries calls for the rapid development of seven emerging industries, namely, energy-saving and environmental protection, new generation information technology, biotechnology, high-end equipment manufacturing, new energy, new materials and new energy automobiles. The consultative taskforce of this project carried out research into emerging industries that have attracted the largest investment worldwide and have a huge bearing on national economic growth, such as integrated circuits, flat panel displays, biotechnology, internet information and energy efficient buildings. On the basis of an extensive investigation, it completed a report with recommendations for promoting key emerging industries and related basic research.

Establish an Industrial Institute to Promote Basic Research for Emerging Industrial Development

Under the guidance of the government, an industrial technology institute might be built jointly by enterprises and academia with support from universities and research institutes. It would be devoted to industrial technology innovation and place an emphasis on technical services to industries. It would also keep an eye on the future development of strategic emerging industries, and strive to take favorable positions for competition in this regard. The report also offers suggestions for supporting basic technology and critical links in such industries as integrate circuits, flat panel displays, biotechnology, internet information and energy efficient buildings.

Strengthen Intellectual Property Rights Protection and Pay Attention to the Application of Expired Patents

Indigenous intellectual property and standards are key to the international competitiveness of emerging industries. It is advisable to make early and active deployment of technology research and development for emerging industries, intensify the filing for relevant patents, and give more protection to promising enterprises with indigenous intellectual property, and independent standards in particular. As for enterprises depending on foreign patents, such as pharmaceutical manufacturing enterprises, China should seize the historic opportunity of the expiration of a large number of patents and take steps to translate relevant knowledge into industrialized products. It would also be advisable to pay equal attention to generic biological drugs and innovative biological drugs, so as to promote the maturation of China's biopharmaceutical industry.

Spare no Effort in Promoting Education Concerning Emerging Industries and Accelerate Talent Training

At present, there is a serious shortage of talent in the various links from basic research to process development in emerging industries such as biotechnology, integrate circuits, flat panel displays, network information and energy efficient buildings. While recruiting high-end overseas technological and industrial professionals, it would be advisable to expand the enrollment in existing programs concerning emerging industries in universities and colleges. To develop a sustainable talent training base, a national curriculum for institutions of higher learning should be formulated as soon as possible for such fields as synthetic biology, flat panel displays and building energy efficiency.

Advance Information Services for Emerging Industries

Industrial information services are the vanguard for understanding developmental trends, supporting decision-making, improving competency, upgrading innovation capacity and selecting strategic industries. In the past, every industrial ministry used to have its own industrial information unit. After the 1980s, this work has been weakened somewhat. The government should therefore increase investment in industrial information services, and information research for basic research in particular, formulate standards and norms for the information sector and strengthen the qualifications management of information provision and consultancy.