8

U.S.Science and Technology Policy Trends
— Report on the 2003 AAAS Colloquium on Science and Technology Policy—

TOMOE KIYOSADA (*Affiliated Fellow*)

8.1 Introduction

The American Association for the Advancement of Science (AAAS) Colloquium on Science and Technology Policy was held on April 10 and 11 in Washington, DC. Held every spring for 28 years, the colloquium is the largest meeting on science and technology policy in the U.S. Over 500 people participated in this year's colloquium, including government officials such as John H. Marburger, director of the White House Office of Science and Technology Policy; Elias A. Zerhounis, director of the National Institutes of Health; Charles A. McQueary, under secretary for science and technology of the U.S. Department of Homeland Security; Congressional staffers such as William Bonvillian, legislative director for the office of Senator Joseph I. Lieberman; academics such as Shirley Ann Jackson, president of Rensselaer Polytechnic Institute and Karen A. Holbrook, president of Ohio State University; as well as think-tank policy analysts, corporate research and development managers, and science and technology leaders from many other countries. Among the topics participants discussed were:

- The estimated federal government research and development budget for fiscal 2004
- Strengthening homeland security through science and technology
- Visa difficulties faced by students and researchers from foreign countries
- Science and technology trends in government agencies.

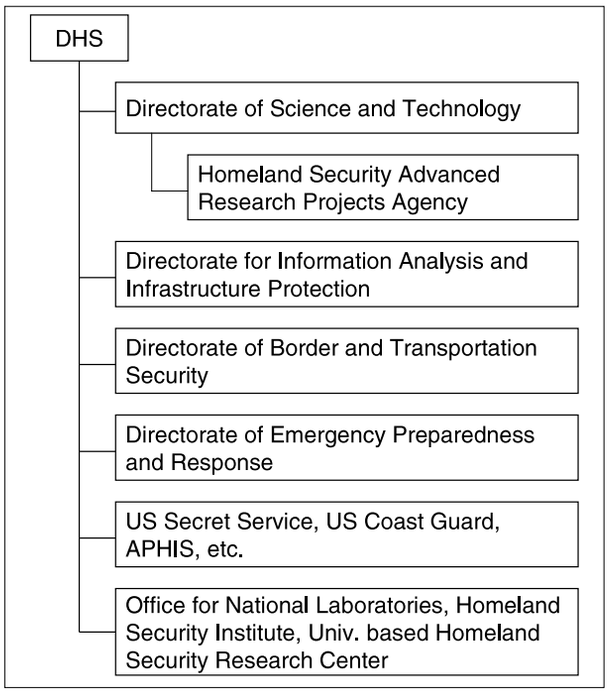
8.2 Federal government R&D budget for fiscal 2004

On February 2, 2003, U.S. president George W. Bush released his fiscal 2004 budget proposal. The proposed research and development budget was $122.7 billion, a 4.4 percent increase. Breaking down the content, defense development and homeland security R&D show major increases, but non-defense R&D remains almost unchanged from last year, with only a 0.1 percent increase. (See "Changes in R&D Priorities Seen in the U.S. President's Fiscal 2004 Budget Message" in the eighth issue of this bulletin for more details.) Congressional budget debate is beginning. Considering the increase in the federal deficit caused by the war with Iraq and support for that country's reconstruction, there is likely to be pressure in Congress to control domestic spending, including R&D. During his presentation at the colloquium, AAAS R&D Budget and Policy Program director Kei Koizumi predicted a "zero sum game," with funding in the fiscal 2004 R&D budget increasing for the Bush Administration priorities of defense and homeland security increasing and that for non-defense research decreasing.

8.3 Homeland security policy

With the colloquium being held during the war with Iraq, interest in topics related to homeland security was high. The Department of Homeland Security (DHS) began operating last March. Under Secretary McQueary oversees science and technology policy related to homeland security. The Directorate of Science and Technology

Figure 1: DHS organization



Source : DHS official website

as shown in Figure 1 is primarily in charge of science and technology within DHS. The DHS under secretary for science and technology is also the head of that directorate. The Homeland Security Advanced Research Projects Agency (HSARPA), modeled after the Department of Defense's Defense Advanced Research Projects Agency (DARPA), is also a part of the directorate. HSARPA funds all types of R&D programs related to homeland security, from basic research to product development. HSARPA's fiscal 2004 budget is expected to be between $350 million and $500 million dollars ("Department of Homeland Security Opens Doors, Proposes $1.0 Billion for R&D," AAAS R&D Budget and Policy Program, March 4, 2003).

During his presentation at the colloquium, Under Secretary McQueary described the tasks of the Directorate of Science and Technology as follows.

- **Internal R&D**

The National Laboratory for Homeland Security carries out interdisciplinary research and development related to homeland security. The laboratory carries out homeland security related R&D programs transferred from the Technology Security Laboratory of the Transportation Security Administration, the Environmental Measurements Laboratory, the U.S. Coast Guard, the U.S. Secret Service, and the former Immigration and Customs Services. It will also work on biological programs with the NIH and the Centers for Disease Control and Prevention (CDC), and on food safety programs with the U.S. Department of Agriculture (USDA).

- **Industry-academia-government cooperation**

In conjunction with industry and academia, the directorate promotes R&D that can enhance homeland security. In cooperation with industry, it promotes technological standardization and technology transfer related to homeland security.

- **Human resources development**

To foster human resources in relation to homeland security, the directorate has a scholarship system and offers doctoral and postdoctoral fellowships.

At the colloquium, Under Secretary McQueary also described the following DHS initiatives.

- **Border Protection and Monitoring**

This initiative develops technologies to discover nuclear weapons and other illegal materials being brought across the U.S. border.

- **Biological Protection**

This initiative develops technologies to oversee pathology laboratories, emergency rooms, and pharmaceutical sales, as well as to detect indications of disease outbreaks.

- **Information Analysis**

This initiative develops information analysis systems to comprehensively analyze information gathered from various kinds of resources and to prevent cyber-attacks and illicit uses of information networks.

8.4 NIH science and technology policy trends

Topics related to severe acute respiratory syndrome (SARS), which is striking Asia particularly hard, also drew much interest at the colloquium. In his colloquium presentation, NIH director Zerhounis stated that NIH is actively pursuing SARS research, mainly through the Centers for Disease Control and Prevention (CDC). Vigorous work to understand the cause and to develop preventative methods is being carried out not only in the U.S., but also in a

CDC laboratory in Hong Kong. Not only do they carry out research, he said, but the CDC website also disseminates SARS information. Director Zerhounis also described a plan to invest $9.5 billion in capital improvements to U.S. medical schools, and warned the academic community of cuts in NIH capital investment. In the president's fiscal 2004 budget message released February 3, NIH, which had just finished a budget-increase campaign, suggested a cut in capital investment funding in order to secure sufficient R&D funding despite stagnant research budgets. (See "Flash Report on 2002 AAAS Annual Colloquium" in the fifth issue of this bulletin.

8.5 Visa difficulties faced by students and researchers from foreign countries

In his keynote address to the colloquium, John H. Marburger, Director of the White House Office of Science and Technology Policy noted that while there may be several trends and high-priority issues that should be discussed at the colloquium, he wanted to speak about a problem that is having a particularly serious effect on the science and higher education communities. Ordinarily the colloquium's keynote address each year is offered by the president's chief science advisor, and it is widely reported as indicating major elements of the federal government's science and technology policies. For example, last year's keynote address by Director Marburger covered a wide range of topics, such as R&D initiatives to enhance the war on terror and homeland security, balancing fields of government R&D investment, strategies to set priorities for fields such as nanotechnology and life science, and reforming federal government R&D management. (See "Flash Report on 2002 AAAS Annual Colloquium" in the fifth issue of this bulletin for details.) Narrowing the topic of this year's address to visa problems therefore took most participants by surprise. It was a clear indication of how serious an effect heightened security screening is having, and will have, on science and technology activity in the U.S.

This section will present an overview, based on Director Marburger's address, of the causes of visa problems and the steps the government is taking to solve them.

8.5.1 Visas issued to foreign students and researchers

A recent special report in the Chronicle of Higher Education (http://chronicle.com) entitled "Closing the Gates" pointed out that enhanced homeland security is "closing the gates" on research by foreign students and scientists who had improved U.S. research and development competitiveness, which in turn contributed to economic development and better lives for the American people. Are the U.S. scientific and higher education communities really trying to shut out foreign students and scientists? In response to this question, Director Marburger pointed out in his colloquium address that while approvals of the F, M, and J visas awarded to foreign students and scientists entering the country for fixed periods have declined over the past five years, the drop is only a slight one. According to Director Marburger, the problem is not that the U.S. is shutting out foreign students and scientists, but rather that the examination process is taking too long.

8.5.2 The visa examination process

To deepen understanding of visa problems, this section will provide an overview of the visa examination process. Ordinarily, the following three examinations are required to issue an F, M, or J visa for a foreign student or a scientist entering the country for a fixed term:

- CLASS
  (Consular Lookout Automated Support System)
- MANTIS
- CONDOR

CLASS (Consular Lookout Automated Support System) runs the applicant's name through the FBI National Criminal Information Center's criminal database and the CIA's terrorist database. This is done in every case. Any matches are referred to Washington for further examination. According to Director Marburger, about 90 percent of cases referred to Washington for further examination are processed within 30 days, so it cannot be considered a major cause of delays.

MANTIS screens applicants based on a Technology Alert List (TAL) compiled by the State Department and other relevant agencies under section 212 of the Immigration and Nationality Act. It is intended to prevent individuals likely to illegally export products, technologies, or sensitive information from entering the country. According to Director Marburger, cases referred to MANTIS have rapidly increased, from about 1,000 in 2000 to about 2,500 in 2001 and approximately 14,000 in 2002. There usually about 1,000 cases in the system at any given time.

Like MANTIS, CONDOR is an examination reserved only for applications that meet certain special criteria, and was established following the September 11, 2001, terrorist attacks. The purpose of CONDOR is to exclude possible terrorists.

8.5.3 Measures taken by the federal government to eliminate visa examination delays

As mentioned above, since the decline in visa approvals over the past five years is small, it is clearly not the case that MANTIS and CONDOR are keeping the numbers down. Obviously, protecting the public through enhanced homeland security is important. Yet, if the problem of visa delays is ignored and research cannot be carried out at the necessary time, the influence on the scientific and higher education communities will be profound. This is a point that the federal government is well aware of. Although reviews of the examination process and personnel increases are being undertaken, the backlog of unprocessed visas continues to increase. Director Marburger stated that the problem of visa delays will be solved by their efforts, and offered the following plans for doing so.

- Cooperation with external expert communities and the sustained, organized hiring of personnel who can help to expedite the visa examination process.
- Elimination of duplicate examinations among CLASS, MANTIS, and CONDOR to speed up visa processing.
- An improved information reporting system from the institutions involved, and the elimination of unnecessary examinations.

Director Marburger also proposed making the examination process more open to applicants to decrease their worry. This would be good news for anxious students and scientists waiting for results without knowing the reason for the long delays they face.

The gathering of top personnel from all over the world has been an engine of growth for the U.S. The contributions of foreign nationals in science and technology are particularly large, and in many laboratories more than half the staff comes from foreign countries such as India and China. Visa delays are shaking this foundation, and may decrease U.S. R&D competitiveness. Director Marburger's colloquium keynote address on visa delays and his proposals for improving the situation are encouraging news for the scientific and higher education communities and for students and scientists who want to go to the U.S.

8.6 Conclusion

With the annual AAAS held during the war with Iraq and the SARS outbreak, interest in research and development policy related to homeland security and infectious disease was high. The deficit increase caused by extraordinary expenditures associated with the war with Iraq and support for its reconstruction is leading to pressure to control domestic spending. The fiscal 2004 R&D budget is likely to be a zero sum game with increases for R&D related to defense and homeland security, and decreases for non-defense research.

Visa processing delays caused by enhanced homeland security are having a profound effect of the scientific and higher education communities. To maintain and enhance its R&D competitiveness, the U.S. must work quickly to solve the problem. The concrete measures described by Director Marburger are a major step in the right direction.

(Original Japanese version: published in April 2003)

9

Futur
— German Demand Side Science and Technology Policy Formation —*

FUJIO NIWA (*Affiliated Senior Fellow*)

*The study of Futur forms a portion of research on "Demand Side Science and Technology Policy Formation," as adopted from the "Policy Suggestions" of the "Promotional Coordination Fund" implemented by the Ministry of Education, Culture, Sports, Science and Technology.

9.1 Introduction

Futur*[1] is a project overseen by Germany's Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF). It attempted to form research and development policies based on future social demand. It offers several important points to study when examining the development of science and technology policy from a demand perspective.

Futur can be summarized based on the five following points.

(a) Demand oriented

Futur asked not "What is possible?" but rather "What is necessary?" In other words, rather than setting research and development goals based on opening new frontiers favored by most scientists in the lab, Futur set goals based on what society will require in the future.

(b) It was premised upon future (circa 2020) social demands

Futur imagined a future society desired and considered what must be done now to realize it. It imagined future social problems and considered what must be done now to overcome them.

(c) It adopted the slogan German Research Dialog (Der deutsche Forschungsdialog).

German research & development as well as science and technology policy are clearly predicated upon dialog between experts and citizens from all levels of society due to trend over the past few years of public participation in science and technology. Dialog is also intended to be based on values with a high degree of universality reached through deliberation rather than on glib ideas or biased values.

(d) It sought out diverse participants

(e) It examined interdisciplinary themes

Looking at these five points, we see that the first two can be classified as goals (content of Futur goals), while the latter three can be classified as process (aspects of its processes). Research dialogs, diverse participants, and an interdisciplinary nature are necessary conditions for achieving goals that are demand and future-oriented.

Futur results were epitomized as Leitvisionen (visions to lead society, or "lead visions"). Lead visions describe central social problems of the future and indicate what type of research projects are required to solve them. When Futur began, the necessary conditions of lead visions were considered. The resulting selection criteria were determined and made known to all participants:

- Orientation towards a societal goal such as solving a pressing social problem
- Linking the needs of society with technological & social innovation
- Contributing to the strengthening of Germany as a place for economic production
- High complexity & interdisciplinary aspects
- Easy to understand in its entirety

It is noteworthy that this vision included social as well as technological innovation. The fusion of technology and society will be essential to future science and technology policy. Expressing government policy in understandable terms will be needed in order to form science and technology policy from the demand side, which is dominated by non-experts.

9.2 Structure of Futur

This chapter will describe the structure of Futur. The predecessor of Futur, Futur 0 (Zero) was created through an open Internet debate process that failed miserably. Taking that failure into account, Futur was begun only after much time and preparation.

The Federal Ministry of Education and Research's Section Z22 (in charge of strategy, planning formation, and research coordination) managed Futur's progress. The project was carried out under the Minister's strong leadership.

The Federal Ministry of Education and Research had a clear vision of both results and processes, of lead visions and their selection criteria, right from the very start of Futur. As complex and broad processes would be vital while diverse methods and tools would have to be utilized, project implementation would thus require trained and talented personnel. The experience of Futur 0 made it clear that face-to-face discussions must be at the core of the process. It required six months of preparatory work to refine the details and make this vision come to fruition. The project actually began in June 2001, and the operation period was about one year.

Funding for the project was provided by utilizing approximately half the sum raised by selling radio wave licenses for mobile telephones.

9.2.1 Consortium formation

The Federal Ministry of Education and Research publicly began soliciting for members at the end of 2000. Based on the content of three proposals and a review of the achievements of participating organizations, implementation of the project was entrusted to a consortium of IFOK*2 (process design and management, communication), ISI*3 (advice on science and technology, providing future predictive methods and international comparisons), IZT*4 (scenario writing and contributions to future workshops), VDI/VDE-IT*5 (organization of scientific and technological expertise), Pixelpark AG*6 (design and sponsoring Internet workspaces), and Science & Media (pubic relations; withdrew from project at the outset). On the Ministry's side, contributors to the project included various bureaus, Projektträger (organizations that distribute Federal Ministry of Education and Research funding outside the Ministry; 11 organizations in all), and the Innovation Council (Innovationsbeirat; formed by the Minister of Education and Research in July 2001, it comprises 12 prominent figures from academia, business and society).

9.2.2 Project overview

One characteristic of Futur is that a wide variety of participants was focusing on issues and providing fresh ideas. To achieve this, different groups with a variety of backgrounds (e.g., science and technology, government administration, corporations, management, etc.) and specialty areas were formed using a method called co-nomination. The following is the process by which it was implemented.

Preliminary stage

One hundred fifty-two original members were named by the consortium.

Stage 1

Each original member recommended 4 or 5 candidates based on predetermined criteria. Candidates were selected from this pool based on clear selection criteria.

Stage 2

Original members and those selected through co-nomination in stage 1 recommended candidates. The process continued as in stage 1 and was repeated an appropriate number of times.

Futur effectively utilized the Internet as an efficient tool to distribute data throughout all processes, ensuring transparency and reaching mutual understanding. Participants were divided into an inner circle that actually met for

face-to-face discussions and an outer circle that participated only over the Internet. Workspaces for both groups were provided on the Futur website. Most communication among participants took place over the Internet. In addition to give and take over meeting agendas and newsletters, discussions took place in the inner circle workspace, while information was exchanged in the outer circle workspace.

When the inner circle engaged in debates or reviews, it would sometimes become necessary for members of the outer circle to participate. Futur flexibly enabled movement of members between circles and the participation of outer circle members in inner circle debates via the Internet.

Participants as of May 2002 were as shown in Table 1. Total participants numbered 1,462, with the ratio of inner to outer circle members about 6:4. Almost all the original members were in the inner circle, while most self-referred members were in the outer. Participants selected through co-nomination numbered 1,148, almost 80 percent of the whole.

The breakdown of participants by gender and field is shown in Figure 1. About three times as many men as women participated. As for fields of expertise, science and technology experts accounted for approximately half the participants. Among the science and technology experts, half were from science and engineering fields and half were from humanities and social science fields.

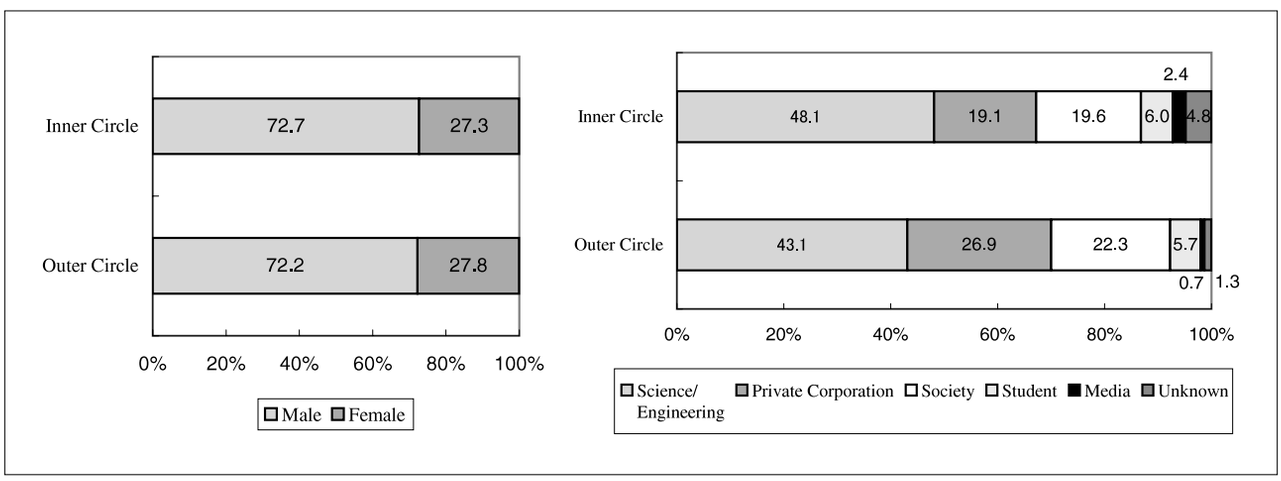
As shown in Table 2, Futur comprised six stages. The first stage was the round of discussions, which was held in June and July 2001. The second stage was the Futur conference. These are formally called the first round of discussion and the first conference. First refers to this being the first Futur, with the projected second Futur to have a round of discussions called the second round of discussion. The first Futur round of discussion will simply be referred to as the "round of discussion" in the remainder of this article. The first two stages are a divergent topic formation process that allows ideas to diverge to form topics that are then sorted and

Table1: Number of participants

Selection Method	Inner Circle	Outer Circle	Total
Original Members	152	4	156
Stage 1 Co-nomination*	194	120	314
Stage 2 Co-nomination	489	345	834
Self-referred	30	125	155
Total	865	597	1,462

*Nominated by original members
Source: K. Cuhls, "The German Research & Dialog" 2002 (unpublished)

Figure 1: Gender, field breakdown of participants



Source: Created by author from K. Cuhls, op. cit

classified. The latter three stages are a convergent process that narrows down the topics that have been formed.

9.3 Futur processes I: Topic formation process

The topic formation process consisted of the round of discussions and the conference. (see Figure 2) The next 20 years are predicted, and measures required to respond to problems envisioned were considered. Desirable future outcomes were also imagined, and the necessary scientific and technological responses for these problems and outcomes were enumerated as topics. A large number of enumerated topics were divided among groups, in which focus topics were created.

9.3.1 Round of discussion (workshops)

The purpose of the round of discussions was to collect from the participants trends considered likely to be important in society around 2020. Approximately 400 inner circle members attended eight workshops held in Berlin and Frankfurt. Those in similar specialties and fields attended the same workshops. The largest ones divided into groups of less than 20 people. The workshops were set up to enable people to share their thoughts in an atmosphere of freedom. Workshops lasted one day.

Workshops operated in the following two stages.

Stage 1

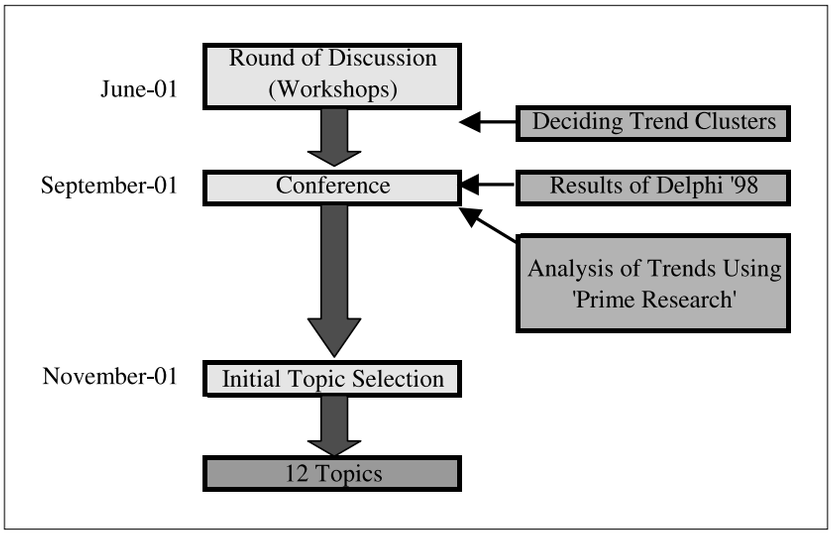
Participants discuss the trends they think of in response to the question, "What will society be like in 2020?"

Table 2: Futur process

No.	Date	Process	Content	Remarks
1	June/July 2001	Round of Discussion	Collection of topics and future trends	Topic formation process
2	September 2001	Conference (Open Space)	Formation of trend clusters	
3	Autumn/Winter 2001	Selection of 12 Focus Groups	Work in online workshops Work in future workshops	Topic narrowing process
4	Spring 2002	Prioritization of Focus Topics	Development of first scenarios	
5	Spring/Summer 2002	Elaboration of Lead Visions	In scenario workshops	
6	Summer/Autumn 2002	Implementation	Lead visions in specific projects	

Sources: Futur website (http: //www.futur.de/en/index.htm), except for "Remarks" from K. Cuhls, op. cit.

Figure 2:Topic formation process



Stage 2

Participants discuss future problems expected to appear in their own fields.

The results were made available on the inner circle website, where workshop participants could comment on them.

Approximately 2,000 topics were suggested at the workshops. Nearly 10,000 were suggested, which included those that were repeated or similar. Clustering resulted in 63 elementary clusters being formed, which were reduced to 21 trend clusters (later called "topic packages"). The consortium foresaw trends that would become most important, and added titles suggesting their meaning as well as three subtitles for each. To deepen subsequent discussions, specific or representative future projections and issues were added as keywords. Each of these was a subject for discussion at the workshops.

9.3.2 Conference (Open space)

The conference was held on November 26, 2001, in Berlin. Its purposes were to deepen the debates which were launched in the round of discussions, to probe into trends that will influence society in the future, and to explain those trends in detail. To eliminate unsupported ideas or personal wishes of participants at the conference, the results of analysis of related projection research were presented. Through these presentations, participants learned the positions of future trend projections at the round of discussions, and were able to make projections that were more objective, universal, and certain. The presentations were the results of Delphi '98*[7] and trend analysis from the Institute Prime Research*[8]. The method used by the former is the same as that utilized by the Ministry of Education, Culture, Sports, Science and Technology's National Institute of Science and Technology Policy in its technology forecast surveys.

Approximately 300 inner circle members attended the conference. The conference process was as follows. When making selection or judgments, criteria such as social needs, interdisciplinary nature, relevance to research and development as well as the possibility of narrowing the focus of the topic were indicated.

(1) Group composition: The 21 topic packages resulting from the workshops were presented, and participants joined the group focusing on the topic in which they were most interested. New groups could be formed and topic titles could be changed (effectively resulting in the formation of new groups). Large groups divided into subgroups.
(2) Preparation for group discussion: Each topic was redefined through discussion in a group and a summary of the topic was created. The groups were then reconfigured so that participants could join the discussions of the topics they found most interesting.
(3) Full-fledged group discussion: The issues that would form the core of a topic from a broad perspective were extracted through detailed discussion. Overlap with other topics, latent topics and fusion with similar groups were considered, as were ways to make topics distinct from each other.
(4) Topic profiling: Topic profiles were clarified. Then the most outstanding topics were selected as best examples and deeper discussions took place with respect to them.

Facilitators and subject advisors were assigned to the discussions to ensure that they progressed smoothly and productively. Their roles were as follows.

Facilitators: They worked to advance the discussions at the initial stage. They subsequently worked to advance debate or to support its advance.

Subject advisors: They were selected from within the consortium because of their expertise. They assisted the facilitators, provided scientific and technical expertise concerning the discussion subject, or prepared target proposals from science and technology aspects. They also assisted with discussion minutes and attached documents, helping ensure that they were technically correct.

9.3.3 First topic selection

Following the conference, topics were selected through the following means.

- Online voting: Voting by 680 members of the inner and outer circles
- Technical evaluation by VDI/VDE-IT: Basic pre-evaluation of the technical content of topics
- Federal Ministry of Education and Research workshops: Ministry bureau chiefs and Projektträger representatives could participate in and vote at internal workshops held by Section Z22
- Expressions of opinion by the Innovation Council
- Workshops with the consortium and the Federal Ministry of Education and Research's Section Z22

Participants, Federal Ministry of Education and Research bureaus, and the Innovation Council were considered most important. Since their results were, in fact, almost identical, the situation did not become serious. Final decisions were made by the Minister of Education and Research, Ms. Edelgard Bulmahn. The 12 focus topics selected are shown in Table 3.

Table 3: 12 Focus topics

1	Long-term planning & organization of motivational work in a knowledge-based society
2	Germany as a place of learning—a learning society as a future factor
3	Living in a networked world: individual and secure
4	Promotion of intercultural potentials
5	Handling information
6	Sustainable mobility
7	Individualized medicine and health care 2020
8	Developing a sustainable culture of nutrition in a changing society
9	Globally responsible sustainable agricultural production
10	Global change—regional change: recognizing challenges and opportunities for global change & local action
11	Decentralization—a strategy for a sustainable economy and lifestyle
12	Intelligent products and systems for tomorrow's society/intelligent products

Note: Numbers 2, 3, and 7 were finally selected as lead visions (with slightly different names)

Source: www.futur.de

9.4 Futur processes II: Topic narrowing process

The 12 focus topics that resulted from the topic formation process were the starting point for the topic narrowing process. The process had the following four purposes.

(a) To narrow the topics and make them more specific based on Futur criteria.
(b) To clarify the key elements to develop relevant fields and to evaluate their importance, uncertainty, and relationship to other elements.
(c) To clarify the need for research and development.
(d) To form basic ideas for each lead vision and scenario.

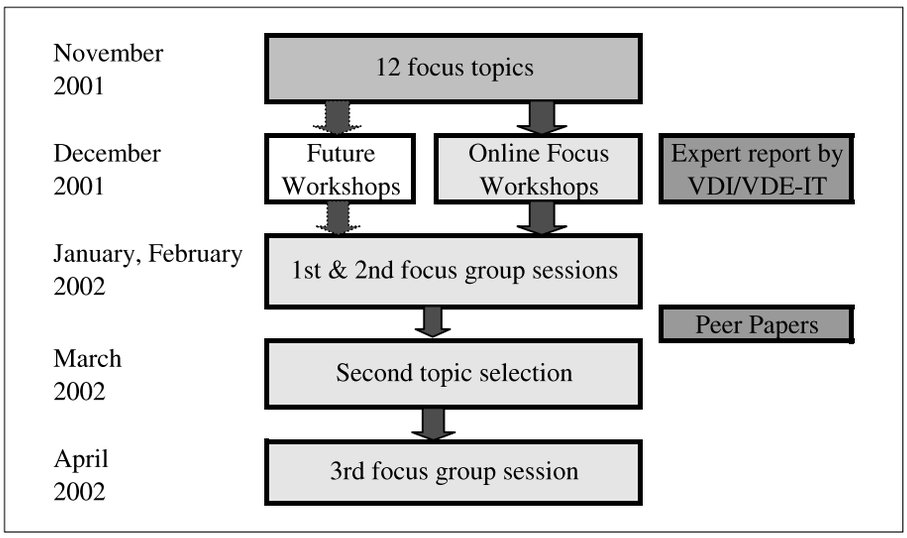
Narrowing process participants were designated by the consortium from conference participants, supplemental inner circle members, and members moving from the outer to the inner circle. Participants selected one topic from the 12, and 12 groups were organized based on that selection. Appropriate personnel were added through the suggestions of group members (co-nomination). The focus groups formed in this way were the basic organizations for the narrowing process that followed.

Two types of events comprised the work of the focus groups.

- Online workshops
- Three focus group sessions: The first two sessions covered all 12 focus topics. Topic selection took place after the second session, thus the third session covered 5 topics.

"Future Workshops," which originally had no direct connection with the narrowing process, were included. This is because it was considered necessary to increase the reliability of insights into the future and to improve the content of the topics. The process is explained in order below (see Figure 3).

Figure 3: Topic narrowing process



9.4.1 Future Workshops*[9] (Zukunftwerkstäte)

The Future Workshop method is a means of imagining (normatively) desirable futures and finding ways to make them a reality. Five topics were covered: the future of health and happiness, balancing work and life, the aging of a sustainable society, amalgamation of tomorrow's cities, and the learning society of the future. The participants comprised 125 inner and outer circle members (25 per topic).

Each workshop was composed of three stages, (1) collection of problems and ideas, (2) clarification of problems that must be overcome, (3) estimation of the degree to which research and development can contribute to supporting solutions for a sustainable society. The results were posted on Internet workspaces where they could be utilized in individual idea formulation and focus group sessions.

9.4.2 Online workshops

Online workshops were held from December 12 to 18, 2001. Their purposes were (1) to organize focus groups, (2) to provide participants with information regarding each topic, and (3) to clarify the conditions for topic selection. The secondary goals were to prepare for the opening of discussion and to clarify focus topics. Web pages for each topic were set up with related information, working papers, and the content of discussions during the topic formation process. Each inner circle member participated in the web pages of the single topic to which they belonged.

9.4.3 First and second focus group sessions

The functions of the sessions were to further settle on contents and select topics. Facilitators played an important role in this. That role had five parts.

(a) Guidance sessions (with the support of subject advisors on matters of technical expertise).
(b) Serving as liaison for participants before the sessions as well as constructing and guiding discussion. After the sessions, minutes were created in cooperation with subject advisors.
(c) Contributing to website creation by summarizing discussion, requiring participation, and other activities.
(d) At the first and second sessions, participant opinions on the topic were gathered and actual subjects that should be debated were clarified. After the second session, efforts were made towards mutual information exchanges and to prepare active development of debate. At the third session, efforts were made to strengthen profiles by confirming topic weak points, obtaining the cooperation of experts, and other activities.
(e) A final summary of session discussion was made.

The first session was held on January 15 and 17, 2002, with about 160 people participating. Its purposes were to decide the fields of innovation needed to achieve the focus topics and to clarify actual research domains related to those fields

of innovation. Through this session, the focus topics were made more specific and the fields of innovative research and the research subjects were clarified.

The second session was held on February 19 and 20, 2002. Its purpose was to decide the content of the focus topics. Specifically, this meant (1) the selection of innovation fields considered most important, (2) the creation of topic titles containing their key ideas, (3) deciding on the appropriate fields for innovation through explicit titles, and the clarification of specific fields of application, research needs and the importance of research, (4) deciding on major factors that would contribute to development of topic fields, and (5) the creation of a vision expressing the possibilities of future development related to the topic. (Note that (5) was optional.) At the second session, experts were added as requested by facilitators and the Federal Ministry of Education and Research, and Ministry bureaus concerned with distribution of funds and Projektträger personnel were permitted to attend.

Discussion results were compiled for necessary elements for future development of the field, such as social demand, fields of application and required research and outlook. These results were utilized as basic data for topic selection. The comments of leading experts in the subject fields were also added.

9.4.4 Second topic selection

After the second focus group session, the second topic selection was carried out with the goal of reducing the 12 focus topics to 5. The following methods were used.

- Online voting: Inner and outer circle participants numbered 332. Selection criteria consisted of the importance as lead visions, research prospects and social demand.
- Ranking by Projektträger and Federal Ministry of Education and Research experts: Topics were ranked by suitability for research, social demand, topic maturity, and political viability.
- Innovation Council Debates: The strategic direction of research policies were debated from a broad perspective including bettering lives, health and longevity with respect to innovativeness and topic quality.

Table 4: Futur favorites (5+1)

1	Access a world of learning
2	Living in a networked world: personalized worlds of interaction
3	Efficient knowledge processes
4	Individualized medicine and health 2020
5	Intelligent processes
6	Understanding thought processes

Source: www.futur.de

At the final decision stage, Minister Bulmahn made the final decision after the Federal Ministry of Education and Research carefully scrutinized reports based on the Futur criteria with the assistance of the consortium. At that time, "Understanding thought processes," which had been omitted during the first topic selection process, was revived, which led to 6 Futur favorites (see Table 4).

9.4.5 Third focus group session

The third session was described as an idea workshop to prepare lead visions and scenarios. It was held on April 16, 2002, in Berlin. The purpose of the session was to deepen the focus topics by giving direction to lead visions and creating scenarios. The relationship of topics to people's lives and future prospects for topics were debated. The results of the discussion were utilized in the final lead vision proposals and in the creation of scenarios.

9.4.6 Creation of scenarios and lead visions

The creation of scenarios and lead visions was the mission of the focus groups. Scenarios were created through the following steps.

(1) Profiles of each topic were presented for review, and leading experts in related fields added technical information.
(2) Based on reviews carried out during previous processes, IZT created scenarios for the five focus topics, excluding "Understanding thought processes," which was added later.
(3) Scenarios were revised based on the comments of focus groups, participants and the consortium itself.

Table 5: Structure of lead vision reports

Title	
Goals and Visions	
Description	• Social and economic importance • Issues to be dealt with • Potential for overcoming issues • Danger in delaying resolution of issues
Scenarios	• State of research, including existing research programs • Focus on future research • Scientific-oriented information • Research issues • Potential solution methods • Related research fields

Source: Taken from four lead vision reports available at www.futur.de

Lead visions were created by using the following steps.

(1) A lead vision team was formed for each Futur favorite. Teams comprised IZT, VDI/VDE-IT, ISI, IFOK, the Federal Ministry of Education and Research and focus group participants.

(2) Information regarding the status of research as well as current research programs were integrated with the lead visions by Projektträger experts and leading experts in relevant fields.

(3) IFOK prepared draft lead visions while other teams joined in their revision.

9.5 Futur's results: lead visions

The final determination of lead visions was made by the Federal Ministry of Education and Research. Four favorites (equivalents of 1, 2, 4, and 6 in Table 4) were chosen as lead visions: (1) Understanding thought processes, (2) Creating open access to tomorrow's world of learning, (3) Living healthy with vitality through prevention, and (4) Living in a networked world: individual and secure. "Intelligent products and systems for tomorrow's society/the intelligent product" was recommended to be handled as a cross-sectional topic throughout the Federal Ministry of Education and Research, while "Handling knowledge" was left as a future focus topic.

Completion of its scenario was delayed as "Understanding thought processes" was added by the Ministry which bypassed the scenario workshops. (A PDF version in German only was made available on June 15, 2003.) This has invited criticisms of the Futur process, claiming that it is not transparent, but others see it as demonstrating the flexibility of the process and the government's responsibilities towards it.

The first thing required for further development is the implementation of the lead visions. Within the Federal Ministry of Education and Research, which will play the main role in implementation, the establishment of action teams is already being planned. Changed priorities for the distribution of research support funding are expected. An internal Ministry workshop was held on August 27, 2002, Futur's topics & ideas were summarized while the start of Futur II was confirmed. The goals of the workshop were to further elucidate the concept and content of Futur, to launch ideas, and to implement intra-ministerial brainstorming throughout the Ministry. Underlying this is the clear recognition that innovation is required in science and technology policy, and that a change in the consciousness of policy bureaus is essential for that purpose.

German insiders point to the following as the results of Futur.

- Without adding new funding (unavailable in any event), lead visions will be reflected in priorities for the distribution of research funding beginning next fiscal year.
- Close cooperation on medical issues has been established between the Federal Ministry of Education and Research and the Federal Ministry for Health and Social Security.
- The creation of policies that cross organizational barriers within the Federal Ministry of Education and Research has been streamlined.
  The difficulties of so-called vertical policy formation have been recognized thanks to participation in Futur.

- In terms of future organizational forms, the tendency of horizontal organization to strengthen and vertical organization to weaken has been enhanced. This reorganization is already taking place, and the Z bureaus that handle core issues and strategies have been strengthened.
- There is a changed consciousness within the Ministry, with an awareness of the importance of demand beginning to take hold.

An external international evaluation of Futur was carried out in October 2002, resulting in an evaluation of "Good." An international workshop leading towards Futur II was held on December 12 and 13, 2002. The plan for Futur (as of May 15, 2003) is to take those topics not yet turned into lead visions and develop two or three of them into lead visions each year for the next few years. Futur II will then take place in a new form.

9.6 Conclusion

Although Futur is now underway, it is somewhat premature to offer any final evaluation on it. To understand its significance, however, it is necessary to place it in the context of its times.

Futur did not suddenly appear along with the Schröder's SPD Government. Its seeds were already planted during the CDU government of Kohl's . According to State Secretary Uwe Thomas of the Federal Ministry of Education and Research, Germany's science and technology policy has experienced two periods of transformation.

First period

During the latter half of the 1970s through the first half of the 1980s, reforms led to a shift from research based on the curiosity of individual scientists to research planned by institutions such as the Max Planck Institute. In the generational theory of research and development management, this is seen as a response to the shift from first-generation research and development centered on scientists to a second-generation R&D centered on institutional management.

Because the first generation was centered on the curiosity and interests of individual scientists, numerous problems arose, such as the duplication of research, a lack of research on important subject areas, and the proliferation of research institutions conducting similar research such as system theory and information sciences. Rapid advances at that time had also begun in space development, large high-speed computers, nuclear power, high-speed transportation systems, environmental protection and manufacturing technology. Germany lost the lead it once held in all those areas, then having to chase the USA and Japan led to an acute awareness of the problems. Facing these circumstances, research institutes consolidated and reorganized, attempting to improve the efficiency of research and development and to secure international competitiveness in science and technology.

Second period

The second half of the 1990s and into the early 2000s can also be likened to a generational change in research and development. In this case, the shift is from the second-generation seed-oriented research and development to third-generation R&D oriented towards markets and social needs. Research and development centered on large institutions is linked to increased inflexibility in research funding. Senior researchers heavily influenced internal distribution of the funds as research operation-type funds were going to institutions without their use being clearly delineated. The result was a lack of a demand orientation. There were also strong doubts at the national level that acute social problems were being solved. In light of this situation, the Federal Ministry of Education and Research's first step was to stop distributing research operation funds. The next step was the implementation of Futur with its clear demand orientation.

The following three points are seen as problems with Germany's history of traditional funding distribution.

(1) In its traditional systems and priorities, the Federal Ministry of Education and Research's existing research funding systems are strongly oriented towards seed research,

thus fresh ideas should be introduced.

(2) Negotiations among those concerned are closed and not transparent, and should be made open and transparent.

(3) There is a danger that new serious issues will be overlooked, thus these dangers must be minimized.

Against this background, Futur had the following characteristics.

(1) It added policy based on future social demand to innovation-oriented research policy. Yet it is not a panacea by any stretch of the imagination.

(2) It offered leadership visions for society that were interdisciplinary and solution-oriented.

(3) Without methods for heterogeneous creativity, mutual understanding and analysis from diverse participants, such goals cannot possibly be reached. Development of such methods was one of Futur's goals.

Can Futur be made universal and applied internationally? The Finnish parliament's Special Parliamentary Committee for the Future, for example, is carrying out essentially the same experiment. Japan should examine the question of whether it could be introduced here, and if so, how it should be modified.

Notes

*1 Futur is Latin, and is the root of the English word future. In German, future is Zukunft.

*2 Institute für Organisationskommunikation, http: //www.ifok.de/index.html

*3 Fraunhofer-Institute für Systemtechnik und Innovationsforschung, http: //www.isi.fhg.de/

*4 Institute für Zukunftsstudien und Technologie-bewertung, http: //www.izt.de/

*5 VDI/VDE-Technologiezentrum Informationstechnik GmbH, http: //www.vdivde-it.de/

*6 http: //www.pixelpark.de/

*7 Approximately one-third of the over 1,000 technology subjects covered in this second Delphi survey carried out in Germany made use of technology subjects in Japan's Sixth Technology Forecast Survey (1998).

*8 This report analyzed future journals from Germany and the USA and compiled the results of forecasts in 20 categories such as labor, natural resources/sustainability, science and research as well as learning and education. Prime Research, which carried out the study, is a think tank affiliated with a German newspaper.

*9 A future workshop method developed by Austrian futurologist Robert Jungk during the first half of the 1960s. For details, see Robert Jungk & Norbert Mullert, Future Workshops, Institute for Social Inventions, London (ISBN 0 948826 07 X)

(Original Japanese version: published in June 2003)

About SCIENCE AND TECHNOLOGY FORESIGHT CENTER

It is essential to enhance survey functions that underpin policy formulation in order for the science and technology administrative organizations, with MEXT and other ministries under the general supervision of the Council for Science and Technology Policy, Cabinet Office (CSTP), to develop strategic science and technology policy.

NISTEP has established the Science and Technology Foresight Center (STFC) with the aim to strengthen survey functions about trends of important science and technology field. The mission is to provide timely and detailed information about the latest science and technology trends both in Japan and overseas, comprehensive analysis of these trends, and reliable predictions of future science and technology directions to policy makers.

Beneath the Director are five units, each of which conducts surveys of trends in their respective science and technology fields. STFC conducts surveys and analyses from a broad range of perspectives, including the future outlook for society.

The research results will form a basic reference database for MEXT, CSTP, and other ministries. STFC makes them widely available to private companies, organizations outside the administrative departments, mass media, etc. on NISTEP website.

The following are major activities:

1. Collection and analysis of information on science and technology trends through expert network

— STFC builds an information network linking about 3000 experts of various science and technology fields in the industrial, academic and government sectors. They are in the front line or have advanced knowledge in their fields.

— Through the network, STFC collects information in various science and technology fields via the Internet, analyzes trends both in Japan and overseas, identifies important R&D activities, and prospects the future directions. STFC also collects information on its own terms from vast resources.

— Collected information is regularly reported to MEXT and CSTP. Furthermore, STFC compiles the chief points of this information as topics for "Science and Technology Trends" (monthly report).

2. Research into trends in major science and technology fields

— Targeting the vital subjects for science and technology progress, STFC analyzes its trends deeply, and helps administrative departments to set priority in policy formulating.

— STFC publishes the research results as feature articles for "Science Technology Trends" (monthly report).

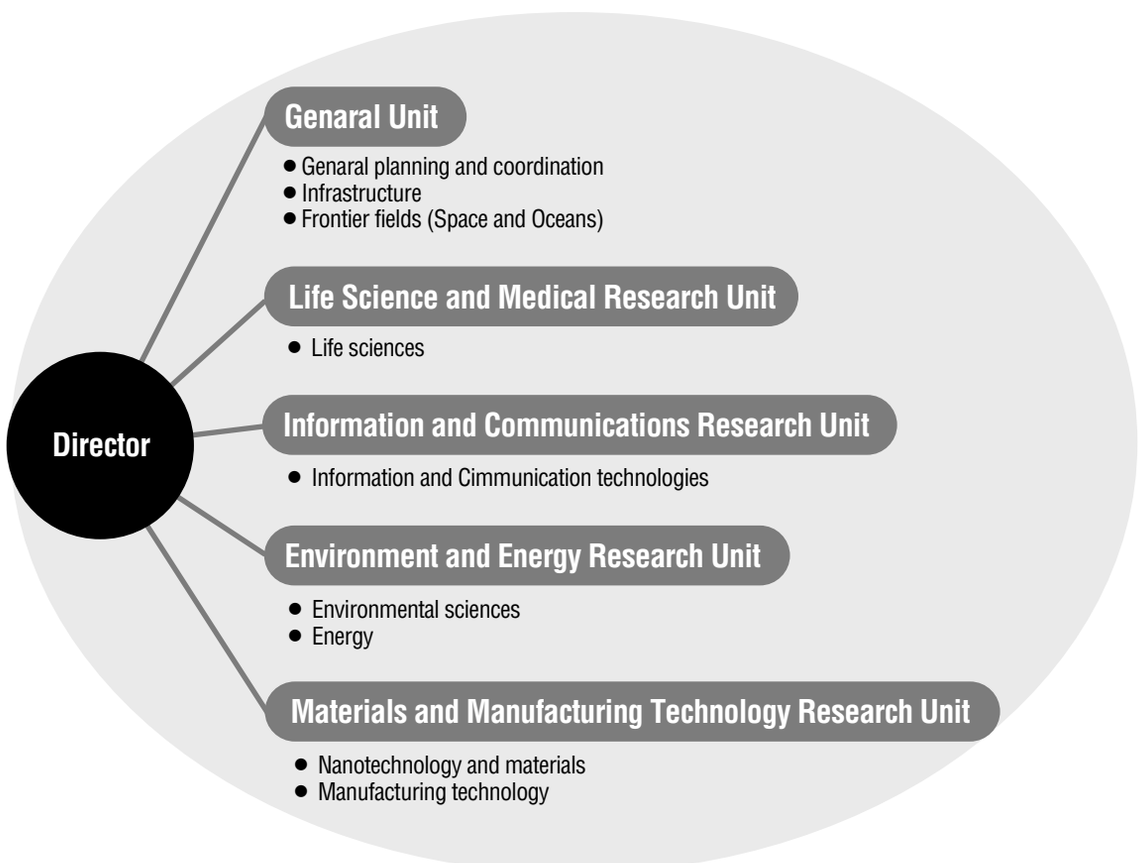
3. Technology foresight and S&T benchmarking survey

— STFC conducts technology foresight survey every five years to grasp the direction of technological development in coming 30 years with the cooperation of experts in various fields.

— STFC benchmarks Japan's current and future position in key technologies of various fields with those of the U.S and major European nations.

— The research results are published as NISTEP report.

Organization of the Science and Technology Foresight Center



* Units comprise permanent staff and visiting reseachers (non-permanent staff)
* The Center's organization and responsible are reviewed as required

- Life Sciences
- Information & Communication Technologies
- Environmental Sciences
- Nanotechnology and Materials
- Energy
- Manufacturing Technology
- Infrastructure
- Frontier
- Science & Technology Policy

Science and Technology Trends —Quarterly Review

No.9 October 2003

Science & Technology Foresight Center
National Institute of Science and Technology Policy (NISTEP)
Ministry of Education, Culture, Sports, Science and Technology, JAPAN