Introduction

AIST is conducting research in six areas ranging from the environment and energy fields to the fields of geological survey and applied geoscience. The methodology promoted by AIST that characterizes this wide range of research and development is “Full Research.” When we look back over the years, the very first time this term appeared in AIST TODAY International Ed. was in the New Year’s Greetings for 2002. Thus, it can be said to be a term that has accompanied AIST throughout its history as well as a term that represents the essence of AIST itself.

In this article, I will examine this concept in further detail.

What is Full Research?

As regards the exact definition of the term “Full Research,” although I would like to defer to the definition given in the “Message from the Editorial Board” that appear in Synthesiology, the academic journal published by AIST, as well as to a book on the subject, my understanding of the term is as follows: A research method used to create social value through the development of new knowledge. When this term is defined in this manner, many of you may notice its similarity with the following text extracted from the Fourth Science and Technology Basic Plan, which was approved by the Cabinet last year. The text I am referring to in the Basic Plan is where “science, technology, and innovation” are defined as the “creation of intellectual/cultural values based on new knowledge obtained from scientific discovery, invention, etc., and the innovation to develop such knowledge into economic value and social and public value.”

To summarize, Full Research is a research methodology that is oriented toward science, technology, and innovation, and is a methodology that can be said to promote “science in society and science for society,” the goal of 21st-century research and development affirmed during the 1999 World Conference on Science in Budapest.

Challenges at AIST

– Direction of Full Research –

What is important for AIST next is the direction of development of Full Research in terms of research resources. In my opinion, the answer to this question is to
focus our research resources on technology development that aims to overcome bottlenecks, based on scenarios to create bridges between technological seeds and social needs.

Certainly, the ways in which social needs are defined will greatly affect the scenarios to be created and the focus of research resources. For example, to respond to the ongoing social need for sustainable development, focusing research resources on highly innovative elemental technologies might be considered a matter of higher priority. On the other hand, to respond to the pressing social need for recovery and rehabilitation from the earthquake and tsunami disaster which occurred in 2011, it is also likely that a research and development scenario that aims to combine various existing technology components and to improve their connectivity can provide the speed needed to achieve such a goal.

In any case, along with the creativity to visualize what may lie ahead in the future, the ability to analyze, integrate (synthesize), and combine necessary components contained in aggregated information on cutting-edge technology is indispensable for creating and implementing the scenario. AIST cannot achieve this alone, however. The goal of AIST is thus to function to its fullest as an open innovation hub where members both within Japan and overseas strive to accumulate knowledge.

– Actual example –

AIST has been the leader in Japan’s research and development of carbon-based materials, and carbon fiber materials developed in Japan are used in the Boeing Company’s latest jet. This can be cited as an example of the outcome of research that was carried out in one of AIST’s predecessors, the Osaka National Research Institute, and was further developed and brought to fruition through the efforts of private companies. In line with this tradition, AIST is focusing its efforts especially on the research and development of single-walled carbon nanotubes (CNTs).

The main issues that were selected to become the focus of prioritized research investment for the Full Research of single-walled CNTs were as follows: (1) To overcome the bottleneck of limited supply: Break through the present situation where there is stagnation in utilization technology development due to high material prices by developing large-scale synthesis technology of single-walled CNTs. (2) To overcome the bottleneck of social acceptance: Given the underlying concerns over new industrial nanomaterials including single-walled CNTs, objectively evaluate biological safety and (workplace) environmental safety based on scientific methods.

As regards point (1), we discovered and established a synthesis method that makes it possible to manufacture large quantities of high-quality single-walled CNTs and were able to pave the way to overcoming the bottleneck. Presently, we have established a facility, which has the capacity to produce 600 g of single-walled CNTs on a daily basis, and are distributing the produced samples. Additionally, with this facility at the core, we are exploring new applications by joining hands with the members of the industrial sector who have come together at AIST. This, I believe, is a true manifestation of AIST’s function as an open innovation hub.

As for point (2), we were given the opportunity to lead the worldwide discussion on the risk of industrial nanomaterials at the Organisation for Economic Co-operation and Development for three materials: single-walled CNTs, multi-walled CNTs, and fullerenes. The research was pursued in collaboration with members of academia and the industrial sector and in 2011, detailed risk assessment reports for the above three materials were published. I believe it is true to say that widespread attention and high evaluations were given to these activities throughout the world, and this is something that is still fresh in our memory.

– The next bottleneck –

In pursuing Full Research, a certain dynamism that allows the reconstruction of scenarios in accordance with the advancing stages of technology development aimed at overcoming bottlenecks is also necessary. There are a wide variety of issues that may become the next bottleneck for single-walled CNTs. One such issue that should be taken into consideration is a new movement centering around European nations that emphasizes the precautionary principle. In France, for example, in order to handle more than a fixed quantity of nanomaterials, one will soon be required to submit a report providing details of their quantity and usage (enforcement will begin in January 2013). Single-walled CNTs are also within the scope of this regulation.

Moreover, the European Commission has directed
its affiliated standardization organizations (the European Committee for Standardization [CEN], etc.) to formulate international standards for physico-chemical characterization of nanomaterials with the cooperation of international standardization organizations such as the International Organization for Standardization (ISO). AIST has been showing leadership, both nationally and internationally, from the moment the technical committee for nanotechnologies (TC 229) was established in ISO, but we believe that we must work much faster. We intend to move forward in unison with the industrial sector to accomplish our function as an innovation hub.

Incidentally, in order to report the quantity of nanomaterials, the acquisition of considerable detailed information such as their size distribution is indispensable. In addition, when physico-chemical characterization is taken into consideration, the development of new measuring and analytical techniques is an absolute necessity. The feature articles in this issue of *AIST TODAY* International Ed. are an introduction to some of the efforts being made at AIST based on this background.

**– Standardization and certification strategy –**

According to the directive of the European Commission mentioned above, the formulation of international standards for physico-chemical characterization of nanomaterials is expected to be completed in about three years. There are concerns that when this is completed, much stricter regulations might be enforced. As illustrated in this example, we are gradually moving away from the time when one needed not to worry about making sales as long as a product had high performance, to a time in which if one does not provide safety assessments along with the product, the product cannot even be placed on the market.

Overseas certification organizations have recently been actively expanding their operations, including in Asia, and are greatly increasing their sales. When we consider the point that one objective of the certification business is to promote social acceptance of new technologies, it might well be assumed that behind this movement is the issue of safety. There is a greatly increasing need for public research organizations such as AIST to pioneer risk (safety) assessments and to conduct pilot certifications that the present certification organizations in Japan are not yet well prepared to handle.

The concurrent promotion of research and development and standardization is also strongly emphasized as a component of the intellectual property strategy in the Fourth Science and Technology Basic Plan. AIST has been engaging in the formulation of international standards based on scientific knowledge alongside our efforts to nurture personnel who can act as international leaders such as convenors and secretaries (of ISO technical committees). Based on our emphasis on *Full Research*, we are determined to continue making our best efforts.

**Reference**