Session 1: Identifying National Innovation Systems—Diversity or Common Challenge?

Chairperson: Prof. Yasunori Baba

Prof. Yasunori Baba: The concept of "national innovation system" is not necessarily a lucky one for the Japanese. In the 1980s and 1990s, Japan had such good industrial performance that I and many other researchers tended to focus all our energies on Japanese innovation systems and industrial systems. We held lots of conferences, primarily on Japanese-style innovation systems. We Japanese understand Japanese innovation systems, but we should also make the same effort to learn from the innovation systems of other countries. Perhaps we have not done that in the past. We have some of the world's top experts in innovation systems with us today, so we can examine the innovation that is taking place in other countries, the factors that facilitated it and perhaps learn things from their research.

Prof. Diana Hicks: Academic discussion of innovation often focuses on stereotypical, canonical examples. Discussion of US innovation often focuses on Silicon Valley, highly mobile employees, networked firms, venture capital, university excellence and university spinoff firms. However, a more systematic approach, which I've taken, reveals that these examples emerge from a broader spectrum of organizations and institutions.

The US is the largest spender on R&D and it also enjoys the largest amount of licensing income. Most alliances are between American and foreign firms. American firms have increased their research expenditures abroad, but foreign companies are spending even more of their research dollars in the US. Both are growing. This can be illustrated by the location of high-technology manufacturing output. All of these indicators combine to remind us that the US has a very strong innovation system that produces results in terms of employment, jobs and economic growth.

What are the institutions and organizations behind this? The first is large multinational firms. Many large multinationals are headquartered in the US. These firms excel in innovation and have the resources to pursue large-scale projects as well as the market share to derive profits from them. They are often very competently run. There is also a vibrant population of highly innovative small firms fostered by the ease of setting up small firms and lack of stigma attached to bankruptcy. There's a strong incentive provided to people who succeed. Small firms, however, are not necessarily innovative. There's also a vibrant university sector. It is an open, challenging environment that attracts the brightest minds from around the world. This fosters intellectual development, high achievement and integrity.

Moving to broader societal structures that support innovation in the US, the US benefits from "adventure consumption" in which people "buy new stuff." This is measured in terms of IT expenditures by GDP and also gross fixed investment/GDP. The US also has a very large and highly competitive market-based economy. This provides a structure for innovation and strong incentives to innovate. Our deep, innovative, risk-taking capital markets provide opportunities for financing and strong incentives for innovation.

Behind all our successes are decades of generous government R&D funding. But there are also vulnerabilities. Several high-level reports have raised alarms, noting that we don't publish as many scientific papers as the EU and our share of the most cited scientific papers is also declining. As other

countries strengthen their systems, there is an effect on US dominance. Even the future of the science and technology workforce is a concern.

The US has a good university system, but the percentage of 24-year-olds achieving science and engineering degrees is far below other countries. We could be training a lot more natural scientists and engineers, and we need to do so in a knowledge-based economy.

There are also worries about the patent system, namely eroding standards of patentability, the proliferation of upstream patents on scientific discoveries, rising costs, differences in national patent systems, and an accelerating pace of technological development. Recommendations include instituting a relatively low-cost procedure to challenge patents, reintegrating the non-obvious standard, shielding some research uses of patented inventions from liability for infringement, and providing budgetary funds for more staff at the patent office.

Prof. Yoko Ishikura: You introduced us the concerns in the U.S., as well as the strengths. What solutions is your group thinking about and/or has actually implemented to alleviate these worries from unique perspective of the national innovation ecosystem ?

Prof. Diana Hicks: The most successful initiatives will be made on the educational side. The No Child Left Behind Act aims to strengthens schools. There is a national competitiveness initiative in the works that emphasizes teacher training, provision of incentives for college graduates to achieve proper science and engineering degrees and then work in schools. These are quite popular in Congress. There is broad support for increasing the budget for physical sciences. There's also legislation coming on the patent system.

Prof. Nathan Rosenberg: You listed "declining indicators as other countries strengthen" as something America should be worried about. Is that really a worry?

Prof. Diana Hicks: It is something that we do worry about. Personally, I think it is unavoidable. Ten years of science and technology policy in Europe and Asia are paying off and strong science is coming out of other places. This should be a celebration at the globalization level, but it is hard for Americans not to be number one.

Dr. Charles W. Wessner: I agree that the investments in science are paying off, but I think that misses the point. Prof. Rosenberg is quite right that the more science there is, the better off we are. The US's premier position should evolve as others contribute. What we're talking about today is how you convert research and scientific papers into products and processes that generate economic wealth. I'm not optimistic about the patent legislation. Small patent lobbies have a very powerful voice in American system. The universities do us a disservice in that they do not work on the commercialization part. The Council on Competitiveness has neglected the small-business community. It is mostly heads of universities and heads of large corporations. The Advanced Technology Program is being disabled and dismantled. In addition, the Department of Defense basic research budget is down.

Prof. Maureen McKelvey: In the case of Sweden, 72% of R&D is funded by companies and 21% by the public sector. The total amount of R&D, however, is small—amounting to only 1% of world expenditures. Sweden has done a lot to stimulate public-private interaction, holding much debate on basic science and mission-oriented research and applied research. The notion is that if you start with scientific research, then innovations emerge.

Sweden is struggling to sustain its social welfare system. In 2004, the government launched a new initiative called Innovative Sweden, which sounds like the Lisbon Strategy. It involves not just

Vinnova but is also promoted by the ministries of education and industry. Innovative Sweden sets big goals for a small country as it aims to make Sweden one of the world's most attractive countries for knowledge-based companies.

In looking to the future, there is need for more debate on two issues. The first is the need to understand better how and why innovation policy has to reach beyond the mandates of government. In Sweden, policy tries to influence stakeholders outside government. The second point relates to the famous statement, "Don't ask what your country can do for you but ask what you can do for your country." What industry does matters to the country but what can the country do that matters for industry? Despite a long history of working with industry, there has been a bit of a chill between government and large multinationals. I think the government needs to think more about this relationship.

The issue is how does public policy reach relevant stakeholders. The Vinnova Report shows a focus on SMEs and is a step away from multinationals. The second emphasis is on improving the supply use and mobility of human resources. In the last decade, there has been a rapid expansion in education. The number of students has increased but not education expenditure.

Another matter for debate is new regimes for user-producer, public-private partnerships. One area here is to stimulate demand for biofuels to dissuade companies such as Volvo and Saab from moving to the US and to Germany and have them change their focus.

Recently a debate has arisen about mission-based research. Another debate concerns university-company collaboration. Although it has not been discussed much in Sweden, from 2001 to 2003 there was a decrease in total R&D for the first time. This primarily reflects Ericsson's decision to cut R&D by 50%.

What are the trends of multinationals in Sweden? A number do not conduct R&D in Sweden because of buyouts overseas. These companies believe they are truly international and are changing R&D models and doing less in-house research while pursuing more interaction.

Finally, I think we need a new view of innovation as a future potential and to focus on training people to think in new ways.

Dr. Charles W. Wessner: I think one exception in new product development is mobile telephones. At the moment, because no one agrees with mission-based R&D, maybe we will end up with too much short-term research to solve known problems. We need more mission-oriented research. Sweden has a two-tiered society. One is very local and the other is very internationalized. The multinational companies do not think of Sweden as their home base.

Prof. Nina Dey Gupta: Could you comment on the influence of population factor?

Prof. Maureen McKelvey: Sweden faces a population problem involving pensions and rising medical costs. From this, there are many related issues and problems. As a society, Sweden has managed better than France and Germany, partly because Sweden is a middle class society. Basically most people are at the same level and therefore Sweden can make some pension and welfare reforms to reduce benefits.

Dr. Ayao Tsuge: It seems to me that Sweden has a good balance of national and global innovation ecosystems. Could you comment on that?

Prof. Maureen McKelvey: I'm afraid Sweden is overlooking the importance of the role of multinationals. I know smaller companies are important but if multinationals are overlooked, what

will become of the country? The issue is what can the country do for the firms? Why live in Sweden? The country must offer a different environment where well-educated people are part of a global of work force while at the same time living in Sweden.

Prof. Xiangdon Chen: China's central planning system has three layers: basic research, sector-specific research institutes that provide research results free of charge to any actors inside the sector, and factories. The national innovation ecosystem cannot rely only on the resources in one country. It has to be a global inter-reliance.

In national and international innovation, alliances are especially important for China. In terms of GDP, China has gone through several stages of growth and economic growth has been very fast since 1992. It was then that investment from Europe and America began to boom. The boom in China's GDP is within the context of foreign investment; it is not a coincidence. Per capita GDP has gone through several stages as well. Foreign capital firms have more reason to come to China and expand their markets.

Between 1978 and 2005, China's international trade increased by 69-fold according to statistical data, and in high-tech industries nearly two-thirds of exports are contributed by foreign capital companies. The output from the system is designed to be built in China but exported to other countries.

Domestic-based endogenous innovation is the result of science and technology spin-offs, university-industry relationships and entrepreneurship in high-tech fields. Government policy focuses on this area. Exogenous innovation plays a very important role in terms of national innovation systems. In China, the main factor is foreign direct investment and its spillover effects. Some scholars consider spillover effects to have a mixture of positive and some negative results. The question revolves around the kind of measurement used to indicate the quality of investments in terms of innovation.

China's policy for national innovation focuses on indigenous innovation together with open systems that provide for international collaboration. Research indicates that innovation happens in networks. However, most Chinese policy has not been related to networks, just to encourage organizations to commercialize. Supplier-customer relationships also relate to ecosystems. Chinese factories and companies are sometime suppliers, sometimes industrial buyers.

China's strengths are its qualified manufacturing base, national support in R&D, human capital in research, active connection with overseas scholars and foreign direct investment-based innovation. Its weaknesses are a vertical transfer of technology into industries, technology and innovation-based networking, R&D industries, entrepreneurship, foreign direct investment and multinational enterprises' technology lock-in effect.

Dr. Hee-Yol Yu: In 2005, Korea spent about US$23 billion dollars on research, just behind that spent by China. The country also has about 234,000 researchers. Some 76% of R&D expenditures came from the private sector, a rate even higher than in Japan. With respect to Korea's national innovation system, so far it has gained an accumulation of innovation experiences through large national programs. Korea has also managed to set up world-class information infrastructure and improve innovation potential through quantitative expansion of research facilities. Korea now has 10,000 private research institutes. The country has also improved its technology import mechanism and developed world-class technology in selected areas.

One weak point is Korea's lack of capability for producing world-level output. In response, the country chose 21 key technologies in the Korea Future Strategy Technology 21 program to address this problem. Korea also suffers from a poor diffusion of innovation output and poor interaction

among private firms, the government and universities. Private companies use almost their entire research budget on their own research and do not spend on university research. There is also an imbalance in supply and demand of human resources.

Korea requires a paradigm shift in its national innovation system. In this process, Korea hopes to move from an imitative and modifying-based system to a value creation-based system, and from a stand-alone, closed system to a networked, open system. For this, we have identified five areas of infrastructure innovation, namely, strengthening the creative innovation capacity of playing actors; factor innovation through the efficient allocation of R&D resources for innovation; nurturing cluster innovation centers like Tsukuba in Japan to achieve better diffusion of innovation and creative R&D results over the full cycle; system innovation by planning to establish networks to facilitate industry-academia-research institute interaction and also to create an advanced planning, coordination and evaluation system; and the environment and culture area in which we are launching private led campaigns to spread science culture and widen opinion leaders' understanding of science and technology.

Priority items for Korea's national programs include utilizing the large pool of university R&D personnel, nurturing innovation driven SMEs and ventures, and promoting commercialization of technological innovation outputs. All these initiatives will take place amidst institutional reforms.

In order to coordinate the various policies, the Office of Science and Technology Innovation (OSTI) has been granted presidential discretion to screen the budgets of the various ministries. In doing so, each Ministry first sends its R&D programs to the Korea Institute of Science & Technology Evaluation Planning (KISTEP), which is a think tank for OSTI and the NSTC, where the programs are put into a database and evaluated using experts. Based on these evaluations, the government allocates the budget and can coordinate all R&D programs in Korea.

Challenging issues remain in Korea. The country has an unprecedented system and therefore it will take time to take root. The process will also involve much trial and error. Another issue is that most innovation initiatives in Korea are focused on Seoul. We need to spread innovation across regions in order to vitalize regional R&D. Korea is also facing a decrease in the R&D contributions to economic growth. The challenge, therefore, is to strengthen planning and evaluation. Another issue for Korea is that only 23% of R&D is on basic science. We wish to increase the proportion of R&D on basic science but politicians and business favor applied research. Finally, R&D requires a stable supply of high quality human resources. It is projected that the human resources shortage in Korea will continue until 2015.

Floor: My question concerns the reorganization of science and technology management including OSTI. How does academia assess this reorganization?

Dr. Hee-Yol Yu: It is too early to evaluate because next month marks just two years since the reorganization. We are proceeding by trial and error and are gradually correcting problems. But it is too early to say whether we are successful. Nevertheless, many academics have shown a positive attitude and the press has given us very good marks. They have been very positive.

Prof. Nathan Rosenberg: Concerning the contribution of R&D to economic growth, how did you reach those numbers? What were the inputs?

Dr. Hee-Yol Yu: We have used American methodology, usually total factor productivity theory.

Prof. Yoko Ishikura: When I look at Korea I am always amazed at its pace of change. Many other countries take a long time to make change happen. Why is it so quick in Korea?

Dr. Hee-Yol Yu: My personal view is it that it is due to the presidential system. The president is very strong. If he agrees, then the attitude is "why not?".

Dr. Toshiaki Ikoma: In OSTI how many people specialize in science and technology innovation? The reason I ask is because we are short of innovation specialists here in Japan.

Dr. Hee-Yol Yu: OSTI has 170 people. We are increasing the number next year. Most (70% or 80%) specialize in innovation.

Prof. Diana Hicks: I have a question about metrics. You mentioned start up problems with your self evaluation. Did you have any metrics?

Dr. Hee-Yol Yu: We gave good guidelines and have trained the ministries. However, Korea is a patron-based society so ministries sometimes use a subjective system and give proposed programs high marks. We need to correct them and deter the use of this patron-based system.

Dr. Ca Ngoc Tran: Vietnam's science and technology system is undergoing a transformation, having set its priorities and orientation similar to other countries: ICT, biotech, automation, advanced materials, new energy, mechanical engineering, environmental technology.

Obstacles in conducting innovation are a lack of technology information, lack of skill in evaluating technology, lack of knowledge to select appropriate forms of technology acquisition, lack of experience in the negotiation of technology transfer agreements, difficultly in accessing capital and intellectual property rights.

Vietnam's strategy is to build up and maintain a system of science and technology personnel and to set up a system of support organizations. There are now 19 key laboratories and two high-tech parks in the country. Vietnam has more research capability in the north while the hub of economic activity is in the south. There are generation gaps in age and desires/capabilities with fewer people going into research. Research quality is also poor, tends to be theoretical and not connected to the needs of the productive sector.

In networking, there is lack of cooperation, trust and good will. Vietnam has a weak technology market. Corporate culture norms and rules are lacking. This prevents the provision of new institutions. In incubating, there is no incentive for small and medium enterprises. This is not a common and fully developed concept in Vietnam. There is no venture capital or business angel in Vietnam; banks are unhelpful for innovation. The stock market is in its infancy.

Vietnam has several new issues to address. There is the question of achieving long-term goals for modernization versus the immediate need for poverty-reduction. Likewise, there are trade-offs between industrialization and agro-based rural development. International integration must also be weighed against the interests of domestic productive enterprises.

To further the lead innovation functions, one government decree is to turn R&D into a firm-type operation (Decree 115). The country also needs to work more closely with foreign partners, promote networking, conduct training and advance cooperation. Vietnam is working with the World Bank and a group from Princeton on the millennium science initiative to create centers of excellence in key areas.

I believe that for many countries, but especially for developing countries, agriculture is still important for innovation. This is especially the case for global sustainability. We also need to pay more attention to small and medium enterprises, not only in the poor and developing world, but in large countries like the US and Japan.

Floor: Entrepreneurship and technology innovation require rule of law, property rights, capital institutions, and social networks so that entrepreneurs can access scarce resources like finance. What is your view about entrepreneurship in Vietnam?

Dr. Ca Ngoc Tran: Since Vietnam started its reforms in the mid 1980s, growth has been booming and new companies have been mushrooming. There is the feeling that we had been left behind in many senses. Because of that, everyone wants to catch up. The government has done a lot in introducing new laws that give our economy more space for private entrepreneurship to grow.

Prof. Kazuo Ueta: With respect to the trade-off between economic growth and environmental sustainability, we need to understand the process of technological change first because of the environmental impact caused by the rate of change. New technology may also create improvements to environmental problems. Technological innovation may create new incentives. Science and technology for sustainability is a difficult issue to deal with on a common basis.

Most people agree that current development patterns are not viable from both an environmental and ultimately economic viewpoint. How, therefore, do we maintain a sustainable society and how do we innovate? Although we need technological innovation there could be a trade-off between environmentally friendly technology and the current socio-economic system. The Japanese experience suggests that innovation can help ease the adverse effects of some trade-offs posed by existing technology.

An OECD report from 1977 points out that technology should not constrain policy choices; rather, it should be the other way around. There are two strands of thought concerning the determinants innovation. One is the induced approach. The other is the evolutionary innovation approach. The induced approach is based on the conventional view of innovation as a profit-oriented activity. If we take the evolutionary view, firms' behavior has a greater scope of consequences. According to the evolutionary view, an external shock such as regulation can stimulate innovation and so regulation is not necessarily a constraint. The new way may be more profitable than the old way. This is Porter's win-win hypothesis.

We should be careful about big changes in the structure of environmental governance. Multi-level environmental governance is critical in dealing with such issues as climate change. We become more interdependent as each country responds to the challenges in each country. Here it is critical to coordinate regional with international approaches.

There is also the role of stakeholders. Due to corporate social responsibility, some countries are voluntarily undertaking environmental activities. It is not only the market and the government sector that are important but also social pressure and the interrelationship between the three. We should at least consider how to integrate science and technology innovation with environmental policy for sustainable development.