論説 Commentary

Review on the four primary priority areas

— Separation between science and technology, interdisciplinary approach/fusion of areas, and importance of organizations —

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Restraint of the four primary priority areas

The Council for Science and Technology Policy was founded in January 2001. Its first mission was to formulate the 2nd Science and Technology Basic Plan, which highlighted the Promotion Strategy for 8 Prioritized Areas. More specifically, the Basic Plan established the ongoing 4 primary priority areas (life sciences, information and communication technology, environmental sciences, and nanotechnology and materials) and the other 4 areas (energy, manufacturing technology, infrastructure, and frontier (outer space and oceans)).

This promotion strategy has been substantially influencing R&D and research grant/promotion activities by shifting emphasis of Japan's science and technology policy toward selection and concentration. However, now that this strategy has been maintained for almost 10 years, some negative influences are emerging apart from the initial purposes. For this reason, I believe that now is the time to review our promotion strategy.

For example, I suspect the concept of "selection and concentration" is now applied even to free ideas-based basic research, ignoring the nature of free ideas. I also suspect that priorities are placed on narrowly-defined research activities, although various combinations of diversified knowledge and means are required to enhance effects and efficiencies of research. Under such circumstances, researchers seeking external funds would feel psychological pressure. I am deeply concerned that purposes might be confused with means.

The review results of the third basic plan have yet to be announced. Nevertheless, I am seriously concerned that various activities from policy decision, system designing for measures to fronts of research implementation and research support might be losing their flexibility under the restraint, and I fear that negative influences have been increasing.

There is concern that the promotion strategy might promote the segregation of areas, enclosure, and elimination of other areas, and as a result, interdisciplinary approach/fusion of areas, which are supposed to be promoted, might be downplayed. Due to such paradox, the key policies of "policy-oriented subjects", "fusion of areas into interdisciplinary fields" and "innovation," which were proposed as new policies in the third basic plan, might be in danger of not taking shape.

Change in the public policy for science and technology: innovation policy and separation between science and technology

The public policy for science and technology has been undergoing a big change on a global scale, shifting from the Science and Technology Policy to the Innovation Policy. The scope covered by the policy has become so extensive as to include not only support for scientific and technological R&D activities but also value creation for the socioeconomy, development of socioeconomic conditions for such value creation, and reform of researchers' consciousness.

In such circumstances, it is considered difficult to flexibly and speedily respond to social needs or to implement, support and evaluate research activities with the aim of problem solving or innovation, while at the same time maintaining the current promotion strategy and methods.

I believe the first step toward reform is to work on separation between science and technology at the policy level. In Japan, "Science and Technology" has been customarily treated as a unit for many years, especially in the context of politics and public administration. However, now that it has become essential to generate value on the basis of Japan-originated unique knowledge and technology seeds through long innovation processes from stages of "free ideas-based basic research" and "purpose-oriented basic research" to social needs, I believe it is time for us to review the current thinking framework and seriously consider separation between science and technology. In my opinion, it is of significance to have this point of view constantly in our thinking axis especially when we consider policies and systems at the level of politics and public administration.

By doing so, we can expect a new horizon to open in various fronts, for example in the identity re-definition of "science faculty" and "engineering faculty," reform and purpose clarification of science and technological education which should turn out the next-generation of researchers and engineers, and measures to cope with disengagement from science and technology. It will also guide the reforms of many public research grant systems, research institutions and other research implementation organizations.

Both R&D investment in science research as well as interdisciplinary fields and fostering/ensuring human resources have become important policy themes on a global scale. Not only in the corporate sector but also in the public sector, open innovation and brain circulation beyond boundaries of nations, organizations and areas have become essential. It will be beneficial to separate science and technology once and then reunite them. Such attempts are fre-

quently witnessed in Nobel Prize winners' achievements and innovation results.

Institutional building for promoting interdisciplinary approach/fusion of areas

In Europe and the United States, theme set-up and research methods, new research grant systems, and development of interdisciplinary areas, all of which are aiming to promote interdisciplinary approach/fusion of areas, such as European Technology Platform (ETP), Converging Technologies, Transformative Research, Service Science, and Complex Research have begun to materialize. Even in Japan, efforts to fuse areas have been initiated, such as Optical Application Research, Applied Mathematics, and Service Science.

In October 2007, the OECD organized the Workshop on Complex Systems and the Science of Unanticipated Consequences and Unrealized Opportunities. A great number of policy makers and experts from various countries participated in the OECD workshop and discussed epidemic diffusion, environmental impact from new technologies, resilience and vulnerability to extreme events, projection and measures concerning climate change, etc.

In response to these movements, the Research Institute of Science and Technology for Society (RISTEX), an affiliate of the Japan Science and Technology Agency and the organization this author works for, has been developing a methodology for extracting issues/subjects in which the national government should make R&D investments by structuring such social needs as enhancement of international competitiveness of industries, improvement of life quality and problem-solving on a global scale, and then by associating the structured needs with traditional scientific areas. With regard to the fusion of areas into interdisciplinary fields, RISTEX has also been discussing subject-setting methods and promotion measures. Based on these ongoing efforts, we will write up our recommendations for public announcement next spring. For reference, theses efforts attracted much interest in the above-mentioned OECD workshop.

Regarding the fusion of areas into interdisciplinary fields, we have been striving to extract technological issues/subjects and structure relationships by repeatedly organizing workshops to be attended by experts in various academic fields such as mathematics, physics, engineering, chemistry, biology, information science, psychology, economics and sociology. In theses efforts, we always ask ourselves what kinds of new science, technology and interdisciplinary fields are necessary to solve tough challenges imposed on the modern world, and which measures and systems are necessary to promote knowledge management methods. Tough challenges under consideration include climate and environmental changes, epidemic diffusion and its wide area treatment, global security to ensure the supply of energy, food and water, and sustainability and risk control of important infrastructures.

Admittedly, it is extremely difficult to introduce the concepts of "knowledge integration" and "knowledge management" in modern science and technological methods where "reductionism" and "knowledge production" have been the mainstream. Yet, I believe that we need to strategically institute new research grant systems, evaluation methods, and education & research environments in order to integrate ongoing individual efforts both at home and abroad and effectively promote the interdisciplinary approach/fusion of areas.

Importance of organizations

One of the key issues in the third basic plan is the "Shift of emphasis from "hard" to "soft", such as human resources, creating a greater significance of individuals in institutions".

Just like the promotion strategy, this was also an unconventionally innovative principle back then, but I suspect that the role of "greater significance of individuals in institutions" in the latter part of the expression has been downplayed, causing an unbalanced impact. More precisely, I suspect such an unbalanced impact has resulted in heavier burdens on individual researchers who have to bear responsibility for administrative and operational work concerning research and evaluations, although such responsibility should be inherently borne by institutions or organizations. I am concerned that "greater significance of individuals" turns into "greater significance of incumbent researchers" and consequently little attention is paid to education and training for the next generation of youths. Young people who will open new scientific frontiers must be internally fostered in each organization. I also believe that (1) collaboration among people, goods, money and information; (2) organizations which support such collaboration; and (3) roles of people who link such organizations are all important for promoting the interdisciplinary approach/fusion of areas and innovation.

The importance of universities is now the focus of attention around the world. This phenomenon reflects keen expectations of universities as a foundation for the nation's total power and value in the future, and the organizational strength and total strength of each university has been under scrutiny. As part of this phenomenon, acceleration has been witnessed in various fronts including construction and globalization of universities, recruiting of university presidents, review of educational systems, and soft and hard investments in interdisciplinary fields. Under such circumstances, the purpose of fostering human resources during graduate courses has been expanding from just teaching knowledge and skills inherent in each academic field to producing diversified individuals who not only have professional skills and an academic career, but also generate innovation. Presumably as part of this change or enlargement, issues such as structuring of learning and the acceleration of engineering education are now being seriously considered.

These responsibilities for universities and public research institutions to take on for the 21st century cannot be borne by individuals. I believe that another round of elaborate discussions on the importance of organizations is urgently needed in addition to the greater significance of individuals.

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