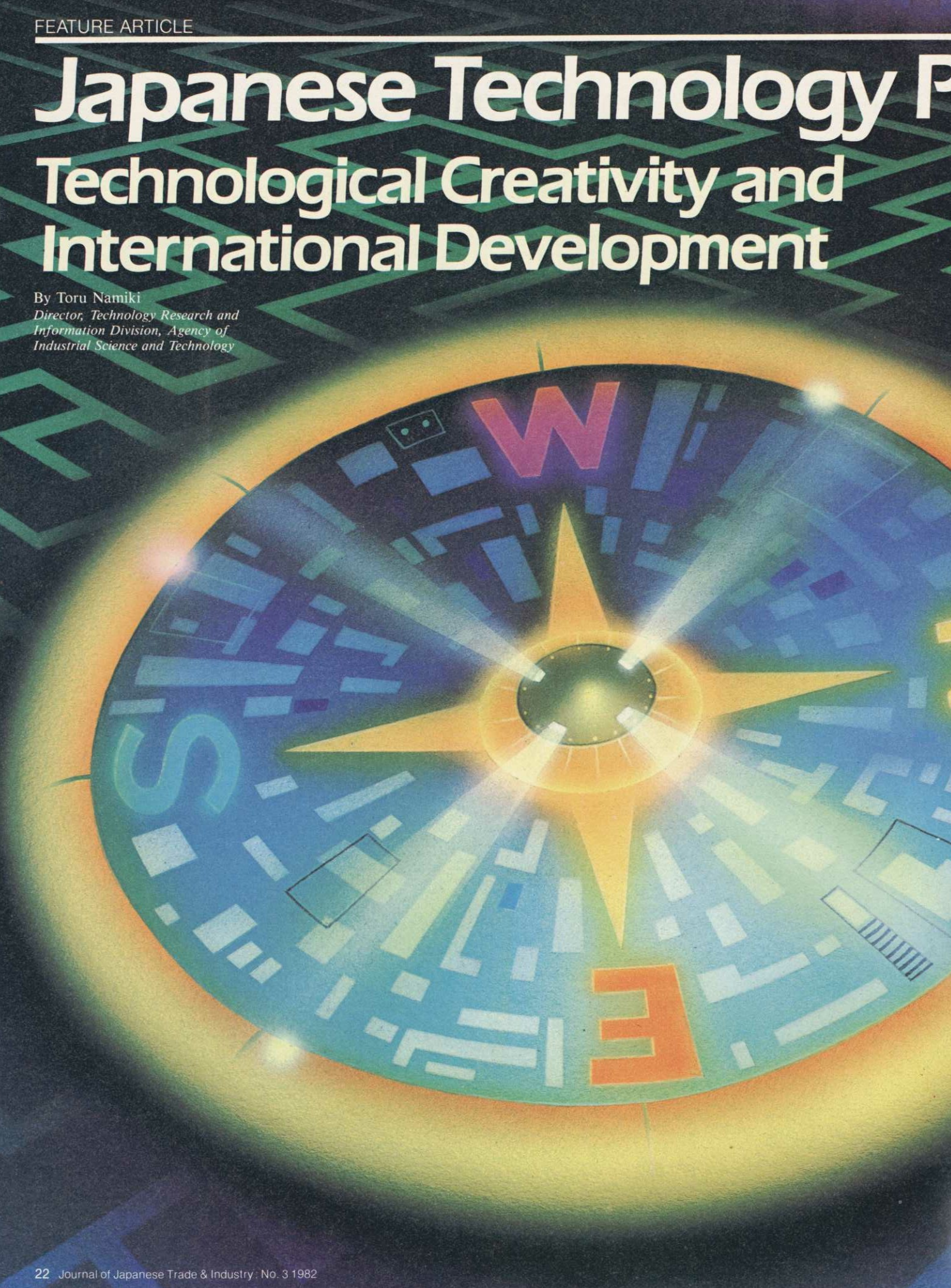
Japanese Technology P

Technological Creativity and International Development

By Toru Namiki
Director, Technology Research and Information Division, Agency of Industrial Science and Technology



olicy

Mr. Toru Namiki, born in 1944, joined the Ministry of International Trade and Industry in 1967 after graduating from the Department of Technology of the University of Tokyo, where he majored in electrology. He served in the Atomic Industry Department of the Resources and Energy Agency of the Ministry of International Trade and Industry and as a secretary at the Japanese Embassy in Jakarta before assuming his current post.

Industrial Policy for the 1980s: Proposal for Transformation to a Technological Nation

On March 17, 1980, the Ministry of International Trade and Industry released a long-term policy paper titled Industrial Policy for the 1980s. This policy paper proposes the following three new national goals for the 1980s and on into the 1990s:

a. Contributing internationally as an economic power
b. Overcoming the constraints of resource scarcity
c. Achieving vitality and leisurely living

The policy paper further points out that enhanced technological development is one of the most important policy issues for the fulfilment of these goals.

In effect, this policy orientation is premised on the realization that technological development is fundamental to progress, not only for Japan but for the world at large. Accordingly, it is seen as necessary to expand Japanese investment in such technological research and development. Specifically, the paper proposes (a) raising the ratio of expenditures for technological development from under 2% of GNP at present to 3% of GNP by the end of this decade and (b) upping the government's share of technological development expenditures from currently less than 30% of the total to the 40-50% level prevalent in the West.

This policy approach was soon afterward approved by the Ministerial Conference on Science and Technology (which includes, among others, the Ministry of International Trade and Industry, the Ministry of Education and the Science and Technology Agency) as official government policy.

Current State of Japanese Technological Development

The Japanese economy achieved striking development during the postwar reconstruction period and technology played an extremely important role in this process. As may be seen from Figures 1 and 2, the various industries were able to achieve higher value added and to increase their international competitiveness through the vigorous use of research and development.

(1) Spending on Technological Development

Japanese spending on technological development has been steadily increasing. By fiscal 1979, it had grown to over ¥4 trillion in absolute terms, a figure surpassed in the free world only by the United States. However, seen in terms of technological development expenditures as a percentage of GNP, the Japanese level is still low by Western standards, as shown in Figure 3.

(2) Private-Sector-Led Technological Development

Table 1 shows the degree of government involvement in funding technological research and development in five leading industrialized nations. As may be seen, Japanese government involvement is less than 30%. By contrast, the figures for the other countries shown are all in the 40-55% range. Thus the Japanese government's involvement is comparatively small. This same private-sector leadership is also evident in the number of researchers. Nearly 60% of all Japanese researchers are employed by private-sector organizations. Japan's technological development is clearly led by the private sector.

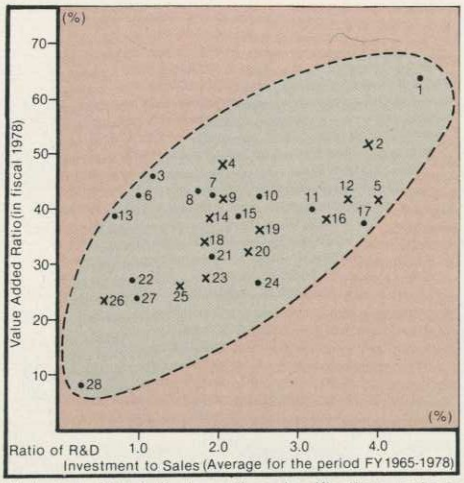
(3) Japanese Technological Levels

For many years after the war, Japan actively imported and absorbed state-of-the-art technologies in an ambitious effort to catch up with the Western industrialized nations. Details of this effort have been reported elsewhere (e.g. M. Moritani's "Japanese Technology" beginning on page 26 of this issue) and it suffices here to note simply that, as a result, Japan has attained internationally recognized levels of technical capability very rapidly. In private-sector production technology and especially mass production technology, Japan is among the best in the world. Nevertheless, recent improvements notwithstanding, the Japanese balance of technology trade is still in the red. That Japan remains a net importer of technology suggests that Japanese technological levels still lag behind those of the West.

Need for Attention to Basic Creative Technology

According to a 1976 study by the U.S. National Science Foundation analyzing approximately 500 major technologies commercialized in Japan, Europe and the United States during the two decades 1953-1973, Japanese technological development during that period was not especially fecund with highly innovative technologies (Fig. 4). As also pointed out in the same study, average product life in Japan was approximately 3.5 years. This is a much shorter product cycle than the 5-7 year average in the United States and Europe. This short commercial life indicates that the emphasis in research and development in Japan has been on products, ensuring market viability, and that technical improvements have been made in smaller increments. Recently, however,

Fig. 1. R&D Investment and Value Added Ratio

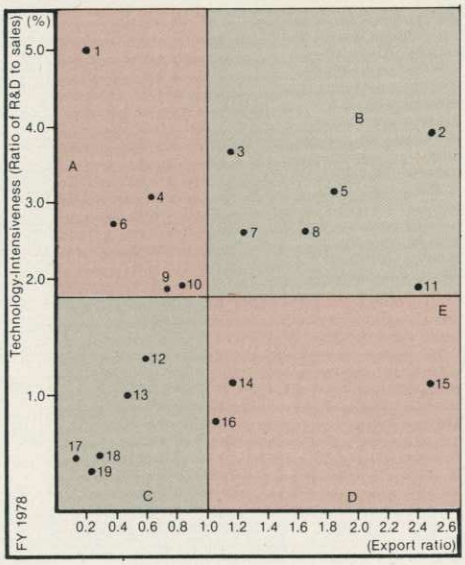


1. Pharmaceuticals
2. Physical and chemical appliances
3. Ceramics
4. Medical equipment
5. Household electric appliances
6. Metals
7. Rubber
8. Machinery
9. Electronic parts
10. Precision machinery
11. Electricals
12. Power generation
13. Fabrics
14. Aircraft
15. Fats and oils
16. Optical equipment
17. Communication and electronic equipment
18. Inorganic chemicals
19. Watches and clocks
20. Office equipment
21. Chemicals
22. Steel
23. Organic chemicals
24. Automobiles
25. Electric wires and cables
26. Steel
27. Non-ferrous metals
28. Petroleum

(Notes) 1. Dots indicate medium classifications, and crosses subclassifications.
2. The value added is expressed as the value added ÷ shipped product value×100%
(Value added and shipped product value based on industrial statistics)

(Sources) Science and Technology Agency and 1978 Industrial Statistics Table

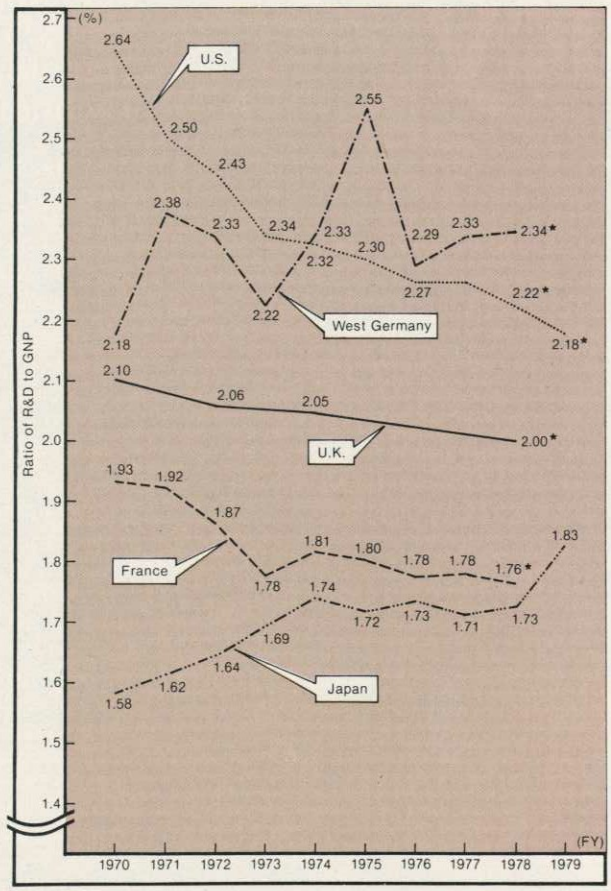
Fig. 2. Technology-Intensiveness and Export Ratios



A. High technology-intensity
B. Low technology-intensity
C. Low export ratio
D. High export ratio
E. Average for all manufacturing

1. Pharmaceuticals
2. Communications, electronic, and electric measuring equipment
3. Electrical equipment and appliances
4. Other chemicals
5. Precision machinery
6. Fats, oil and paints
7. Rubber products
8. Automobiles
9. General chemicals
10. General machinery
11. Transport machinery
12. Ceramics
13. Non-ferrous metals
14. Metal products
15. Steel
16. Fabrics
17. Foodstuffs
18. Pulp and paper
19. Publishing and printing

Fig. 3. R&D Expenditures to GNP



(Notes) 1. Figures marked with asterisks are estimates.
2. Figures for Britain obtained from OECD Statistics and JETRO survey (FY 1978).
3. Nominal GNP based on 1970 for 1969 to 1974, on 1975 for 1975 to 1979

(Sources)
Japan: FY 1971-1979 Science and Technology *Survey Report*, FY 1980 *National Economy Annual Report*, FY 1980 Science and Technology *Survey Summary*
U.S.: IMF (*International Financial Statistics*, 1980), NSF (*National Patterns of R&D Resources*, NSF78-313)
U.K.: IMF (*International Financial Statistics*, 1980), OECD (*International Statistical Year*, 1975)
West Germany: IMF data, *Bundesbericht Forschung IV* issued by BMFT
France: IMF data, materials attached to the FY 1980 budget bill

there have been signs of improvement, as in the increasing number of Japanese applications for patents in other countries and the gradual rectification of Japan's technology trade imbalance.

Nevertheless, analysis shows Japanese corporate investment in basic research and development has actually been declining over the decade of the 1970s. This trend, should it continue, can only bode ill for the promotion of a Japanese contribution to creative technological development for a better world.

4. Technology Development Policy for the Future

In view of the current state of Japanese technology development and the various problems faced, it is important that long-term Japanese policy for technology development promote a shift to more basic and riskier development fields so as to advance creative technological development contributing to the betterment of the international economic society. From this perspective, it is advocated that technology development investment be increased as a percentage of GNP and that the government pick up a larger portion of the total tab.

Traditionally, Japanese technology policy has focused primarily upon efforts to create an environment more conducive to those private-sector activities which have been central to technological development. If the goals proposed here are to be achieved, however, it will be necessary to generate a broader policy and to accord the government a greater role. Government policy priorities should be on the following areas:

(1) It is first necessary to clarify directions for Japanese industrial and economic development and to indicate guidelines for future research and development, for example through government policy papers.

(2) As private-sector investment in technological development increases, it is also necessary to raise the percentage of these costs borne by the government. It is especially important to direct government funding for research and development to the technologies needed for such sophisticated industries as aircraft, aerospace, nuclear energy, machinery and electronics, and for such supply-stabilizing resource industries as mining. If this is done, it should also be possible to revitalize chemicals, steel, non-ferrous metals, ceramics and other materials industries through technology transfers among industries. The government also has a role to play in funding the research facilities and equipment needed for basic research on breakthrough technologies.

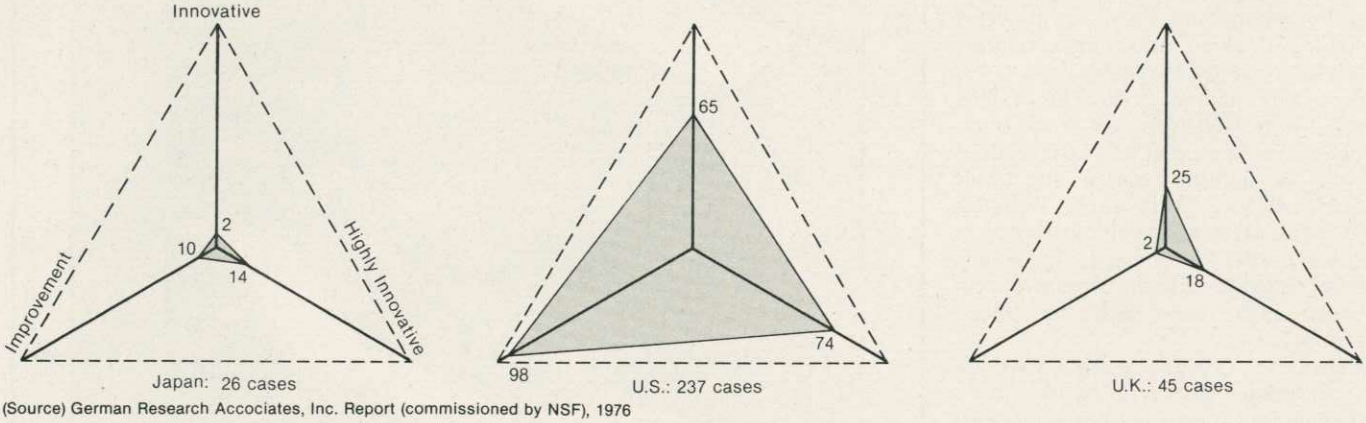
(3) In pursuing this development, however, it should be noted that the United States and European countries are emphasizing these very same industries in order to buttress their economies.

Table 1. Governmental Funding of R&D

Institute classification \ Country	Japan (1977)	U.S. (1977)	U.K. (1975)	France (1977)	W. Germany (1977)
Government	13.1 (12.9)	15.3 (15.3)	26.6 (24.1)	22.8 (21.5)	15.2 (14.6)
Universities	19.5 (13.0)	14.7 (10.0)	8.4 (6.4)	15.5 (15.1)	16.2 (15.7)
Non-profit corporate bodies	2.2 (0.3)	3.2 (2.2)	2.4 (1.8)	1.4 (0.9)	0.2 (0.2)
Companies	65.2 (1.2)	66.8 (23.6)	62.7 (19.4)	60.3 (15.2)	68.4 (10.8)
R&D total	100 (27.4)	100 (51.1)	100 (51.7)	100 (52.7)	100 (41.3)

(Note) Figures in parentheses are governmental shares excluding defense-related R&D.
(Source) OECD statistics

Fig. 4. Innovative Levels of Technological Development in Major Countries



(Source) German Research Accociates, Inc. Report (commissioned by NSF), 1976

Accordingly, it may be desirable to promote international cooperation in research and development, as was done for the aircraft industry. In the natural resource field, consideration must be given to cooperative research and technical cooperation including technology transfers with the resource-producing nations, many of which are less-developed countries.

(4) Industrial property protection is also important in promoting international technological cooperation. Here, Japan has steadily improved its domestic arrangements until they are now on a par with internationally accepted standards, including the adoption of a modern patent system and the acceptance of international patent applications. For the future, it is necessary to make fullest use of international industrial property protection arrangements to promote research and development and to strengthen the nation's industrial foundations.

(5) As technology becomes more complex and sophisticated, it is expected to have an ever greater impact upon the economy, society and culture, and this heightened social importance makes it all the more necessary to properly assess technology's efficiency and safety as it affects the individual and society. This entails, for example, a need to develop software technology policies facilitating smooth establishment of technological assessment and public acceptance mechanisms.

(6) Although Japanese technological development is being advanced primarily by the private sector, there are a number of areas in which it is important that the government take a leadership role. These include:

a. Fields which have long gestation periods yet which have major ramifications for the economy, society, industry and general technological standards in the long run
b. Fields entailing large-scale research projects where cooperation among a number of private companies is needed, for example to bring together primary technologies from a number of fields
c. Fields where the social need is extremely great and the imperative is urgent
d. Fields where the development is a social imperative and must be coordinated with other social aspects

In these fields, national and other government research institutes should play the leading role. Some of this has already been done with such government-sponsored research as the project to lay the research foundations for the next generation of computers, the various projects to develop alternative energies and the efforts to develop new large-scale industrial technologies, yet more is needed if Japan is to fulfil its international research and development responsibilities for the betterment of the global community. ●