Benchmarking analysis of overseas policy trends and its achievements ～ from the view point of Japan ' s national innovation～[1]

Masaharu Sakuta, Ph. D
Research Director
The Japan Research Institute, Limited

1. Issue of the S&T Activities in Japan

We conducted a survey on overseas policy trends and its achievement last year. The purpose of the survey is to learn the latest good examples of S&T policies, and to examine the possibilities of adoption to Japan's policy.

Fact 1: National S&T budget has steadily increased since 1996. This increase intensified the whole national S&T activities.

Fact 2: On the other hand, the Japanese economy has remained sluggish since 1996.

ISSUE

Have "national S&T budget increase" and "overall R&D activation in Japan" made a contribution towards our economy?

Backgrounds of our survey are the following two concerns about S&T activities in Japan. The first one is that since 1996 National S&T budget has increased, and the whole S&T activities have intensified. However, the Japanese economy has remained sluggish since 1996. Then we have a very simple question; Have "national S&T budget increase" and "overall R&D activation in Japan" made a contribution towards our economic strength?

[1] *This paper has been prepared in cooperation with NISTEP.

2. Our Awareness in Japan: Five Concerns on the National S&T System

In relation to the issue, we assumed that the following five concerns could be major problems on the national S&T system in Japan.

(i) Does the government ensure the effective R&D budget prioritization?

(ii) Does an industry-academia-government cooperation effectively function?

(iii) Do universities produce capable human resources in the S&T field?

(iv) Do policies for regional innovation effectively function?

(v) Most S&T activities in Japan are excessively depend on the private sector. Is the investment in future industry sufficient?

3. Overview of the Benchmarking Survey of Overseas S&T Policy

(1) Target Countries

US, EU, UK, Germany, Sweden, Finland, China and South Korea were chosen as target countries.

(2) Survey Items

The following items were analyzed for each country:

- Goal-setting & trends of S&T policy
- Strategies for R&D prioritization
- Fostering and securing S&T human resources
- The industry-academia-government cooperation
- Regional innovation
- S&T budget distribution system
- S&T policy Reviewing System

4. Features of S&T Policy in Major Countries and their Implications for Japan

4.1 US

US: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	***Implications for Japan***
-Top-priority on "Defense" and "Homeland Security" **-Highly "competitive environment"** **-High mobility of human resources**	**-Difficult to introduce the US "competitive environment" into Japan** **-Training program for "multidisciplinary" human resources**

United State's characteristics are:

※ Top-priority on "Defense" and "Homeland Security"

※ Highly "competitive environment"

※ High mobility of human resources

However it seems difficult to introduce the idea of the US "competitive environment" into Japan. The only mean seems to be introduction of "multidisciplinary" in human resource training.

4.2 UK

UK : Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	***Implications for Japan***
- **The UK research activities have highly contributed to worldwide 'Basic Science'.** - **A national budget increase in R&D investments in spite of the limited budget.** - **R&D prioritization of the specific areas such as stem cells.**	- **Scientists in UK are required to demonstrate how the S&T research contributes to the society.** - **The communication between science community and society are emphasized.** - **"Value for Money and Value for QOL"**

The UK contributed to worldwide 'Basic Science'. In General, Scientists in UK are trying to demonstrate their contribution to the society very actively. As a result, communication between science community and society are very close. Concepts of "Value for Money and Value for QOL" are also useful idea for Japan to improve public support and acceptance for science.

4.3 Germany

Germany: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	*Implications for Japan*
- **Active cooperation among industry-academia-government.** **(i) Steinbeis Foundation (StW) transfers technologies of the universities, etc. to the SMEs** **(ii) Fraunhofer-Gesellschaft (FhG) and "An-Institutes" also play the important role for the industry-academia collaboration** - **Unique regional innovation programs: "BioRegio"('96), the first trial for the bio-cluster creation was successful supported by strong regional cooperation.**	- **Germany has established the system for "future innovation";** **(i) Traditionally-high S&T potential of Länder (State) universities etc., in each region.** **(ii) "Bridge-building" organizations for the industry-academia-government cooperation such as FhG & StW.** **(iii) Strong authority of the Länder (State) governments**

In Germany, very active cooperation among industry-academia-government is known. Steinbeis Foundation (StW) transfers technologies of the universities to the small Firms. Fraunhofer-Gesellschaft (FhG) and "An-Institutes" also play the important role for the industry-academia collaboration.

As for Japan there is no influential bridge building organization such as FhG & StW. We ought to examine the possibility of similar functions in the society.

4.4 Sweden

Sweden: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	*Implications for Japan*
- **In spite of recession in the 90's, Sweden increased its R&D budgets.** - **Since the mid-90's to utilize the universities' potential has been strongly recognized as a key issue.** - **NUTEK launched "Competence Centre Program" and established a joint research center to support a long-term joint researches by universities and enterprises.**	- **The "Competence Center Program" 's four features:** **(i) Long-term (ex. a decade)** **(ii) A part of the budget by the government, and the rest is self-financed by fund-recipients.** **(iii) Dividing a program period into the several "Phases" to evaluate and review for the additional funding.** **(iv) Selection process is based on two-step proposal review system.**

In 1995 NUTEK (original organization of VINNOVA) started “Competence Centre Program” and established a joint research center to support a long-term joint researches by universities and enterprises.

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(ii) A part of the budget by the government, and the rest is self-financed by fund-recipients.

(iii) Dividing a program period into the several “Phases” to evaluate and review for the additional funding.

These features seem to be effective to encourage the success of regional innovation program.

4.5 Finland

Finland: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	***Implications for Japan***
- During the confusion period due to the collapse of the Soviet Union in early 90’s, Finland suffered a serious depression. A that time, Finland started the “Innovation Promotion Policy”. **- Finland has successfully shifted to knowledge-based industry especially IT, strongly depending on Nokia, the private company.** **- Oulu, a representative successful regional innovation: “Oulu Model” based on the “Center of Expertise Program”.**	**- Three main features:** **(i) Industry-oriented and application-oriented** **(ii) Improving the competitive environment** **(iii) Close cooperation among the clusters** **- The Finnish concept of “the competitive environment” means; the government should not intervene the market directly, but concentrate on remedying a ‘market failure’ and promoting competition.**

During the confusion period due to the collapse of the Soviet Union and eastern European countries in early 90's, Finland suffered a serious depression. A that time, Finland started the “Innovation Promotion Policy”.

Finland has successfully shifted to knowledge-based industry especially IT, strongly depending on Nokia, the private company.

Finnish concept of competitive environment is very clear. ”The government should not intervene the market directly, but concentrate on remedying a ‘market failure’ and promoting competition.”

4.6 China

China: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	*Implications for Japan*
- **"Reform and Opening Up"(1979) and Nanxun "southern tour"(1992) by Deng Xiaoping formed the base for the current Chinese policy.** - **Affiliation to the WTO (2001) accelerated the Opening Up.** - **Programs to encourage world-class scientists to return from overseas ("Sea Turtle").** - **"Zhu Rongji" and "Hu Jintao"et al. showed the strong leadership to promote S&T in China.**	- **Government's slogan; "S&T promises the best productivity".** - **Japan also needs to show the appropriate goals of S&T.**

The breakthroughs of economy and technology just started 5 years ago. These rapid changes are closely connected to Political history.

"Reform and Opening Up" policy in 1979 and Nanxun Lecture in 1992 by Deng Xiaoping formed the base for the current Chinese policy. Affiliation to the WTO in 2001 accelerated the Opening Up. "Zhu Rongji" and "Hu Jintao" et al. showed very strong leadership to promote S&T in China.

Now, Government's slogan is "S&T promises the best productivity", and most of the people support this slogan. Japan also needs to show the appropriate goals of S&T. This issue seems common to all developed countries.

4.7 South Korea

South Korea: Characteristics of S&T Policy and Implications for Japan

Characteristics of S&T Policy	*Implications for Japan*
- For recovering in the postwar period the government had launched new industrial and economical policy initiatives. **- In the 90's Korea shifted its focus to its own R&D to attain the world level S&T.** **- The Kim Dae-jung administration established the "Vision 2025" (1999). Roh Moo Hyun claimed S&T-oriented society including "the second plan for the foundation of the S&T nation" (2003).**	**- The government's strong leadership was required to catch up the other developed countries.** **- Drastic policies including "Active industry-academia-government cooperation supported by matching funds" and "Strict R&D review system" are notable.** **- South Korea's modest attitude towards benchmark is remarkable.**

For recovering of Korean war damage, the government started the new industrial and economical policy initiatives in 1960's. In the 1990's Korea shifted its focus to its own R&D to attain the world level S&T.

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5. Comparison of Major Policies

5.1 Innovation Policy

Recent Situation of Innovation Policies of major countries

US	US government claimed “innovation in all areas in the society” as a breakthrough of a lower competitiveness (1985 “Young Report). Several business scholars including Michael Porter have seriously addressed “innovation” as a research topic and conducted an intensive study on National Innovation Systems since 1990. The final goal of the S&T policies set by the Clinton & Gore Administration is to focus on the US national innovation.
UK	The UK government issued the Skills Strategy White Paper, “21st Century Skills Realizing our Potential” in 1993. This report addresses the significance of innovation, showing prioritization effects and discussing what S&T is effective to meet industrial needs to increase national capital.
Germany	In response to the Schröder administration's basic policy, the Bundesministeriums für Bildung und Forschung (BMBF) declared that “it is a new policy study that would produce innovation and new employment” in 2000. The study was conducted under the name of “Research for Shaping the Future.”
Sweden	“Our national wealth is innovation ability” is described in the Swedish “Research Bill of 1999/2000.” Interestingly, such a mature nation, Sweden also places greater value on “innovation ability” than on “accumulated capital” and “high-level technology.”
Finland	Finland was affected by a serious economic slump due to “collapse of the economic bubble” and “breakup of the whole Soviet Union.” Facing this crisis, the nation reduced budgets, but only the budget for R&D investment was expanded. Simultaneously, the idea of “national innovation system” was introduced. Investments made at this era proved effective and contributed to the rapid economic recovery including in the IT field in the middle of the 1990.
China	It is noteworthy that China, one of socialist countries, identified “innovation” as one of important policies. China uses “creation (創新)” in the sense of the word “innovation” and addressed “innovation needs” to solve issues on “economic construction and economic system reform” in the Report of the 16th National Congress of the Communist Party of China, 2002. “A study on S&T system reform and national innovation systems” is the second subject in the National Medium-long term Science and Technology Development Plan 2006-2020, which is being formulated.
South Korea	The recent noteworthy change is that the government integrated the ministries in the fields of basic science, industrial technology and IT. Vice prime minister directly administers R&D in these fields.

As for China, we can found some notable points because China is a socialism country. China identified “innovation” as one of important policies. China uses “creation (創新)” in the sense of the word “innovation” and addressed “innovation needs” to solve issues on “economic construction and economic system reform” in the Report of the 16th National Congress of the Communist Party of China, 2002.

“A study on S&T system reform and national innovation systems” is the second subject in the National Medium-long term Science and Technology Development

Plan 2006-2020, which is being formulated.

Implications to Japan from each national innovation policy may be summarized as follows:

(1) “Innovation” is claimed as one of the major objectives regardless of existing social system.

(2) While mature developed nations are pushing forward an economic reform with S&T achievements, developing nations take S&T advantage to catch up with the developed and to obtain wealth.

(3) Without any governmental effort, it is impossible to create innovation nationwide.

Especially, to encourage innovation in Japan, the governmental support is strongly needed.

5.2 Prioritization Policies: R&D Investment in Major Countries

Comparison of the R&D Prioritization Policies in Major Countries

items	JAPAN	US	EU-15	UK	GERMANY
(i)Total of Government R&D Investment (Million Yen, PPP)	4.0 trillion yen including regional budgets	14.8 billion yen	Equals 9.7 trillion yen (2001)	1.95 trillion yen	2.61 trillion yen *1 (Total of public investment in FY 2002)
(ii)% of GDP	0.8%	0.9%	0.67% (2001)	0.57% (FY2001)	0.80% (FY2002) *2
(iii)Quantitative Targets for	..Total budgets from FY200 to FY2005 equals 24 trillion yen including regional government budgets ..1% of GDP in FY2005	None	3% of European GDP by 2010 [6th Framework Programme:2002-2006]	..Real S&T budget is to be doubled between FY1997 and FY2006 [A policy target of the Labour Party]	None
(iv)Priority R&D Areas	..Life Sciences ..IT ..Environment ..Nanotechnology & Materials [Second Basic Plan]	..Life Sciences(NIH) ..Nanotechnology (NNI) ..Homeland Security(HS) ..Networking & Information Technology ..Environment & Energy	..Life Sciences ..Information Society Technologies ..Nanotechnologies & Nanosciences ..Aeronautics & Space ..Food Quality & Safety ..Sustainable Development ..Citizens and Governance [6th Framework Programme]	..E-science ..Life science(Genome Program) ..Basic Technology ..Stem Cells ..Economy for Sustainable Energy ..Rural Economy & Land Use	<Federal Government Priority Areas>*3 ..IT ..Biotechnology ..Medical Care and Health ..Technology for Sustainable Development ..Material ..Nanotechnology
(v)Quantitative Targets for (iv)	None (Doubling the competitive research funds during the Second Plan)	..Doubling NIH budget [FY1998-FY2003:achieved] ..Doubling NNI budget [FY2005-2009:Total $3.7 billion]	None	Annual growth (10%) until 2005	None
Reference (data sources)		AAAS, etc	DG Research, OECD	OECD, DTI/OST	*1, 2: OECD *3: BMBF, etc.

The prioritization in each country is summarized these two points: The first point is that Life Sciences, Information Technology (IT) and Environment (Sustainable Development) are common priority areas in most countries, and the second point is

that since around 2000 Nanotechnology and Nanoscience have been highlighted as prioritized areas in the major countries.

In US, Homeland security is a priority R&D area. In EU-15, various fields are specified as priority R&D areas because of various needs of the affiliated countries, such as Aeronautics & space, Food Quality and Safety, Sustainable development, Citizens & Governance. In UK, a very specific area like Stem Cell research is prioritized. Also Rural Economy & Land Use is mentioned. In EU-15, UK and Germany, all are focusing on the technologies for sustainable development.

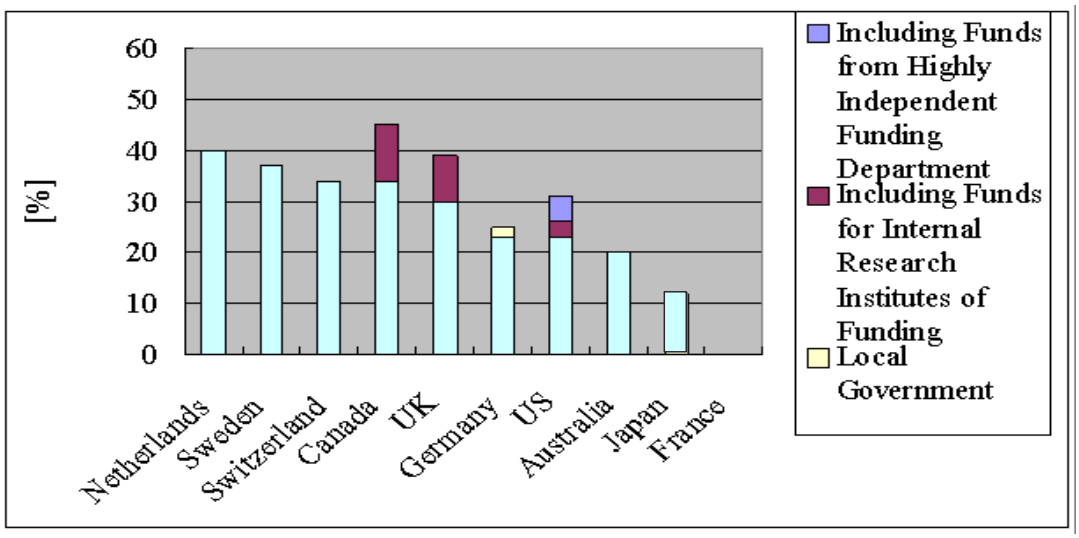
5.3 Prioritization Policies: A Role of Competitive Research Funds

As for prioritization policies, we focused on the role of competitive research funds. In this survey, especially differences between US and Japan were analyzed. This was a very difficult task because the funding system is very different from each other.

Here we would like to point out Two Concerns through surveys on “Funding Structure of Universities & Colleges”. Our first concern is that “Could the ratio of external fund at R&D expenditures” affect “quality of R&D activities”? Second concern is that “Is diversity of R&D funding” indispensable to maintain and increase “quality”?

5.4 Organizations for Public Research Fund Distribution

The ratio of funds distributed through funding organizations (agencies) in public funding



Source: International Comparison of Funding Agencies for R&D budget, Institute for Policy Sciences, 2004

In this bar chart, the ratio of funds distributed through funding organizations (agencies) in public funding is shown as a bottom part in each bar. According to this chart, the ratio of Japan is extremely low. Japan's public funding organizations should have more authority. To realize this, the highly-trained reviewers are strongly needed in Japan.

5.5 Human Resources in the S&T Field

The following presumptions are based on the several interviews with the governments, universities and private companies in each country.

※ In the US, the mobility of advanced HRST such as doctorate recipients is high among employment sectors.
※ " High mobility" of advanced HRST is the result from strong demand for "Principal Investigator (PI)" at various employment sectors.
※ In Japan, "demand for PI in industries" is also increasing, especially in the pharmaceutical companies. However, "the mobility of advanced HRST to industries" is still low in Japan.

We think that one of the most important issues is the Human Resources in the S&T Field, HRST, especially, the mobility of HRST. We conducted several interviews with the governments, universities and private companies in each country.

In the US, the mobility of advanced HRST such as doctors is high among employment sectors. This result from strong demand for "Principal Investigator", PI, at various employment sectors. In Japan, "demand for PI in industries" is also increasing, especially in the pharmaceutical companies. However, "the mobility of advanced HRST to industries" is still low in Japan.

5.6 Efforts in the Industry-Academia-Government Cooperation and Regional Innovation

Regional innovation supported by the active Industry-Academia-Government Cooperation is one of the key issues for S&T policy.

Regional innovation programs in the world

Country	GERMANY	GERMANY	GERMANY	SWEDEN	FINLAND
Program Name	**BioRegio**	**InnoRegio**	**EXIST**	**VINNVÄXT**	**Centre of Expertise**
Funding Organization	BMBF	BMBF	BMBF	VINNOVA	Ministry of the Interior
Start Year	1996-2000	1999-2006	1998-2004	2003-	1994
Overview & Objectives	To create clusters of biotechnology by two times-competitions	To create clusters in east Germany to activate economy	To build regional networks to foster univ.-based start-ups	Effective research environment, high R&D level of specific areas, catalytic role in industry-academia	To utilize first-class expertise &professional skills in the industry.
Support	50 million DM/region (approx. 3.3 billion yen/5 years)	255.6 million Euro in total (approx. 32 billion yen)	30 million DM/year in five regions (approx. 2 billion yen)	600 million SEK (approx. 7.2 billion yen) in total (*each region	2nd Term: The central government offered 20million Euro
Support Term	5 years	Basically, 7 years	6 years	10 years (3 intermediate reviews/term)	1st Term: 5 2nd : 3 3rd : 3 years
Number of Designated Regions	3 regions	23 regions	5 regions	3 regions	1st Term: 8 2nd: 6 3rd : 4 regions
Results	Rapid increase in the number of biotech companies	Certain Network has created 3,000 employment since 1999	150 companies started business in 5 regions in the first year	-	2nd Term: 5,700 employment 1,400 new Innovations

These are the outlines of well-known regional innovation programs in the world; “BioRegio”, “InnoRegio” and “EXIST” in Germany, “VINVAXT” in Sweden, and “Centre of Expertise” in Finland. These programs are planned very carefully with the clear target, the severe selection process, the limited regions and so on. The most important point is they have already contributed to the regional economy, namely, creation of new industry and employment.

5.7 The Industry-Academia-Government Collaboration/ A Role of Public Research Institutes in Japan

Next we focused on a Role of Public Research Institutes in the

Industry-Academia-Government Cooperation in Japan. We examined based on the paper: “Public Research Institutes and National Innovation,” Report of March 2003, by Prof. Akira Goto.

As for the current situation, the proportion of researchers is 2.7% and the ratio of research budgets 7.6%. These figures are considerably high. Most Public Research Institutes in Japan are focusing on the ‘Basic Research’. Public research institutes in other countries place emphasis on contributions to innovation and commercialization of research results. A further reform of public research institutes should be pursued to promote innovation in Japan.

6. Conclusion ~ Japan’s Challenge for Innovation ~

In chapter 2 at page 2, five concerns of the national S&T system in Japan are pointed out. On the basis of our survey, it may be concluded that these five concerns really exist in Japan. All of the concerns, however, could be solved. The following six challenges would be keys for solution:

1. Efforts to identify innovation as cornerstones of both ‘technology policy’ and ‘economic policy’ and build consensus in the society;
2. Clear logics for R&D prioritization aiming at achieving the nation's goal, besides quantitative approach;
3. Extended goal-setting for the balance between basic appropriation and external funding for the university and public research institute (integration of external funding from overseas and from industry);
4. S&T related personnel fostering, placing emphasis on improving the practical skills of Ph.D. students and post-doctoral researcher (as a principal investigator) and human resource mobility;
5. Promotion of 'sustainable' regional innovations through adequate role-sharing of central government and local community, as an effective process for bridging S&T activities in the region and the revitalization of regional industry and economy;
6. Role definition of public research institutes in the industry-academia-government cooperation.