7

Notable Points of the US "21st Century Nanotechnology Research and Development Act"

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1 Introduction

After the US Senate and House of Representatives had passed the bill entitled "21st Century Nanotechnology Research and Development Act" (S.189; hereinafter, "NRDA") at the 108th Congress, the bill became an official legislation on December 3, 2003 when President Bush appended his signature. War with Iraq has delayed congressional debates on the NRDA bill, and, due to this, NRDA mirrors current public awareness and clearly stipulates the attitude to integrate research on societal, ethical, and environmental concerns with nanotechnology R&D activities as much as possible.

The United States is the first nation to enact a law regarding how to proceed with nanotechnology R&D activities. In this sense, NRDA will have impacts on the future directions in other nations as well. This article explains the notable points of NRDA and outlines NRDA in the attached Exhibit.

2 Notable points of "21st Century Nanotechnology Research and Development Act"[1]

2-1 Background information on NRDA

Lawmakers submitted the NRDA bill to the 107th US Congress in 2002, but they failed to enact it during the session. Following this, the new bill was submitted to the 108th US Congress again in 2003. (The US Congress treats a resubmitted bill as a new bill in the following year.)

Since Congress has significant influence over the budget amount for science and technology public administration affairs in the U.S., NRDA proposers originally aimed at securing stable long-term budget funds for nanotechnology R&D and at accelerating the reorganization of the currently rigid science and technology research framework. Although the US government has steadily increased federal budgets for nanotechnology R&D activities since President Clinton's directive in 2000, the interagency coordinator NNI (National Nanotechnology Initiative)[2] has held a relatively weak status and unstable budget fund, which has been dependent on the fiscal position of the overall federal government. NRDA has successfully secured R&D budgets and program frameworks at least leading up to 2008, and has also enabled relatively long-term nanotechnology R&D activities.

During one year and a half long congressional debates, the United States changed its viewpoints on nanotechnologies. As nanotechnology seemed to have much fewer ethical concerns than bioscience, the NRDA bill would have gone through Congress quite easily. However, while countermeasures for anthrax and other bioterror attacks, the SARS outbreak and war with Iraq delayed the debates on the NDRA bill, US lawmakers perceived that uncontrolled nanotechnology advancements would yield some risks. As a result, they dramatically revised the NDRA bill to put emphasis on societal, ethical and environmental concerns.

As other reports provide detailed information on NDRA bill's congressional debates, please refer to these reports for more information[3].

2-2 Features in NDRA

Roughly speaking, NDRA specifically stipulates federal nanotechnology R&D efforts in

Section 2 (National Nanotechnology Program), establishes and defines the roles of the National Nanotechnology Coordination Office and the National Nanotechnology Advisory Panel in Sections 3 and 4, triennial external reviews in Section 5, and authorization of appropriations in Section 6. Except for the budget, the National Science and Technology Council is to prepare strategic plans within 12 months after the enactment of NDRA and update it every three years thereafter. NNI and other existing committees should play leading roles in establishing the Coordination Office and the Advisory Panel. The National Research Council of the National Academy of Sciences will be in charge of external reviews of the Program.

As a core component of NRDA, the National Nanotechnology Program (Section 2) has the following purposes under presidential responsibility: 1) setting up goals, priorities, and assessment criteria, 2) providing investments to achieve these goals, and 3) carrying out interagency coordination. As mentioned in Paragraph (b)(10)(c), the Program ultimately aims at "ensuring that advances in nanotechnology bring about improvements in the quality of life for all Americans." From this perspective, the government will establish goals and priorities for the Program based on "national needs for a set of broad applications of nanotechnology" (Paragraph (c)(1)) as mentioned in the first sentence in the "Program Management" section of NRDA.

Getting down to specifics, NRDA stipulates the Program as encouraging fundamental understanding of matters that enable control and manipulation at nanoscale, accelerating deployment and application of nanotechnology R&D activities in the private sector including startup companies, and advancing the US productivity and industrial competitiveness. As one of its interesting features, NRDA will encourage nanotechnology education and training "so that a true interdisciplinary research culture can emerge," in Paragraph (b)(9). Facility installation, stable fund infusion, various projects and partnership formation are all methods for creating such a "culture." As another features, NRDA describes in detail considerations for ethical, legal, environmental and other societal concerns (Paragraph (b)(10)). It does not provide specific solutions for nanotechnology-based adverse impacts, but does describe the US decision-making process through expert research programs (probably led by the American Nanotechnology Preparedness Center as stipulated in Section 9) and ongoing public discussions, such as citizens' panels, consensus conferences, and educational events. With these backgrounds, Americans have already started nationwide discussions on societal implications for nanotechnology. Of course, NRDA also aims at "ensuring United States global leadership in the development and application of nanotechnology" as mentioned in Paragraph (b)(5). However, unlike the common perception for Japanese people, NRDA does not give a strong impression that the US would countervail against excellent nanotechnologies in foreign nations (including Japan). Although US lawmakers might have intended to incorporate such propaganda into the NRDA bill to some extent in the year 2000, the current situation is totally different. NRDA also calls for identifying critical research areas where the United States should be the world leader in terms of comparison with other nations (Section 5, Paragraph (a)(12)).

As specific measures for the Program, NRDA sets some criteria for establishing "interdisciplinary nanotechnology research centers," "networks," and "interdisciplinary projects and collaborations." When selecting these facilities, NRDA pays attention to past actual results and competitiveness, and to utilize existing methods and techniques. NRDA recommends utilization of existing micrometer-level research facilities and idle capacities rather than creating new facilities. The US government seems to have started evaluating some facilities based on their applications. For example, NNIN (National Nanotechnology Infrastructure Network)[4] corresponds to such a center/network. When the NNIN was invited, three university consortia subscribed, which were "self-assembled" to meet the requirements specified in NRDA. One of them, consisting of 13 universities such as Cornell University and Stanford University, has won the long-term stable

NNIN funding.

On the other hand, NRDA has only a few descriptions on specific research fields. The White House press release regarding NRDA[5] included examples of nanotechnology research themes that seemingly brought about some misunderstandings, but NRDA itself basically does not stipulate specific research themes (There are some program examples of departments and agencies in Sections 8 and 9). As exceptions, NRDA requires to make early decisions for following two themes in Section 5, where are strong expressions of "one-time study" that the National Research Council is supposed to make decisions as a part of the first triennial review (June 2005) and will not reverse the decisions thereafter.

One of such "one-time studies" is on molecular self-assembly. In this study, the technical feasibility will be reviewed in the view point of manufacturing materials and devices at the molecular scale. Although the molecular self-assembly had been recognized as one of the important nanotechnologies[6] , it has become a more urgent matter for the US researchers to have to prove its technical feasibility as soon as possible. While it is not certain why NRDA exemplifies only this technology in its text, the US lawmakers might regard it as a primary model case that has promising feasibility.

Another study is on the responsible development of nanotechnology. The National Research Council will assess the needs for standards, guidelines or strategies especially on the following six research targets: 1) self-replicating nanoscale machines or devices; 2) the release of such machines in natural environments; 3) encryption; 4) the development of defensive technologies; 5) the use of nanotechnology in the enhancement of human intelligence; and 6) the use of nanotechnology in developing artificial intelligence. In a sense, the US lawmakers recognize that these research programs would yield some risks that would also bring about some adverse impacts without proper control frameworks. Recent terrorism and infective disease outbreaks have forced US citizens to acknowledge risk awareness that some able researchers could turn SF horror movie stories into reality if they had such intention to do so.

When the House of Representatives passed the NRDA bill in May 2003, the bill stipulated a longer duration for the technical feasibility study on molecular self-assembly (for three years after the enactment of NRDA) and for the study on responsible nanotechnology development (for six years). However, the final text of NRDA specifies a shorter period (1.5 years) for these one-time studies.

In terms of authorization of appropriations (Section 6), NRDA authorizes the total $3.7 billion budget fund for nanotechnology programs for 2005 to 2008. The fund will gradually increase over a relatively long run. (Congress separately discusses the nanotechnology federal budgets leading up to FY 2004.) However, it should be noted that this authorization of appropriations does not include DOD (Department of Defense) and NIH (National Institutes of Health), which occupy large shares in the US science and technology federal budget (These two funding will also support nanotechnologies, but they will have their own separate programs; please see Section 2, Paragraph (c)(3)). In this sense, NRDA does not provide enough information on the correct amount of the entire nanotechnology federal budget; however, the overall US nanotechnology budget is estimated to be at least twice as much as $3.7 billion. During debates in the House of Representatives in May 2003, some congress members submitted an amended bill that defined specific allocation percentages in the budget for addressing societal implications, but Congress decided not to incorporate such specific percentages in the final text. In addition, the original NRDA bill also described the budget amounts for NIH, Department of Justice, Department of Agriculture, and Department of Transportation when it was submitted in January 2003, but Congress did not adopt them.

The last section (Section 10) defines the specific terminologies. "Nanotechnology" is defined as "the science and technology that will enable one to understand, measure, manipulate, and manufacture at the atomic, molecular, and supramolecular levels, aimed at creating materials, devices, and systems with

fundamentally new molecular organization, properties, and functions." This definition is almost the same as the common understanding of nanotechnology here in Japan. In addition, the "Program" covers all projects and activities mentioned in Section 2, which is a vague expression in order to encompass a broad spectrum.

NRDA will be effective at least until 2008. In particular, as shown in Section 4, Paragraph (f), only the Advisory Panel is exempted from the Sunset law (which means automatic abolishment of rules and regulations after a certain duration). From this viewpoint, the Advisory Panel would play a key role after 2008. The National Science and Technology Council will be in charge of overseeing interagency coordination with DOD and NIH that have their own separate programs as described in Section 2, Paragraph (c)(3). (While DOD has the Defense Nanotechnology Research and Development Program, NIH also has the Nanomedicine Centers establishment program). Since their budgets will also play important roles in advancing nanotechnologies, it is necessary to pay attention to how well the Council will function as an interagency coordinator.

By and large, NRDA calls for some important strategic planning and decision-making to be completed in 2005 at the latest. In this sense, US nanotechnology advancement will surely see its turning point in the coming one to two years.

Translation into Japanese

The National Institute of Science and Technology Policy worked with the Nanotechnology Researchers Network Center of Japan for the translation of the NRDA text into Japanese, and posted it on the Center's website[1] for Japanese reader.

Acknowledgement

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References

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[2] NNI: http://www.nano.gov/
[3] NEDO Overseas Reports, No. 907 (May 19, 2003) and No. 923 (January 14, 2004) (in Japanese)
[4] NNIN: http://www.nnin.org/
[5] The White House: http://whitehouse.gov/news/releases/2003/12/20031203-7.html
[6] Science & Technology Trends, December 2003, topics on nanotechnology and materials (in Japanese)

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