(English Translation by JAERI)

Report on the Allocation of Resources for Research and the Sharing of Responsibilities in International Co-operation

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Introduction

The Special Committee on the ITER Project of the Atomic Energy Commission has been established in December 1996 under the Chairmanship of Prof. Hiroyuki Yoshikawa, Chairman of the Science Council of Japan, in order to investigate widely how to deal with the ITER project from various view points such as Japan's long-term role in the international community as well as its social and economic aspects.

In March 1998, the Committee summarized the results in an Interim Report entitled " Discussion points and further consideration in the Special Committee on ITER Project" and clarified the issues to be discussed in future. The Interim report stated that "the Committee understands the great significance of Japan becoming the host country of the ITER Program," but on the other hand it stated that "through examination of problems, we identified subject areas requiring clarification in order for Japan to determine whether or not to become the host country," and presented six subject areas as follows:

(1) Survey on long-term energy supply and demand
(2) Feasibility study on alternative energy sources
(3) Technical feasibility of fusion energy
(4) Fundamental research as scientific basis of the project
(5) Allocation of resources for research
(6) International relations

The current committee was requested to investigate subjects (5) and (6). Regarding subject (5), it was indicated in the Interim Report that:

"Many research fields need public funding. Although the final allocation of funds across these fields should be made in accordance with a policy based on sound basic strategy, the basic concept of the general rule for the allocation should be established.

In particular, the trade-off between front-developing type and mankind-sustaining type researches is important. These are by no means antinomy against each other. Clarifying the fundamental relationship between these researches, the basic idea on the allocation of research resources should be created by reflecting the current trend of increasing demand for the latter type of research."

Regarding subject (6), the Interim Report said:

"With respect to the sharing of responsibility for international co-operation, any of several possible criteria might be used, depending on the type of project. Our aim is to establish a basic guideline for an actual project. For this task, discussions in the Mega-science Forum, established by the OECD-CSTP (Organization for Economic Co-operation and Development - Committee for Science and Technology Policy), would be useful as a reference."

This report summarizes the results of investigations based on these indications.

1. Allocation of Resources for Research

1.1 Basis for Consideration on the Problem of the Allocation of Resources for National Research Activities in Science

(1) The Case of Prototypic Science

In the 19th century, during the course of systematizing science, a prototypic pattern and a structure of scientific research was formed. One can recognize that the most significant feature of the basic structure was its self-closed, self-sufficient and self-contained characteristics of the scientific research. Scientists organized their own community as a professional group, and their research activities were completely self-contained, self-sufficient in their community. This was the essential feature of the structure. The knowledge produced as a result of research activities was circulated, consumed, used, and evaluated only inside the community of scientists.

Other groups of educated professionals, such as clergymen, medical doctors, and lawyers, also organized themselves as professional groups, which were exclusive and tightly united. However, there was a decisive difference between the scientists and other groups: the other groups had clients outside of the group, to whom they were accountable, while scientists did not. For instance, clergymen had as clients believers and seekers after truth. Medical doctors had as clients patients. And lawyers had clients fighting for their legal rights. Without clients, these professions simply would not have existed.

Scientists, by contrast, performed their work to satisfy their own curiosity and were not accountable to outsiders. Moreover, the scientific community was limited to individuals who shared the same scientific curiosity. Objectives of their researches existed only inside themselves. When they achieved their research objectives, a cycle of research was terminated. This type of research may be called “self-contained prototypic scientific research.”

In the case of self-contained prototypic scientific research, problems related to the allocation of resources simply did not arise. Historically, in the 19th century, almost all scientific research (including research at universities) was self-funded or supported financially by wealthy patrons who had curiosity in science, but were not involved in research itself. In one way or another, individual scientists raised their own research funds.

In the 20th century, scientific research gradually gained public recognition. Foundations were established to support scientific research systematically. The principle of the support was “Philanthropy”. Research resources were allocated based on the merits of each individual research program. Moreover, at the beginning of the 20th century, private enterprise, with the exception of a few chemical organizations, did not try to profit from the fruits of scientific research.

Scientific research at this stage relied on independent scientists and their self-management. Therefore, scientists had few problems related to the

allocation of resources including human resources. Today, this system is still to be found, particularly in the area of pure research. For example, this can be seen in the examination of general researches in the Government Subsidy for Promoting Scientific Research, where researches are evaluated and selected on the basis of the internal propriety rather than the priority of research themes. In addition, the outcomes of the research are evaluated by the researchers themselves. There is no final evaluation system in principle. These evidences suggest that such an understanding be accepted in the area of pure research.

(2) Science Based on the Bush Principle

Over time, changes occurred in the structure of scientific research. The most dramatic change was the rise of the so-called Bush Principle, based on a report, entitled "Science: The Endless Frontier" (1945) by Vannevar Bush, Secretary General of the Research and Development Division of the Defense Department at that time, which was written at the request of Mr. Roosevelt, the President of the United States.

The Bush Principle was based on experiences during World War II. The Roosevelt Administration had sought to use the fruits of scientific research and scientists' effort as an important key to win the war coping with the outbreak of the war in Europe in 1939 and that against Japan in 1941. Dr. Bush was appointed as Secretary General of the Research and Development Division of the Defense Department in 1941, and played a leading role in this effort. By the end of 1944, when the Manhattan project was near completion, Mr. Roosevelt was very pleased with the service of Dr. Bush who was executing successfully the unprecedented work where all scientists joined for the national objectives in the emergency. Anticipating the end of the war, the president wrote to Dr. Bush and asked what should be done to maintain a system similar to that which the central government had used so successfully during wartime for the national objectives during peacetime.

Dr. Bush's response to this letter was the so-called Bush Report. Based on his wartime experience, Dr. Bush recommended the systematic and organized use of scientific research through the central government as a national policy of the United States. Dr. Bush believed that governmental support of research and development and the resulting increase of knowledge of nature would advance peacetime national objectives, such as reducing poverty, increasing employment, creating new industries, and battling disease. This understanding was absorbed by Japan, where the Bush Principle still underlies the basic law of the present Japanese Science and Technology and the enactment of its basic plans.

It should be noted, however, that the Bush Principle is controversial, and many believe it to be obsolete. After World War II, the United States applied the Bush Principle in the execution of many large-scale projects, such as the further development of nuclear weapons, the development of intercontinental ballistic missiles, and the many space-exploration projects of NASA. After the end of the Cold War, however, such projects diminished. This might be called "the end of the Bush Principle."

However, this view ignores the fact or historical coincidence that the original Roosevelt-Bush concept was not actually applied due to the postwar military conflict with the Soviet Union. Whereas the aim of Roosevelt and Bush was to increase public welfare by applying the Bush Principle, postwar research and development was influenced by the military competition with the Soviet Union. Considering this, the Bush Principle was applied in a pure form, so one cannot easily claim it is obsolete.

In any event, it is clear to see that the Bush Principle produced a new phase of scientific research. The self-contained structure of prototypic scientific research changed to a new structure with clients outside the community of scientists. And, the powerful central government is a representative of the clients.

(3) The Gap between the Bottom-Up and Top-Down Approaches

In the application of the Bush Principle, a problem arises. On one hand, the attitudes of scientists toward their research are still basically self-reliant and self-contained. The selection of research themes is still decided fundamentally by the spontaneous curiosity of individual scientists. On the other hand, the nation, as a client, establishes themes (the missions) as tools to advance national policies, and tries to direct the efforts of the scientists. Sometimes, there is a happy accordance between the wishes of each. But, at other times, there is a conflict. When the government controls the work of scientists, resources are allocated in accordance with research themes that advance the goals of national policy.

In the case of government direction of research, two different principles of resource allocation coexist. One principle is "top-down direction," wherein research themes are selected primarily according to national policy and goals. The other principle is bottom-up direction, wherein research themes are selected by scientists according to their own interests.

In the case of prototypic scientific research, research resources once were furnished by the scientists themselves. But this means of support is not sufficient to meet the needs of large-scale research. At present, therefore, it is reasonable that the nation provides a fair amount of research resources, even for research projects that originate from the curiosity of individual scientists.

(4) Principles of Resource Allocation for Prototypic Science

As mentioned above, it is reasonable for a nation to allocate a certain share of research resources for projects stemming from the curiosity of individual scientists. However, this principle must be applied with care, particularly in comparison with other cultural activities.

When scientific research is based on the curiosity of scientists, it should be based on the principle of philanthropy. After all, the allocation is based on the recognition that scientific research is useful to expand the width and depth of human beings.

Of course, fine arts such as literature, poetry, painting, sculpture, and

dancing are also useful for that same purpose, but for the most part the government does not give financial support for creative arts. Novelists and painters, even if they are very poor, do not demand financial help from the nation for their creative activities. An exception is the fields of opera and Kabuki, where a movement has begun to provide government support for building national theaters and preparing the infrastructure of these artistic activities.

If prototypic science is driven by the curiosity of researchers, it should be discussed whether the project should be financially supported by the nation's taxpayers or not, even if a research project is large in financial and human resources. The rationale for that support is not significantly clear compared with that for supporting artistic activities.

If the results of scientific research bring "national benefits" such as winning the Novel Prize and enhancing Japan's international prestige, this is an additional benefit and an additional rationale for the use of government funds. However, world-famous novels, poems, paintings, or sculptures, all of which can be produced with the support of government funds, would also raise Japan's international prestige.

In the light of the foregoing discussion, it would be hard to argue that there is a unique rationale to provide government support for prototypic scientific research. Rather, the question of support must be considered within a broader context of how and to what extent the government should give financial support for cultural activities.

(5) Research Resources in Private Organizations

Another basis for consideration of research resources is investments in research and development by private organizations. After basic science had been established in the 19th century, research was confined mostly to universities and private laboratories owned by the wealthy. At that time, scientists did conduct some research in private industrial organizations. Industries did not have means to use the research results of scientists. The government had divisions handling national standards and regulations, international standards, or patents. These divisions included the Bureau of Weights and Measures, and Bureau of Standards. A very small portion of scientists was employed by these divisions. For instance, Dr. Einstein worked as a scientist in the patent office in Bern.

About 1920, a new pattern was born, in which private organizations employed scientists in their in-house laboratories to conduct research aimed at the development of new products. During World War II, a structure was formed in which private companies sharply increased their investments in research and development, and the government relied upon their success. In other words, private companies cooperated with government entities for war-related goals. The Bush Report, interestingly enough, discussed the question of the proper ratio of the research in government organizations to that of private ones. As will be explained shortly, it is widely known that the research and development activities in Japan, as compared to other developed countries, are considerably biased toward those of private organizations.

1.2 The Problem of the Allocation of Resources for Research Activities

(1) Allocation of Funding Sources of Nation for Research and Development

A key question is the optimal relative contributions of public and private resources to a nation's total research and development expenditures. International data on the current situation are presented in Figures 1 and 2.

As can be seen, Japan has the world's highest ratio of research and development to GDP, as well as a unique pattern of funding sources compared with other developed countries. In Japan, private resources account for about 80% of total research and development, and government investment about 20%. In the United States, government investment in the United States is about 30% of the total, and in France, the government share is over 40%.

Of course, one cannot say what ratio is optimal. These patterns are a product of historical accidents rather than intentional designs. Therefore, one cannot say, because Japan's pattern is unique, that it entails some sort of "imbalance."

Nevertheless, the unusual Japanese pattern exhibited for many years has frequently been a subject of discussion, as a strange example, internationally. In this situation, it is possible to recommend particular goals, such as to increase the government investment up to 25% of the all research expenditures over the next ten years. The rationale for this recommendation is not clear, but any reason that it is not unreasonable cannot be found. To take this example, assume that the gross domestic product will increase by 1% every year, and that the ratio of research expenditure to GDP will remain at 3%. Then the situation in 2009, compared with 1997, would be roughly as shown below.

	GDP (trillion yen)	Total Research Expenditure (trillion yen)	Research as Share of GDP (%)	Government Research Expenditure (trillion yen)	Government Share of Research (%)
1997	505	15.7	3.12	3.20	20.4
2009	560	17.0	3.03	4.25	25.0

Increasing government expenditure to 4.25 trillion yen over ten years would require an annual growth rate of slightly less than 5%. Of course, it might be necessary to assume that private investment in development would decrease from the present level. In any event, these figures for 2009 are not unrealistic. This recommendation is worth investigating at least as a policy issue.

It is not our intention to base further discussions on these estimates for the year 2009. Considerations of the case wherein the government share increases by the amount shown above would be somewhat related to the discussions concerning the realistic allocation of resources. We cannot avoid having discussions on what would be the purposes for increasing the government share.

(2) Uses of Government Resources

Let us assume that the Bush Principle continues to govern practice in Japan. In this case, the Science and Technology Basic Law and Basic Plan of Japan will be maintained for a considerable time. The government share of support for research and development will be decided primarily within the framework of using science to improve the level of public welfare including the promotion of industries, employment problems, and medical care.

The government share of support for research and development will be based on the principle that research themes will be in accordance with government policies. As described above, a major portion of the resources should be allocated to advance the national policies, even though it is fair to support prototypic scientific research.

As a basis for discussion on the execution of national policy, it is essential to think of the area of roles of a nation needed to function as a nation. In the field of research and development based on the Bush Principle, there are several fields in which the government cannot rely on local governments, private organizations, or individuals. By order of priority, these fields are:

(1) National security from the standpoint of the entire nation

(2) International functions of the nation

(3) Support for the research and development, which is scientifically necessary, but is unlikely to be supported by sub-national organizations.

(4) Support for the development of leading industrial technologies

(5) Research and development by requests of (part of) the public

Field (1), "national security," includes the following subfields: (i) defense strategies; (ii) the security of essential public utilities; (iii) countermeasures against national disasters; (iv) the security of energy sources for the stable public life; (v) medical science of national interest (e.g., cancers, fatal accidents, allergies, incurable diseases, mental disorders, etc.); (vi) health systems; (vii) security (including quantity, quality, and safety) of the domestic food supply; (viii) crime and terrorism, and (ix) the waste treatment.

These may be a present-day expression of issues that have been within the purview of "historical issues of nation". In the past, the list included such items as "enrichment and military strength," "development and expansion," and

"industrialization." In the future, the general goal will be "the promotion of an appreciation of values to free ourselves from a large amount of consumption of material and energy".

Field (2), "international functions," includes the sharing of international functions which Japan can be expected to assume as a developed country. More specifically, Japan can contribute to international co-operation and large-scale research in the following subjects: (i) world environmental problems, (ii) support for industrial technologies and medical care in developing countries, (iii) space development, and (iv) ocean development.

Field (3), "research and development, which is scientifically necessary, but is unlikely to be supported by sub-national organizations," is mainly related to prototypic scientific research. Such research should be recognized as a part of a wide range of cultural activities. Therefore, such research must be balanced with the support for the cultural and social sciences, and the arts.

Field (4), "leading industrial technologies," includes subjects for which the government takes the initiative to promote competitiveness and accelerate the maturation of private Japanese organizations.

Field (5), "requests by the public," includes subjects that the citizenry proposes. The subjects include (i) environmental problems, (ii) private certification systems for food, medicine, and other necessities, and (iii) the construction of viable communities. (In the 21st century, research and development in these subjects will probably increase as more attention is paid to "citizens" as active clients.)

Needless to say, these five categories cannot be strictly separated. In some cases, research and development, which starts in one category, will migrate into other category with the progress of the research. In other cases, a single subject of research will span several different fields.

Regarding government investment in those categories, several facts are noteworthy. First, the United States has canceled its Superconducting Super Collider (SSC) project, and is now concentrating its efforts to striving to lead in the areas of information technology, and life-science technology. The fact that Japan is behind in these two areas has become a serious problem. In light of this situation, Japan must focus its own "strategy" on these areas to compete with the United States. However, to adopt this focus as a Japanese strategy is only to reveal that Japan has no original strategy of its own, but is merely following the United States.

Second, Japan's future will be greatly influenced by how the Japanese government maps out an original strategy and how it directs its science and technology policy in the 21st century. In this respect, we believe that the Japanese government has not functioned satisfactorily thus far. For example, it is rare to observe the Science and Technology Agency independently planning, designing, and promoting a science and technology policy based on consistent ideas and actively directing the policy of the entire government.

Moreover, we are concerned with several problems. First, even the Agency's own projects were not always conducted on the basis of a well-defined agenda. Presumably this problem is not limited to the field of science and technology. Similar problems exist in any of the other agencies and ministries.

Second, it is increasingly important for Japan to settle on a "strategy." The planning of such a strategy is the very function assigned to the General Council for Science and Technology to be renewed at the time of the administrative reform. Up to now, the Council for Science and Technology has been a consultative organization for the Prime Minister. At present, the Council submits reports when asked. The new function, i.e., the planning of strategy, which will be added to the newly reformed Council, must be given a high priority.

Suppose that Japan already had an original strategy. Then a question would be what is the next step? It is important to realize that Japan does not need to follow the strategy of the United States. With regard to national security and economic structure, Japan should cooperate with the United Stated from the standpoint of mutual dependence. But with regard to research and development, we are free to do something other than follow in the footsteps of the United States. We should have a flexible attitude and sometimes select a course different from that of the United States or a course supplementary to the United States.

From both the theoretical and practical points of view, in information technology and life science and technology, the fields of which the United States is in the lead, Japan has many possibilities of developing a prosperous future. Thus, it is quite natural that research and development in these fields attract much attention, and there is no reason not to highlight these fields as a matter of policy. These fields indeed have a bright future. This is because research in the fields is expected to be so fruitful as to open up a new field of knowledge beyond fully established sciences, and to contribute greatly to the happiness of humankind, now and in the future. Choosing the independent course mentioned above is not because Japan intends, for some "strategic" reason, to avoid a position subordinate to the United States.

From the standpoint of urgency and fundamental importance, energy technology simply cannot compete with life sciences and technology, and information technology as a short-range priority. However, for the long term, continuous and stable progress of mankind, clearly energy technology has a fundamental importance.

Moreover, private organizations are investing actively in the areas of genome research and technologies related to computers and networking, and recently this activity has becoming more prominent. Therefore, the need for government support in these fields should be discussed and evaluated from the viewpoint of sharing the roles of government and private organizations.

Now is time for Japan to have a reasonable share in the progress of knowledge. For instance, in "the Subaru project", remarkable results have already been obtained at a preliminary stage of the research. And "the Reizer

drilling-ship project", Japan is expected to play a major role for the hardware construction and management of the project as a contribution to "the Ocean Drilling Program (ODP)". Many Japanese researchers have achieved various kinds of success in science using the facilities and equipment of other countries. However, we have few such cases in which Japan has invested in the facilities and systems to attract researchers of the world and that the outcomes obtained using the facilities and systems contributed to enrich the intellectual properties of mankind beyond the boundaries of Japan.

In fact, for the past ten years, the Ministry of Education and the Science and Technology Agency have put forward a plan named "Centers of Excellence" (COE). The main idea is to develop research sites of the highest quality, similar to the National Institutes of Health (NIH) in the United States. As currently designed, however, COE would be built on the basis of "Comparison and Equality." In this case we do not think we can have true COE. It may be adequate for Japan to have several research sites where researchers of the world can devote themselves to their research with ample time and funds, being unconscious of direct propagative effects of the results of their research over industries and economy. The installations and effective uses of the facilities would result in giving remarkable contributions to the international society by providing the world with open research sites and by accumulating intellectual properties of mankind under the leadership of Japan.

(3) Principles of the Allocation of Government Research Funds

In the beginning of the previous section, we listed five research categories that merit government support. Except for field (3) (research and development which is scientifically necessary, but is unlikely to be supported by sub-national organizations), the allocation of funds to each field and within each field should be guided by the following two principles. First, allocations within each field should be based on a well-defined government policy. Second, competition between and among the fields should be discouraged. This applies with special force between fields (1) and (2), on one side, and field (3), on the other.

Regarding field (3), priorities should be decided by a peer-review process conducted by the Science Council of Japan or a similar organization. As a basic rule, policy considerations should not be introduced into decision-making.

As discussed above in the section 1.2 (1) "Allocation of Funding Sources of Nation for Research and Development," we assume that the government's contribution rises. The question then arises as to which category the increment should be allocated. Also, the allocation among these categories is the most difficult policy issue. At this point, we have to recognize that there are no grounds on which we can choose a rational allocation. One possibility would be to simply modify funding for each category based on the present allocation. Unfortunately, since no data are available in which the expenditures of research and development were categorized in the manner shown above, even this simple approach is problematic.

Figure 3 shows data arranged in categories somewhat similar to the

categories above. Based on these data, rough estimates can be made of the present allocation of government funding into the categories above:

(1) 52 %
(2) 13 %
(3) 13 %
(4) 22 %
(5) 0 %

It is no wonder that there is a current lack of funding for category (5). There are various views on this ratio, which is simply due to the result of historical coincidence. To change the balance of funds for this category, allocations to other categories might be reduced in accordance with several possible rationales. For instance, category (4) could be reduced since there are currently incentives to promote research and development in this category by private organizations, and the government should not intervene in the activities of private organizations. It is suggested here that the allocation to category (4) could simply be set at the same level as category (2) or (3). If the ratio of the category (1) were left unchanged, and if categories (2) and (3) were increased slightly, the following allocation might result:

(1) 52%
(2) 15%
(3) 15%
(4) 15%
(5) 3%

Once again, it should be stressed that there are no rational grounds supporting this allocation. Conversely, there are no grounds to call the allocation irrational. In view of this, the ratios proposed above should be discussed extensively in various fora, e.g., the Science Council of Japan and the Federation of Economic Organizations.

The following points merit re-emphasis. First, after the allocation of funds to each category has been decided, then it is possible to discuss allocations, based on explicit policies, within the categories. Second, explicit policies will tend to minimize random allocations and forestall useless opposition or unnecessary competition, both of which are seen in funding discussions for projects belonging to the different categories. Such projects are exemplified by the prototypic scientific research and the research and development needed to construct national infrastructure.

At this point, in deciding the allocation or in discussing policy issues, it should be added that, whereas in the past, science research was conducted in a close space occupied by specific scientists who are directly associated with the research, now research is becoming more open and socialized. We think that, in the future, this openness should increase, for the following reasons. First, government support for research activities is at the expense of individual, tax-paying citizens.

Second, the fruits of research have direct or indirect influences on the social

lives of the people. The results of scientific research can be seen in many facets of society. Research is closely related to social and political problems, as well as to problems of foreign affairs, defense, and medicare. It is necessary for the government to share with the people its visions regarding what research should be undertaken, what problems are involved with the research, and what questions and issues can be enlightened. With the power to choose come responsibilities.

On the side of the people, it is needed for the people to have acute sights to perceive the fascinations and advantages of science and technology and such potential risks experienced with nuclear physics research, which furnished nuclear weapons, and to have sound judgements concerning these matters. This also goes with responsibilities. The acuteness and soundness should be in relation with human society. In this sense, it is important to give a basic science education to those who aim to go into non-scientific, non-technical fields in an educational course ranging from elementary to higher education. It is also important to educate those who would like to have jobs in the fields of science and technology for obtaining a basic knowledge on society and mankind. Hopefully, the people have deep concern with and consciousness of science and technology as fields having profound daily influences on individual and society and, moreover, the future of mankind. The following should be fully recognized: The government and administration have responsibilities on the visions which they showed. On the side of the people, similarly, an individual person has responsibility for his or her judgement in a sense that the judgement could have an influence on the direction of national science research and, in turn, on what the society and economy of Japan should be in his or her day and in the coming days.

For advancing scientific research, particularly, the project-type research supported by the government, it is important to repeatedly evaluate the research results. The evaluations include pre-initiation, post-completion, and interim-assessment of long-term research. Since project-type research is generally performed by investing large amounts of money, strict and multiple evaluations are justified. The evaluation criteria include the adequacy of the targets, the chances for success, whether progress is continuing, the effects, positive or negative, on society when the fruits of the research are utilized, and the magnitude of the effects.

In addition to the evaluation by scientific peers, it may be necessary to include others in the evaluation. More specifically, the people are investors in the research, who have a stake in the success or failure. At present, however, more efforts are needed to improve this situation, though it might be a general problem of science and technology in Japan.

Moreover, risk assessments are also important. In international projects there are other sources of uncertainly, including the withdrawal of foreign participants and a change in people's interest which may result in changes of project targets. This has been the case in some past projects. In international projects, therefore, the research should be reviewed at least once every few years, with the projects viewed as investments carrying risks, and with the understanding that original plans may need to be changed. In the worst case, projects might be discontinued.

1.3 Allocation of Resources for ITER

It is beyond the function of this Committee to discuss conclusively the ITER project. However, it is possible to touch upon the fundamental points of this issue in conjunction with discussions given in the previous sections. In section 1.2 (2) above, five categories of research that the government should support were listed. Support for ITER falls in the two, highest priority categories,

(1) National security and
(2) International functions.

Support for ITER also bears to a lessor extend on category (3),

(3) Research and development, which is scientifically necessary, but is unlikely to be supported by sub-national organizations.

ITER is expected to play a role as the first step in securing a long-term energy source for Japan, that is, in insuring the security of energy for resource-scarce Japan.

The ITER project cannot be carried out by private organizations for the following reasons. First, the project entails advanced technologies and further progress can be realized only through the construction of large-scale and enormously expensive research facilities. In fact, the huge expense is one reason the project is a candidate for international co-operation. Second, the project falls within the domain of nuclear fusion. This is a field for which Japan is able to play a leading role.

The ITER project is of large scientific significance. Even if the ITER project does not entail prototypic scientific research, it still is significant within the framework set out by Dr. Bush.

The Subaru project, by contrast, is one entailing largely pure prototypic research. It is a typical example of a project belonging to category (3). The project was first discussed in the Science Council of Japan as a researcher-initiative plan and, then, decision-making was performed on the basis of a peer-review of the Council. The project gained added support because it was recognized for its secondary importance in category (2). As a result, the project was finally approved as a national project.

In contrast to the Subaru project, the final goal of fusion projects including the ITER project is to construct a commercial reactor, the “thermonuclear fusion reactor.” Still, ITER would be an experimental reactor, and would serve as only one step in a series of steps, which eventually would include prototype and demonstration reactors. ITER could be widely shared and used by researchers affiliated with universities and other organizations to conduct research on burning plasma and studies of extreme conditions. Thus, there would be a large potential to advance knowledge and information in the fields of physics, including plasma physics and material science. Therefore, there is every reason to expect ITER to have great scientific significance.

However, one should not ignore the fact that the ITER project is one of energy development. In that sense, the pre-, post-, and interim- evaluations and the risk assessments should be regarded as the essential parts of government-supported projects, rather than mere administrative procedures. In this respect, the administration and those who are related to fusion projects should remain mindful of public criticism.

The ITER project is only one part of a larger program to develop nuclear fusion. The government expects that many years will be needed to complete the research on this ultimate source of energy. It is indispensable that the public understands this long-term nature of the project.

An examination of the progress made so far reveals the following. First, actual achievements have diverged from the targets set originally for the construction of an experimental reactor and a prototype reactor. It is unavoidable that the public would feel disappointed. If ITER were built, we expect results sufficient to improve public attitudes toward this type of research, and earnest efforts of the researchers to gain public understanding, provided the public is shown signs of progress. Toward this end, the researchers must understand what was wrong with the past efforts and make full use of lessons learned from the past in future activities.

If the ITER project proceeds, certain points should be considered. Since these points have been already discussed in other special fields, we would like to mention them only very briefly. First, there are problems related to materials. ITER, i.e., an experimental reactor, does not present the problems, but a prototype, demonstration, and commercial reactor, all of which follow the experimental reactor, will encounter the problem of severe neutron irradiation. As a consequence, the structural materials of the reactors are radioactivated and tend to become brittle. This will produce a large amount of radioactive waste material and frequent replacement of the materials. This will tend to increase operating costs. Regarding the plasma-facing first wall, which will be under excessively severe conditions, but reportedly, candidate materials have already been found, the development of low activation materials should be conducted steadily toward the development of a demonstration reactor and later.

Second, there are issues related to safety. Out of necessity, careful attention was paid to the safety of ITER during its design, with special attention to the following points. First, ITER has a large amount of a radioactive substance named tritium. Second, a considerable amount of high-energy neutrons are produced. Third, ITER is a large-scale fusion machine to produce a large amount of energy by a thermonuclear fusion reaction, which mankind has never handled before.

The third issue is the professional people who can play a leading role in the management, scientific and technical areas of the international project such as ITER. If Japan is to play a leading role, it must start training personnel able to play this role.

Finally, it is important to consider the resource allocation for the ITER project on the basis of historical context. Japan succeeded in strengthening her industrial competitiveness by assiduously gathering scientific and technological knowledge and information from Europe and America. By this means, Japan achieved its present prosperity as a trading country in a favorable international environment. The environment comprised both an economic system based on free trade, and a well functioning security system, both of which were built by Europe and America. As a consequence, it can be said that Japan is indebted to those countries and is obligated to repay this debt. This is the reason why the Subaru project was accepted as a national project. For the research in the field of nuclear fusion, Japan has a high valuation in the world and seems to have obtained the international right to speak on the research. The ITER project will provide the best opportunity to fulfil Japan's responsibility for such intentional co-operations.

2. Sharing of Responsibilities in International Co-operations

2.1 Incentives of Conducting International Co-operations

Research and projects can be advanced by international co-operations in the field of science and technology. We can list the main incentives for the co-operations as follows. First, the basic problem of finite natural resources must be solved if mankind is to achieve sustainable development. The problem is global in nature. All of mankind faces this problem, and a global effort is needed to solve the problem. Thus, the nature of the problem calls for international co-operations.

Second, it is well understood that more of mankind could enjoy the fruits of science and technology. But present scientific research often requires large-scale investment. The fruits of this scientific research are international common properties. There is an increased need to cope with the research by the international co-operations. The co-operation is needed to pay expenses proportional to the benefits.

Recently, certain trends are emerging. First, due to the rapid progress of science and technology, it is rather difficult for any one country to be a leader in all fields of science and technology. Yet, often progress in one area requires technology from many fields. It follows that each country should have outstanding research fields to contribute, in order not only to use effectively the worldwide potentials, but also to make the global progress in science and technology. International co-operations will inevitably entail first-line scientists by giving increased opportunities for the exchange of views and the intellectual stimulation by discussions. More such opportunities increase chances of advancing science and technology.

Second, recent scientific research requires a vast amount of investment to construct a large-scale and high-grade infrastructure. This can be seen in the field of space programs and accelerator sciences. In addition, the developed countries that play a major role in science research are constantly suffering from a low economic growth rate. In future, we cannot expect to have an economic growth rate of two figures.

As a consequence of slow economic growth, a substantial increase of tax revenue cannot be expected. In general, any country has political groups that strongly oppose increases in government expenditures. This serves to impede investment. Furthermore, the aging of national populations and the demands for fully supported welfare will make financial constraints on scientific research even more severe in the future. Under these circumstances, interested countries must share the cost of scientific research.

2.2 Types of International Co-operation in Scientific Researches

There are several different types of international co-operation in science

research. One type is exemplified by the genome research. In this case, each country is conducting its own research with relative freedom, and their activities are only loosely connected between countries.

The second type is seen in the field of accelerators. One country takes the initiative and builds a large-scale core facility, but allows other countries to join in as members.

The third type is the case wherein there is a general interchange of research and a wide exchange of information. These types of co-operations vary, depending upon the contents of the research. Sometimes the activities are centralized, and sometimes they are decentralized.

We can have different types of co-operation when we widen our view from individual projects to science research in specific areas. In the development of nuclear fusion, for example, one country plays a leadership in the field of plasma physics. Another country plays a leading role in the field of reactor engineering. Further, a different country plays a leading role in the construction, operation and exploitation of large-scale facility.

Furthermore, taking an even wider perspective, beyond scientific research in specific areas to the whole scientific research, we see from an examination of micro-scale research activities of each country that although the country takes charge of the domestic research. Nevertheless, a type of international co-operation is formed. This may be a case wherein each country displays a leadership in the strongest field of the scientific research. As an example, the United States leads the space program and, on the contrary, Europe leads accelerator science.

2.3 Sharing of Responsibilities in International Co-operations

In this section we can consider scientific, technical, financial, and management sharing of responsibilities. When we widen our views on research, as shown in the preceding section, we have a case that a country exhibits leadership in one field of scientific research and undertakes almost all other fields, including research, funding, and project management. From the broad point of view, this may be considered to form a type of responsibility sharing in international co-operation.

In almost all cases of scientific research projects which are carried out under international co-operation, any country joining a project contributes to almost all components of the project, including scientific research, funding, and project management. The only difference may be the extent of the contribution.

A question naturally arises. What kinds of contributions should be made, and to what extent? Unfortunately, there is no generalized principle applicable for all international scientific research projects. The method and extent of contributions varies from country to country. There is no one single form of international scientific research co-operation. However we can discern certain general forms, depending on the type and the nature of the research. Actually,

the appropriate form is determined by various factors, including the level of enthusiasm in each country, and economic power and political power. Even if the resulting type is less than ideal, it is worthwhile to consider what type of responsibility sharing should be selected, depending on the type of scientific research project.

As one possible approach, it would be helpful to examine the type of responsibility sharing in actual cases of scientific research projects. First, let us consider the centralized project where research activities are mostly concentrated in a leading country. Representative examples include the International Space Station program, Large Hadron Collider (LHC) project of the European Organization for Nuclear Physics (CERN), the European Synchrotron Radiation Facility (ESRF), and the Neutron Reactor of the Institute Laue-Langevin (ILL). Examinations of these cases reveal large differences among them in the types of responsibility sharing, in particular between the International Space Station program and other European projects.

Regarding the International Space Station project, an international scientific research project in which the United States, European countries, Japan, Russia, and Canada are working co-operatively, the United States carries a large share of the responsibility. The United States provides a major portion of the cost. On the technical side, the contributions of countries other than the United States are limited to the development of modules, which they are in charge, and a portion of equipment and units. For its part, the United States plays a major role in the development of technical concepts and systems for the entire space station. In addition, the United States plays a leadership role in unifying the whole system, including planning and co-ordination of the whole project, management, adjustment of procurements, and the system integration including modules developed by other member countries. The proper use of the space station, the assignment of boarding opportunities, and the allocation of resources for the use of the station are based on the contribution of each participating country in providing the modular equipment. The United States contributes the most and enjoys the largest share of the benefits.

In the case of CERN, an international facility, members include about twenty European countries, while Japan and the United States are observers. Apparently, the sharing of responsibilities among the European member countries is decided either on the principle of the equal contribution, or the principle of the contribution corresponding to the national power. The allocation of the CERN funds is in proportional to the national income of each member country. Germany offers the largest contribution, with a share of slightly more than 20%. This percentage is considerably lower than that of the United Stares in the International Space Station program. For the scientific research and project management of CERN, the council plays a major role as the highest decision-making body, but voting is on the basis of one vote per country. The director of CERN is selected by the council using the forgoing procedures, and entrusted with full power.

The ESRF was established based on the municipal law of France. It has about ten member countries with official contracts. Several other countries join as scientific partners. The type of its responsibility sharing basically resembles

that of the CERN. A board of directors decides important policy issues. The issues include personnel administration, financial issues, programs of scientific research, and the like. The board is composed of representatives of each member company, the number of which is not more than three. They employ a voting method of one vote per person. Motions must either be unanimous or have a two-third majority, depending upon the issue. This indicates that no single country has a major share of the responsibilities. The sharing of funds is similar to that of CERN, but France, the hosting country, offers a contribution slightly higher than other member countries do. It should be noted that France has a so-called add-on share by furnishing land, buildings, education of children of other member countries, and so on.

Finally, there is the case of the Joint European Torus (JET). This is another case wherein the hosting country, the United Kingdom, supplies an add-on fund.

A review of the various cases indicates that responsibility sharing differs greatly even within the category of centralized projects. The types include a type in which a country bears almost all the responsibilities, a type in which responsibilities are shared equally among the member countries, and a type in which responsibilities are shared based on the national power of each member country.

In the case of the International Space Station program, the United States originally proposed the program with much enthusiasm. The program was launched in a form in which the member countries followed the United States. For reasons of national security, both the United States and Soviet Union made tremendous investments in space development such as the Apollo project during the Cold War, and provided researchers and engineers with various opportunities for the development of space technologies. As a result the United States became exceedingly superior to other countries in those aspects. Russia, on the other hand, placed efforts on space development to compete with the United States and attained a technological level comparable to that of the United States. However, Russia was practically defeated in the Cold War. For this reason, Russia had an economy having no surplus for such investments.

Due to these circumstances and the technological ambitions of the United States, the United States became the sole country that was able to propose the International Space Station program, a large-scale international space development project. It was able to play a leading role in the areas of funding, technology, and project management. With respect to project funds, the United States used funds appropriated during the Cold War and shifted them toward the space development program, and was able to do so even though it was in a poor financial condition. In addition, the United States had the political will to symbolically show the end the Cold War by co-operating with Russia in scientific and technological researches on a large scale.

With the exception of international scientific research projects for which a country has a strong incentive to drive for some reasons and in which a country makes investment for its fate and prestige for such reasons as national security, international scientific research projects usually attract much concern of a variety

of researchers of many countries. Regarding international scientific research projects which provide only civil applications, we consider that the type employed by CERN and ESRF furnish a common type of responsibility share.

In the case of ESRF, as described above, France, the host country, has an add-on share by making a special contribution in the areas of fund sharing and other supporting activities. In centralized international scientific research, it is very important to consider how the responsibility is shared between the host country and non-host countries.

For a study of this problem, the discussions conducted by the Mega-science forum of OECD/CSTP (the Organization for Economic Co-operation and Development/The Committee of Science and Technology Policy) should be referred to. The CSTP had broad discussions on the various problems related to Mega-science, and analyzed the effects of hosting international scientific research facilities.

The discussions cannot be quoted in detail. The CSTP analyzed the benefits, which the host country enjoys, and the disadvantages, which it suffers. The results are summarized in the following table:

Benefits and Disadvantages of Hosting

Category	Potential benefit	Potential disadvantage
Political	• Prestige • Management control	• Increased difficulty of withdrawal
Economic	• Effects of salary spending and tax revenue • Regional development • Reduced travel costs	• Hosting premium • Creation of infrastructure • Decommissioning/closure cost
Industrial	• Contracting to local industry • Improved technology in industry • Technological spin-off	• Displacement from other economic activities
Scientific	• Creation of COE (Center Of Excellence) • Ease of access • Return from critical mass	• Opportunity cost to national program
Employment & Skills	• Local administration and maintenance staff • Higher proportion of national scientific staff • Prevention of brain drain • Training – PhDs, Tech., Eng.	• Possible salary difference • Opportunity cost to employment • Skills/expertise left over when facility closes
Cultural	• European/international school • Science education/public understanding	
Environmental	• Sustainable development/green policies	• Destruction of greenfield site • Nuclear concerns

Mega- science Forum, Policy Issues (OECD, 1995)

The CSTP indicates simply that the host country should pay careful attention to establishing a mechanism to maintain the balance of benefits and disadvantages, which will be brought to the country by hosting the project.

The above indications suggest certain implications for the consideration of responsibility sharing in the international co-operation of scientific research. In the table above, management control, hosting premium, and creation of infrastructure are considered to be related to the means for responsibility sharing. Regarding the responsibility share, it can be easily seen that the host country has both potential benefits and potential disadvantages.

The means for responsibility sharing is not limited to the items shown above. It also includes the offer of services needed for a smooth management of a project. In the case of international scientific research entailing the construction of a large-scale facility, it is inevitable to have contacts with local agencies handling various regulations and residents in the neighborhood of the facilities. This is true even in the case that the project is carried out mainly by an international organization or a corporate one established according to the municipal law of the host country. For such local dealings, advice from the host country is necessary. In addition, great care is needed in various fields such as education and welfare of the visiting researchers and engineers and their families. For these functions, needless to say, the host country is the only country that can furnish this help, and it must do its duty.

The responsibility share in the international scientific research co-operation is considered to be a part of elements handled from the view point of benefits and disadvantages and the share is correlated with many other benefits and disadvantages. Thus, it may be rational to consider that the means for responsibility share have relatively strong correlation with each other. For the responsibility share which is most likely decided by discussions conducted in an international negotiation where the claims of countries collide, each country recognizes the sharing to be relatively flexible. For other benefits and disadvantages, each country has a tendency to grasp the benefits and disadvantages as relatively definite ones, even though it is hard to estimate quantitatively the extent of the benefits and disadvantages. In the case that an add-on portion of responsibility share called “hosting premium” becomes substantial, it is natural for the host country to demand “management control”, the extent of which is corresponding to that of the add-on portion. In the case of ESRF, actually, they changed their voting method from the one vote per one country method to a method in which the contribution of funds is reflected in a decision making. The CSTP considers this a prudent approach, which respects the large amount of financial burden carried by leading member countries of a Mega-science project.

In reality, the problems related to the responsibility share are more complex, even if we grasp the perceived benefits and disadvantages with which each country does not entrust to an international discussion, as relatively definite ones. As shown above, it is relatively difficult to make a quantitative estimation for many of such benefits and disadvantages. Moreover, there exists a chance to include a subjective judgement for their valuations. The problems are usually resolved through such a process that a type of responsibility share is converged to a

form by collecting the images of benefits and disadvantages consciously or unconsciously. Therefore, it is hard to accurately predict a final form of responsibility share, even if the opinion of the host country is close to those of other countries.

We would like to consider the ways of responsibility share in the international co-operation for decentralized international scientific research projects. The projects are exemplified by the international co-operation of scientific researches in the fields of the genome and global change. In these projects, a large amount of funds are needed, but the projects are quite different from the centralized projects in the points shown below: not much is required to fix the working schedule of each country in a time table of the project and to advance along a straight line to the final target. Even if the extent of contribution of each country is slightly changed for various reasons, including the changes of project environments, changes of concerns of the project, and financial problems, the progress of the project is not much disturbed. This is quite contrary to centralized projects. Needless to say, these changes may give troubles to other member countries. In the decentralized co-operation of international scientific researches, the funds which member countries should contribute give almost no problems to be discussed, because of the characteristic of the researches. Moreover, we see very few cases where the ratio of fund share of each country is strictly fixed by an international promise. In the centralized project, on the contrary, the fund sharing becomes a large problem.

In the decentralized international co-operation of scientific researches, we understand that the interested countries make fund contributing to a permissible extent, depending on changeable factors. They include the social and economic environments, the financial conditions, and the degrees of concerns for the projects. Concerning the project management, a centralized international co-operation of scientific research has a project manager at the site to conduct daily management and supervision. The activities of the decentralized co-operation are performed basically inside each country. They construct databases and interchange information through networks. For various co-ordinations and progress management it is sufficient if they conduct the co-ordinations and management in a timely manner wherever they are necessary. Regarding these who are in charge of co-ordinations and progress management in the centralized project, there are many cases that some people exhibit considerable leadership. In the decentralized international co-operation we have many cases that each country concerned plays a certain role. In this type of co-operation, needless to say, each country does not have such responsibilities that the host country inevitably takes in the centralized international co-operation.

Presumably, therefore, the case in which the type of responsibility share becomes an important issue is mainly for the centralized project. Regarding the responsibility share for this case, the points of the foregoing discussions can be summarized as follows. The extent of responsibility share is decided on the basis of the benefits and disadvantages which the host country receives and the extent is partly settled as a product of compromise in international negotiations. Thus we can perform only some considerations for the type and extent of responsibility share on the basis of the cases of past projects and the specific situations of each

project.

However, we should not give up efforts to pursue the type suited for the responsibility share in a project of international scientific research. We are requested to make an analysis as precisely as possible. For the analysis of benefits and disadvantages we have factors which are possible to handle quantitatively and which are almost impossible to handle quantitatively. The former factors include the spreading effect of economy and the latter ones are exemplified by the increase of national prestige and the deepening of public understanding on science and technology. For the factors for which we can conduct quantitative evaluations, we should place good efforts for the evaluations. For the factors for which quantitative evaluations are also impossible to perform we should evaluate the factors seriously to grasp the extent of both positive and negative effects, even if the results of the evaluations become qualitative. In relation to the benefits and disadvantages we should discuss how to combine the following various factors for responsibility share based on the characteristics of the project, the scientific research potential of each country, and the conditions of each country, and the situation of the research site. The factors include the extent of add-on funds contribution of the host country, the preparation of infrastructures, leadership in project management, and specific services which the host country can furnish.

We would like to point out that the responsibility share of international co-operation contains facts which cannot be predicted from the sole standpoint of benefits and disadvantages. Let us consider the international co-operation to resolve the problems related to global warming, a problem common for humankind. If the co-operation is successful, all of mankind can enjoy various benefits, including ensuring the security of living for people who reside in an area that may be under a sea level as a result of the global warming, and to support a stable supply of food in the world by preventing a decrease of crop yield which is caused by the global warming and the climate variation of the earth, and to prevent the disorder of a balance in ecological system. Concerning the international co-operation shown by this example, all of mankind as well as our country can enjoy the fruits of the project, if our country joins the project. In that sense the benefits and disadvantages arising from this sort of project cannot be treated uniformly as the benefits and disadvantages with a narrow scope which takes account only of the benefits and disadvantages for our country. Instead we should have room to think of a moralistic motivation for Japan to play a role suitable to her position as an advanced country in science and technology.

Finally, we would like to study the responsibility share for the international thermonuclear experimental reactor (ITER) as a model case of an international scientific research project. Regarding this project the benefits and disadvantages of the host country are summarized in the following table. The table is based on the report of the CSTP. The benefits, which the host country can enjoy, seem to be quite substantial. We cannot believe so unconditionally unless we fully examine various factors such as the extent of “burden of larger cost” and “burden for site preparation”, and the degree of “ initiative in international joint enterprise”.

Benefits and Disadvantages of Hosting in ITER Project

Category	Benefit	Disadvantage
Science-technology Policy	♦ Major role in specific scientific and technological fields (U.S. Space station; EU: LHC) ♦ Initiative in international joint enterprise • Worldwide COE (Center of Excellence) • Getting rid of catch-up of joint enterprise • Learning of implementation • Promoter for the security of global environment ♦ Prevention of brain drain ♦ Core site of information network ♦ Significance in the history of science and technology; to be stated as "Japan is in the first place in nuclear fusion" ♦ Science education / public understanding	♦ Increased difficulty of withdrawal ♦ Possible salary differentials for scientists and engineers ♦ Surplus of technological and professional knowledge after the closure of facilities ♦ Decrease of international credibility due to the change of the national acceptability, interfering with the progress of the joint enterprise.
Development of nuclear fusion	♦ Initiative of administration of ITER project • Extension of participating chances for domestic researchers; extension of the basis for the study on the education of human talents • Cultivation of the basis for independent development of nuclear-fusion energy ♦ Initiative for the concept of safety design of nuclear fusion • The concept of safety design based on Japan's safety culture leads a fundamental direction in the safety of a future nuclear fusion reactor ♦ Ease of access	• Responsibility for the disposition of waste
Energy and environment	♦ Security of long-term energy with low environmental effects and high specific safety ♦ Sustainable development / green policies ♦ Japan's initiative for the insurance of humankind	♦ Problems related to the radiation treatment
Economic aspect	♦ Economic benefits due to domestic procurement • Orders are placed mainly to the host country especially during the period of operation ♦ Extension of employment opportunity ♦ Reduction of travel costs	• Burden of larger cost • Burden for site preparation
Industrial aspect	♦ Spin-off and technology transfer of high technology ♦ Promotion of industrial technology • Transmission of technology through successive orders and technological base of independent development	♦ Displacement of other economic activities
Cultural aspect	♦ Promotion of the chance of international interchange • Daily cultural interchange with local residents • Introduction of Japanese culture by foreigners	

The construction cost of ITER was estimated to be about half of that of the original estimate. Even so, a total construction cost of the main hardware exceeds 400 billion yen, with the inclusion of the cost for supplemental facilities; a total investment of about 500 billion yen would be needed. Issues were often presented to justify such a vast investment.

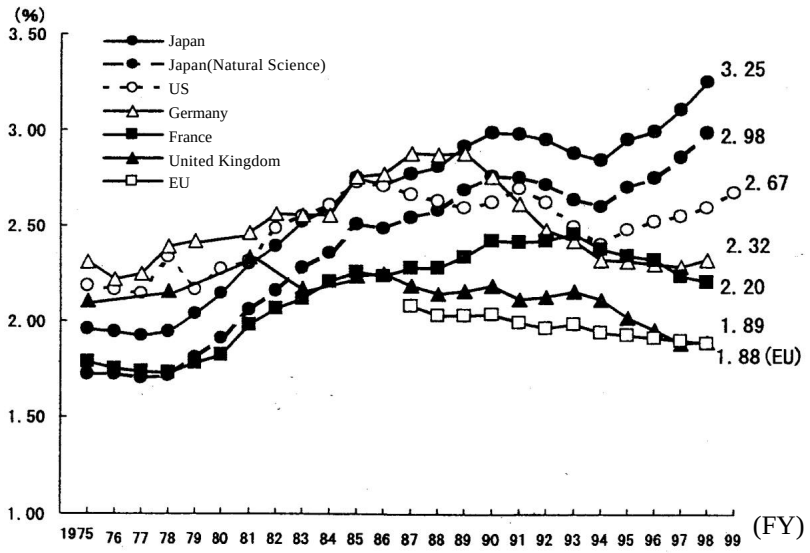
A report prepared by the ITER Special Working Group in January this year shows that discussions were put forward in the direction that the host party had more shares than the non-host parties for the construction cost of ITER. The future discussions most likely will talk about whether or not the concrete amount of Japan's share is high, low, or reasonable. As described above, the share may be closely related to the responsibility of leading the project and other responsibilities. More detailed discussions will be needed to decide the extent of share in relation to the various benefits and disadvantages arising from hosting the project. Moreover we cannot disregard factors motivated by a moralistic point of view. These factors include the contribution to the welfare of humankind, even though the contribution cannot be measured by a scale of benefits and disadvantages for Japan.

A final judgement of its value will be done by policy decision. For the preparation of the forthcoming discussions relative to the concrete amount of share it is required to analyze the merits and demerits shown in the table in a more subdivided form. In that sense, although we do not think that the quantification of the factors is possible, at present the following various analyses are being conducted and the activities should be evaluated: analyses related to the values of energy policy such as the forecast of demands and supplies of long-term energy of Japan and the feasibility studies of alternative energy, analyses of the promotion of public understanding and recognition and the accumulation of experiences in the field of science and technology.

The followings may be repeated in part. The ITER project is a project, which responds to the most basic need of people, that is, the security from the standpoint of the entire nation. The project has many varieties of possibilities to return the past debts which Japan owed European countries and the United States, to positively contribute to a continued development of economic society of the world, and to help improving the welfare of people of the next generation. The project provides a chance to exhibit the moralistic spirits of our people, which are beyond the generation.

In order to judge the rights and wrongs of hosting ITER, we should discuss the project from many different view points, not only the resource allocations of the research, share responsibility of international co-operation, but also whether or not nuclear fusion has the significance of existence in future as a long-term energy supply and demand, and whether or not fusion energy is technically feasible. Since we did not study the project from those points, we would like to refrain from presenting any opinions on the rights and wrongs of hosting the project.

We expect the Special Committee on the ITER Project to make an adequate judgement on hosting ITER through discussions on the points described above.



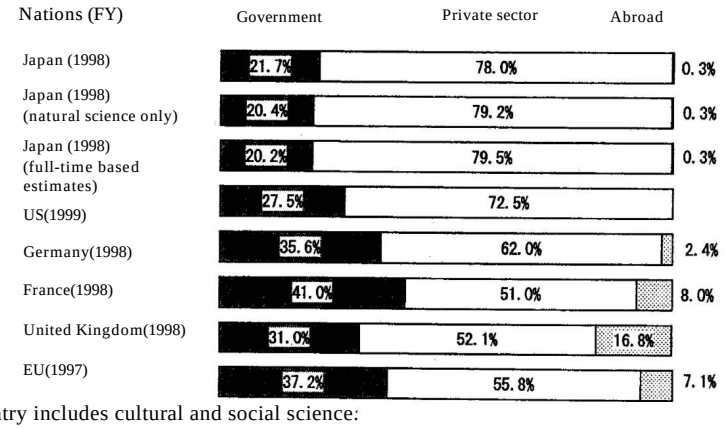
Notes:

1. For the purpose of international comparison the research expenditure of each country includes the expenditures in the fields of cultural and social science.
2. Starting 1996, the software industry is added as an object of expenditure survey.
3. The values shown for the United States are for the calendar year. After 1998 the values are provisional ones.
4. The 1998 values of Germany are estimates and the 1998 values of France are provisional ones.
5. The values of EU are estimates of Eurostat.

Source: Annual Report of the Promotion of Science and Technology, 1999

Figure 1 Annual Profile of the Ratio of Research Expenditure to Gross Domestic Product for Selected Countries

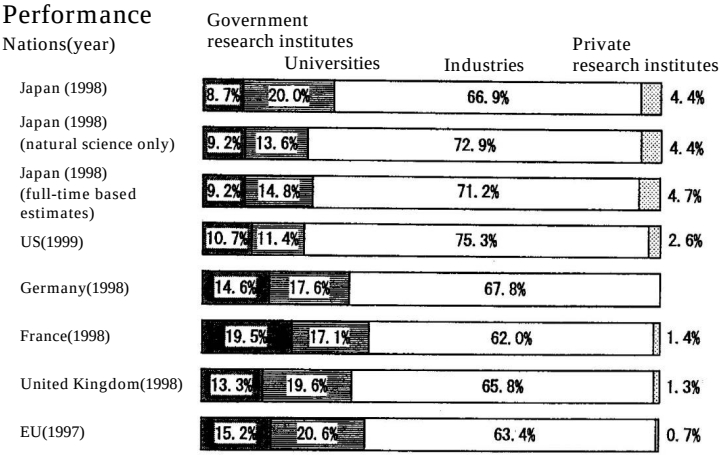
(1) Financing



Notes:

1. Each country includes cultural and social science:
2. A share other than government and foreign organizations is assumed to be shares of private organizations.
3. The values of the United States and France are provisional values of the calendar year and the values of Germany and EU are estimates.

(2) Performance

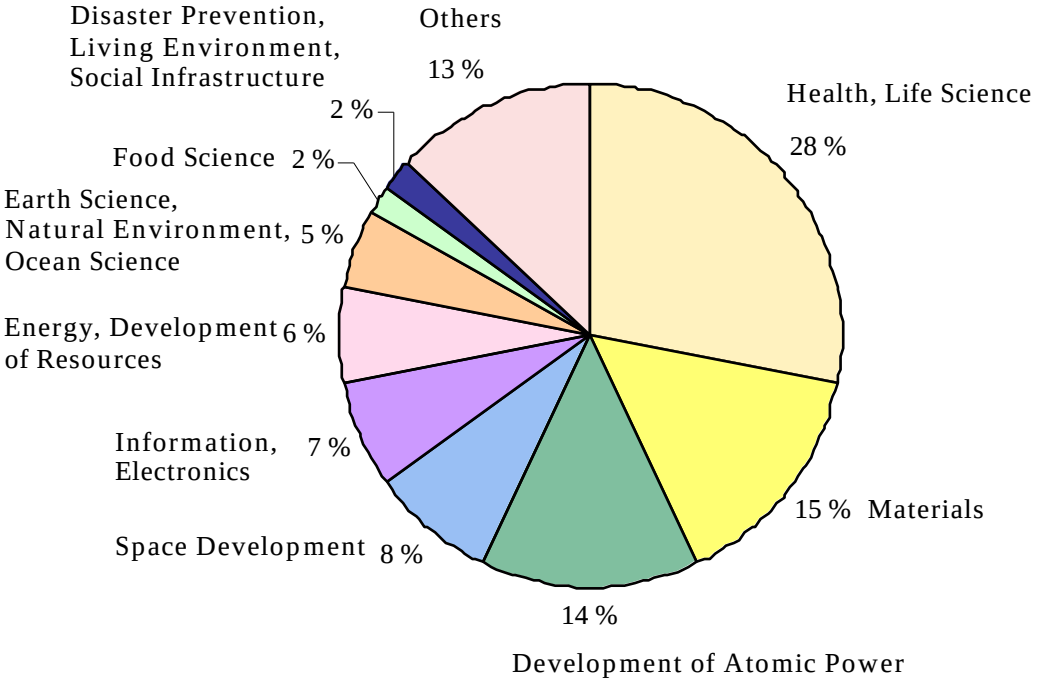


Notes:

1. Each country includes cultural and social science.
2. The values of the United States and France are provisional values of the calendar year. The values of Germany and EU are estimates. For Germany the research expenditures of private research organizations are included in those of

Source: Annual Report of the Promotion of Science and Technology, 1999

Figure 2 R&D Expenditures Financing and Performance Sector in Selected Countries



Source: Survey regarding the strategic promotion of science and technology
A survey report on the expenditure for science promotion,1997

Figure 3 Government Budget of Japan

Committee on the Allocation of Resources for Research and the Sharing of Responsibilities in International Co-operation

Members (As of July 1999)

Tetsuhiko Ikegami,
Vice President
The University of Aizu

Teruo Kishi
Director General
National Institute for Advanced Interdisciplinary Research

Kei Takeuchi
Professor
Meiji Gakuin University

Naomasa Nakajima
Dean
School of Engineering
The University of Tokyo

Chairman Yoichiro Murakami
Professor
International Christian University

Tamito Yoshida
Professor
Chuo University

Schedule

1st	July 9, 1999
2nd	August 5, 1999
3rd	September 20, 1999
4th	December 29, 1999
5th	November 30. 1999
6th	February 4, 2000