National Institute of Science and Technology Policy

Analysis of Recent Trends in Science, Technology and Innovation Policies in Selected Countries/Areas

Report Overview

March 2009

3rd Policy-Oriented Research Group
National Institute of Science and Technology Policy (NISTEP)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)

16th Floor, Central Government Building No. 7 East Wing
3-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013 JAPAN
Phone:＋81-3-3581-2419 / Fax:＋81-3-3503-3996
http://www.nistep.go.jp

Introduction

When research for this report has just begun, prices for resources such as crude oil and food had risen sharply, and the subprime loan problem in the USA had touched off global financial uncertainty and an economic crisis. The rapid development of emerging nations and resource-rich countries was also advancing the multi-polarization of the global economy. Amidst these circumstances, clarifying how a select number of countries/areas positioned science and technology in their policies, as well as the nature of those policies, were judged to be important research areas by Japan's National Institute of Science and Technology Policy (NISTEP), as it began to examine how Japanese science and technology policy should change and advance.

Through globalization, the impact of a global economic and financial crisis can spread instantly to every country in the world, forcing these countries to announce and pursue their own policies in succession. In the USA, where the financial crisis originated, it is no exaggeration to say that the abilities of the new administration, brought in through a historic change of government, will be gauged by the performance of its financial and economic measures. In order to prevent long-term stagnation of economic growth under difficult circumstances, resources should be diverted to industries where innovation is possible (i.e. to new fields, away from fields where growth is stagnant). The political economic environment must not hinder this. Leaders in each country should seize this crisis as an opportunity. How countries are able to link this crisis to development will influence whether they thrive or fail in this era of great competition. Emphasizing innovation, the reallocation of human resources, capital, and other resources, as well as investment, and education, will play an important role in overcoming this global economic and financial crisis[1].

This report clarifies the measures that selected countries/areas are taking during this global economic and financial crisis, and how they integrate science, technology, and innovation policies within these measures. In addition, this report observes over a medium-term span the basic content of science and technology policies in each of the selected countries/areas, recent science and technology policy trends, the reasons and background behind such policymaking, policymaking mechanisms, and the status of and changes in activities of organizations related to science and technology. It also performs comparison and analysis across selected countries/areas.

In Japan, policies similar to those in other countries have already been adopted. In each country, science, technology, and innovation policies are positioned as important long-term measures; an understanding of these trends, as well as policymaking background and mechanisms, should serve as a reference for Japan as it works towards policy shifts in the future.

[1] From Daron Acemoglu, MIT, The Crisis of 2008: Structural Lessons for and from Economics (January 2009)

1 Aims and Methods of this Research

(1) Aims of this Research

With increased international competition and the advance of globalization, various countries and areas have positioned science and technology as a source of innovation and international competitiveness. There is a trend towards enhancing the strategic nature of science, technology and innovation policy. This research therefore performed cross-sectional analysis of policy trends regarding science and technology in selected countries/areas. Through comparison with Japanese initiatives, it aimed to provide suggestions that will be useful for the future development of Japanese science and technology policy.

This research clarified measures taken by selected countries/areas in light of the global economic and financial crisis that emerged during the summer of 2008, and analyzed the position of science, technology, and innovation policies within them. In addition, it observed the basic content of science and technology policies in each major country and area, recent science and technology policy trends, the reasons and background behind such policymaking, policymaking mechanisms, and the status of and changes in the activities of organizations related to science and technology, performing comparison and analysis across selected countries/areas.

(2) Research Methods

(i) Items Researched

This research examined countries and areas with high total domestic research and development (R&D) spending relative to gross domestic product (GDP). These countries/areas are likely to provide hints for Japanese policymakers as they try to improve Japan's legal framework and other systems, in order to advance science and technology policy. The countries and areas examined were the United States of America (USA), the European Union (EU), the United Kingdom of Great Britain and Northern Ireland (UK), the Federal Republic of Germany, the French Republic, the People's Republic of China, and the Republic of Korea (hereinafter, "selected countries/areas"). They were studied in terms of 1) world science and technology policy trends within the context of globalization and the global economic and financial crisis, and 2) cross-sectional analysis of science and technology policy trends in selected countries/areas. As for the period covered by the research, in principle it covers the period since the previous "Study for Evaluating the Achievements of the Second S&T Basic Plan in Japan." This means it generally addresses policy trends from 2004 through the end of March 2009. Where necessary, policy trends before 2004 were also examined.

1) World Science and Technology Policy Trends within the Context of Globalization and the Global Economic and Financial Crisis

NISTEP examined policy measures in selected countries/areas aimed at the global economic and financial crisis (including the integration of science, technology and innovation policies within these measures); NISTEP also examined the prioritization and use of science, technology, and innovation-related policies during economic crises.

In addition the same areas, as they relate to in Japan, were discussed for reference.

2) Cross-Sectional Analysis of Science and Technology Policy Trends in Selected Countries/Areas

In order to provide suggestions that will be useful for the future development of Japanese science and technology policy, cross-sectional analysis of trends in selected countries/areas was carried out in terms of the following items:

- Basic content of science and technology policy, in particular since the publication of a 2004 study entitled: “Study for Evaluating the Achievements of the Second S&T Basic Plan in Japan”
- Recent science and technology policy trends
- Recent policymaking background
- Science and technology policymaking mechanisms
- Organizations related to science and technology policy, and the status of their activities

(ii) Research Methods

Research methods included surveys of internet websites, literature research, and interviews with experts in Japan and abroad. Overseas interviews were conducted in the USA, the UK, and South Korea.

In addition, a group entitled “Science and Technology Trends in Selected Countries/Areas Analysis Project Committee” was established inside the National Institute of Science and Technology Policy (NISTEP), in order to receive evaluation and advice from experts, and make research and analysis more effective.

2 World Science and Technology Policy Trends within the Context of the Global Economic and Financial Crisis

(1) Global Economic and Financial Crisis Measures in the United States of America (USA), and the Integration of Science, Technology and Innovation Policies within these Measures

On February 13, 2009, the American Recovery and Reinvestment Act of 2009 passed. It will cost a total of 787 billion dollars (about 81 trillion yen[1]). At the ceremony where he signed the law, President Barack Obama said, "... this recovery act represents the biggest increase in basic research funding in the long history of [America].... I hope this investment will ... [spur] new discoveries ... in science, in medicine, in energy, to make our economy stronger ..."[2].

According to analysis by the American Association for the Advancement of Science (AAAS), a total of 21.5 billion dollars (about 2 trillion yen) was allocated to science and technology related institutions in four priority fields: 1) basic competitiveness-related research, 2) biomedical research, 3) energy-related R&D, and 4) climate change programs[3]. This included allocations of 3 billion dollars (about 300 billion yen) to the National Science Foundation (NSF), 10.4 billion dollars (about 1.1 trillion yen) to the National Institutes of Health (NIH), and 5.1 billion dollars (about 500 billion yen) to the science and technology budget of the Department of Energy (DOE).

In his FY 2010 budget message upon submission of the budget to Congress on February 26, 2009, President Obama spoke about science and technology in terms of prioritizing investment in clean energy, education, healthcare, and new infrastructure, taking necessary steps towards a clean-energy economy, and the need to invest in science, technology, and research[4].

Furthermore, looking at the sections relevant to science and technology in "Jumpstarting the Economy and Investing for the Future," which is a pointed overview of the FY 2010 budget message, "investment in science" is positioned as a part of "building 21st century infrastructure" in order to "create employment and investment for long-term economic growth." In the same way, "creation of a clean-energy economy," including the necessary R&D for "development of low carbon emission technology" is positioned as a policy for long-term economic growth.

In January 2009 in the USA, during the middle of the global economic and financial crisis, both the President and Congress took new stances. Because the Democratic Party held majorities in Congress, the American Recovery and Reinvestment Act was passed with unusual swiftness, with approval of the FY 2009 budget following immediately after. At the same time, details of the FY 2010 budget were being worked out (as of the end of March 2009). Because policy change was the main premise of the change in government, it is not possible to discern specifically the extent to which science, technology, and innovation policymaking has been impacted by the global economic and financial crisis.

---

1 Calculated at 1 dollar to 103.36 yen, the average exchange rate on the Tokyo foreign currency market during 2008 (on a 5:00 p.m. basis), according to the Bank of Japan (*the same rate is used throughout this report*).
2 From the White House website
3 From American Association for the Advancement of Science (AAAS) analysis (dated February 16, 2009)
4 From the White House Office of Management and Budget website

However, in his inaugural address and on other occasions, President Obama has repeatedly stated the importance he attaches to science and technology. This is symbolized by his use of expressions such as "restoring science to its rightful place," and "returning scientific integrity to the governmental decision making process[1]," as well as his appointment, as promised, of a higher-level Assistant to the President for Science and Technology (rather than just a presidential advisor), and his selection of respected scientists for important science and technology policy posts.

Since he was elected, President Obama has hammered out science and technology policies consistent with his campaign promises. In policies outlined in "The Agenda," which was released after he was elected, President Obama describes the science and technology needed to address current important issues. These policies are gradually being implemented through the American Recovery and Reinvestment Act and the FY 2010 budget message.

(2) Global Economic and Financial Crisis Measures in the European Union (EU), and the Integration of Science, Technology and Innovation Policies within these Measures

On November 26, 2008, the European Commission announced the European Economic Recovery Plan. This plan is backed by about 200 billion euros (around 30.5 trillion yen[2]), including "wise investment" from a long-term perspective for economic growth and sustained prosperity. Around 170 billion euros (about 25.9 trillion yen), which is 1.2 percent of the EU's GDP, will be provided by member countries. Around 30 billion euros (about 4.6 trillion yen), which is 0.3 percent of the EU's GDP, will come from the EU and European Investment Bank budgets. The plan addresses both climate change and job creation through initiatives on entrepreneurial activity in automobiles and other industries, and contains concrete steps to promote research and innovation, and strategic investment in energy-efficient buildings and technologies[3].

The EU's science, technology, and innovation policies have been carried out through the Seventh Framework Programme (FP7) and other initiatives, and the broad outlines remain unchanged. However, the EU was notable for its quick reaction in the form of the European Economic Recovery Plan. Still, steady implementation by member countries is key to the success of the economic recovery plan, so the status of these steps bears watching into the future.

In a speech at the annual conference of the AAAS on February 13, 2009, Director-General J. M. Silva Rodríguez of the European Commission's Research Directorate-General, stressed that he wanted to share with American stakeholders his view that research and innovation, in areas such as environmental issues, hold the key to escaping economic recession and leading future growth. In his speech, he positioned research and innovation as generating new demand, causing increased production, and promoting new investment. He further stated that addressing climate change through increased investment in research, along with sustained development, are means to overcome the crisis

[1] On March 9, 2009, when President Obama signed an executive order permitting federal government support for research on embryonic stem cells, he also signed the Presidential Memorandum on Scientific Integrity, which included these phrases. The intended idea is that in government policymaking, it is necessary to obtain the most reliable and useful scientific advice in order to use the full power of science and technology to solve problems that face society (from the White House website).

[2] Calculated at a rate of 1 euro to 152.49 yen, the average exchange rate on the Tokyo foreign currency market during 2008 (on a 5:00 p.m. basis), according to the Bank of Japan (*the same rate is used throughout this report*).

[3] From the EU website

we are facing. He said that the European Commission's economic recovery plan would raise demand, protect people from unemployment, and restore confidence in the European economy, thus limiting the impact of the crisis. He stated that solving environmental issues (through research and innovation policy) and improving energy efficiency, would lay a foundation for new jobs, sustainability, and high long-term growth.

It is thus clear that the aims of science, technology, and innovation policies, especially where they address environmental issues and climate change, include the creation of jobs and escape from the economic crisis.

Mirek Topolánek, President of the European Council and Prime Minister of the Czech Republic during the early part of 2009, rejected criticism that the European Union was not doing enough to tackle the economic crisis, emphasizing that the European Economic Recovery plan represented a strong response to the economic crisis. However, the Czech Prime Minister also noted the European Union member states could not adopt an economic stimulus package as extensive as the one adopted by the United States, for that could destabilize many member states and potentially threaten the stability of the eurozone (also known as "euro area"). However, he noted that differences in problem solving must not hinder the United States and the European Union from finding a common approach[1].

(3) Global Economic and Financial Crisis Measures in the United Kingdom of Great Britain and Northern Ireland (UK), and the Integration of Science, Technology and Innovation Policies within these Measures[2]

On November 24, 2008, about 20 billion pounds (around 4 trillion yen[3]) worth of financial/economic measures were announced in the UK's 2008 pre-budget report. There were no changes to science, technology, and innovation policies.

During the global economic and financial crisis, however, Prime Minister Gordon Brown, Secretary of State for Innovation, Universities and Skills John Denham, and Minister for Science and Innovation Paul Drayson, all stated publicly that economic crises are when science and technology are most important. They strongly asserted that the UK is second only to the USA in science, and must use that strength to come through this crisis safely. The public understands and supports this position.

In October 2008, the National Economic Council (NEC) was established to coordinate economic policy across the entire government. This is in addition to the existing Ministerial Committee on Economic Development, which includes ministers with portfolios related to the economy. In addition to the Secretary of State for Innovation, Universities and Skills, the NEC's members include the Minister for Science and Innovation. This indicates an effort to coordinate science and innovation policy with economic policy at the ministerial level.

---

1 From the March 26, 2009, EU press release "EU News 71/2009"

2 HM Treasury, 2008, *2008 Pre-Budget Report – Facing global challenges: Supporting people through difficult times*, Presented to Parliament by the Chancellor of the Exchequer by Command of Her Majesty, Cm 7484, London: The Stationery Office, November 2008; from the Department for Innovation, Universities and Skills (DIUS), Department for Business, Enterprise and Regulatory Reform (BERR), and Prime Minister's Office websites (from Part 2 Chapter 4)

3 Calculated at a rate of 1 pound to 192.5 yen, the average 2008 value for Mitsubishi UFJ Research and Consulting's TTS and TTB; the same rate is used throughout this report.

In a speech, Prime Minister Brown stated that the Government would protect the science and innovation budget until 2014 as promised, and that it would not be affected by other policy areas (the UK has already revised the "Science & Innovation Investment Framework 2004–2014" set in 2004, with the 2006 "Science & Innovation Investment Framework 2004–2014: Next Steps"). This was intended to ensure that when the UK's economy recovered, the nation's foundation for science would be among the world's strongest. Furthermore, progress in the debate on which fields to emphasize moving forward, can be glimpsed in speeches by Prime Minister Brown and other politicians. On a related note, the issue of which fields people formerly engaged in financial services must shift their careers into, has also become a major issue. From the three men's speeches, one can see that the Government considers the biomedical industry one of the UK's strengths, and that life sciences are a particular field of emphasis. In April 2009, an Office of Life Science was to be created within the Department for Innovation, Universities and Skills, utilizing personnel from other ministries as well, to form a virtual team. A general election must be held by June 2010, so how science, technology, and innovation policies will change depending on the Government[1] bears watching. However, science and technology policy has not been a major point of contention between the Labour Party and the Conservative Party. In preparation for the coming general election, the Conservative Party has formed a task force on STEM (Science, Technology, Engineering, and Mathematics) policy headed by House of Commons Member Ian Taylor. The task force produced a report called "An Innovative Society: Capturing the Potential of Science and Engineering." The report is considered a likely basis for the Conservative Party's future platform on science, technology, and innovation policies.

(4) Global Economic and Financial Crisis Measures in the Federal Republic of Germany, and the Integration of Science, Technology and Innovation Policies within these Measures

On November 5, 2008, Germany's federal government announced its first package of financial/economic measures, totaling 31 billion euros (about 4.7 trillion yen). On January 13, 2009, it announced its second package, worth 50 billion euros (about 7.6 trillion yen) over a two-year period (2009 and 2010). The core of the second set of measures is a total of 14 billion euros (about 2.1 trillion yen) from the federal government for new investment. Investments will be made in infrastructure improvement for job creation, and in education-related enterprises. Measures in the second package related to science, technology, and innovation policies are as follows[2]:

- The federal government will promote environmental protection and energy efficiency.
- It will provide 450 million euros (about 69 billion yen) in financial support during both 2009 and 2010 to small and medium-size businesses carrying out research projects.
- Over the two-year period, it will provide 500 million euros (about 76 billion yen) in support and loans to promote the development of fuel cell and hydrogen-powered automobiles.

Budget committee deliberations on the 2009 Federal education and research budget added 200 million euros to the original proposal submitted by the Government, resulting in a total budget of 10.204 billion euros. On that occasion, Minister of Education and Research Annette Schavan stated, "It

[1] At the time of this research, the party in power, Labour, was reported to be weakening.
[2] From the German federal government website

is during times of economic difficulty that we must invest in education and research for the sake of future growth amidst global competition." She judged that the budget increase indicated that education and research are essential to growth and employment. The additional funding will be assigned to energy, climate, and environment-related fields[1].

On March 4, 2009, the federal government's Commission of Experts for Research and Innovation (Expertenkommission Forschung und Innovation, EFI) submitted its "2009 Report on Research, Innovation, and Technical Capability" to Chancellor Angela Merkel and Minister of Education and Research Annette Schavan[2]. The commission emphasized that education and research are vital to overcoming the global economic and financial crisis, noting, "the federal government has taken important steps to support and stimulate the economy through its package of financial/economic measures." The report also stated that "recent research policy based on the High-Tech Strategy is creating necessary conditions for economic growth." The main points of the report were as follows:

- During economic recessions, Germany must consider education, research, and innovation to be priorities.
- It is necessary to promote greater career fluidity for researchers, improved educational environments, and investment in innovative small and medium-size businesses.
- Climate change, future energy supplies, and the shift to a sustainable economy represent opportunities.
- Simplification of residency procedures for skilled immigrants, adoption of tax systems that promote innovation in R&D, greater independence for universities and research institutions, knowledge and technology transfer policies, and further expansion of the education budget are important.

In response, Minister Schavan stated, "Investment in research and innovation is an optimal policy during an economic crisis." The report will be studied by the Ministry of Education and Research, and the Government is to issue a report on "German Research and Innovation" based on that study at the end of April 2009.

In these ways, Germany is expanding its budget for education and research as an investment in the future during the current global economic and financial crisis. This is executed based on the High-Tech Strategy, which is the federal government's comprehensive plan on R&D and innovation launched in August 2006. One may therefore take this as indicating that Germany has decided on the importance of science, technology, and innovation, and is working to further expand research and education.

(5) Global Economic and Financial Crisis Measures in the French Republic, and the Integration of Science, Technology and Innovation Policies within these Measures[3]

On December 4, 2008, President Nicolas Sarkozy announced fiscal measures totaling 26 billion euros (about 4 trillion yen). As for measures related to science, technology, and innovation, 700

1 From the Federal Ministry of Education and Research website (November 21, 2008, press release), etc.
2 From the Federal Ministry of Education and Research website (March 4, 2009, press release) and JST/CRDS "Daily Watcher."
3 From French Presidency, Ministry of Higher Education and Research, and JST/CRDS websites.

million euros (about 100 billion yen) is expected to be allocated to “higher education and research.” Details are as follows:

• 47 million euros to secure and renovate housing for university students
• Doubled funding allocated to university buildings
• 46 million euros to large-scale research facilities
• 20 million euros for safety measures, maintenance, and upgraded facilities at research institutions
• 70 million euros for the Nanotechnology Plan
• 110 million euros for the promotion of research on defense technology
• 40 million euros for the Grenelle Environment Roundtable’s experimental research fund

Furthermore, on January 22, 2009, President Sarkozy ordered a committee to begin working towards setting a National Strategy of Research and Innovation. The Government plans to decide on this strategy during 2009. The draft released on March 31 included several elements that referred to the economic crisis. For example, in the draft “innovation ecosystem,” SWOT analysis of France’s innovation ecosystem was performed. As follows, it takes the perspective that the economic crisis is an “opportunity,” and that the crisis can accelerate the evolution of France’s innovation ecosystem:

- When global issues, such as the economic crisis and the need for sustainable development exist, it is a good opportunity for enhancing the role of science and innovation.
- Crisis can be a catalyst for change.

The draft “international position of France’s research” stated the following:

- Through the current crisis in the international financial system, France should strengthen its will to become more open internationally and aim for a place on the world stage rather than becoming more inward-looking.

As described above, higher education and research have been high-priority fields in French government policy, and the government has emphasized them in its budgets. In addition, economic crisis-related measures announced in December 2008 included additional measures for buildings at large-scale research facilities and universities as strategic investments. Further, during the presidential election, the current Sarkozy Government promised to strengthen France’s universities, raising them to a world-class level. The government undertook bold reforms, beginning with passage of the Universities’ Freedom and Responsibility Act in August 2007. In September 2008, France began historic work on setting a basic long-term strategy for science, technology, and innovation. However, uncertainties caused by the global economic and financial crisis erupted during this effort. Although the original policy direction has not changed, President Sarkozy and others have stated that research and innovation are keys for France to overcome the economic crisis; he has tried to overcome the crisis facing France, and promote solutions to global problems via science and technology, by improving the country’s competitive edge, and by promoting the integration of various sectors of the economy.

(6) Global Economic and Financial Crisis Measures in the People's Republic of China, and the Integration of Science, Technology and Innovation Policies within these Measures[1]

On November 5, 2008, China decided on financial/economic measures totaling 4 trillion yuan (about 60.6 trillion yen[2] and approximately 15 percent of GDP) through the end of 2010. Of this, 370 billion yuan (about 5.5 trillion yen, 9.3 percent of the total), is allocated for spontaneous innovation and economic structural adjustment. According to the National Development and Reform Commission, these financial/economic measures are concerned with properly building infrastructure, strengthening environmental protection, and advancing energy conservation and emission reduction.

As for statements by Chinese leaders regarding the position of science, technology, and innovation policies during the financial-economic crisis, on December 27, 2008, Premier Wen Jiabao[3] stated that "As a means of responding to the financial crisis, we must take steps to expand domestic demand and carry out important special projects set forth in national medium- and long-term science and technology development plans." He also said, "China must foster innovative industries and generate products that incorporate intellectual property," and "Science and technology are important elements in the security of the nation and the economy, competitiveness, and sustained development. They are essential strengths for overcoming economic difficulties, as well as engines of product development and corporate competitiveness."

Thus, China decided on the aforementioned financial/economic measures valued at 4 trillion yuan by the end of 2010; this was one of the world's quickest responses to the global economic and financial crisis. Premier Wen stated that as an essential response to the financial crisis, science and technology are important elements for the security of the nation, the economy, competitiveness, and sustained development, and are vital to overcoming economic difficulties. This indicates China's emphasis on science, technology, and innovation.

(7) Global Economic and Financial Crisis Measures in the Republic of Korea, and the Integration of Science, Technology, and Innovation Policies within these Measures[4]

On January 6, 2009, South Korea decided on measures to promote the Green New Deal Job Creation Plan, spending about 50 trillion won (around 4.8 trillion yen[5]) through 2012 on 36 projects, including improving the nation's four major rivers, and creating jobs for 960,000 people. The nine core projects include science and technology related items such as spreading and expanding green cars and green energy. The other 27 projects include science and technology related items such as development of bioethanol technology and producing original technologies for green cars.

1 From JST/CRDS, the Japan Research Institute's *Asia Monthly* January 2009 issue, and *Science and Technology Daily*
2 Calculated at a rate of 1 yuan to 14.874 yen, the average *Explore China* exchange rate from January 1 through December 31, 2008 (the same rate is used throughout this report).
3 *People's Daily* and *Science and Technology Daily* (December 2, 2008)
4 From National Assembly materials dated January 6, 2009, records on the Korean National Science and Technology Council website, an article in the *JoongAng Ilbo* (January 15, 2009), and interviews with people in charge of technology and industry within the Green Growth Planning Office, which is the secretariat of the Office of the Presidential Committee on Green Growth (March 3, 2009)
5 Calculated at a rate of 1 yen to 0.0965 won, the average 2008 value for Mitsubishi UFJ Research and Consulting's TTS and TTB (*the same rate is used throughout this report*).

On January 13, 2009, President Lee Myung-bak emphasized the need for science and technology policy that drives growth at the joint meeting of the National Science and Technology Council (NSTC)[1] and the Presidential Council on Future & Vision. He noted, “If the recently announced Green New Deal will save your father’s job, the New Growth Engines we have decided on today will create a job for your son. We must steadily prepare to leap forward as a developed nation, a great nation, after this crisis by creating and fostering new growth engines such as green technology development.” That same day, the Korean government announced its blueprint mapping out 17 new national growth engines, to drive the national economy over the next three to 10 years. These new national growth engines include six projects in green technology industries[2]; at the same time, it also released the fifth Five-Year Plan for Industrial Technology Innovation.

According to people in charge of technology and industry within the Green Growth Planning Office, which is the secretariat of the Office of the Presidential Committee on Green Growth[3][4], in August 2008, before the economic crisis surfaced, the President worked out a vision for “green growth” that looked 60 years into the future. Even without the economic crisis, the President would therefore have taken up the same green policies (with the exception of the short-term measures in the Green New Deal). “Growth” comes from the idea of breaking down the conflict between “green” and economic growth, by using green initiatives to stimulate the economy. Indeed, the Korean Government was able to respond so quickly with measures against the economic crisis because it was already examining new frameworks following the change in government. The global economic and financial crisis surfaced during that examination, so the government was able to smoothly correct its course with these new initiatives already in mind.

In January 2009, President Lee made clear his belief that investment in science and technology should be made especially during difficult times, with an eye to what will happen after the crisis. In the Government’s series of financial/economic measures, science, technology, and innovation-related policies have been emphasized, and the President’s strong leadership has quickly set forth a strategy with a clear direction.

---

1 NSTC official website: http://www.nstc.go.kr/ Also see: http://www.linearcollider.org/newsline/readmore_20090129_atw.html

2 http://english.president.go.kr/pre_activity/latest/latest_view.php?uno=659&board_no=E02&search_key=&search_value=&search_cate_code=&cur_page_no=15

3 http://www.greengrowth.go.kr/index.do See also: http://greenkorea2009.org/eng/04_host/01_host.php

4 From interview with Chon Gyon-tek, head of the Technology and Industry Bureau, within the Green Growth Planning Office: http://www.korea.net/News/news/newsView.asp?serial_no=20090217002&part=101&SearchDay=2009.02.17. This office acts as the “planning” secretariat of the Office of the President's Green Growth Commission (March 4, 2009).

Reference: <u>Overview of Japan's Economic Crisis related Expenses (Supplementary Budget for Fiscal 2009)</u>

(Unit: Billion Yen)

(1) Employment Measures	1,270
(2) Financial Measures	2,966
(3) Low-Carbon revolution	1,578
<Main Contents> ○ Solar Power Generation: 608.1billion yen ・ School New Deal plan: 489.2 billion yen Including provisions for "Earthquake-Proof School" and "Eco-Repair" (in public primary and junior high schools): 264.1billion yen Terrestrial digital broadcasting and deployment of PCs to schools: 208.9 billion yen ・ Sunlight introduction support (home and office): 47 billion yen ○ Fuel Efficient Vehicles and other Energy-Saving Products: 866.5 billion yen ・ Promoting purchases of environmentally friendly cars: 370.2 billion yen ・ Market expansion of "green" consumer electronics (eco-point system): 29.46 billion yen ○ Transportation and infrastructure reformation: 29.8 billion yen ○ Achieving the goal of being a country that effectively uses resource: 73.1 billion yen	
(4) Promotion of a Healthy Long Life and Support for Child Rearing	2,022
(5) Promotion activities demonstrating strength of reserves and maintaining infrastructure appropriate for the 21st century	2,578
＜Main contents＞ ○ Demonstrating strength of agriculture, forestry and fishery reserves: 1,013.1billion yen ○ High-tech development, strengthening workforce talent, and small and medium-sized (SME) enterprise support: 793.2 billion yen ・ Support for "Cutting Edge Research" (restrengthened program): 300 billion yen 1) Support for "Cutting Edge Research" (restrengthened program) : The aim is to create new outlets and applications for basic research and development (R&D), including future oriented research platforms. The strategy includes creating an up-to-date R&D system, with the aim of being best in the world in several key areas within 3-5 years. It includes designing a research system which places utmost importance on the researchers themselves. (Number of researchers: approx. 30, Financial Plan: 3-15 billion yen/project) 2) Dispatch of "Excellent Young Researchers" to foreign countries: This program supports highly talented young Japanese researchers, providing them with an opportunity to conduct research in renowned foreign research laboratories including universities, to help foster international research experience. Through this program they are provided an opportunity to study hard with foreign researchers. (Support period: 90 days or more,12 months or less; Total number of researchers dispatched (FY2009): Full-time researchers (100 - 200 persons), Special researchers (300 - 550 persons); Support of expenses to include round-trip air travel and accommodation, etc.) ・ Support for technology of manufacturing base: 70.5 billion yen ○ Regional alliance and infrastructure-building to strengthen Japan's competitive edge: 426.2 billion yen ○ Demonstrating strength in reserves via IT: 282.7 billion yen ○ "Soft Power" -related diplomatic activities, sightseeing, etc.: 62.4 billion yen	
(6) Revitalization of Local Areas	198
(7) Ensuring Safety and Consumer Confidence, etc.	1,709
(8) Support for Local government	2,379
Total	**14,699**

Note: There is an inconsistency in the total due to rounding of numbers in each of the individual headings.

Source: Based on materials from the Ministry of Finance's Budget Bureau, the Cabinet Office, and the Japan Society for the Promotion of Science.

3 Cross-sectional Analysis of Science and Technology Policy Trends in Selected Countries/Areas

(1) United States of America (USA)

Current Situation in the USA

On November 4, 2008, Barack Obama, the Democratic Party candidate, was elected President. At that time, the subprime loan problem was becoming apparent, and the Obama Administration had to deal with emergency economic measures as well as policies outlined in his campaign promises. In the USA, presidential candidates begin formulating basic policies during intra-party primary elections. The candidates' policies gradually form through interaction with citizens and political advisors throughout the duration of the campaigns. Subsequently, when parties unify behind their candidates, a selection of broad directions and policy frameworks are already in place. Underlying this, campaign committees summarize concrete campaign promises, and policy is firmed up through a mainly open process involving discussions with voters and supporters, with a careful eye on trends in public opinion. When a candidate is elected President, he forms a transition team made up mainly of members of his campaign committee. The next two months are spent setting concrete policies based on campaign promises, and deciding on personnel for the new administration. This can be called the heart of the democratic policy formation process in the USA.

The new Obama Administration had to deal with setting forth emergency economic measures from the transition stage. On January 20, in addition to his inauguration, President Obama began negotiating with Congress on financial asset preservation, financial/economic measures, and disposal of nonperforming assets. The financial/economic measures included items from his campaign promises, such as emergency economic measures to upgrade IT infrastructure and clean energy (including clean coal) facilities, which will have major investment effects. After passing the House, the measures moved to the Senate for deliberation. Passage in the Senate required compromise with the Republican Party, and some of the President's campaign promises had to be removed from the bill. After further revision through deliberation in both houses of Congress, the American Recovery and Reinvestment Act of 2009 was passed by Congress and signed by the President on February 17[1]. It was a good example demonstrating the characteristic way in which the policymaking process in the USA includes revisions made by Congress. In addition, on the final issue, disposal of nonperforming assets, a framework and the scale of the funding involved were announced on March 23, and even with Congressional debate still to come, markets generally responded favorably. Even so, disposal of nonperforming assets, the main cause of the current global economic crisis, is expected to take from one to three years.

Events since the global economic and financial crisis began could be called a silver lining for the USA: a presidential candidate whose mantra was "Change," benefited from an election held only a month and a half after major impacts of the financial crisis became apparent; the newly inaugurated President was prepared with comprehensive policies to change the nation's frameworks; government was organized to

[1] US Government Printing Office website: http://www.gpo.gov/fdsys/pkg/PLAW-111publ5/content-detail.html

quickly turn comprehensive policy into concrete proposals, and, if some of the public opposed the Obama Administration's measures, the Senate was balanced enough to require some compromise, due to the presence of its filibuster system. The global economic and financial crisis can be said to have brought this uniquely American politico-socioeconomic situation to light.

Current State of Science and Technology in the United States

Looking at recent OECD analysis, the current state of science and technology in the United States is as follows[1]:

Following a period of robust expansion since 2001, economic growth in the United States slowed at the end of 2007. The diffusion of information and communication technologies (ICTs) continues to fuel productivity growth, especially in the business services sector.
The United States is an innovation powerhouse, but its lead is increasingly challenged from some of its main international trading partners and emerging economies. R&D intensity fell slightly to 2.6% of GDP in 2006, down from 2.7% of GDP in 2001, although total R&D expenditure expanded in real terms to USD 344 billion, led by increases in business sector R&D spending (USD 208 billion in 2006).
In the United States, the majority of business R&D spending is by manufacturing firms in high-technology sectors (63% of total manufacturing R&D is high-technology compared to 47% in the EU and 43% in Japan).
At the same time, the US share of total OECD technology exports fell between 1996 and 2005 while that of Germany and Korea increased. Since the early 1990s services R&D has been growing at a rapid rate – exceeding that for manufacturing R&D. In 2003, services R&D had expanded to account for 36% of total business R&D.
The United States has 1.4 million researchers, or 9.6 per 1 000 total employment, but growth has slowed relative to dynamic economies in the EU and in China.
US output of scientific publications (29% in 2005) is second only to the EU (33.1% in 2005), and is world-class in fields such as nanosciences, environmental sciences and biosciences, which have benefited from large increases in federal research funding (e.g. through the National Institutes of Health). The United States retains its lead in innovation in critical sectors such as pharmaceuticals and ICTs, in which it invests more than any other OECD country. Since 1995, however, growth in triadic patent filings has slowed while other countries continue to catch up.

[1] From OECD Science, Technology and Industry Outlook 2008 (see: www.oecd.org/sti/outlook)

Overview of the USA's Science and Technology Policy

Even after the collapse of the Cold War, the U.S.'s national goal has been to maintain global hegemony. In many cases, policy goals have been formulated to promote this hegemony (or, "world leadership"). Even if policies are separately made by each organization, there are few instances where this overall directionality is contradicted. As seen also in the promotion of basic science, science and technology are viewed as infrastructure supporting the hegemonic state. Though it differs in degree, every administration maintains the view that this is an important issue. However, a majority of the Research and Policy Community (RPC) interested in science and technology policy, supports the Democratic Party. Policies supporting the RPC are therefore emphasized under Democratic administrations, while Republican administrations tend to remove support for this sector as a national goal.

Furthermore, the USA has no comprehensive science and technology basic plan that spans all government agencies. Many science and technology-related policies are programs developed based on strategic plans set independently by government agencies. In addition, there are interagency initiatives that create unified policies based on comprehensive programs or bundles of programs. In the USA, these frameworks and directions, based on strategic plans and initiatives, have become comprehensive policies that take the place of a "basic plan." One can say that in place of a basic plan, these initiatives together from comprehensive policy for serious, concrete issues.

Based on its political platform, the Obama Administration's science and technology policy can be broadly divided into "R&D" and "business development through innovation." Major fields on the R&D side are concentrated in basic science, biotech and health, energy, and climate change; business development through innovation focuses on information technology. The campaign promises compiled by the Obama campaign team were structured in this way, with development of IT business intended to maintain economic hegemony for the time being, and the four research fields mentioned above intended to create next-generation industries.

After taking office, President Obama revealed the directions of his policies in rapid succession. Typical policies are as follows:

- Memorandum on Transparency and Open Government[1] (January 21, 2009)
- American Recovery and Reinvestment Act[2] (February 17, 2009)
- Memorandum on Scientific Integrity[3] (March 9, 2009)
- FY 2010 budget draft entitled "A New Era of responsibility"[4] (February 26, 2009)

After being held up since his hearing on February 12, 2009, John Holdren was finally confirmed in the Senate, and he officially took office as Director of the Office of Science and Technology Policy (OSTP) on March 20. This completed the internal organization of the OSTP. Policy issues for each area it oversees were published on the OSTP website. An overview of these categories is as follows[5]. Each of these policy issues is either the same as listed during the campaign, or has been enhanced and clarified since then:

1 US Government Printing Office website: http://www.gpo.gov/fdsys/pkg/DCPD-200900010/pdf/DCPD-200900010.pdf
2 US Government Printing Office website: http://www.gpo.gov/fdsys/pkg/PLAW-111publ5/content-detail.html
3 White House website: http://www.whitehouse.gov/the_press_office/Fact-Sheet-on-Presidential-Memorandum-on-Scientific-Integrity/
4 White House website: http://www.whitehouse.gov/omb/assets/fy2010_new_era/a_new_era_of_responsibility2.pdf
5 OSTP website: http://www.ostp.gov/cs/issues/overview

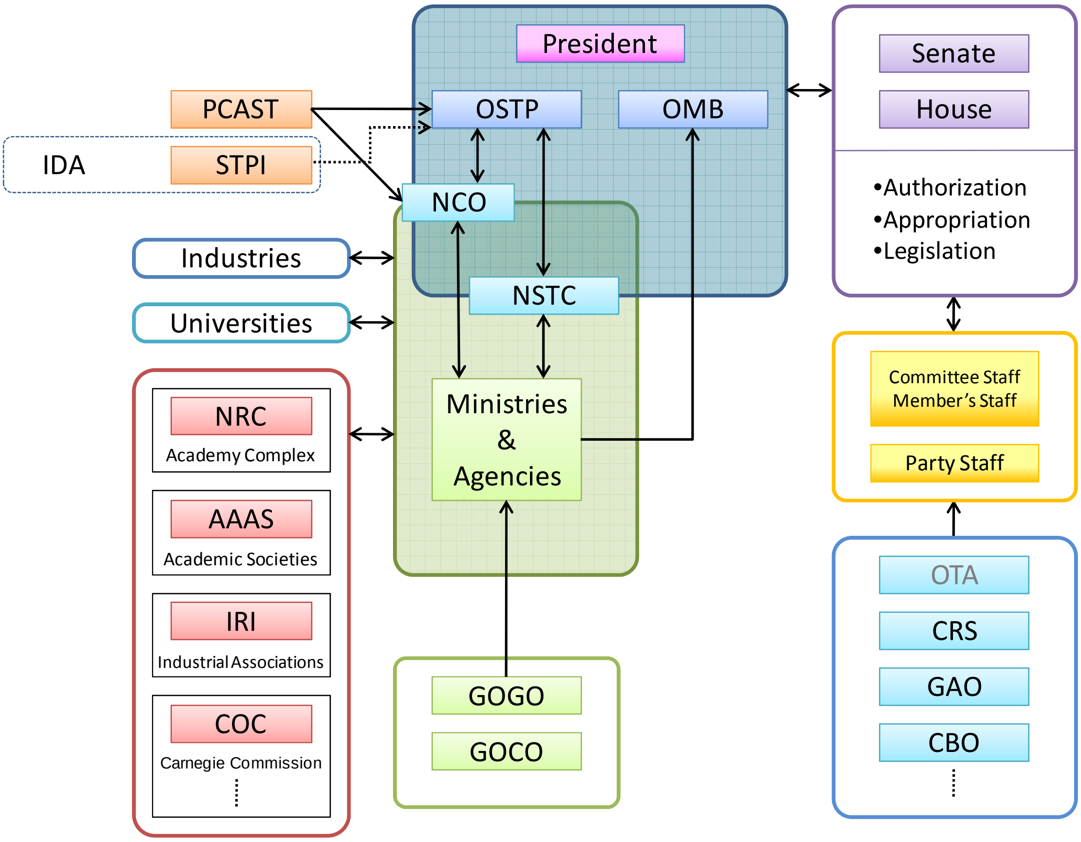
• Science: 4 topics (encouraging science and technology to enhance competitiveness in global markets, encouraging education in science, technology, engineering, and mathematics for the next generation, etc.)
• Technology: 13 topics (upgrading to the latest broadband infrastructure, lowering healthcare costs by computerizing medical records, developing policies for the 21st century with a Chief Technology Officer (CTO), etc.)
• Energy and environment: 11 topics (reducing greenhouse gas emissions to 80 percent of 1990 levels by 2050 through cap and trade and other methods, shifting to renewable sources for 25 percent of electricity by 2025, getting one million plug-in hybrid cars on the road by 2015, making federal buildings zero-emission by 2025, etc.)
• National security and international affairs: 7 topics (working to make the world free of nuclear weapons, securing all loose nuclear materials within four years, etc.)

Overview of Science and Technology related Policy Formation, Implementation Processes, and Relevant Organizations

Looking at policy decisions in the U.S. government, one can see competitive decision making and comprehensive adjustment are carried out. While each agency or bureau makes policy decisions competitively (i.e. federal agencies compete with each other to formulate policy and receive federal funding), there is also extensive communication and coordination between them at the same time. Interagency issues are decided by the President's Office of Science and Technology Policy (OSTP) and the National Science and Technology Council (NSTC), which is made up of relevant agencies (sometimes National Coordinating Offices [NCOs]). There is a two-top system for coordination and collaboration between organizations (OSTP-department), with unified decision-making and implementation structures. In addition, there is a check and balance system that includes Congressional review.

At the level of funding allocation organizations, in addition to departments and the NSF, which has equivalent rank, some offices within departments and outside research agencies oversee funding allocation. The USA does not have "intermediate agencies" (i.e. fund-allocating policy implementation agencies, intermediary to 1. ministry-level bodies that formulate policy, and 2. implementing organizations that carry out R&D) commonly found in EU member countries. However, the independent allocation of R&D funding is very similar to that of intermediate agencies in EU member countries.

Figure 1: Formation of science and technology policy in the United States



Explanatory notes

AAAS: American Association for the Advancement of Science
CBO: Congressional Budget Office
COC: Council on Competitiveness
CRS: Congressional Research Service
GAO: Government Accountability Office
GOCO: Government Owned Contractor Operated
GOGO: Government Owned Government Operated
IDA: Institute for Defense Analyses
IRI: Industrial Research Institute
NCO: National Coordination Office
NRC: National Research Council
NSTC: National Science & Technology Council
OMB: Office of Management and Budget
OSTP: Office of Science & Technology Policy
OTA: Office of Technology Assessment
PCAST: President's Council of Advisors on Science and Technology
STPI: Science and Technology Policy Institute

Source: Professor Ryo Hirasawa, based on an analysis of various sources.

(3) European Union (EU)

Basic Information about the EU

The European Union is a political and economic union formed through the signing of the Maastricht Treaty (officially, the Treaty on European Union) on February 7, 1992. The signing countries were members of three supranational European bodies: the European Economic Community (EEC), the European Coal and Steel Community (ECSC), and the European Atomic Energy Community (EURATOM)[1]. The functions of the above three parent bodies later merged into two organizations, the European Community (EC) and EURATOM[2]. Legally speaking, the EU refers to "three pillars." In addition to the domains handled by those two organizations (the first pillar), there are a Common Foreign and Security Policy (CFSP; the second pillar) and Police and Judicial Co-operation in Criminal Matters (PJCC; the third pillar)[3]. Regarding the first pillar in particular, the EU sets and carries out common policies in areas such as economics, agriculture, transportation, society, and the environment. All science and technology related policy in the EU is handled within this framework[4].

Although the EU respects the "national identities" of its member states, it is a supranational institution that has its own budget and sets and carries out policy. Common policies set and implemented within the framework of the first pillar in particular, are established through the member countries ceding some sovereignty to the EU (EC). Viewed from the opposite direction, the EU (EC) may only exercise those rights granted to it by the member countries (the principal of separate authorization). Power sharing by member countries during policymaking is thus a constant problem. A principle called the "subsidiarity principle" operates in regard to this issue, playing an important role in determining how power is shared. This principle states that for EU (EC) policies, with the exception of rights exclusive to the EU (EC), the EU (EC) should only have rights when 1) goals cannot be adequately reached at the member country level, and 2) action will be more effective when taken by the EU than by the individual member countries. The EU's science and technology policy is developed in accordance with this "subsidiarity principle," with various schemes carried out within its framework.

Overview of Science and Technology Policy in the EU

The Lisbon Strategy plays a major role in setting the direction of the EU's science and technology related policy. A basic strategy for science and technology related policy is the European Research Area (ERA) concept. For innovation policy, there is a Broad-based Innovation Strategy for the European Union, while for higher education policy there is a European Higher Education Area concept.

---

[1] When the 1967 Brussels Treaty (Treaty Establishing a Single Council and a Single Commission of the European Communities) came into effect, the European Commission and the Council of the European Communities were established to operate the above three bodies with a common budget. This was repealed by the 1997 Amsterdam Treaty, but today's EU still uses the name "European Commission," which still functions as the EU's board of directors. One of the EU's parent organizations, the EEC, became concerned with the adoption of EU citizenship and other non-economic matters when the Maastricht Treaty went into effect, so it was renamed the European Community (EC). The ECSC ceased to exist with the expiration of the Treaty of Paris on July 23, 2002. (Katsuhiro Shoji [2003], *EU Laws: Basic Edition*, Iwanami Shoten).

[2] See discussion of EEC and EC above.

[3] PJCC was originally formed as Justice and Home Affairs (JHA) in the Maastricht Treaty. Subsequently, the Amsterdam Treaty transferred jurisdiction over illegal immigration, border screening, asylum, and civil judicial cooperation to the first pillar, the European Community (EC), so the third pillar was renamed to accurately reflect its remaining missions.

[4] On the other hand, matters related to the second and third pillars are handled through cooperation among governments of member countries.

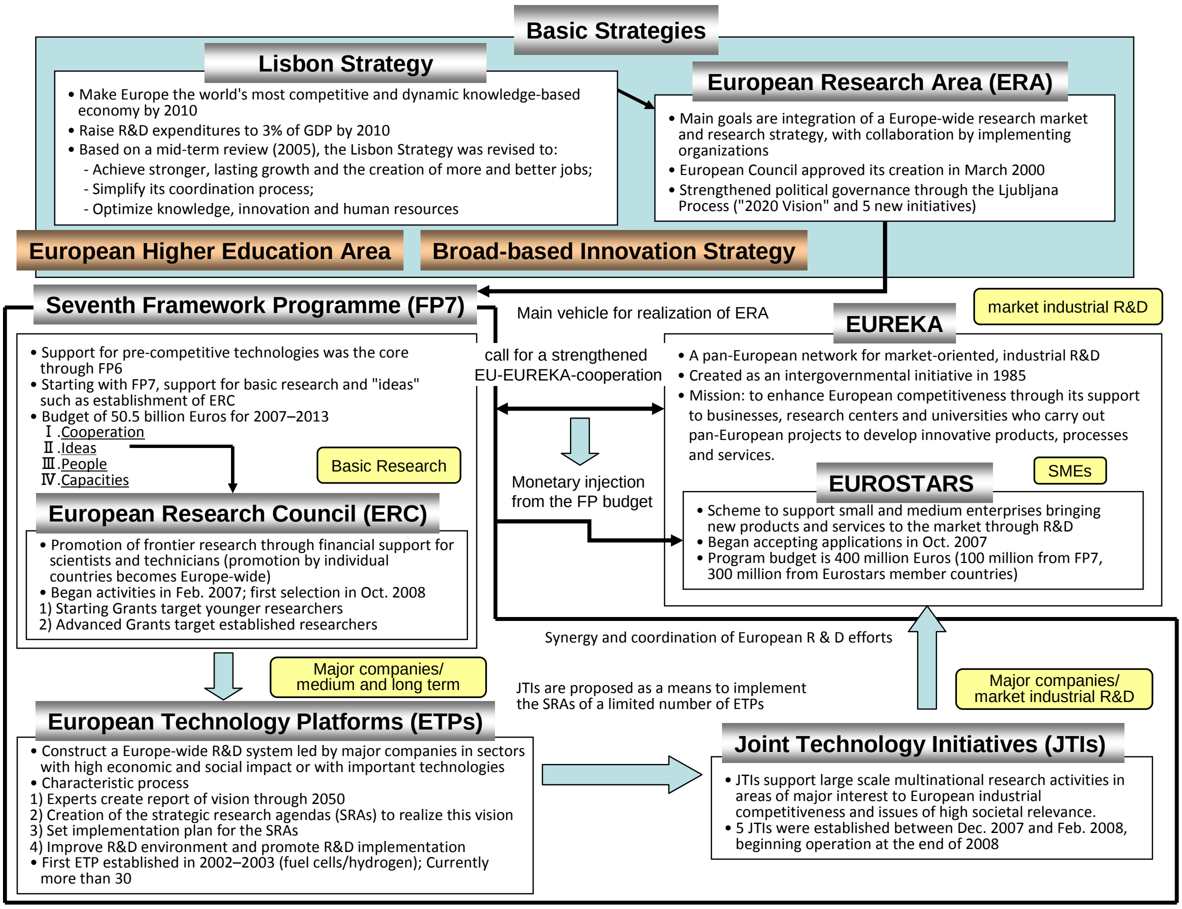
Begun in March 2000, the Lisbon Strategy promised to make the EU “the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment” by 2010. At the March 2002 Barcelona European Council, the concrete quantitative goal of raising total EU R&D investment to three percent of GDP by 2010 was added.

The ERA concept is a plan to turn Europe into a single area in order to realize the free movement of knowledge (the fifth freedom). It fundamentally changes the previous method of EU member countries carrying out individual policies in parallel. While remaining in accordance with the “subsidiarity principle,” it raises Europe’s science and technology prowess through “one policy,” while turning the area into a “research area” that can better draw researchers from around the world[1]. In December 2008, the Ljubljana Process set forth the 2020 Vision to enhance the political governance of the ERA.

The Seventh Framework Program (FP7) is also positioned as a step towards the realization of the Lisbon Strategy and the ERA concept.

[1] Yoshiko Okubo (2001), “The European Union's Policy for Enhancing Global Competitiveness: Development of a European Research Area,” *Journal of Science Policy and Research Management* Vol. 16 No. 3/4, pp. 133–149.

Figure 2: Basic strategies in the EU and characteristic initiatives in FP7



Source: IFTECH, based on various materials.

Overview of Organizations related to Science and Technology

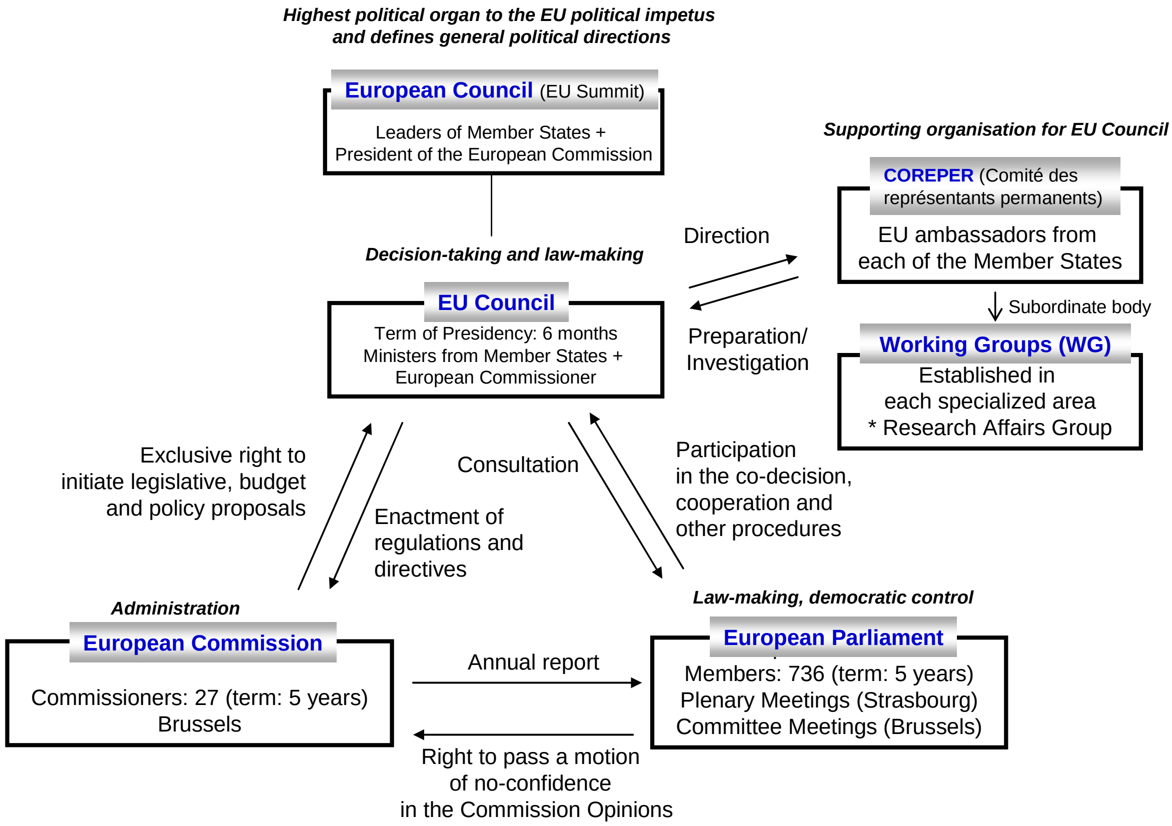
The EU's organizations include the European Council, which comprises the member countries' heads of state and the European Commissioner; the directly-elected European Parliament; the Council of European Union, which comprises cabinet ministers representing the member countries and European Commission members; the European Commission, which has the nature of an administrative organ; the European Court of Justice; and the European Court of Auditors. The EU's high-level advisory organs are the European Economic and Social Committee (EESC) and the Committee of Regions (CoR).

The European Commission has the non-exclusive right to initiate legal and budgetary proposals related to the first pillar. Organizations central to science and technology related policy in particular are the Commission's Research Directorate-General and the Enterprise and Industry Directorate-General. In addition, the Joint Research Center (JRC) has jurisdiction over seven research institutes and provides policymaking support. Other departments with budgets related to science and technology include the

Agriculture and Rural Development Directorate-General, the Environment Directorate-General, the Information Society and Media Directorate-General, and the Energy and Transport Directorate-General. Each of them promotes R&D related to its mission.

The Seventh Framework Program (FP7) established the European Research Council (ERC) in order to support basic research, including engineering, the social sciences, and the humanities. In fact, each country had had authority over basic research support including funding allocation, and most basic research is performed at universities within the framework of each country's education system. Member countries had long considered basic research to be an essential part of national competitiveness, and the idea that the goals of the EU's research policy should be limited to support for applied research and technical development predominated. Most of the support provided by the framework program was therefore actually provided at the pre-competitive stages of R&D. However, an increased understanding regarding the need to advance scientific knowledge and research, including basic research, in order to meet the EU's economic and social goals, made this sort of development possible[1].

Figure 3: Structure of EU institutions



Source: Based on the Delegation of the European Commission to Japan website.

[1] Communication from the Commission, Europe and Basic Research, Brussels, 2004.1.14 (COM [2004] 9 final).

(4) The United Kingdom of Great Britain and Northern Ireland (UK)

Basic Information related to the Political System and Policy Divisions

The full official name of the United Kingdom (UK) is the United Kingdom of Great Britain and Northern Ireland[1]. For historical reasons, it comprises four countries or nations: England, Wales, Scotland, and Northern Ireland. The Monarch is the UK's head of state. It is a constitutional monarchy with a parliamentary system of government. The UK is a member state of institutions, like the United Nations and the European Union. Also for historical reasons, the legal systems of England, Wales, Northern Ireland, and Scotland differ.

Based on a series of laws passed in 1998, the UK has gradually been carrying out devolution since 1999. The governments of Scotland, Wales, and Northern Ireland have authority over devolved policy areas.

Looking at science, technology, and innovation policies, the UK has not devolved science and technology policy; the UK retains authority over them. On the other hand, it has devolved governmental authority over education policy (including higher education policy and further education policy), healthcare policy, industrial policy related to regional innovation, and regional development policy. In order to ensure the unity of the UK as a whole, efforts are made regarding coordination and collaboration, including representatives of the devolved governments and the entire nation. Because of this devolution, it is necessary to bear in mind that some policy documents (for example, "white papers" that explain government policies and activities to the Parliament) published by the UK government relate to the entire nation, while some relate only to England.

National Issues and the Positioning of Science, Technology, and Innovation Policy in Response

Current medium- and long-term issues in the UK, policies that respond to these issues, and the budget compilation to carry them out, are shown in long-term analysis that looks 10 years ahead. The analysis was performed for the 2007 Comprehensive Spending Review. They are also found in the 2007 Pre-Budget Report that was published in light of the Comprehensive Spending Review.

First, analysis of long-term opportunities and issues can be broadly arranged according to the following five points, each of which is discussed in detail in its own chapter in the report.

1) Demographic and socio-economic change, with rapid increases in the old age dependency ratio on the horizon, and rising consumer expectations of public services
2) The intensification of cross-border economic competition, with new opportunities for growth, as the balance of international economic activity shifts towards emerging markets such as China and India
3) The rapid pace of innovation and technological diffusion, which will continue to transform the way people live and open up new ways of delivering public services

[1] Until very recently, Japan's Ministry of Foreign Affairs used the shortened name "rengou ookoku" ("United Kingdom"), but it currently uses "eikoku." The name "eikoku" is based on the Chinese characters (Jpn: *kanji*) used to translate "England." In this report, it was necessary to clearly distinguish between the United Kingdom and England, so they are referred to distinctly as "the United Kingdom (UK)" and "England."

4) Continued global uncertainty with ongoing threats of international terrorism and global conflict and the continued imperative to tackle global poverty
5) Increasing pressures on our natural resources and the global climate, requiring action by governments, businesses, and individuals to maintain prosperity and improve environmental care

The 2007 Pre-Budget Report (basic guidelines for drafting the budget), issued after the 2007 Comprehensive Spending Review, included plans for addressing these opportunities and issues. It advances the following goals:

- Sustainable growth and prosperity
- Fairness and opportunity for all
- Stronger communities and a better quality of life: enabling people to lead healthy, safe, and fulfilling lives
- A more secure, fair, and environmentally sustainable world

In order to meet these comprehensive goals, the Government set forth Public Service Agreements (PSAs), comprised of 30 categories[1]. They specify the highest priority outcomes, set forth shared visions, cross-departmental boundaries, and encourage cooperation at every level of the promise-making system.

The 2008 Budget, set in accordance with these principles, for the most part followed the 2007 Comprehensive Spending Review and the 2007 Pre-Budget Report. It analyzed the UK economy over the past 10 years in terms of long-term performance and strategic issues. It found the following two trends:

- much improved resiliency: the ability to cope with economic shocks and low economic costs — which has resulted in an unprecedented period of macroeconomic stability. The UK economy is now the most stable in the G7. GDP per capita has increased faster than in any of the other G7 economies over the past decade, with employment reaching record levels of more than 29 million.
- the UK has adapted successfully to the changing structure of the world economy by switching resources to sectors in which it maintains a comparative advantage such as services and high-technology manufacturing[2]. While the UK's share of world goods trade has fallen due to a dramatic increase in production from emerging markets, it is the only G7 country that has achieved a rising share of global trade in services.

The UK is thus aware that it maintains relative international advantages in the service industry and high-tech manufacturing sectors, and is working to shift resource allocation towards those industries. In response to the increased importance of the service industry in the economy, its policies are emphasizing improved skills rather than a dependence on human resources. The 2008 Budget continues short-term support for the economy, but it also promotes further advancement of long-term goals that steadily continue the resilience of the past decade. As for science and innovation policy, long-term measures designed to enable the Government to promote productivity growth in order to achieve the goal of "sustainable growth and prosperity" include the following:

[1] http://www.cabinetoffice.gov.uk/about_the_cabinet_office/publicserviceagreements.aspx

[2] This expression is probably used because the OECD has used the term "high-tech manufacturing" for manufacturing where ratio of R&D expenditures to turnover are high. As used here, "high-tech manufacturing" is judged based on the structure of economic activities and the status of research and development activities. It likely refers primarily to pharmaceutical manufacturing.

- Further implementation of the Leitch Review and the Sainsbury Review to build on improvements in the UK skills base and to provide a world-class science base and innovation framework

Overview of Science, Technology, and Innovation Policy

Regarding science, technology, and innovation policies, the 2007 Pre-Budget Report and the 2007 Comprehensive Spending Review state the following about PSAs and indicators:

Indicators for PSA 4: Promote world class science and innovation in the UK are as follows:

- UK percentage share of citations in the leading scientific journals*,
- Income generated by UK Higher Education Institutions and Public Sector Research Establishments through research, consultancy, and licensing of intellectual property*,
- Percentage of UK business with 10 or more employees “innovation-active”*,
- Number of UK PhD completers in STEM subjects at UK Higher Education Institutions *,
- Number of young people taking A-Levels (two-year course and qualification in a subject, an important route to advancing to higher education) in mathematics, physics, chemistry, and biological sciences, and
- UK R&D intensity in the six most R&D intensive industries relative to the other G7 economies*.

Indicators with asterisks (*) are set forth in detail by related Delivery Agreements. In addition, each PSA has a department designated to leading it. The Department for Innovation, Universities and Skills (DIUS) is directly concerned with the PSA related to science and innovation policy[1,2].

The six priorities underpinning delivery of PSA Delivery Agreement 4: Promote world class science and innovation in the UK are as follows:

- World-class research at the UK’s strongest centers of excellence and sustainable and financially robust universities and research institutes across the UK,
- Greater responsiveness of the publicly-funded research base to the needs of the economy and public services,
- Increased business investment in R&D and increased business engagement with the UK science base for ideas and talent: The ten-year Science and Innovation Investment Framework set out the Government’s overall ambition to raise investment in R&D to 2.5 percent of GDP by 2014, with business investment in R&D increasing from 1.25 percent of GDP towards a goal of 1.7 percent. However, business engagement with the research base is just as important in non-R&D intensive sectors,
- a strong supply of scientists, engineers, and technologists,
- Confidence and increased awareness across UK society in scientific research and its innovative applications,

---

1 In addition to PSA 4, DIUS is leading on PSA 2: Improve the skills of the population, on the way to ensuring a world-class skills base by 2020.

2 Of the 30 categories of PSAs, DIUS takes the lead on two, and contributes to 22 others.

- Improving the use and management of science and innovation across Government: Government departments fund some £4.2 billion of R&D outside the science budget to support their policy and delivery objectives.

These indicators for monitoring the progress of the PSA comprise some of the indicators for "Economic Impacts of Investment in Research & Innovation" in the Science and Innovation Investment Framework 2004–14. Their recent status is given in the report "Science & Innovation Investment Framework: Economic Impacts of Investment in Research & Innovation."

In order to support the achievement of the PSA's goals, each department sets departmental strategic objectives (DSOs), which are detailed and strategic frameworks for work to be carried out by the next Comprehensive Spending Review in 2011. Combined with indicators for these DSOs, not only indicators for the two PSAs on which DIUS leads (these indicators are essential to DSOs), they make monitoring of progress possible.

Overview of Organizations related to Science and Technology

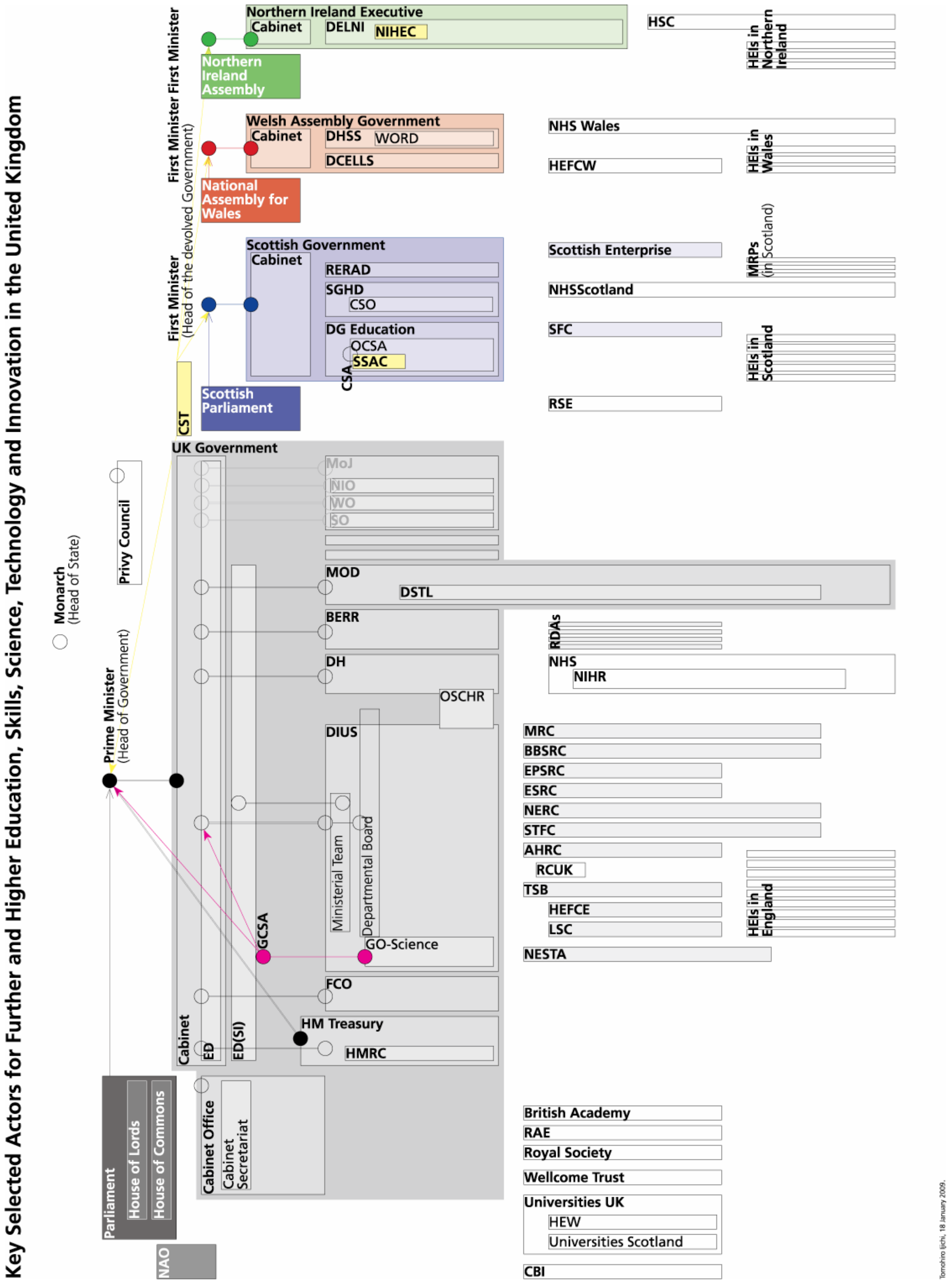
With devolution in the UK, the UK Government retains authority over policies that affect the entire country, while the governments of Scotland, Wales, and Northern Ireland have authority over policies that have been devolved to each country (note: in such cases, the UK Government has authority for England). Policy formation and implementation organizations also adhere to this structure. Not only government organizations, but higher education institutions and organizations representing research communities follow the same pattern, with some addressing the UK as a whole, and some only one country.

Outside the Cabinet, the National Economic Council (NEC) is an institution that exists at a high enough level to undertake coordination among ministers regarding science, technology, and innovation. The Prime Minister chairs the Council, which comprises Cabinet Ministers and a few junior ministers. It includes the Minister for Science and Innovation as well as the Secretary of State for Innovation, Universities and Skills. The Ministerial Committee on Economic Development (ED) is a body comprised of ministers who focus particularly on science, technology, and innovation.

ED has a Sub-Committee on Science and Innovation (ED(SI)). The Minister for Science and Innovation chairs ED(SI), which is composed of junior ministers from relevant departments.

Another characteristic of the UK is the presence of a Government Chief Scientific Adviser (GCSA), who is selected by the Prime Minister from among scientists working in academia to provide the Prime Minister and the Government with advice on important science and technology issues. The GCSA is currently placed within the DIUS, but he or she also heads the Government Office for Science (GO-Science), which works to enable the entire Government to formulate policy and make decisions based on sound science, and to develop and coordinate international issues related to science and innovation for the Government.

Figure 4: Key selected actors for further and higher education, skills, science, technology and innovation in the United Kingdom



Source: Professor Tomohiro Ijichi, based on analysis of various sources.

(5) Federal Republic of Germany (Germany)

Current Situation in Germany

The current administrative structure in Germany was formed in light of lessons learned from its experiences in World War II. Regarding science and technology policy, a distance is maintained between science and politics, so that government will not misuse science. Careful frameworks are in place to make it difficult for the federal government's desires to be reflected in research. Furthermore, multifaceted decentralization measures are in place to prevent too much power from concentrating in the federal government. For example, research support is provided by both the federal government and state governments. This way of thinking is not necessarily always officially acknowledged, but the design of the political system clearly bears it in mind. This carefully designed system based on history can sometimes be a hindrance when it comes to reacting to rapid changes in world conditions.

Germany is one of the world's leading trading nations[1]. That status is supported by R&D and the production of knowledge-intensive goods. Even though the German economy is performing well in terms of innovation, it trails the USA and Japan from the perspective of maintaining and developing innovation. This is because of the poor education system, a shortage of high-quality labor, falling behind in some high-tech fields, and a lack of adequate support for entrepreneurial businesses and small and medium companies. Reasons also include a lack of desire to perform R&D investment on the part of small businesses (because of a dearth of tax incentives), and lack of efficient technology transfer between academia and industry[2]. Moreover, Germany has struggled with a high unemployment rate (2005: 11.1 percent, 2006: 10.3 percent, 2007: 8.6 percent)[3] since its reunification in 1990.

In addition, Germany is surrounded by nine other countries in the center of Europe, and has a small coastline. Under these conditions, the country faced environmental problems such as air pollution, acid rain, and waste disposal; facing this situation, Germany quickly took steps to protect the environment, in the process becoming an advanced environmental country. Germany has regulated environmental protection since the early 1970s. Corporations are pressured to undertake environmental protection in a unique social market economy in which efforts are made to unite the environment and the economy to stabilize society[4]. Germany is therefore proud that among its leading technologies, its environmental technology leads the world.

Current State of Science and Technology in Germany

Looking at INNO-Policy and OECD analysis, the state of science and technology in Germany

[1] According to customs statistics for 2008 released by China Customs on January 13, 2009, China's trade surplus was 295.5 billion dollars (about 26.5 trillion yen), moving it ahead of Germany. With exports worth 1.4285 trillion dollars, it may have moved ahead of Germany, the 2007 leader, in that area as well.
[2] INNO-Policy TrendChart-Policy Trends and Appraisal Report Germany 2008
[3] From Statistics Bureau, Ministry of Internal Affairs and Communications, "World Statistics 2009"
[4] From "Germany: An Advanced Environmental Nation, Revised Edition," German Consulate General Osaka-Kobe and German Chamber of Commerce and Industry in Japan

is as follows[1]:

Germany has traditionally been one of the OECD's top performers in science, technology and innovation.

The European Innovation Scoreboard (EIS) supports this assessment. In 2007, Germany ranked seventh globally, and fourth within the EU-27.

It has a large and growing share in total OECD high- and medium-high-technology exports, and is the fourth most intensive patent producer in the OECD area (adjusted for population). In-house product innovation is high and many firms also perform non-technological innovation. Germany shows particular strength in environmental science – almost one-quarter of environmental technology patent applications to the European Patent Office, and almost one-fifth of the technologies sold worldwide in the sector, originate in Germany.

In Germany, R&D investment accounted for 2.5% of GDP in 2006, or 58.9 billion euro, which ranked 1st within EC major countries.

Germany has large scale and first class research institutes such as MPG and FhG, and world class enterprises related to chemistry and medicine. Germany is maintaining a highly-competitive national innovation system.

However, its productivity performance has been slipping against the leading OECD countries. Extracting greater benefits from existing innovation capabilities will be essential to boost productivity and maintain high living standards.

Therefore, Germany has tried to strengthen applied research and the industry-university cooperation, and made enhancements in personnel training and venture promotion plans. Further, it has made a concentrated effort to strengthen basic research.

The specialization of the German innovation system in medium-tech areas results in a comparably high 'efficiency' of innovation activities. This high efficiency is mainly driven by sectors such as machinery, automotive, electrical engineering and chemicals. Germany aims to reach the EU Lisbon Strategy target of 3% of GDP invested in R&D by 2010, and in 2006, gross domestic expenditure on R&D (GERD) reached 2.5% of GDP.

Gross Domestic Expenditures on Research and Development (GERD) of the business sector is 1.8%, which accounts for 70% of Germany's total GERD. On the other hand GERD of the higher education sector is 0.4%, which accounts for only 16.3% of total GERD.

This trend appears to be similar in other major EC countries.

In 2002-04, 4.4% of small and medium-sized enterprises (SMEs) and 22.4% of large firms collaborated with higher education on innovation.

However Germany has had difficulties for start-ups and small- to medium-sized enterprises (SMEs) in finding sufficient funding for innovation especially venture capital (VC), a decreasing propensity to perform R&D among small firms, and a means of technology transfer between science and business that is perhaps not as effective as it could be.

---

1 From INNO-Policy Trendchart - Policy Trends and Appraisal Report Germany 2008, and OECD Science, Technology and Industry Outlook 2008.

The tertiary graduation rate is among the lowest in the OECD area, potentially narrowing the skills base for innovative activities. Compared to similar OECD countries, the number of R&D personnel and researchers has grown very slowly.

Overview of Science, Technology, and Innovation Policy

Germany has implemented various innovation promotion policies: the "Pact for Research and Innovation" (June 2005) and "The Six-Billion Euro Program" (January 2006) were followed by the federal government's "High-Tech Strategy," which began in 2006. This national strategy links all government agencies and establishes 17 "future fields," aiming to turn ideas from basic research into highly marketable products, services, and processes as quickly as possible.

In addition, in February 2008 the federal government launched an "internationalization strategy" designed to attract foreign researchers, students, and investors through a strong focus on R&D.

In higher education, German universities' are lagging in comparison to universities in the USA and other European countries. Germany needs measures to introduce technology and innovation into its educational system, in order to make up ground. The key to developing the university sector has been the federal government's "Excellence Initiative," through which Germany provides project funding to graduate schools and "Excellence Clusters" in order to support advanced research at universities. Furthermore, in order to clear up systemic issues regarding the authority of the federal government and state governments over education, the federal government and the state governments concluded the Higher Education Pact 2020. Through this and other similar policies, Germany is addressing higher education issues[1].

Overview of Organizations related to Science and Technology

Germany rejects centralization in favor of decentralization in its policymaking. It recognizes the need to strategically set comprehensive policies, so some means of overall coordination are appearing.

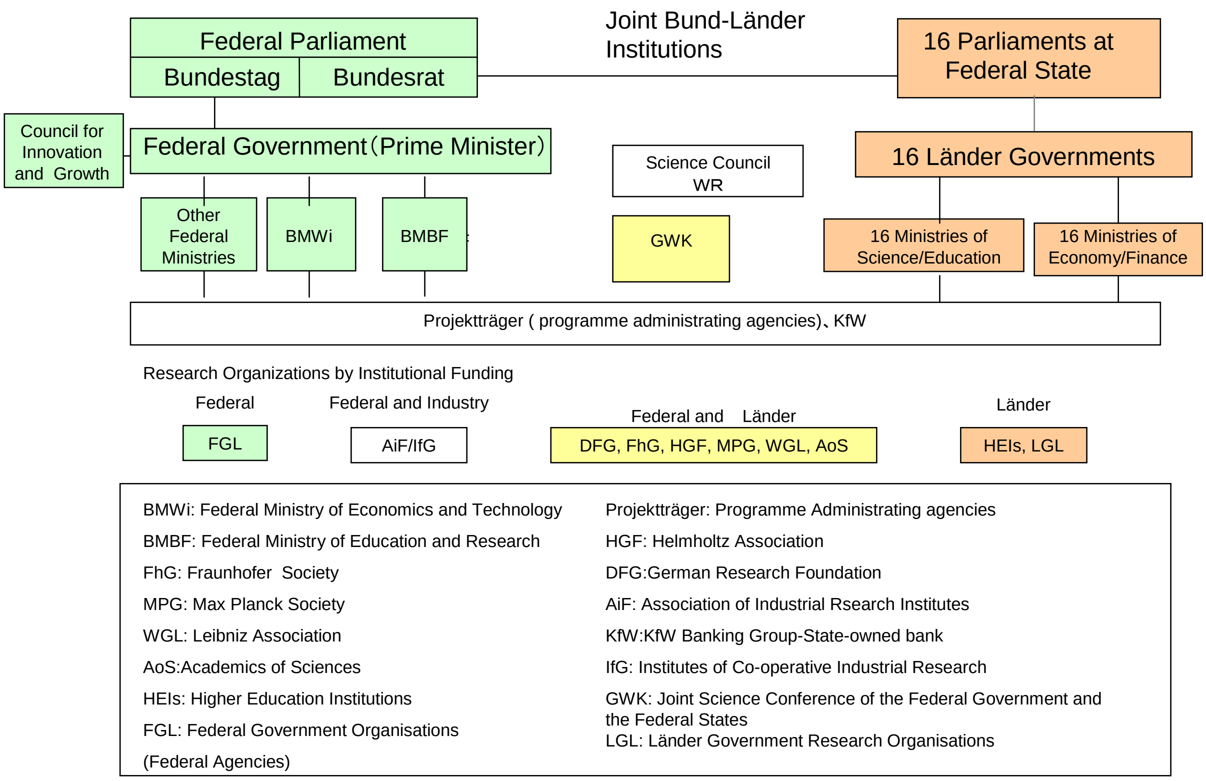
Recently, comprehensive policies have been set based on the recommendations of the Science Council (WR), especially by the Federal Ministry of Education and Research (BMBF). The BMBF and ministries with other missions are closely engaged on a policy coordination level.

The Joint Science Conference (GWK) coordinates matters between the federal government and state governments.

Although the Council for Innovation and Growth was established in 2006 as an advisory organ, it has not had an obvious influence on other related institutions. In other words, because the systemization of government organizations is so advanced, it is difficult to initiate changes on the organizational level, much less the policy level.

[1] From OECD STI Outlook 2008

Figure 5: Organizations within the German innovation governance system



Source: Based on original materials of the Centre for European Economic Research (ZEW).

(6) French Republic (France)

Basic Information on the French Political System

In the Fifth Republic (which is the current republican constitution introduced in 1958), France's political system combines a presidential system and a parliamentary system. The President has authority over foreign policy and national defense, while the Government (Cabinet) handles other matters based on the Prime Minister's proposals. When the President and the Prime Minister are from opposing parties (cohabitation), their roles are divided such that the President appears very little in everyday political affairs. When considering civilian science and technology policy as a whole, France may therefore safely be regarded as having a parliamentary system[1]. During the first half of 2007, French science and technology policy operated under such a system. On May 16, 2007, however, Nicolas Sarkozy was elected President. Since then, that division of roles has undergone a substantial change.

During the presidential election, Mr. Sarkozy promised to achieve a 30-year "gap strategy" and create a new model for France. He clearly indicated that in his administration, he would take the lead in deciding all policies, and that he would bear final responsibility for them. The mechanism for this is the General Review of Public Policies (RGPP) process. The RGPP process clarifies a series of procedures for large-scale administrative reforms, and the content of the reforms. It established an audit team to comprehensively expose issues, and a follow-up committee (comité de suivi) to create proposals. In addition, it proposes and implements concrete proposals for various ministries, through decisions by a Policy Modernization Council. Further, in order to achieve reform, it is necessary to create functional tracking methods and a professional follow-up system. In light of this problem, a number of schemes are used to carefully follow the progress of reform. In the area of science and technology related policy, France is to establish its first national research and innovation strategy during 2009. To ensure maximum conformity to and integration with the reform process, the presidential advisory organ, the High Council for Science and Technology (HCST), carries out the final stages of debate and Cabinet resolution.

In addition, the French budget setting process was substantially changed with the full adoption of the Constitutional Bylaw on Budget Acts (LOLF) in 2006. It is an ambitious attempt to introduce the concept of performance into the national government administration. It strengthens the authority of the National Assembly over the budget compilation process, and shifts the budget mechanism from the conventional listing of items of expenditure to articulation of missions and programs. The effects are eagerly awaited.

Current Status of French Science and Technology

In the Academic Ranking of World Universities, which rated the world's top 500 institutions of higher learning in 2003, France had only three institutions. Subsequently, a similar pattern emerged in another ranking (Leyde, Times Higher Education), indicating that French institutions of higher education and

[1] Ijichi, Tomohiro (1998) "Survey on strategic promotion of science and technology - 1) Survey of trends in science and technology policy formation and implementation in major countries, France, Policy Science Research Institute, March 1998, p. 109.

research suffer from poor international recognition. It was felt that French systems should be brought more in line with the world's standard models for science and technology systems.

The so-called European paradox of tending to be strong in basic research and weak in applied research fits France. In particular, the country lacks adequate mechanisms to link basic science with applications that can contribute to economic development. France's weak points are as follows: French corporations show little interest in R&D, few of the best students of the Grandes Écoles are interested in obtaining doctorates or doing research, and scientists at French research institutions have little enthusiasm for applied science or technological development.

In OECD's analysis, the state of the science and technology of France is as follows[1]:

> *France's strengths in areas such as nuclear energy, aerospace and transport are renowned. However, innovation performance, as measured by various indicators, has declined in recent years. R&D expenditures slowed from 2.3% of GDP in 1995 to 2.1% in 2006, behind Germany (2.5%) but just ahead of the United Kingdom (1.8%).*
> *Until the mid-2000s, France lagged its main competitors in expanding fields such as biotechnology and nanotechnology.*
> *As in many EU countries, the public sector accounts for a large share of R&D expenditure. Growth in business R&D has been slow.*
>
> *France accounted for 4.5% of world patents in 2005 and triadic patents per capita are close to the OECD average. While patenting by universities has increased, commercialization of research results remains weak.*
> *The rate of new firm creation has improved, supported by initiatives such as the Young Innovative Company, but few new firms experience sustained growth. The venture capital market is small and less oriented towards early-stage investments than that of the United Kingdom.*
>
> *French firms lag in the number of product innovations developed in-house, notably in manufacturing, where innovation is crucial to export competitiveness. Indeed, between 1996 and 2005, France's share of medium-, medium-high- and high-technology exports fell to 6.8% of the world total. French firms do somewhat better in process innovation but still rank as average.*

Overview of Science, Technology, and Innovation Policy

Although France's infrastructure related to science, technology, and innovation has made some progress thanks to the 1999 Law No. 99-587 on Innovation and Research, which relaxed regulations to allow publicly employed researchers to start companies and hold outside jobs, the basic framework regulating this sector is still the Law No. 82-610 (Law on the Direction and Programming for Research and Technological

[1] OECD Science, Technology and Industry Outlook 2008

Development). Thus, basic law has seen no major changes in more than 20 years. However, following the adoption of the EU's Lisbon Strategy (March 2000) and a national strike by French researchers during 2003 and 2004, since 2005 France has passed a series of laws, such as the Law No. 2006-450 on Program for Research (April 2006) to reform the research system, and the Law No. 2007-1199 Related to the Freedom and Responsibilities of Universities (August 2007) to reform universities.

One notable point in these reforms, is that the Anglo-American style innovation system is being regarded as the most effective international model. In reforms aimed at creating an international model for a science and technology innovation system, "excellence" is being used as a standard for evaluation and funding allocation. Based on this kind of understanding, the Research Program Law works to shift funding from the conventional block grants, to project-based funding by independent agencies, by establishing independent funding agencies and evaluation agencies. The 2007 Law Related to the Freedom and Responsibilities of Universities, also attempts to reform universities to match the Anglo-American style of independence and responsibility as autonomous bodies. In order to transform universities into major actors in science, technology, and innovation, the reforms greatly strengthen the authority of university presidents, giving universities the freedom to recruit and select human resources, establish education research expenses and employment conditions such as salaries and bonuses for faculty researchers, enter into contracts with corporations, set tuition rates, and adopt entrance examination systems. Universities sign four-year contracts with the national government, and their activities are evaluated every four years at the end of the contract.

Recently the Government began studying the National Research and Innovation Strategy (2009–2012), releasing a draft in March 2009. It is being framed in light of President Sarkozy's view of the problem: "It has been pointed out that we have had no custom of setting out long-term visions for R&D. This has caused defects, in particular, a gap between social needs and public research, as well as weakness in linking French basic science to technology and innovation, which has a negative effect on the nation's economic competitiveness." Utilizing the advantages of a late start, France could analyze other countries' policies, ascertain their results, and incorporate outstanding policies into its own research system, but it has chosen the uniquely French model of the RGPP process described above for setting strategic policy.

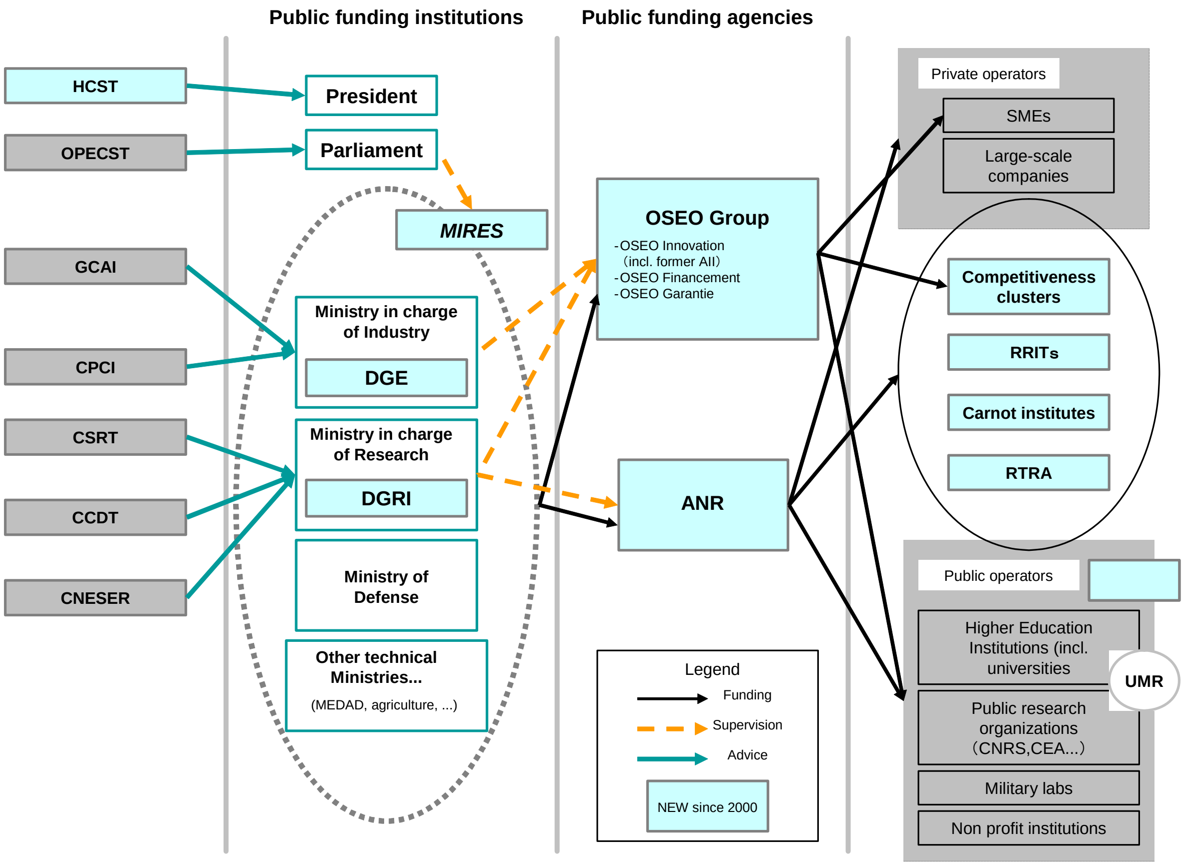
Overview of Organizations Related to Science and Technology

The April 2006 "Research Program Law" established the High Council for Science and Technology (HSCT), with the mission of serving as an advisory body to the President. It provides advice to the President and the Government on the direction of national research, including science research policy, technology transfer, and innovation, in order to assist them with policy formulation. The High Council for Research and Technology (CSRT) serves as an advisory body to the Government on all important decisions related to science and technology policy. It advises the minister in charge of research (currently the Minister of Higher Education and Research) on allocation of the civil R&D budget, the annual report on research and technological development submitted to the National Assembly, reports on items to include projections and analyses of science and technology, and reform projects related to research organizations.

At the ministry level, the ministerial portfolio for "research" has been made more independent, as there are now two ministries: the Ministry of National Education, and the Ministry of Higher Education and Research, rather than one Ministry of Higher Education, National Education, and Research. The assignment of a minister to each ministry indicates the importance attached to higher education and research during the reorganization of the Cabinet. On March 16, 2009, the Ministry of Higher Education and Research was reorganized by a decree. The former Directorate General for Higher Education became the Directorate General for Higher Education and Vocational Assimilation[1]. For matters that span both higher education and research, the Directorate General for Research and Innovation, and the Directorate General for Higher Education and Vocational Assimilation, jointly oversee three services: Service of Strategic Coordination and Territories Service of Large Real Estate Projects and Sub-Directorate of Information Systems and Statistical Studies.

Historically, France had no funding agencies, but the National Research Agency (ANR), established in 2005, plays a similar function.

Figure 6: Structure of the research system in France



Source: ERAWATCH Research Inventory Report for France

[1] The term "insertion professionnelle," when used as part of the Directorate General's French name, includes the concept of training young people in order to provide them with specialized knowledge. Once they have reached a certain level, it calls for placing them into specialized work, helping them to be assimilated into the workforce. This report emphasizes this nuance, and therefore translates the term as "vocational assimilation."

(7) People's Republic of China (China)

Current Situation in China

Although it has developed polices of "reform and openness," China remains a socialist state. This means leadership by the Communist Party, a planned economy, and, regarding science and technology, administration by the Academy of Sciences and industry-specific groups. On the other hand, this "reform and openness" has given remarkable vigor to corporate activity, even though it must coexist within a mandated regulatory framework. Throughout its drive to increase economic strength, attempts both official and unofficial to break down this regulatory framework have been apparent.

Currently, China is in the midst of its 11th Five-Year Plan (which is usually abbreviated "eleven-five plan"), which began in 2006. The "973 Plan," which aimed to promote basic research, and the "863 Plan," which is related to the development of advanced technology, were developed in accordance with the framework of the 11th Five-Year Plan. The highest-level framework for science and technology is the 15-year National Medium- and Long-Term Program for Scientific and Technological Development, which began in 2006. Over 1,000 core experts gathered the wisdom of nearly 20,000 people over the course of three years to create this plan.

China's policy system is layered, from top to bottom in the following way: "slogans that specify national goals," "comprehensive medium- and long-term plans," "individual five-year plans," "implementation systems," and "individual projects." The form of a "10th Five-Year Plan," is the quintessence of a planned economy; but under its guidance, formerly public organizations have become vibrant independent corporations. The detailed frameworks of these national plans, have become estranged from the nation's *real* vitality. Because the old planned economy system is no longer dominant, the "11th Five-Year Plan" is not a "plan" in the sense of detailed commands from the state; rather, it is format emphasizing achievable goals based on projections. Moreover, important items in the 15-year plan are in the form of guidelines.

The highest political decision-making body is the Politburo Standing Committee of the Central Committee of the Communist Party. It states major principles and policy frameworks such as national goals and slogans. The State Council's National Development and Reform Commission formulates medium- and long-term plans as concrete policy frameworks. The plans are reported to the Central Committee of the Communist Party and the Political Consultative Conference. After approval by the National People's Congress, they enter the administrative process. During the administrative process, the state-sector (the equivalent of ministries and agencies) leads the way in setting forth details of the comprehensive medium- and long-term plans. The plans are finally implemented after approval by the Standing Committee of the State Council.

China's President is also the Communist Party Secretary General and Chairman of the Central Military Commission. The Vice President is the Secretary of the Secretariat of the Central Committee. In addition to the President and the Vice President, the Standing Committee of the Politburo of the Central Committee of the Communist Party is made up of the Premier and Vice Premier of the State Council, the Speaker of the National People's Congress, the Chairman of the Political Consultative Conference, and three other high-level party Secretaries. China's policymaking mechanism is characterized by a coordinating function that works through the human networks created by people holding positions in multiple organizations. The Standing Committee of the Politburo of the Central Committee of the Communist Party is at the core of this system. There are party posts at every level of administrative body and national organ. Each organization is held to an administrative framework that runs through the pervasive party organization. The Standing Committee is at the pinnacle of this system.

As exemplified in the expression “three-academy review,” advice on important matters is provided according to content by one of three academies: the Chinese Academy of Social Sciences, the Chinese Academy of Sciences, and the Chinese Academy of Engineering. Generally, the Chinese Academy of Sciences provides support during science and technology policy formulation by the Ministry of Science and Technology.

Chinese science and technology policy is set and enhanced with related policy fields in a systematic and integrated way through human-mediated mechanisms under this administrative framework. In addition, there is a cultural background underlying this that provides unique logic and concepts[1].

Current Status of Chinese Science and Technology

China’s economic development, centered on manufacturing industries, is remarkable. The 1992 “Southern Tour” confirmed that China’s path of “reform and openness” is permanent, spurring an inflow of foreign capital. In the 16 years since then, China’s GDP grew more than ten-fold[2].

However, China remains dependent on coal for energy, from which it obtains about 70 percent of its power. On the other hand, during 2007 the nation had 11 nuclear power facilities in operation, and another 18 are under construction. Seventeen more are planned under the 11th Five-Year Plan. Connecting them with military technology, China has long carried out advanced development of some aspects of nuclear power and space technologies. It has succeeded with manned space flight.

In terms of quality, it will still take time for China to become a great power in terms of science and technology, but in terms of quantity, because economic development continues to spread through the nation, China’s vitality bears watching.

In OECD’s analysis, the state of the science and technology of China is as follows[3]:

> *China’s R&D intensity reached 1.42% of GDP in 2006, thanks to a rapid, decade-long increase in R&D expenditure. The government intends to have R&D intensity reach 2% by 2010.*
>
> *On the other hand, the overall level of tertiary attainment is still quite low, even by developing country standards, and the number of researchers per 1 000 total employment is very low, at about one-tenth of the level of Finland, the world leader.*
>
> *Production of triadic patent families and scientific articles is still very low on a per*

[1] For example, development in the above-described policies is called “plans,” “guidelines,” “specialized-big,” “major,” and “important,” based on separation of concepts in accordance with the Chinese language. Related logical structure depends on this in ways unique to the language.

[2] Susumu Yabuki, “Diagram of the medium- and long-term outlook for the Chinese economy” (August 2008)

[3] From OECD Science, Technology and Industry Outlook 2008

capita basis. Foreign inventors own a large share of invention patents granted in China, and foreign-owned firms account for an increasing share of high-technology exports. In absolute numbers, however, China entered the top 15 for triadic patent families in 2005.

Only a small share of gross domestic expenditure on R&D is funded from abroad. However, motivated by the availability of quality HRST and a large domestic market, inflows of foreign R&D investment have increased strongly in the past years, and funding from foreign firms based in China and abroad is estimated to account for 25% of business enterprise R&D. This is set to continue, as multinational firms consider China a prime destination for future R&D investment.

While foreign ownership of Chinese inventions held abroad is still at 47%, it has decreased from 55% in the early 1990s, owing in part to a marked increase in domestic patenting activity.

The Medium and Long-term S&T Strategic Plan (2006-20) provides a blueprint for further developing China's innovation capacity and for becoming an innovation-oriented country by 2020. However, achieving these strategic objectives requires not only high investment in R&D, but also overcoming the weaknesses in the innovation system and improving government innovation policies and instruments. A priority is to improve the framework conditions for innovation, particularly with respect to the environment, the infrastructure for financing R&D, entrepreneurship and small and medium-sized enterprises, corporate governance, and the protection of intellectual property rights.

Overview of Chinese Science and Technology Policy

The Five-Year Plan implemented in 2006 is the 11th since the founding of the People's Republic. Since "reform and openness" began, the five-year plans have gradually added market economy mechanisms to the planned economy system. The 11th Plan in particular has moved to position plans and guidelines above commands. It has moved to a format of setting concrete plans, particularly in the parts that correspond to public planning. It specifies plans and guidelines for the national economy and social development, including newly arisen corporate activity.

Regarding science and technology, in 2006 China set forth the National Medium- and Long-Term Program for Scientific and Technological Development, which looks ahead over the coming 15 years. It sets development goals and major policies for the development of science and technology, based on the slogan "autonomous innovation." An overview is shown in (1)–(4) below[1].

[1] http://www.gov.cn/jrzg/2006-02/09/content_183787.htm

(1) Goals for R&D expenditures

Relative to GDP, increase from 1.4 percent in 2006, to at least 2 percent in 2010, and at least 2.5 percent in 2020

(2) Degree of dependence on foreign technology

Less than 30 percent in 2020

(3) Number of patents and number of papers cited

Fifth place in the world in 2020

(4) Policy items

- Creation of technical innovation systems through industry-academia-government collaboration and military-civilian links
- Full tax incentives for intellectual property rights, policy on technical standards, and autonomous innovation
- Expanded government investment in science and technology
- Five strategic "important" areas: energy, water, and environmental protection; manufacturing industries and information industries; biotechnology; aviation, space, and marine technology; basic science and advanced technological research
- Important individual technology themes (economic and social development: 11 important areas and 68 priority themes; major special projects: 16 categories; advanced technology: 8 areas and 27 themes; basic research: 18 themes; major science research plans: 4 themes)

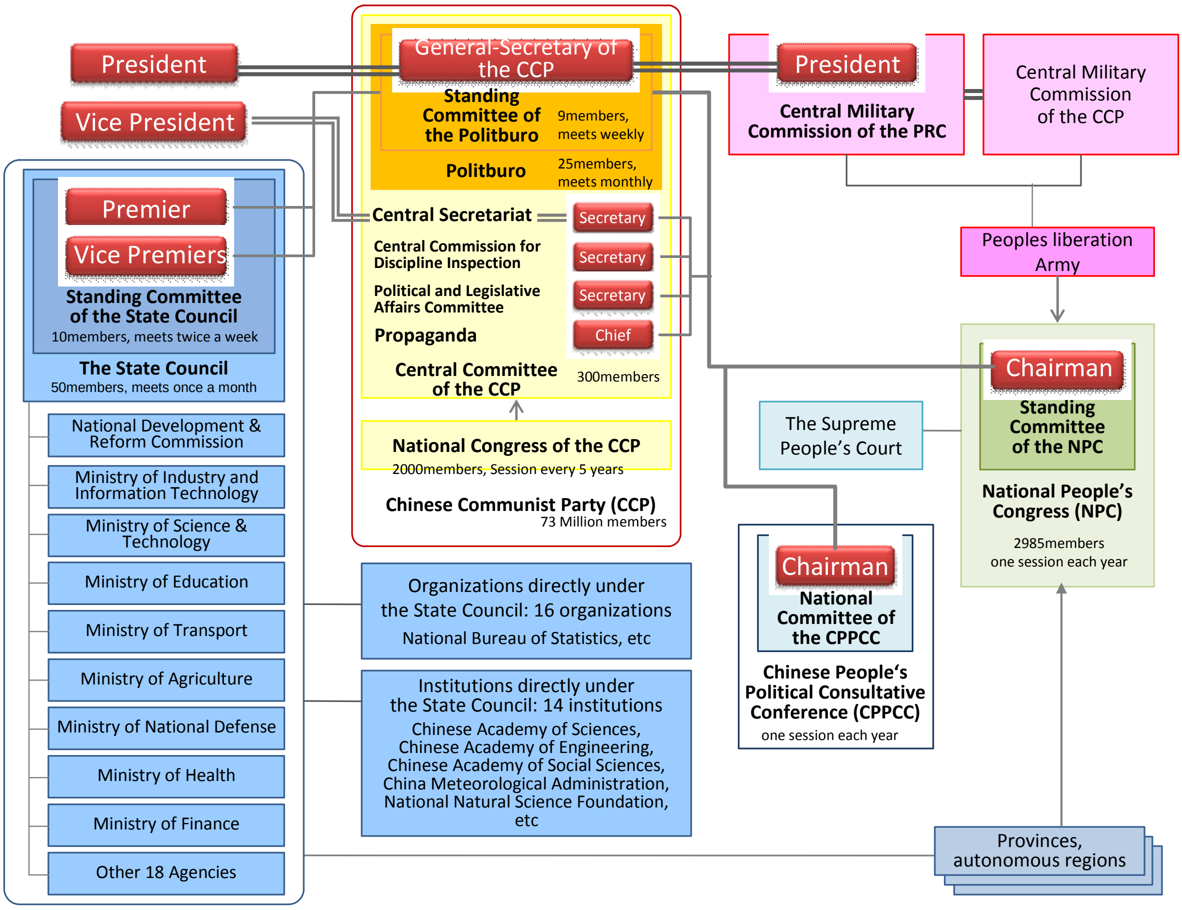
These guidelines were created by the State Council in response to the 16th Communist Party Congress's request for a national long-term development plan for science and technology, from the perspective of building all aspects of a "small prosperity" society, and promoting the acceleration of the construction of socialist modernization.

Overview of Organizations related to Science and Technology

In China, science, technology, and innovation are dealt with as national issues. Looking only at science and technology (S&T) institutions, it is not easy to understand the relationship between S&T issues and national issues.

In practice, political decision making is performed by the Politburo's Standing Committee. The Politburo is comprised of nine standing members and 16 members. The nine standing members are the President (Secretary General), the Vice President (Secretary of the Secretariat of the Central Committee), the Secretary of the Central Commission for Discipline Inspection, the Secretary of the Political and Legislative Affairs Committee, the "propaganda chief" of the Communist Party, the Speaker of the National People's Congress, the Chairman of the People's Political Consultative Conference, and two members of the Standing Committee of the State Council. The two members are the Premier and his heir-apparent, the Vice Premier. The 16 members of the Politburo include people in charge of military, security, and party affairs, and regional Secretaries. Three Vice Premiers and the State Councilor in charge of science, technology, and education are also standing members of the State Council.

Figure 7: China's political administrative organization chart



Source: Professor Ryo Hirasawa, based on the CIA's website.

(8) Republic of Korea (South Korea)

Current Situation in South Korea

Left with almost no infrastructure at the end of the Korean War, South Korea has strongly pursued policies to foster science, technology, and industry, becoming a “miraculously” prosperous country. However, export-based companies which emerged after the Korean War, were dependent on technologies transferred from overseas, while constant labor strife led to increased personnel costs. With its technology base still weak, South Korea fell into a state of excessive competition. Soon after, it rapidly lost export competitiveness, and in 1997 faced a sudden currency crisis.

South Korea has worked to recover over the past 10-plus years, but for the most part an industrial structure, in which there are only a few giant companies and many micro enterprises (sometimes referred to as “big trees and undergrowth”) remains. Korea depends on imports from Japan for capital goods, such as advanced materials, parts, and equipment, because there are not enough medium-sized firms to take over production. South Korea’s trade deficit with Japan during 2008 was projected to be more than 32 billion dollars. The country faces a trade structure issue in which the more it exports to developed nations, the larger its trade deficit with Japan grows. Moreover, in general-purpose goods, which accounts for most of South Korea’s exports, developing nations are overtaking Korea in terms of price competitiveness. Having lost price competitiveness in primary products and light industrial goods, Korea now depends on China in a develop-and-import relationship, leading to a growing trade deficit to China. South Korea is in a difficult position, with its trade structure disparaged as a “sandwich economy”.

To help solve these structural issues, and to rid itself of the direct involvement of the IMF, under President Kim Dae-jung (1998-2003), South Korea passed the Science and Technology Framework Law (1999). Based on this law, the government formulated the Five-Year Science and Technology Plan (1998-2002) and National Technology Road Map[1].

With passage of the 2001 Basic law for Science and Technology, South Korea shifted to a system based on Science and Technology Basic Plans (first plan: 2002–2006). However, because the President’s term of office and the plan’s implementation period did not match, President Roh Moo-hyun (2003-2008) revised the first Basic Plan at the beginning of his term, and it was implemented as the Science and Technology Basic Plan (2003–2007). The Science and Technology Agency was upgraded to a ministry under the Kim Government, and President Roh made the Minister of Science and Technology Deputy Prime Minister. The Roh Government worked to strengthen South Korea’s science and technology through public funding, achieving the goal of making R&D expenditures five percent of the total government budget, and also attempted to improve policy formulation and implementation systems.

President Lee Myung-bak’s campaign focused on stimulating the economy and increasing employment through deregulation, tax cuts, and public works, making government more efficient, and cutting the national budget. The centerpiece of his campaign promises was “the Republic of Korea 747 policy,” which called for seven-percent annual economic growth to create three million jobs over five years, reaching per capita income of 40,000 dollars over the next 10 years, and becoming the world’s seventh-largest economy

1 http://www.unesco.org/science/psd/thm_innov/forums/korea.pdf

within 10 years. In order to achieve these promises, the Lee Government undertook a major reorganization at the ministry level when it took office. Reorganization of subordinate organizations is still underway. Regarding science and technology policy, the Lee Government has emphasized basic research, giving it priority in the R&D-related budget. The Government also aims to reorganize and enhance the R&D implementation system; however, drastic structural reform from the Roh Government has met with resistance, so this aim has not necessarily been met[1].

Current State of Science and Technology in Korea

In OECD's analysis, the situation of science and technology in Korea is as follows[2]:

> *Korea has performed exceptionally well over the past decades. Innovation – with the adoption and adaptation of imported technologies – played an important role in its efforts to catch up with the leading OECD economies. However, to maintain its strong productivity performance and move more towards being a technological leader, Korea must address some challenges.*
> *Korea's development trajectory has shaped its innovation system in important ways. Owing to its chaebol[3]-driven industrialization process, Korea has very large firms and a strong focus on information and communication technologies and automobiles.*
> *In the public sector, universities tend to play a minor role in R&D, as they have historically been teaching institutions. There is little collaboration between small and medium-sized firms (SMEs) and the public sector and relatively few international linkages (e.g. very little cross-border involvement in patenting). As a result, the R&D landscape is dominated by the indigenous private sector.*
> *R&D expenditure has grown rapidly in recent years and Korea is now among the OECD leaders in terms of R&D intensity. Gross domestic expenditure on R&D was over 3.2% of GDP in 2006. The number of researchers is also above the OECD average. Business enterprises account for most of the R&D expenditure, financing 75% and performing 77% in 2006. The dominance of the business sector in R&D, with its natural emphasis on development rather than on basic research, has led the government to increase its spending on R&D and to set targets designed to increase basic research.*
> *Outputs from R&D investment indicate a mixed performance. The number of triadic patent families has grown immensely in the last decade and is now well above the OECD average when adjusted for population.*
> *However, most of the patents are in low-technology industries, and there are questions about low levels of patent exploitation.*
> *The output of scientific articles, while growing, is still well below the OECD average*

[1] From interviews with Mr. Sho Ko-ki (STEPI) and others
[2] From the OECD Science, Technology and Industry Outlook 2008
[3] Otherwise known as "conglomerates"

when adjusted for population (although language may be an issue here). In addition, Korea's services sector accounts for a small share of business R&D and for little in-house product or process innovation. With services now accounting for more than 50% of GDP, improving innovation in services is crucial.

Innovation and creativity have been a policy focus for some time. Various ministries are involved in science, technology and innovation policy, and recent initiatives have attempted to bring greater coherence to the system. For example, the R&D Total Roadmap seeks to set the public research base on a strategic path. Korea is also attempting to broaden the spectrum for future growth by funding biotechnology, nanotechnology and other promising areas.

The key challenge for Korea is to create an innovation system that enables its leading firms to remain at the world technology frontier, while encouraging greater innovation in other sectors of the economy. Continued support for the development of capabilities and research infrastructure in universities and more strenuous efforts to diffuse knowledge from the public to the private sector will be important. It is also essential to ensure that the broader regulatory environment supports innovation.

Overview of South Korean Science and Technology Policy

Based on "The 1999 Long-term Vision for Science and Technology Development toward 2025," set forth under the Kim Government, the Roh Government's "Science and Technology Basic Plan (2003–2007)" separated information and communications from the Ministry of Science and Technology, placing it in its own ministry. Along with upgrading infrastructure for R&D and innovation and setting up South Korea's National Innovation System (NIS), the Government reached its goal of devoting five-percent of expenditures to R&D. Results were seen in the reorganization of *chaebol* (conglomerates) through the united efforts of the Government and the public, and in the creation and dissemination of world-class information and communications' infrastructure. On the other hand, it was pointed out that public research institutions grew bloated and that the shift to basic research went too far.

As indicated in its "747 Policy" campaign promise, the Lee Government shifted to a policy emphasizing economic growth led by science and technology. Upon taking office in February 2008, the Lee Government began working to strengthen presidential power, and to reorganize administrative bodies at the ministry and agency level. At the first meeting of the National Science and Technology Council (May 2008), the Government set forth the following two great national goals and four basic strategies as a framework for the Basic Plan[1]:

[1] National Science and Technology Council website: www.nstc.go.kr

Two great national goals:	Be a great power in human resources, and construction of science
Four basic strategies and plans:	New government national R&D investment strategy, industry R&D for economic stimulus strategy, medium- and long-term strategy to promote healthcare R&D, Second Comprehensive Environmental Technology Development Plan

At the second meeting of the National Science and Technology Council after President Lee's inauguration (August 2008), the "Lee Government's Science and Technology Basic Plan to Make Korea a Leading Advanced Country" was set forth. This science and technology related policy developed under the leadership of President Lee is summarized in "The Second Science and Technology Basic Plan." Its main content is referred to as "the 577 Initiative:"

* 5 percent: Expand total investment in R&D to five-percent of GDP (government 1.25 percent, private sector 3.75 percent) by 2012. In order to accomplish this, expansion of private sector corporate R&D investment must be encouraged. Government R&D investment will expand by 1.5 of its current size.
* 7 R&D areas: backbone industry technology field, new industry creation field, intellectual infrastructure services field, state-led technology field, issue-related special field, global issue field, basic, fundamental, and integrated technology field
* 7 system reform: human resources system, basic research promotion system, small and medium enterprise promotion system, internationalization promotion system, regional technology system, research infrastructure system, S&T and society linkage system

In addition, an overall goal of the Basic Plan is to become one of the world's seven greatest science and technology powers by 2012.

The National Science and Technology Council led by the President, meets four times a year to manage the progress and revise strategic plans and individual policies. Here, independent analysis of policy progress is undertaken, and results are reported. In principle, the National Science and Technology Council handles the setting and evaluation of policies at the program level and above, while ministry and agency funding bodies handle operations at the project level.

South Korean science and technology related policy is developed with unified authority over research, development, and innovation. Policy goals are clearly established, and an evaluation system is incorporated within a structured architecture in which the "Plan, Do, Check, Act" (PDCA) cycle is somehow carried out.

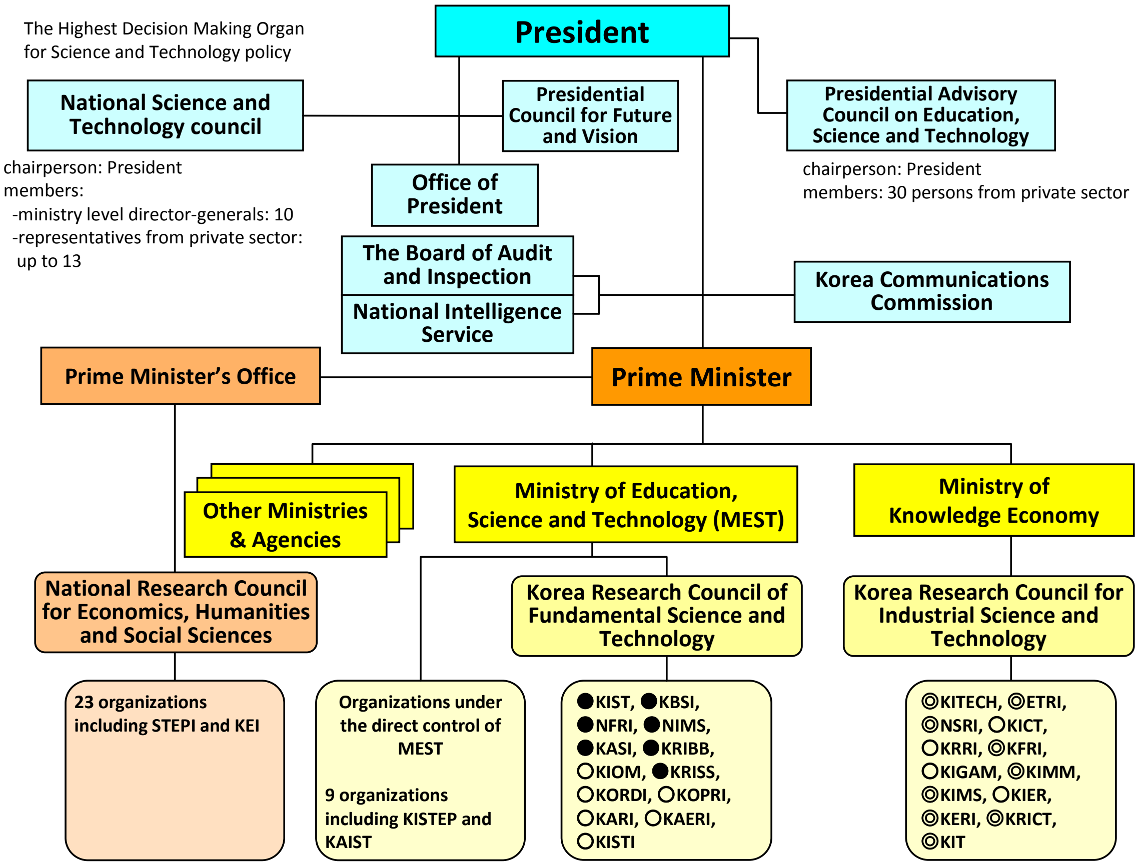
After the Lee Government took office and began its arguably somewhat coercive systemic changes, it lost some momentum. This was in part due to a trade deficit that began with the rise in crude oil prices, sudden contraction of export markets due to the global economic and financial crisis, and a sharp drop in the won (echoing the 1997 currency crisis). However a quick response to this economic crisis has recovered support for the Government. Emergency economic measures intended to secure jobs and expand domestic markets were announced at the January 13, 2009 meeting of the National Science and Technology Council.

Overview of Organizations related to Science and Technology

Science and technology related policy is set in the President's National Science and Technology Council. Urgent reform matters are handled in joint meetings with the Future Planning Commission, which is also attached to the President's office.

The National Science and Technology Council is led by the President. Comprehensive questions are brought up for discussion in expert committees whose members all come from the private sector, and then introduced to the Steering Committee. In the Steering Committee, integration and implementation policies related to matters brought up by government agencies are examined under the leadership of the President's Office. Decisions are made by the National Science and Technology Council.

Figure 8: Organization chart related to the science and technology policy under Lee Myung-bak's administration



NOTE:
● formerly part of the Korea Research Council of Fundamental Science and Technology
◎ formerly part of the Korea Research Council for Industrial Science and Technology
○ formerly part of the Korea Research Council of Public Science and Technology (now defunct)

Source: Professor Ryo Hirasawa, based on hearings with STEPI.