Wrap-up Session: How Can We Collaborate to Promote Science-Based Innovation for a Sustainable Globe?

Chairperson: Dr. Toshiaki Ikoma

(Reports from previous 4 sessions)

Prof. Masaru Yarime: The theme of the Session 1 discussion was national innovation systems. The session heard about the US, Chinese, Korean, and Vietnamese innovation systems, highlighting in particular their strengths and weaknesses. Among the issues identified in the session were the diversity of national innovation systems reflecting historical conditions and specificities, convergence to a global innovation ecosystem, and the integration of science and technology policy as well as environmental policy for sustainable society.

Dr. Masahiro Kuroda: The theme of Session 2 was capitalization of science to socioeconomic values: roles of players. Science and technology will be very important in the 21st century. We need a commitment to "science for peace," "science for sustainable development" and "science in society and science for society." Innovation is a key driver of economic growth. Analysts described the specific problems in national innovation systems. We heard from the point of view of international organizations about the global innovation and Japanese innovation systems. We also heard from the private sector about having both managers and investors think on the same "timeline." There are serious problems in the capital markets because of the differences in the timelines of investors and managers.

In the second round of the panel, we tried to design a framework for the market and for competition and collaboration as a global innovation ecosystem for sustainable development. Each country has its own national innovation system, and they are often in conflict with the global innovation system. It is important to have international coordination, but the session felt we are at a premature stage.

Prof. Dominique Foray: Session 3 discussed new challenges for the formation and accumulation of human capital in the knowledge economy. In the session, we identified six challenges, namely securing the supply of human capital, equipping workers with new skills, human resource management practices as a productivity driver, equipping people with capabilities to confront constant change, adjusting supply to demand side heterogeneity, and making the education system a truly innovative sector.

Human resource issues are different according to how advanced a country may be and how close it is to the technological frontier. However, there are two things which are generic in human capital policy: investing in human resources; and training and teaching technologies is crucial.

Prof. Itaru Yasui: In Session 4, we discussed the role of researchers in all of the interaction fields and the role of supporting systems. One of the most important points made was that funding should be wide enough and have enough variety. Another point stressed was the importance of learning from nature to expand the horizon of our knowledge. We heard about special institutions for innovation and about the importance of international M&A as a reduction of risk. Effective deployment of venture capital was also emphasized. On the output side, we heard about the function of the directions on the baton zone, the need to physically share space. We agree that innovation is not a linear model but something stochastic.

Among the observations from the session, partnerships between universities and industry are important to create a field to nurture talents and promote innovation through processes required for product development; globalization is effective in innovation, making it necessary to be globally competitive and to accept that investment benefits and control can be dispensed globally; governments are encouraged to invest in the transfer of findings of fundamental sciences to innovations through the development of interaction fields; pro-invention interaction fields by should be championed; and it is important to move to a private innovation approach especially in life sciences.

There's a huge accumulation of knowledge, mostly written in English, so if we would like to have a global innovation ecosystem, we need to move this knowledge not only horizontally but also vertically. How to move factors vertically should be the topic of discussion at the next conference.

(Panel start)

Dr. Toshiaki Ikoma: The challenge for us is to discuss the right elements for a GIES and then discuss regional advantages and disadvantages and how to globally cooperate. Then there is the issue of defining innovation, because it has many meanings. We define it as science-based innovation, the process of converting scientific and technological knowledge into social and economic value. This brings a paradigm shift in science and social systems. How is innovation achieved? This chart was invented by Klein and Rosenberg in 1986 and illustrates the process. Each stage has a feedback loop. This is one basis for innovation.

An ecosystem is a total system that enhances science-based innovation creation. The "eco" represents that the system should process the following characters, in an analogy to a natural ecological system: evolution selection, diversity, symbiosis, interaction among players and stakeholders.

The importance of innovation is knowledge creation and long-term research. It is a proof of concept in the applied interaction fields.

Prof. Kazuhito Hashimoto: You said that innovation could be evaluated in terms of social value and not just economic value. In that sense, we must think about the sustainability of society. Technology and funding should be evaluated from the viewpoint of sustainability of society.

Prof. Dominique Foray: International frameworks and agreement for cooperation are tools to cooperate to solve problems that are increasingly global through innovation. I think this is an input in one sense. It is a way to improve how problems are solved, particularly sustainability-related problems.

Prof. Diana Hicks: I think we should show how the model ties into what I said about the American system. I talked about what America is worried about in relation to its innovation system: vision/policy/strategy. As was pointed out, there is a lot of worry in the scientific community that the government has no vision/policy or strategy. The scientific community has ideas, but they are absent at the political level. In other systems, that is absolutely not the case. It is not often recognized in America just how much other countries have vision for their innovation ecosystem whereas we do not. Human resources in education are another worry at the lower levels. I think you can use this to diagnose the problems in your own system.

Prof. Dominique Foray: It is very important for each country and region to have a clear vision of the next areas of growth to which they want to move. In many countries, public policy has not been very imaginative by overemphasizing new science-based leading edge industries. It results in a

greater uniformity of the national knowledge bases and a degradation of the distinctiveness and originality of national knowledge bases. The big question is how many centers of excellence in biotech or nanotechnology can Europe or Asia afford? Not many. One solution is for individual countries and regions to find key areas for focus. This will create an original knowledge base that can be modernized with new technologies. This condition is extremely important. What is original in my knowledge base and how can I modernize it?

Dr. Toshiaki Ikoma: We shall discuss first vision/policy/strategy for science and technology inovation and then industry-academic collaboration. If we have time we shall also pick up the topic of global ecosystem vs. national systems

Prof. Diana Hicks: Korea seems to have a very strong vision. I would like to hear about the connection with reality.

Dr. Hee-Yol Yu: Actions speak louder than words. Our targets were to reach the G8 countries in science and technology by 2010. We said we would provide ¥25 trillion, but are only at one-tenth of that. The problem in Korea is that most funds, 76%, come from industry rather than the government side. How to increase this is a problem. We need institutional reforms. Another problem is that our birth rate is declining rapidly. We need to import foreign talent to Korea to conquer this.

Dr. Toshiaki Ikoma: Do high-level people in the Korean government understand the vision for innovation policy?

Dr. Hee-Yol Yu: The three key words in the current government are strategic innovation, participation and decentralization. We have too much emphasis on only innovation.

Prof. Luke Georghiou: Around three years ago in the UK, the government announced a 10-year investment framework for science and technology. It was very favorable to science, offering 5.7% a year in real increases. In an update to it, the government sees very strong performance on science indicators, very good citation performance, but in the meantime, industrial R&D spending actually went down. They're very worried about this and trying to introduce changes in the incentive system.

Prof. Dominique Foray: When you visit cities in Europe, they show you their biotech center or nanotech center. The result is inefficient competition among regions. No one region is critical and has enough competitive mass. This idea of having a vision cannot be separated from having coordination on a regional basis. You need to complement rather than compete.

Prof. Luke Georghiou: Most countries have left behind the idea of producing lists of key technologies. It is much more project-based where you try to articulate specific ideas that are relevant to a situation. More importantly, you use this to allow the actors to gather around a common shared vision since innovation is interactive. You need something to tie the system together so that people are thinking and moving in the same direction. That is the role of the vision.

Dr. Masahiro Kuroda: In Japan, the innovation policy framework just focuses on the creation of innovation targets. We just allocate budget to specific fields in innovation. Unfortunately, when we consider the creation of social balance, it is a little bit different. We need to look more deeply into strategies and policies that create social values.

Dr. Ayao Tsuge: From the viewpoint of science and technology innovation, it is crucial on the policy side to keep the basic research as a reservoir of generic wisdom. However, the final target must be the creation of social value and economic value. It is our dilemma as how to bridge the science and technology barrier into social value. We need an additional policy above and beyond science and technology policy. That is the issue of how we are able to build up an innovation ecosystem.

Prof. Kazuhito Hashimoto: That is a question of funding, and I want to discuss that because my feeling is that the Japanese system does not work so well.

Dr. Toshiaki Ikoma: The question is in your country do you have a clear vision for innovation? Korea says yes; the US says yes.

Prof. Diana Hicks: Maybe not the administration, but the science policy community has a clear vision. Everyone knows that nanotech and biotech are important. There is a generic vision.

Prof. Luke Georghiou: The European Commission has a long-standing program as to who is responsible for innovation. This is echoed in many countries.

Prof. Dominique Foray: The problem is the responsibilities of state members, not the Commission. The Commission tries to provide incentives.

Dr. Toshiaki Ikoma: Innovation is a probabilistic process. It is by nature very difficult to link innovation with policy. It takes a long time.

Prof. Kazuhito Hashimoto: One of the key issues and points for policy is the distribution system, the money distribution system. It is a question of priority-setting.

With respect to basic research, which provides the seeds for innovation, curiosity-driven research does not have high efficiency. That is why we said funds need to be distributed widely. Some of the research grows and we have to choose the shoots that have the most potential. How do you choose the good results? That is the problem. It is usually experienced people from industry acting as the connoisseurs but my feeling is that this is not enough. We need top-level scientists, pure scientists to play an important role.

Floor: I wonder if we are overemphasizing the role of the government in innovation. Many innovations have happened without the government playing a role. Is a national vision essential for innovation?.

Floor: Innovation cannot be qualified in advance. We are not able to identify the policy implications at the beginning, provide funding and then wait. What we can do is create innovation-friendly environments, not only innovation-friendly markets. This means interaction fields, according to your definition. We should not go back to the pure linear model of innovation.

Dr. Kiyoshi Kurokawa: We have tried to provide a forum that creates innovative minds. You see different ideas that reflect different cultures and social values. The US has been a champion because they historically have encouraged entrepreneurship.

Prof. Dominique Foray: Visions need to be very practical in order to be effective.

Floor: We need to discuss the differences between developed and developing countries in terms of vision. In developing countries, you do not have the luxury of driving research processes purely for curiosity.

Dr. Hee-Yol Yu: The vision must be concrete and visible to the people. Korea has set goals to catch up to different countries and groups. When we talk about priority setting, it is not only scientists, but also economists and businessmen who are involved in the decision making.

Dr. Toshiaki Ikoma: The next subject is industry-academia collaboration.

Prof. Kazuhito Hashimoto: The circumstances for collaboration have become very good in Japan over the last 10 years. Collaboration could be a good interactive field for the R&D community. The

role of academia should be to provide a longer-term perspective, to find important and promising scientific issues, to choose the scientific direction.

Prof. Luke Georghiou: I partly agree and partly disagree. Not all universities and not all companies are at the same level. What you describe is the right thing for strong research universities working with research-intensive companies, usually large ones. The needs of most SMEs are much more primitive. They are essentially looking for knowledge transfer rather than leading-edge research.

Prof. Dominique Foray: This is an extremely complex issue. Nelson and Rosenberg wrote a paper about engineering science that indicates a structural solution to the problem. This is to develop an institutionalized engineering science. These are the key disciplines in the chain of events between basic science and industrial application. This is where the transfer of knowledge is going to take place.

Dr. Hee-Yol Yu: Collaboration does not work very well in many countries because there is often no output.

Prof. Diana Hicks: Georgia Tech is historically a technical university. The culture is very positive towards working with industry. We have a cloud of related organizations around the university. We also have a technology transfer office and efforts to generate patents, but in addition to this, we have an associated research institute that does classified work for the military and a lot of industrial contracts.

Dr. Masahiro Kuroda: In Japan, we do not have such a long history of collaboration between universities and industry. The university is considered to be an ivory tower, though this has gradually been changing. Recently, universities have come to understand the importance of collaboration with industry.

Prof. Nathan Rosenberg: One of the distinct things about the American system is that it is decentralized. American universities are free to make their own rules and collect financial support from various sources because they want to build a different kind of system. In the US, there are 3,500 institutions that call themselves universities or colleges. It is impossible and highly undesirable to create a pattern of uniformity out of this.

Dr. Toshiaki Ikoma: What about collaboration on an international basis with foreign firms?

Floor: I think that we have created a myth regarding industry-academic partnerships, which is that there are seeds in the universities and industry should come and commercialize them. Yes, there are some seeds and universities, but there is a large number of seeds within industry itself. The question I would like to pose is whether universities can be used to enhance public acceptance or commercialization or socialization of the seeds which are inside industry. We need to use the university to take the seeds out of industry and make them more broad-based.

Prof. Kazuhito Hashimoto: It is often argued that we are doing the research using government money and government money is from the taxpayers. Therefore, we should use such knowledge and intellectual property for the nation.

Dr. Ayao Tsuge: This is the key issue in solving competition and collaboration between national innovation systems and the global innovation ecosystem.

Floor: In the US, by law, it is clearly declared that the benefit of the taxpayers makes a difference in licensing between national industry and foreign industry.

Floor: We have been told that Japan is very weak in internationalization and that industry-academia collaboration is inadequate, but yet Japan still performs very well. On the other side, the US enjoys a high degree of industry-academic collaboration and also international collaboration, and it also reaches the end goals of profit, growth and welfare. It seems that both systems produce the same result.

Dr. Toshiaki Ikoma: In the 1980s, most people praised Japan for successful industry-academia collaboration. Japan had a national innovation system in the 1980s. Industry-academia collaboration existed in Japan before the last decade. We imported lots of technology from abroad. You need to understand the historical background.

Floor: I represent a funding agency in Finland. Funding mechanisms are necessarily very national. We're talking about funding from the tax base. If we're talking about a global innovation ecosystem, how do we solve this problem?

Dr. Toshiaki Ikoma: The question is how to proceed with co-funding across borders. How to apply tax-based funding and the possible innovation results? What do you think about co-funding across boundaries?

Dr. Hee-Yol Yu: Israel is a very good example. It has set up a foundation and it tracks much funding from the US.

Prof. Luke Georghiou: To some extent it is already happening in Europe. Existing programs involve the transfer of resources across borders. There is a gradual shift in the ideology of funding bodies, which originally felt they were giving funding for research as a duty to society. Now they think of themselves as customers purchasing research on behalf of society.

Dr. Toshiaki Ikoma: Now we have global and regional "ego-systems." We need to have a real national innovation system and consider how to change ego system to ecosystem.

Prof. Yoko Ishikura: I would like to go back to the multi-layer framework of Prof. Yasui. I like the model, as it reflects circular, flexible and dynamic movement, linking advanced and developing economies, rather than the one grand design of "global national ecosystem".

Dr. Toshiaki Ikoma: I like this chart because it shows the dynamic process.

Prof. Nathan Rosenberg: You just have to add movement to the chart to make it dynamic.

Floor: The conclusion from this chart is that for any country to participate in the global innovation ecosystem, the national innovation system must be intact. If a country has a poor national innovation system, it risks being excluded from the global innovation ecosystem. In other words, we need to strengthen national systems to join the global system.

Floor: A lot of developing countries are not focused on innovation. They have to have first steps. As Prof. Foray commented, there seems to be a lot of duplication of technologies. We need research on how we can make resources complementary rather than competing.

Dr. Toshiaki Ikoma: That's a good point but we need to test it. The global innovation ecosystem is just the entrance to this area. We need to research these networks of innovation. The US has a network for innovation studies. We do not have that in Asia. We should establish an Asian network for innovation studies.

Prof. Xiangdong Chen: I think that proposal is useful. Science and technology collaboration is occurring but maybe through a network we can summarize these activities. But I wonder who is the major customer for this? Maybe we should concentrate on a particular group of people.

Dr. Toshiaki Ikoma: Responding to this I would make a proposal to form Asian Innovation Study Network (AISN) for further promotion of GIES in Asia. We should take actions to make it happen right after this symposium.

Floor: We have been pushing for this with technology workshops. Therkai e is so much disparity in Southeast Asia. How will you handle such variation in outputs?

Floor: Why is Africa not included in this idea? Africa is a continent.

Dr. Toshiaki Ikoma: Thank you. We need to consider that.