Technology Roadmap in Korea

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1. Technology Foresight Activities in Korea

Technology foresight activities in Korea have been undertaken in three ways. One is to support the launching of national research and development (R&D) programs and also the establishment of science and technology (S&T) development plans. The first national R&D program was started in the early 1980s and at that time a primitive type of technology foresight activities was performed under the initiative of MOST (Ministry of Science and Technology). After that, a series of large- or small-scale national R&D programs with technology foresight activities have been launched. The most representative one is the HAN program in which the foresight acitvities took about one year and more than 400 experts from industry, academia, and government had participated. In that program, major R&D projects were set up based on foresight activities and particularly on industrial demands.

The establishment of national S&T development plans is another track of the same sort. There have been 8 five-year S&T development plans in total since 1960s. But in the mid-1980s, a large-scale technology foresight activities was carried out in order to establish the Long-range Plan for S&T Development toward the year 2000. When preparing the Plan, more than 800 experts were involved in. Another example of large-scale foresight activities is the Long-term Vision for S&T Development toward the Year 2025. In the Vision, about 200 experts participated in during one year.

Related to such tracks, there has emerged a new tendency: spread out of foresight activities to other ministries. MOST had been the sole body of carrying out foresight activities until the mid- 1980s. However, the Ministry of Commerce, Industry and Energy (MOCIE) joined this track and nowadays performed frequently technology foresight activites in large-scale. The Ministry of Information and Communications (MIC) also got involved in from 1990s and has been performing small- or large-scale foresight activities. In addition, a new group of ministries started to joined into this tendency: They are, for example, the Ministry of Environment, the Ministry of Construction and Transportation, and the Ministry of Health and Welfare.

The second type of activity is the 'technology forecasting' at national level, which is strongly stimulated by Japanese ones. So far, with the support from MOST, there have been two large-scale technology forecasting activities in Korea. The first one was undertaken in 1993, characterized by three-round Delphi through three stages of preliminary activities, pre-foresight and main foresight. This survey dealt with 1, 174

items in total and the forecasting period was 20 years from 1995 to 2015. After the survey, there was a study on comparison with the advanced countries such as Japan and Germany. The second one was done in 1998, with the same methodology as the previous one. It dealt with total 1, 155 items and the forecasting period was extended to 25years from 2000 to 2025to be suitable to compare with advanced countries. And a comparison study with Japan and Germany was followed after the survey.

The third type activity is the establishment of 'technology roadmap (TRM)' at firm level. Although many Korean firms are interested in such activities, but particularly Samsung has been very active. Samsung already recognized the importance of such activities for challenging to world-class frontier technologies. Samsung aims at securing seed technologies in the 21 century in an efficient way of resource inputs through utilizing TRM approach. The process of roadmapping is in brief as follows: Business/ Technology Trends Analysis → Identification of Strategic Unit → Scenario Settings → Roadmap Deployment → Technology Program (Detailed Roadmap) → Action Plan. At the moment, Samsung is known as to operate many TRMs and to revise them annually. And they consist of TRMs in the whole enterprise level and in specific items.

One thing particularly to note here is that the Korean government tried to apply TRM approach at national level in 2002, namely, the National Technology Roadmap (NTRM) in Korea. The main reason is to set up national R&D programs of more closely linked with market demands. TRM approach is originally utilized for technology development activities at firm level. The efficiency of national R&D programs by criteria of commercialization in the market has long been a hot issue between S&T community and bureaucrats in budget ministry.

2. Establishment of Technology Roadmap in 2002

The purpose of establishing NTRM is to analyze industrial transformation and technological trends at home and abroad; to find out promising products and core technologies that are essential to secure global competitiveness 10 years henceforward; and to draw up a technology roadmap at national level for promoting strategic research and development projects. Thus NTRM aims at providing guidelines for sharing strategies related to key technologies among the government and private sectors; and for conducting research and development activities through identifying key technologies at national level.

The NTRM activity has been carried out through two stages. The first stage was to identify technologies for which NTRM will be drawn up. It explored the vision of national S&T development for up-coming 10 years and elements to be secured for industrial competitiveness. It forecasted general technological elements as well as non-technological ones to be strengthened for enhancing the global competitiveness by 2012 and defined key technologies to be developed. And the results of this stage 1 were produced in the first half of 2002

The second stage drew up TRMs for key technologies identified in the first stage. It

derived future visions related to key technology areas and marked milestones of technology development to achieve the visions: It found out technological alternatives in each technology area, which is necessary for attaining the target technological capacity and explains how to reach the target through presuming the process and using time coordinates. And the results of stage 2 were produced in the second half of 2002.

The major activities in establishing NTRM have been guided by the NTRM Head Council. The Executive Committee was also set up with 5 sub- committees that are the core body in developing NTRM. In addition, TRM teams (in total 74 teams) were set up to draw TRMs for key technologies in the second stage. A single TRM team was composed of around 10 technology experts from industries, academic circles and research circles. A total of 751 committee members have participated in drawing NTRM.

The duration of establishing NTRM is relatively very short: From March 2002 to December 2002. This short period time was possible because we had a certain level of prior experience and knowledge about NTRM before starting this work with full-scale and tried to accomplish all related works within the current administration.

The utilization of NTRM is also important. It is expected to be used as guidelines for the government's R&D planning and as a reference for R&D strategies and planning in the private sector. At the moment, there emerges a growing demand from private firms to set up more concrete government's R&D plans.

3. Key Elements of NTRM

To develop comprehensive NTRM, 5 visions for science and technology development by 2012 are set up. And strategic products or functions in order to realize those visions are clarified. The contents of 5 visions and strategic products or functions are as follows.

Vision I: 'Building an Information-Knowledge-Intelligence Society'

It means to meet a variety of human needs in all areas of life by making IT service more intelligent, mobile, and user-friendly and so as to build a wealthy society. Fourteen 'Strategic Products or Functions' to realize this vision are identified as follows.

- 4 'Strategic Products or Functions' about Anytime, Anywhere, Any-device Communication: Digital Convergence, Intelligent Computing, Ubiquitous Network, Mobile & Wearable IT Device
- 4 'Strategic Products or Functions' about Innovation in Contents & Service: E-Commerce, Business Service, Knowledge/Information Security
- 6 'Strategic Products or Functions' about Ambient Intelligence: Intelligent Man-Machine Interface, Intelligent Robot, Intelligent Home Appliance, Intelligent Building/Home, Intelligent Transport System, Intelligent Medical System

Vision II: 'Aiming at Bio-Healthpia'

It means to meet the increased demand for high-quality therapeutic agents and to timely supply new diagnosis, prevention & therapy. Thirteen 'Strategic Products or

Functions' are as follows.

- 7 ‘Strategic Products or Functions’ about new drug discovery & development: Cardiovascular, Anticancer Agent, CNS, Pulmonary, Metabolism, Immune System, Vaccines
- 6 ‘Strategic Products of Functions’ about innovation in disease treatment, diagnosis & prevention: Diagnostics, Rehabilitation System, Medical Imaging System, Cell Therapy, Gene Therapy, Prognostic System

Vision III: 'Advancing the E2 (Environment and Energy) Frontier'

It means to make an efficient and stable energy supply & utilization system corresponding to the international environment regulation and the world situation and to build a society that recycles and lives in harmony with nature. Five 'Strategic Products or Functions' are as follows.

- 3 'Strategic Products or Functions' about pleasant and healthy life : Reduction of Environmental Pollution, Recycling System Harmonizing with Environment, Management of Sustainable Ecosystem
- 2 'Strategic Products or Functions' about supplying efficient/stable and clean energy: Efficient Use of Energy, and Acquisition of Future Energy Source and High Value Energy

Vision IV: 'Upgrading the Value of Major Industries of Korea Today'

It means to pursue sustainable economic growth through strengthening the international competitiveness of current main industries and the infra industry. Eleven 'Strategic Products or Functions' are as follows.

- 3 'Strategic Products or Functions' about next generation transportation mechatronics: New Automotive Systems, New Ocean Transportation Systems, New Railway Systems(Korea Type)
- 3 'Strategic Products or Functions' about advancing of residential building and social infrastructure: Integrated Transporting System, User-friendly Advanced Construction, Sustainable Natural Resources and Effective Development of National Land
- 2 'Strategic Products or Functions' about mechatronics: Next Generation Manufacturing System, Advanced Precision Mechanical System
- 3 'Strategic Products or Functions' about diversification of new materials application: New Functional Information Materials/Devices, Nano Materials, Highly Functional Metals/Ceramics/Polymers/Textile

Vision V: 'Improving National Safety and Prestige'

It means to build the world's 10th aerospace technological capability and to establish national self-sufficiency in food supply. Six 'Strategic Products or Functions' are as follows.

- 4 'Strategic Products or Functions' about entering into the aerospace age: Development of Satellite, Development of Launch Vehicle, Development of UAV, Development of Helicopter
- 2 'Strategic Products or Functions' about food security and resources preservation: Establishment of Food Self-Sufficiency, Establishment of Bio-Resources Self-

Sufficiency

Key technologies are identified to realize each vision in addition. There are 28 key technologies in Vision I: 19 key technologies in Vision II: 21 key technologies in Vision III: 20 key technologies in Vision IV: 11 key technologies in Vision V. As a consequence, 99 key technologies in total are clarified

The structure of NTRM Report in Korean case is very suggestive. Followings are an example of Vision I.

I. Building an Information-Knowledge-Intelligence Society
1. Outline
   A. Definition
   B. Major Characteristics
2. Prospects for the Development of Future Societies
3. Strategic Choices
   A. Strategic Products · Functions
   B. Key Technologies
4. Macro TRMs for Strategic Products · Functions
   A. Development Direction 1: Anytime, Anywhere, Any-device Communication
      1) Strategic Products · Functions: Digital Convergence
         A) Outline
         B) Future prospects
         C) Characteristics of Markets/Technologies and Opportunity/Threat Factors
         D) Macro Technology Roadmap
      2) Strategic Products · Functions: Intelligent Computing
         A) Outline
         B) Future prospects
         C) Characteristics of Markets/Technologies and Opportunity/Threat Factors
         D) Macro Technology Roadmap

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II. Aiming at Bio-Healthpia

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3. Lessons from Korean Experience

Although Korean government has been very much interested in technology foresight activities, we have seen its limited insight and capacity in those activities. First of all, the Korean cases have not solved the gap between S&T factors and socio-economic ones. Many technology foresight activities have been strongly influenced only by S&T elements, thus resulted in no sufficient demand-supply linkages in reality. The majority of experts participated in foresight activities have come from S&T community.

Too many ambitious goals and too many rosy plans in S&T development are also

problems: the gaps between knowing and doing. Limited manpower pool and resources as a small country have resulted in such situations. It has also led to the difficulties in consensus building and leadership in S&T community

Limited technological insight and capacity have been another bottleneck in the Korean case. Brainstorming and peer review have been the major instruments: Applying sophisticated methodologies has been bounded. Particularly the lack of leaders at global level in S&T community has been an obstacle of many foresight activities in terms of providing high-level technological insight and sufficient level of alternative paths of S&T progress.

The size of a country has also raised the issue of less clear boundary between national level and business level S&T activities. The areas of national R&D programs have usually been overlapped with those of private sector, which has led to vague distinction between the two. Private firms in Korea have emerged as the major force in R&D activities: 3/4 of national R&D expenditure are mobilized and also used by private sector. The boundary between the public and private becomes less clear.

High uncertainty for the direction of S&T progress has linked to poor performance in foresight activities. Those emerging technologies such as information technology, biotechnology, nanotechnology, etc. are regarded as the new driving forces of technological progress, but in reality, there is no clear sign for the future direction of progress in those areas. Particularly such a trend strongly influences many developing countries that lack enough information and knowledge for S&T trends.

Despite some limits and problems, there certainly are some positive sides of technology foresight activities. One would be the training effect on S&T experts who join in the processes of foresight activities. It contributes to the cultivation of S&T leaders through expanding their insights on the priority settings to cross-areas. It also contributes to S&T personnels to understand better the socio-economic phenomena. And stimulating CEOs to understand better the importance of and the unique nature of R&D activities is also a positive impact.

Another positive impact of NTRM is that it leads to networking and consensus- building in S&T community, even though there have been conflicts of interests among different parties in choosing strategic areas. The concerted actions among them can promote the recognition for the importance of S&T in society.

Even if technology foresight activities have such difficulties and drawbacks noted above and the methodology for them are not well developed yet and the reality of foresight activities is rather bounded or disappointing than expected, there is a strong tendency to increase those foresight activities in Korea. Particularly, as Korea is moving into world frontier countries in terms of S&T, the importance of such activities is highly emphasized than ever before and a search to find out better way of carrying out those activities in the Korean context will be continued in the future.

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