INTERIM REPORT ON RESEARCH INTERACTIONS AMONG UNIVERSITIES, GOVERMENTAL INSTITUTES AND INDUSTRY

P. 9 3, 25

This material is an extract from an interim report prepared by a study group of the Research Committee on University, Govermental Institute and Industry-Research Interactions, a subgroup of the JATES Executives Committee for Management of Technology

October, 1983

JAPAN TECHNO-ECONOMICS SOCIETY

Contents

1. Need for and Background of Interactions among Private Companies, Govermental Institutes and Universities

Japan has become the third largest economic power in the world after the United States and the Soviet Union with its gross national product (GNP) accounting for approximately 10% of the world's total GNP.

In the field of technological development, too, Japan is now surpassing world standards in such high-technology fields as electronics and communications.

Under these circumstances, the country is now under strong pressure to assume greater leadership in the fields of original research and development in high technology and science in general as well as basic and fundamental research and development.

Indispensable to this task is the need to actively promote research and development activities, organizations, personnel and management systems which integrally carry out a series of technological development processes, such as basic, application and development research, and commercialization.

Therefore, the most important problem now is new, organic interaction among industries, governmental institutions and universities from a long-term and overall point of view without the shackles of the existing framework. Various government agencies, private organizations and private businesses are now buckling down to this issue.

The industrial sector, in particular, attaches importance to the promotion of new technological development through interaction between technologies commensurate with those introduced in exchange.

For all of these reasons, there is a growing need for research and development through industry-university interaction, utilizing the basic research capability of universities and the development capability of private companies.

(2) Qualitative Change in Technology

The second point is a qualitative change in technology -- that is, a movement toward advanced, composite and integrated technology.

Unlike existing technologies, the newest high technologies, such as microelectronics, information and communications technologies, functional polymer, new materials like fine ceramics and amorphous alloys, and biotechnology, involve many research problems and, at the same time, are highly advanced, composite and integral. Thus it is necessary to improve basic research, to provide the latest high quality facilities, to promote cooperation among researchers and engineers over a wide range of different technological fields, and to establish an integral research and development system from basic research to commercialization in order to push ahead with research and development in those advanced technologies.

Interaction between private companies and universities are naturally required.

As internationalization of Japan's economic activities gains added momentum, its interdependence with other countries of the world is increasing in the fields of economy and technology.

Although European and U.S. economies are in the doldrums, the Japanese economy is comparatively stable and Japan's competitiveness in international markets continues to grow in strength. Yet this strong competitiveness is attributable mainly to development that is geared toward practical use and mass production. Japan continues to lag behind the global pace in such areas as discovering new "seeds" and yielding achievements in original research and development.

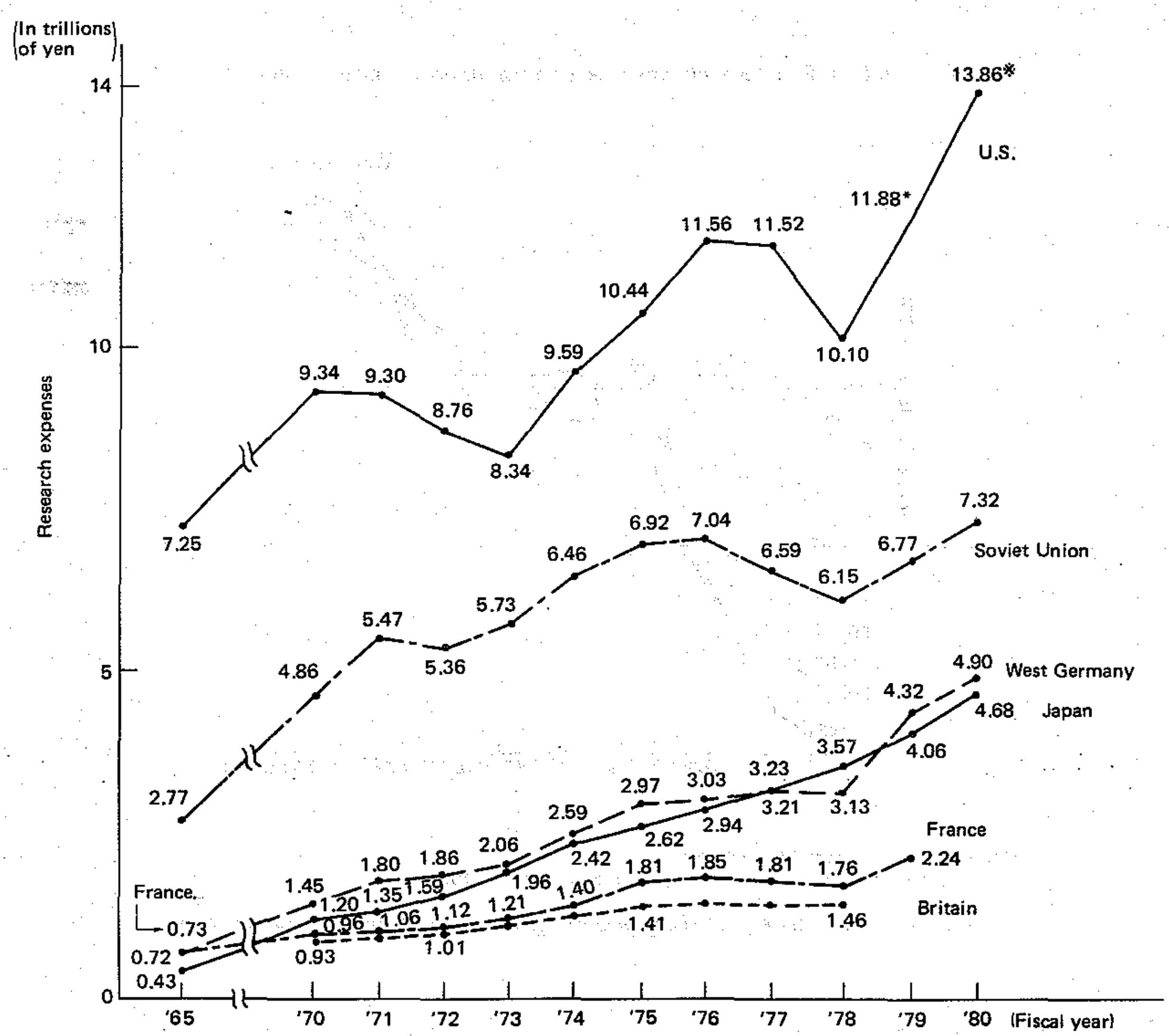
For these reasons, Japan is being urged to increase its contribution in the science and technology field, particularly in the area of original research and development, in accordance with its rising position in the world economy. To make such a contribution, it is necessary to drastically review the stance of the whole nation on science and technology, and study all-out means of improving Japan's research and development potential. New interaction among industry, governmental institutes and universities is now in the limelight as the principle means of achieving this aim.

The significant barriers and restrictions which currently stand in the way of strengthened cooperation must be lifted and removed. Problems must be solved through mutual compromise of the three parties, beyond the existing framework.

The international comparison shows that there is not much difference between Japan, European countries and the United States in the number of researchers per 10,000 people. To promote original research and development, Japan has no other choice but to beef up its basic and fundamental research and development. To this end, all the researchers in Japan's private companies, governmental institutes and universities must join forces. Especially, private companies should positively tackle the problem and propose independent and viable solutions. Japan's research and development program, unlike those in Europe and the United States, is heavily dependent upon the vitality of its private companies.

assisting high-tech or original research and development are either under way or being carried out. In discussing a variety of problems involved in the promotion of cooperation among industry, government institutions and universities, this chapter notes the characteristics of research and development policies of Japan and the United States and refers to points that should be introduced to Japan.

Fig. 2.1: R&D expenditures in major countries



2.2 R&D Assisting Measures in the United States

(1) Industrial Technology Policy of U.S. Government

I Recent Trend of R&D Investment

Research and development investment in the United States has steadily been expanding in the past five years due mostly to growth in the private sector. At present, investment by the private sector surpasses that by the government by a small margin.

However, this does not mean a decline in the government's resolve toward further investment. The Reagan Administration's move for a small government and the strengthening of basic technologies affecting the existence of the nation dictate continued expansion.

Priority investment fields are shifting with the research and development budget of the Department of Defense (DOD) expanding sharply and the budgets of the Environmental Protection Agency (EPA), the Department of Commerce (DOC) and others dropping steeply. This trend is clearly visible in the Budget Message for 1984 announced by President Ronald Reagan in early 1983, shown in Table 2.1. The DOD research and development budget account for 65% of the federal government's total research and development budget. This share expanded from 56% in 1982 to 60% in 1983 and onward to 65% in 1983.

- The assistance of industry should be implemented through research and development investment of industrial circles or measures to stimulate demand (demand pull action) for new products.
- Liaison between industrial circles and universities should be promoted.

In other words, the U.S. government takes charge of long-term basic research involving risks and research and development related to national defense, while depending on vitality of the private circles for research and development in other fields, striving to eliminate various factors hindering the private sector's research activities.

Table 2.1: U.S. research and development budget by department

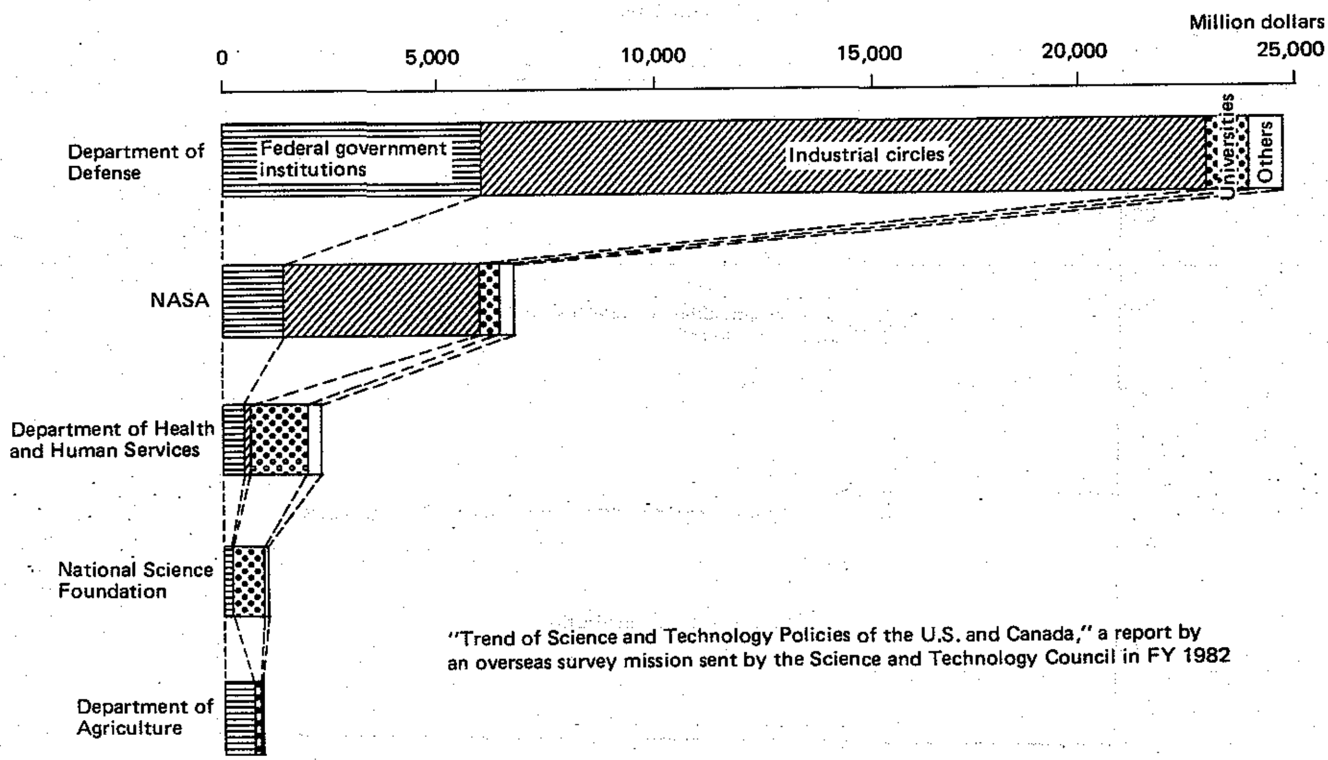
Departments	FY 1983 (in millions of dollars)	FY 1984	1984/1983 (%)	Percentage of total budget for FY 1984
Department of Defense (DOD)	23,179	29,882	+28.9	65.3
Department of Energy (DOE)	4,712	4,713	+ 0.0	10.3
Department of Health and Human Services (HHS)	4,316	4,416	+ 2.3	9.6
[National Institute of Health (NIH)]	[3,771]	[3,842]	[+ 1.9]	[8.4]
National Aeronautics and Space Administration (NASA)	2,506	2,473	△ 1.3	5.4
National Science Foundation (NSF)	1,060	1,240	+17.0	2.7
Department of Agriculture (DOA)	850	849	△ 0.1	1.9
Department of Transportation (DOT)	393	519	+32.1	1.1
Department of Interior (DOI)	373	329	△11.8	0.7
Department of Commerce (DOC)	312	227	△27.2	0.5
Environmental Protection Agency (EPA)	241	208	△13.7	0.5
Others	918	942	+ 2.6	2.1
Total	38,865	45,796	+17.8	100.0

Source: Special Analyses—Budget of the United Stages Government FY 1984 OMB.

General guidelines to basic research assistance under the Reagan Administration are as follows:

. Assistance to all the sectors of basic research should be maintained at the same level.
. Basic and applied research at institutions of the federal government should be strengthened.
. Assistance to universities should be provided from the viewpoint of both securing research personnel and aiding research.
. The government's share in applied and development research approaching the stage of practical application should be limited as far as possible.

Fig. 2.4: **Departmental allocations of research and development funds of the federal government to industrial, government and universities (estimate for 1983)**



But the government's subsidies to the industrial sector were concentrated in development research: subsidies to development research accounted for 89% of the government's total assistance as against 2% and 9% to basic research and applied research, respectively.

Assistance to universities and non-profit organizations accounted for 20% of the government's total research and development funds. Of the sum, assistance for basic research is allocated through the National Science Foundation and the National Institute of Health as subsidies.

(iii) Infrastructure Improvement for Technological Development

Improvement of the infrastructure here means improvement of the environment of technological development, such as patents, the taxation system and the Antitrust Act, to further stimulate development.

As for the patent policy, the United States, by further extending the "Uniform Federal Patent Policy Act of 1980", paved the way for increasing recognition of those in charge of research and development via a Presidential order in February 1983.

In the tax aspect, the United States provided a number of incentives for encouraging technological innovation of U.S. industry in the "Economic Recovery Tax Act of 1981".

Regarding the antitrust act, there is a firm trend for relaxation of its application from the viewpoint of utilizing the vitality of private businesses to revitalize U.S. industry as a whole.

method can be selected in accordance with the contents and nature of research, an entrusted company will not feel burdened with the shackles of contract provisions in conducting research and development.

(ii) Flexible Auditing

As for research and development with a definite goal, faithful implementation of provisions of the original contract is required. However, regarding research and development whose target cannot be made clear, research and development funds can be flexibly used within the radius of common sense, fairly.

(iii) Emphasis on Results of Research and Development

Research and development itself can be flexibly implemented and the contents of research and development can be changed with prior understanding. In exchange, the results of research and development activities will undergo rigorous exmamination, and evaluation of the results will be reflected on the contract for the next year onward.

(iv) Profit Allowed in Contract Money

Due profit is allowed in the contract money. Even when it is not in exceptional cases, half of research and development expenses will be paid in advance so that the recepient can take profit from interest.

As seen so far, the U.S. government strictly examines the results of research and development rather than how the research and development budget was used.

- Personnel and commodity expenses needed for in-house research under development
- Sixty-five percent of money paid to outsiders under research contracts
- Sixty-five percent of money paid to universities and scientific research institutions as grants for basic research

The tax deduction system was created with the aim of directly stimulating research and development activities. Another deduction system, under which 46% of research and development expenses are deductible from corporate income, continues to exist despite the creation of the tax deduction system under review. Thus a company which newly started investing in research and development is subject to a tax deduction of up to 71%. The deduction systems thus work to the advantage of enterprises strongly oriented to research and development.

(ii) Expansion of Tax Deduction for Donation of Equipment to Universities

When a company donates experiment and research equipment or educational equipment that is two years old or less to a university for engineering education and research, an amount equivalent to this [the equipment's manufacturing cost + 1/2 (market price - manufacturing cost)] will be exempted from taxation.

(iii) Shortened Depreciataion Term for Experiment and Research Equipment

The term of depreciation of experiment and research equipment was and non-profit organizations, unless there is any problem from the viewpoint of national defense or the private sector, cannot exercise patent rights.

V Relaxation of Application of Antitrust Act

Joint research projects among companies in the same line of business have not been carried out, shackled by the antitrust act in order to prevent private companies' power from exceeding the government's power. But antitrust regulations have increasingly been relaxed lately in a bid to use the private sector's vitality to revitalize U.S. industry, as exemplified by the announcement by the Department of Justice of guidelines to revise the antitrust act and the announcement of specific application standards by the Assistant Secretary of Justice in charge of antitrust affairs in May 1983.

Table 2.3: Governmental share in research expenses

Classification / Nation (Year)	Government's share (%)	Government's share excluding defense R&D expenses (%)	Research expenses (in 100 million yen)	Defense research expenses (in 100 million yen)
Japan (1978)	28.0	27.5	35,700	243
Japan (1979)	27.4	26.9	40,636	276
Japan (1980)	25.8	25.4	46,836	296
U.S. (1980)	47.9	33.2	138,636	30,507
Britain (1978)	48.1	31.6	14,634	3,535
West Germany (1979)	46.8	43.6	38,056	2,209
France (1979)	51.1	37.9	22,728	4,816

Notes:

1. The government's share (%) excluding defense R&D expenses was obtained by the following equation:

$$\frac{\text{governmental research expenses} - \text{defense research expenses}}{\text{research expenses} - \text{defense research expenses}} \times 100$$

2. The U.S. figures are estimates.

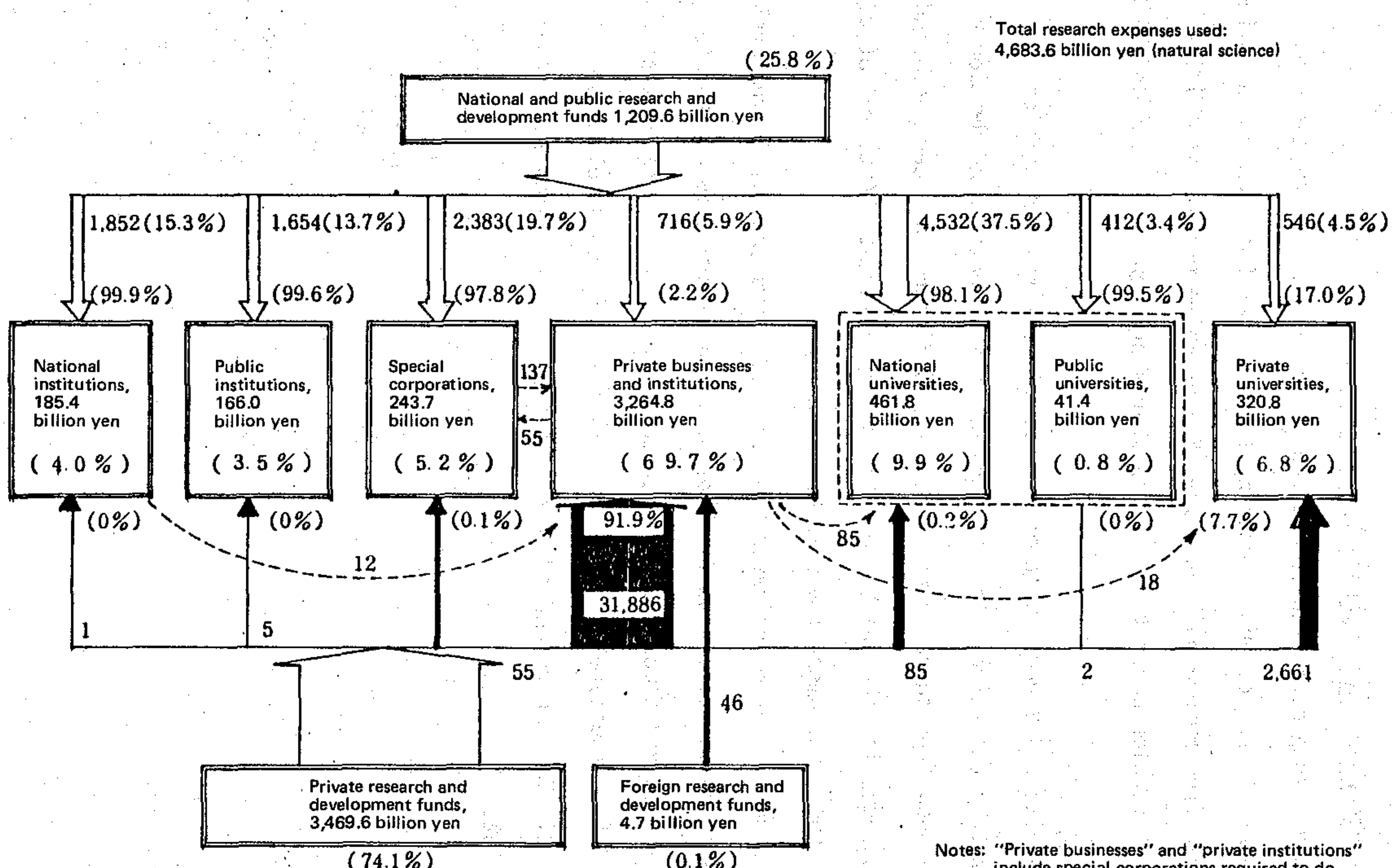
Sources: The sources of research expenses and governmental research expenses are the same as those for Fig. 2.1. Defense research expenses were taken from the following sources:

Japan: Budget
U.S.: Special Analysis of Federal Budget, Office of Management and Budget
Britain: Supply Estimates, Exchequer
West Germany: Faktenbericht 1981 zum Bundesbericht Forschung, Federal Research and Technology Ministry
France: Papers annexed to budget

Japan's governmental research and development expenses are only 1/50 of the United States'. (Fig. 2.7)

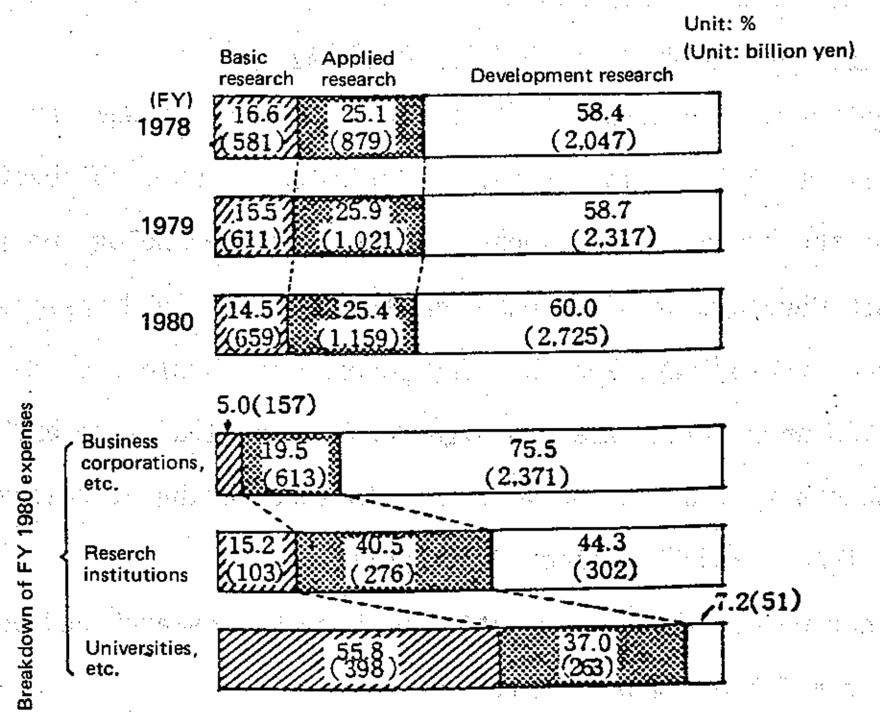
By contrast, the private sector's research and development funds accounted for 74.1%, or 3,469.6 billion yen of Japan's total funds, clearly showing that research and development activities in Japan have been promoted chiefly by private companies.

Fig. 2.6: Breakdown of use of Japan's research and development expenses



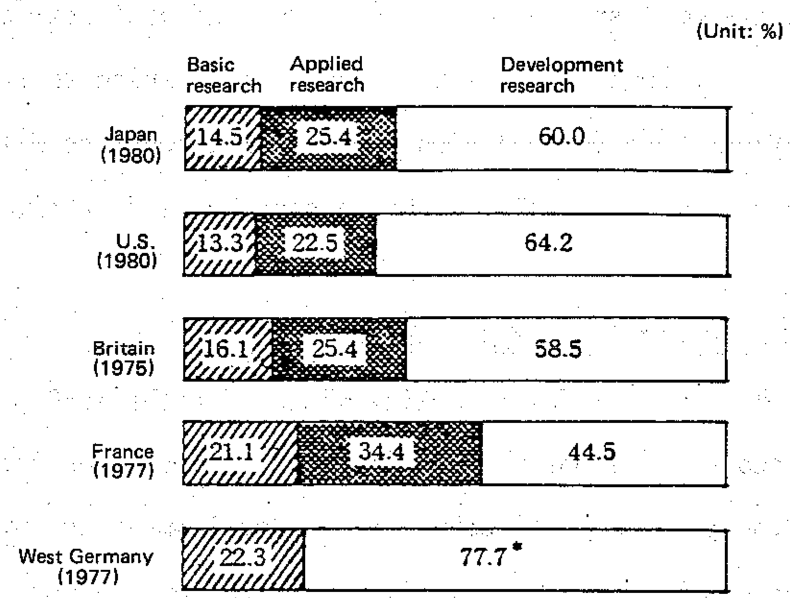
Notes: "Private businesses" and "private institutions" include special corporations required to do business under the self-supporting accounting system.
Source: Survey Report on Science and Technology Research for 1981

Fig. 2.8: Breakdown of reserch expenses by type of research



Source: Survey Report on Science and Technology Research, Statistics Bureau of Prime Minister's office

Fig. 2.9: Breakdown of research expenses of major countries by type of research



Notes: 1. U.S. figures are estimates.
2. Applied research and development research are not distinguished from each other in West Germany.

Source: Same as Fig. 2.1.

1. Technological development, development of advanced technologies in particular, contributes to expanding the economic frontier and revitalizing the world economy. Industrialized countries of the world should cooperate with each other in promoting such development.
2. Such technological development and the transfer of its results should be done in mutually open ways and the exchange should not be restricted.
3. In promoting technological development based on the views, vitality of the private sector should be fully utilized, while the government should improve the environment of technological development and, at the same time, take charge of basic research and long-range, risky research projects.

(iii) Policy Implementation

Based on the basic principle of technology-led development of the country with emphasis on international contribution, the government is implementing specific policies in the following directions:

1. Strengthening of organic cooperative links among the industrial sector, academic circles and the government for creative technological development.
2. Coping with problems of global scale through international technological development.

(iii) System to Promote Creative Science and Technology (Science and Technology Agency)

The system was established by the Science and Technology Agency in 1981 and is now implemented by the Research Development Corporation of Japan.

Under the system, young researchers from industry, government institutes and universities, as well as those from abroad, seek and research innovative technologies for about five years under a project leader appointed by the corporation. Resulting industrial property rights will be held jointly by the corporation and individual investors.

(iv) Basic Technology Research and Development for Next-Generation Industries (MITI)

The system was created by MITI in 1981 to help develop basic technologies expected to contribute greatly to establishing Japan's next-generation industries, maintaining international competitiveness, further advancing the existing industries and finding breakthroughs in sources and energy problems.

In order to efficiently promote research and development, it employs a parallel development system under which multiple research and development systems are simultaneously carried out through interaction among industry, universities and national research institutions. It aims at nurturing such basic technologies from "the stage of a bud" to "the stage of a sapling," in which a practical application of basic technologies is imminent, in about 10 years.

(ii) Special Tax Deduction for Income Accruing from Overseas Technological Deals

Tax deduction is available for the sale and provision of industrial property rights and knowhow abroad to promote diversification of technological transfer and development.

(iii) Incorporation of Contriburions to Experiment and Research Institutions into Loss

The ceiling on incorporation of such contributions into loss is equivalent to half of 2.5/1,000 of the company's capital in any given fiscal year and 2.5/100 of its income.

(iv) Shortening of Durable Years of Depreciable Assests

Durable years of depreciable assets has been shortened to four to seven years to provide for experiments and research specially carried out with the aim of producing new products, inventing new technologies or improving upon already commericalized technologies.

(v) Reduction of Municipal Property Tax on Equipment of Mining and Manufacturing Technological Research Associations (local tax)

For experimental and research purposes, tax municipal property tax on fixed properties acquired by mining and manufacturing technological research assosiations will be reduced to 2/3 over three years.

projects between the government and the industrial sector.

By concentrating research expenses, researchers and research facilities, the system enables large-scale technological development that cannot be done by a single company. The system has achieved favorable results recently in such big projects as the development of very large-scale integration (VLSI).

There are also associations on high-speed calculation systems for scientific and technological use, and development of biotechnology.

(2) Basic Research

Both the Japanese and U.S. governments feel that basic and fundamental research holds the key to technological innovation and revitalizion of their economies, and shoulder more than 70% of funds necessary for such research.

Another common point is that they both chiefly count on universities to make good basic research achievements.

However, they differ in respect to how they provide grants to universities. In Japan, 95% of such grants are directly provided to national universities and the remaining 5% goes to research projects proposed by researchers. In the United States, there are no research grants supplied en masse to universities in the absence of national universities, and assistance is made to each research project in the form of either grant or research contract. As such grant and contract will be terminated in a year if the project fails to produce results, there is severe competition among universities over grant and research contract applications. This leads to projects meeting the needs of social economy and the establishment of efficient research systems.

(3) Incentive Policy for R&D

The basic stance of the United States is that the government will buy research and development it can use directly. Research funds to the industrial sector are all provided in the form of research contracts and the government utilizes the vitality of the private sector by providing

3. Contract System for Interaction among Industries, Governmental Institutions and Universities

Contents

system. Because contracts under the various systems are all concluded within these frameworks, no allowances are made to compensate for variances in research contents and interactive relations.

Regarding contracts between national universities and private enterprises, however, the government has not formulated a uniform contract system outlining interaction. Subsequently each university and faculty has its own guidelines and some follow no guidelines whatsoever.

On May 11, 1983 measures were taken to correct this situation. On this date, the director-general of the Education Ministry's Scientific and International Affairs Bureau and the chief of the Accounting Division issued a notice on handling of joint research with the private sector to the presidents of national universities, thus deepening understanding of the need for cooperation between the industrial sector and universities and clarifying the government's basic view on such cooperation. Not only is the notice expected to open the way for improving contract systems and cooperative relations, it also signals the necessity for private enterprises to make further efforts to strengthen such cooperation.

(3) Contract Simpler than Contract Procedures

Generally speaking, procedures required for the conclusion of a contract are complex and take much time. In contrast, the concluded contract itself tends to be simple because it excludes difficult problems and detailed arrangements. Thus the underlying nature of the finished contract is one of ambiguity.

3.2 Characteristics of Contracts by Type

Research contracts generally vary from a consulting contract to a joint research contract which will not be completed unless each contracting party scores a success in a substantial part of research.

Typical contract methods and characteristics of various contract types follow:

(1) Consulting and Technical Guidance Contract

Consulting contracts private companies conclude with universities or national and public research institutions chiefly cover the following points:

I Private companies regularly invite researchers for lectures.

II Companies dispatch researchers to universities or research institutions to study research techniques in specific fields.

III Companies get their new materials and new products authorized by universities or research institutions through examinations.

A contract method for such a consulting tie-up between a private company and a university is generally quite simple. The two parties make an agreement on the payment only and often make verbal promises regarding other points. The money will be paid in the form of either a contribution or a lecture fee.

As for contracts with national and public research institutions, the Agency of Industrial Science and Technology of MITI, for instance, has a form for technical guidance contracts. When the form is used, private

Private companies aiming at commercialization also offer research contracts under which they sponsor promising research projects already under way at universities.

(4) Entrusted Research Contract

Under this contract, a company is totally entrusted with the implementation of research with necessary funds provided, such as its participation in a national project. When a company concludes such a contract with the government, all the results of research will belong to the government.

In comparatively rare cases, a private business is entrusted by a university with research, mostly for experimental manufacture of a special product.

(5) Joint Research Contract

This contract calls on a private enterprises and a university or national or public research institute having common reserch objectives to carry out research jointly by mutually providing research funds, researchers and facilities. It can be divided into the followiung categories by contractural relations:

I One-to-One System

An independent contract is formed between one business corporation and one university.

3.3 Problems of Contract Provisions

Following are current problems concerning contract provisions for research and development among the industry, governmental institutes and universities:

(1) Patent Applications and Problems

I Patent Application Procedures

Private companies have patent departments and experts take all the procedures for applying for patents. At universities, a professors undertake such procedures on their own behalf.

Apparently, a relatively small number of university researchers have expert knowledge or techniques regarding patents and their ways of acquiring patents are not skillful.

Therefore, when a patent is to be applied for on the basis of joint research between a university and a business, the university seems to leave the application procedures to the company in many cases. Universities should have better understanding of the importance of patents, in which research achievements are concentrated, and consider using patent experts.

II Patent Applicant

In principle, a university professor can apply for patents on research results as his own achievements. But patents will belong to the government when the professor makes the research by receiving more than a specified amount of funds from the government for the specific purpose of research and development, or when he uses large equipment built with governmental funds in the research.

(i) Of Research and Development Achievements, What is Important is Software

Research and development achievements can be divided into two categories -- formless, intangible achievements, such as scientific discoveries, inventions, knowhow and calculation codes, or so-called software, and tangible achievements, such as specimens provided for experiments in the course of research and development, experiment facilities that have been improved on to meet research and development requirements, and products made on an experimental basis, or so-called hardware.

Software is the more important of the two categories of achievements on the ground that if there is software, which stipulates theories, methods, procedures and knowhow, hardware can be reproduced any time.

(ii) Achievements are Products of Funds and Human Wisdom

Research and development cannot be done by simply investing money and combining existing materials and processes. It can be done only when human wisdom is added to the equation.

In other words, accumulatated knowledge and experience of individual researchers are important factors in the successful attainment of research and development goals.

(ii) No Special Consideration is Given Regarding Licenses to Use Industrial Property Rights Resulting from Research Entrusted by Government

No special consideration is given as to licenses of companies entrusted by the government with research projects to use resulting industrial property rights on the grounds that they have already benefited from the projects in the software aspect, such as enhancement of technological potential, in the course of carrying out entrusted research.

Conditions for granting such a license to a company which has been entrusted with research also apply to third parties. Moreover, when the government decides to provide a license to a third company, the company entrusted with the research is required to extend technical cooperation to the licensee.

It is important to further stimulate research by entrusted companies. To this end, special consideration should be given to the use of research results by entrusted companies.

Such special attention may include the provision of an exclusive license to the entrusted company and the establishment of a period during which the entrusted company can exercise the license on a preferential basis.

(iii) Lack of Arrangements on Use of Results of Entrusted Research

From the viewpoint of promoting industry, the government does not make use of the results of research projects it entrusted to private during which the company can exercise the license on a preferential basis should be determined flexibly.

(vi) Company Must Pay License Fees for Industrial Property Rights Shared with Government

A company is required to pay license fees for industrial property rights it shares with the government. However, there are no prior arrangements concerning the amount of fees.

Profit accruing from licenses provided to third parties are shared by the company and the government in accordance with their shares of the industrial property rights concerned.

III Contract on Results of Research between Company and University

There are almost no rules concerning the handling of the results of research entrusted by a private company to a university and joint research between them.

4.1 Government-led Organizations

There are various government-led cooperative systems, which can be classified as follows:

. Research Association for Promotion of Mining and Manufacturing Technology
. Technological research association with joint researchers
. Incorporated foundation for development
. Incorporated foundation with joint research institution
. Special corporation serving as core
. Joint research and development center of the third sector

(1) Research Association for Promotion of Mining and Manufacturing Technology

Under this system, a technological research association is set up by private companies participating in a government-industry joint research project for smooth implementation of specific experiments and research. Based on the "Research Association Act for Promotion of Mining and Manufacturing Technology", enacted in May 1961, research is entrusted to the association.

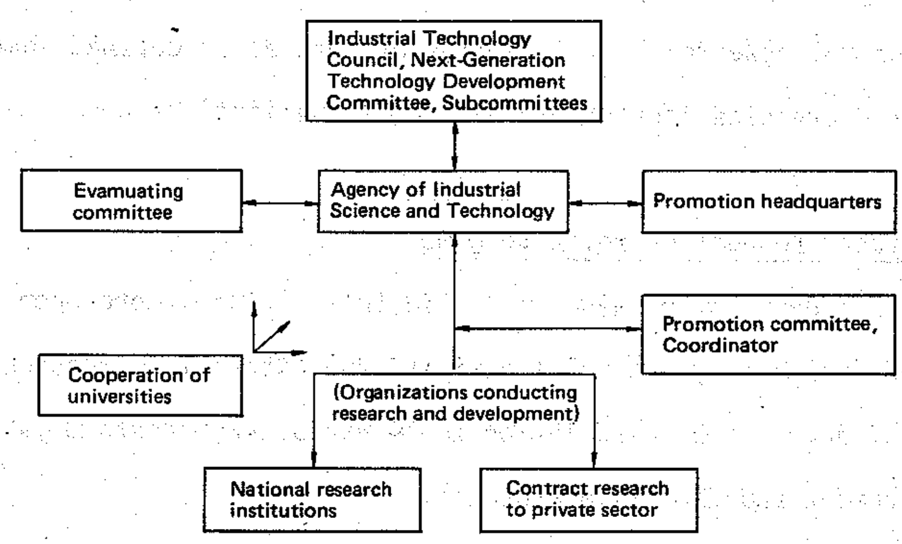
The "Research Association Act for Promotion of Mining and Manufacturing Technology" was enacted by taking the following points into account:

It was necessary to drastically improve the level of Japan's mining and manufacturing technology in order to strengthen international competitiveness of Japanese industry, advance the industrial structure and double national income. But research and development investment by private

Example 2: Technological research association for biotechnology development (MITI, next-generation)

The research and development system for basic technologies for the next-generation industry, which is promoting the latter example, started in 1981. It is aimed at conducting research and development in common basic technologies necessary for the establishment of next-generation industry, such as new materials, biotechnology and new functional elements, coping with an international technological development race. Fig. 4.1 shows its outline.

Fig. 4.1: Research and development system for basic technoligies for the next-generation industry



(2) <u>Technological Research Association with Joint Researchers</u>

This system calls for dispatching researchers from the participating companies and the government to a technological research association to form a joint research institution.

(4) Incorporated Foundation with Joint Research Institution

Under this system, an incorporated foundation is set up for research and development and a joint research institution is established under the incorporated foundation with researchers dispatched from the participating companies.

Example: Technological development organization for next-generation computers and joint research institution (the fifth-generation computer)

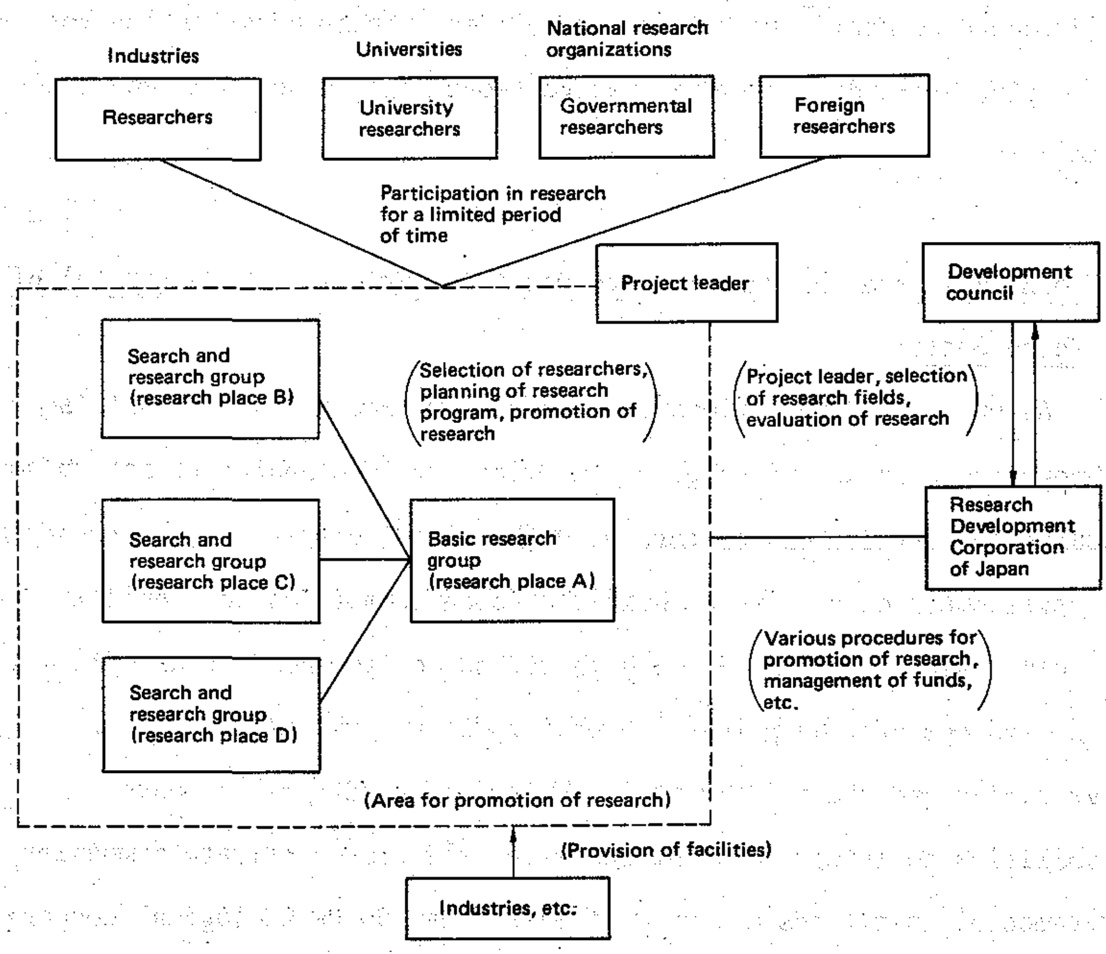
Under this project, the government will seek wide-ranging international cooperation partly in order to avoid overseas criticism of Japan's industrial policy allegedly targeted at fostering high-technology industries. It also aims toward creating a joint project with other countries by strengthening liaison with similar projects in other countries and expanding technological interchange and joint research. Thus the project is considered a test case for internationalization of joint research on a state level.

(5) Special Corporation Serving as Core

This system calls for promoting joint research among industry, governmental institutes and universities as well as entrusted development projects by establishing a special corporation as a core of such research with governmental funds and grants and private funds.

and utilize existing private research institutions. The researchers will continue to belong to their own research organizations and participate in research projects for a certain period of time under contract. After the completion of research, research groups will be disbanded.

Fig. 4.2: Creative science and technology promotion system



The research in hybrid materials shown in Example 2 is aimed at developing new materials that surpass existing materials in terms of functions and properties. This is to be accomplished through research

research facilities of venture businesses, starting in fiscal 1984. Several venture businesses will form a corporate association and this association will promote the construction of a venture business complex. Computers for research and development purposes and facilities for evaluation and experiments will be installed in the complex and used jointly by the venture businesses.

The government will subsidize half of funds needed for purchasing joint facilities through prefectural governments. It also plans to see to it that acquisition of land and buildings will be subject to the Small and Medium Enterprise Agency's financing for the advancement of industry.

Under this system, national universities invite researchers and research investment from private firms, and professors and the researchers jointly select research subjects and conduct joint research. Under the conventional entrusted researcher system, researchers from private companies were treated as graduate students, but they are given the same status as university teachers under the new system. Compared with contracted research conducted solely by university researchers, the new system opens the way for more positive interaction between national universities and private companies.

(2) Promotion of Private Company-University Interaction by Japan Society for Promotion of Science

The Japan Society for the Promotion of Science, which has been encouraging cooperative research between industry and university circles since its inception, established the Liaison Committee for Research consisting of knowledgeable leaders among academic circles and the industrial sector in November 1982 in line with the report of the Science Council. It is conducting surveys and deliberations on promising research fields, selection of research subjects and the establishment of a research and development expert committee; and making an overall study on the promotion of interactive research between industries and universities from a long-term point of view.

(4) Propositions by the Japan Federation of Engineering Societies

According to a survey report entitled "situation of research and development in science and technology in Japan and comprehensive study on long-term promotion of engineering research," engineering academic associations had been inclined to reject outsiders' views from the viewpoint of their autonomy or academic freedom. Compiled by the Japan Federation of Engineering Societies with grants from the Education Ministry, the report said, however, that a place for production is a place for verifying engineering achievements and that engineering research achievements can be valuable only because of the existence of such a production place, emphasizing the need of promoting interaction between private companies and universities positively by taking into account the present situation and the future of engineering in Japan. The report added it is desirable that universities and enterprises step up interchange of persons and implement research by concentrating human resources at an institute of a university or a company.

These propositions indicate that there are growing moves on the part of the universities for positive interaction with private companies.

A rental laboratory set up in the building facilitates their joint research. A team for research in superfine particles is already conducting research activities under a project for the Science and Technology Agency to promote creative science and technology.

There is also a salon outside a conference room for interchange with reserchers visiting from outside. In addition, the consortium is planning to construct a building for a "satellite group" to support its activities.

As noted so far, interaction among the government and universities is carried out in various ways. Yet the most dominant means of implementing such interaction is by way of government-led organizations.

Fig. 4.3 is an extract of the structure of science and technology research in Japan. It is marked by poor interaction among government ministries and agencies, reflecting Japan's vertically-affiliated society.

Table 4.1: Research expenses and researchers in Japan (1980)

	Private sector	Government and public sectors	Universities	Total
Research expenses (in 100 million yen)	31,423	7,176	8,239	46,838
Ratio (%)	67	15	18	100
Researchers	184,889	30,006	102,592	317,487
Ratio (%)	58	10	32	100

The total number of those who are engaged in research activities is 524,000.

As shown in Table 4.1, in research and development expenses and the number of researchers, the private sector accounts for 67% and 58%, respectively, clearly indicating that research and development activities in Japan are chiefly led by the industrial circles. In "On Basic Thinking on Japan's Industrial Policy" announced April 18, 1983, MITI notes that "the private sector is the main propellant of technological development in Japan." It would appear that industry-led research and development will remain dominant in Japan.

basic technology required by next-generation industry.

However, horizontal interaction remains difficult due to various restrictions in implementing these systems.

(2) Present Organizations Lack Interaction with Universities

Existing government-led organizations for implementing interaction are weakened by the inadequate participation and cooperation of universities. This is due to a lack of understanding regarding the merits of industry-government-universities interaction and the scarcity of basic and fundamental research subjects that attract universities.

Part of the problem must also be attributed to the industrial sector: it regards the acquisition of talent as the major objective of its interaction with universities and does not pin much hope on universities regarding research results. This attitude of the industrial sector is exemplified by the fact that there have been virtually no cooperation promoting organizations set up with the initiative of the industrial sector, as noted in 4.3. Such an attitude is likely the result of private companies' past tendency to seek seeds of technologies in the United States and European countries, thereby avoiding a solid technical interchange within Japan.

Industry-led research and development projects have thus far been chiefly market-oriented projects on development and commercialization, giving priority to the interests of enterprises. It is indicated in Table 4.2 that although Japan has surpassed the United States and European countries in the field of production technology, it still lags behind in the product technology field where new product ideas and creativity are so essential.

Table 4.2: Comparison of Japan and U.S. in major technologies

Technological field	Materials technology		Processing and assembling technology					Product technology			
When compared with U.S.	Technology for developing new materials	Improvement of performance during production processes	Technology to increase capacity and size	Automated and continuous processing and assembling technology	Hi-quality production technology	Experiment and testing technology	Production management technology	Technology to make products more functional	Software technology	Designing technology	Total
Higher	6	4	2	6	12	1	6	13	2	2	54
Equal	2	1	1	6	18	2	3	23	2	2	60
Lower	8	0	4	4	7	2	1	22	4	20	72
Total	16	5	7	16	37	5	10	58	8	24	186

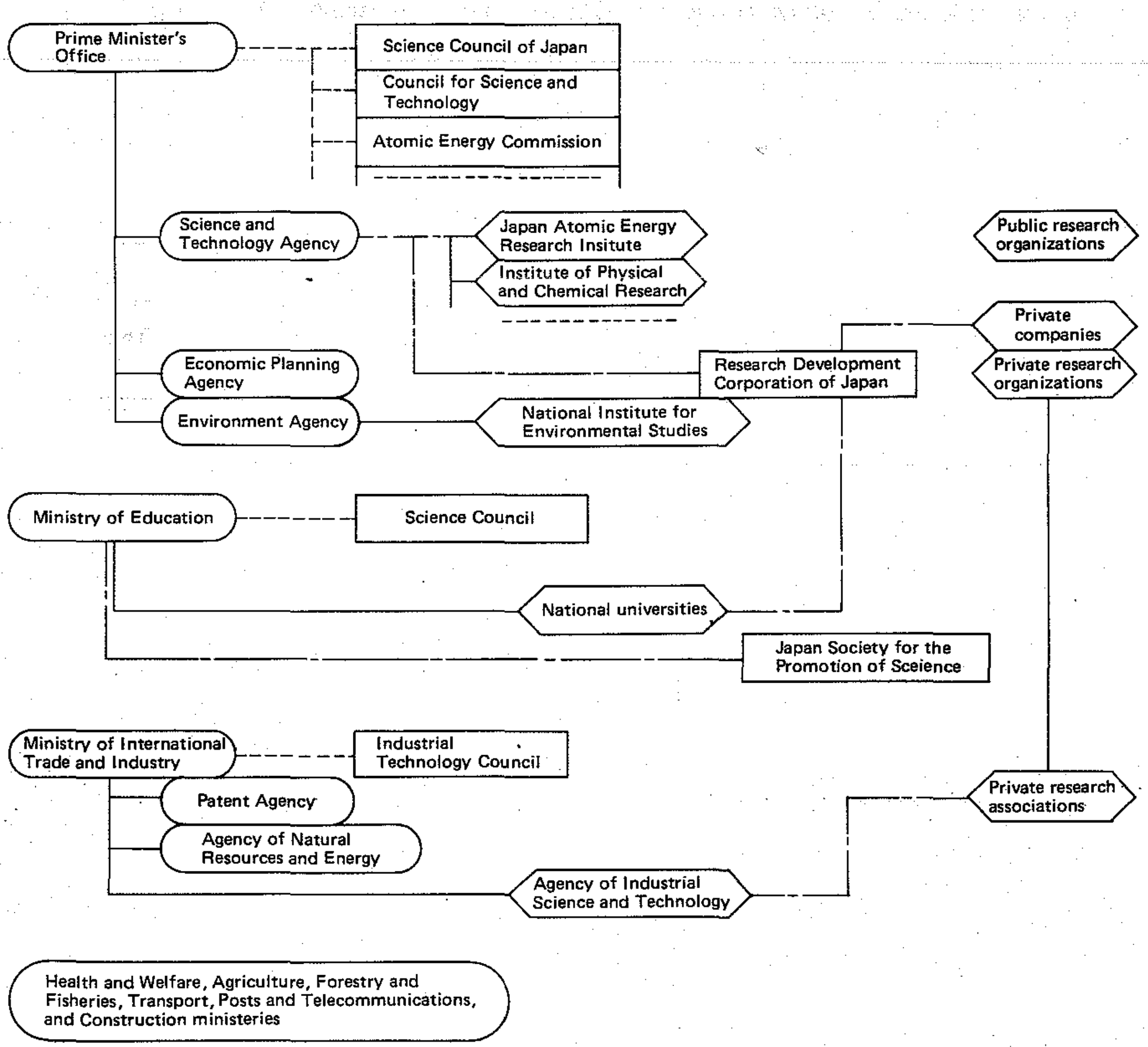
Survey on Conditions of Promoting Technological Development, March 1982, Japan Techno-Economics Society.

The government, which advocates further development of the country on the basis of technology, must be rated highly in that it is devoting its energies to upgrading Japan's basic research and fostering innovative technologies. Examples include new systems such as the one promoting creative science and technology or the research and development system for

4.4 Problems of Organizations Implementing Interaction among Private Companies, Governmental Institutes and Universities

(1) Dominance of Government-Led Organizations

Fig. 4.3: Structure of science and technology research in Japan (extract)



4.3 Industry-Led Organizations

There is virtually no instance in which private companies set up cooperative systems for positive use of research capabilities and research achievements of the governmental institutes and universities. Probable reasons are as follows:

- As for cooperation with the governmental institutes, private companies consider the use of governmental funds or facilites as the chief merit of the cooperation.
- As for interaction with the universities, they feel the main merit of the cooperation is the acquistion of talented people through the establishment of personal relationships.

But here, let us study the case of the Tsukuba Consortium, which was established with the assistance of the Research Development Corporation of Japan. It is a distinctive research organization that is challenging the development of innovative technologies by drawing upon the unique abilities of government and universities.

The consortium was established jointly by eight medium-sized venture businesses with the aim of seeking seeds of future technological innovation in cooperation with national institutions in Tsukuba Science City in Ibaraki Prefecture. One of its characteristics is that there is no overlapping of products and technologies by participating companies.

It consists of a headquarters building jointly owned by the eight companies and eight independent laboratories surrounding it. The secretariats of the companies are located in the headquarters building to facilitate speedy consultations regaring joint research.

(3) Promotion of Interaction between Industries and Universities by Individual Universities

Individual universities have also taken steps to promote interaction between industry and the universities. Of particular note are the Technology Development Center established by the Nagaoka Institute of Technology and Science in April 1981, the Research Center set up by the Tokyo Institute of Technology in June 1982, and the Research and Information Exchange Center. These organizations have attracted attention for promoting cooperation between industry and universities as set forth in the Science Council's proposal for the establishment of a university science hall and a scientific information center.

There are also examples of joint development and use of state-of-the-art, high-tech research facilities by the industrial sector and universities as proposed in the council's report. They include a call for joint research with private companies by the Nippon Institute of Technology, which introduced molecular-beam crystal growing equipment.

As for interaction between industries and universities with research commission funds and contributions provided by companies, which is the most frequently used form of interaction, universities are now urged to improve their systems to make way for such interactive projects. At present, only a few such systems are functioning effectively. They include the Technology Development Center of the Nagaoka Institute of Techonology and Science, and the Industrial Promotion Association of the Tokyo Institute of Technology.

4.2 Organizations Led by Universities

Interaction between industry and the universities has been conducted rather informally when compared with the interaction between industry and the government. The Scientific and International Affairs Bureau of the Ministry of Education recently issued a notice to national university presidents, clarifying the joint research system between the academic and industrial circles for the first time.

(1) Clarification of Joint Research System by Education Ministry

Numerous recommendations and proposals have long been made regarding interaction between private companies and universities. Among these is a report titled "On Basic Policy for Improvement of Scientific Research System" which was submitted to the Eduction Ministry in January 1982, stressing the importance of measures for interaction with various sectors of the society by utilizing accumulated research achievements and research capability under the leadership of universities to meet social needs for scientific research. The financial circles also have increased the call for stepped-up interaction among industry, governmental institutes and universities. In April 1982, the Education Ministry set up the Research Cooperation Office within its Scientific and International Affairs Bureau to promote industry-university interaction and issued a notice on "handling of joint research with the private sector" in May 1983, clarifying the joint research system between universities and the industrial sector.

participated in by national institutions, national, public and private universities, and private companies with the Institute of Physical and Chemical Research, a special corporation, serving as its core.

They plan to start with basic surveys and research and develop the project into an international cooperation program with the United States and European countries in the future. It is attracting attention for its challenging attitude toward innovative technologies and the grand scale of cooperation.

(6) Joint Research and Development Center (Joint Research Institute) of Third Sector

As one of the variations of this system, and as part of MITI's technopolis construction program, the ministry is planning to set up joint research and development centers with the aim of dispersing the research and development capability of high-technology companies to provincial areas and encouraging the transfer of high technology to those areas. It will be funded and operated by private companies, local governments, local universities and the government. The center is designed to have capabilities to integrate joint research projects of private companies, governmental institutes and universities, step up technological cooperative relations with industry, and promote technological interchange among industrial sectors.

MITI's Small and Medium Enterprise Agency has recently revealed that it will encourage construction of "venture business complexes," joint

Example 1: Mizuno biohoronic project (Science and Technology Agency, creative science and technology promotion system)

Example 2: Survey committee for research and development program on hybrid materials (Institute of Physical and Chemical Research, others)

Example 3: Amorphous solar cells (Resarch Development Corporation of Japan, entrusted development)

As shown in Fig. 4.2, the creative science and technology promotion system of the Science and Technology Agency in Example 1 is aimed at seeking innovative technological seeds with the joint efforts of the industrial sector, the governmental institutes and the universities with the Research Development Corporation of Japan serving as the main propellant body. It employs a new method called the fluid research system, under which researchers can buckle down to creative research activities by ignoring organizational boundaries, while benefiting from the lifetime employment system.

A researcher who has original ideas on the research theme and excellent managerial ability will be appointed the project leader, who, having discretionary authority on the management of the research within a certain range, will look to overall promotion of the research.

Researchers will be selected by the project leader or publicly invited from industry, governmental institutes and universities as well as from abroad, and organized into groups of several persons each.

The special corporation will have no state-owned research facilities

Example 1: VLSI technological research association and VLSI joint research instituion (MITI, grant)

Example 2: Optics-applied technological research association and optics joint research institution (MITI, big project)

The VLSI joint research institution in Example 1 was unprecedented for a public research organization in that it conducted research by forming a mixed team of researchers from rival companies of the same line of business under the institution's president hailing from the government sector and that it was established solely for the four years of VLSI research and development and disbanded completely immediately after the completion of the research. It is worthy of note as it defined what joint research organizations should be like among institutions.

(3) Incorporated Foundation for Development

This is a development association in the form of a more open incorporated foundation, set up to mitigate the external impression that technological development association is an exclusive, closed organization of the government and the private sector.

Example: Association for research and development in new functional elements (MITI, next-generation) companies was generally smaller than similar investment in other countries, and private companies were heavily inclined toward short-term development projects. Moreover, there were gaps in technological levels of companies and raising of the average level involved many problems. Obviously it was necessary to efficient use of Japan's limited funds and researchers, the most appropriate measure to this end being the promotion of experiments and research by establishing a joint research system of companies. This was expected to enable large-scale technological development which could not be carried out by a single company; enable efficient utilization of research investment by concentrating research funds, researchers and research facilities; facilitate the implementation of long-range, basic and common research projects that were difficult for individual companies to launch; and make possible more advanced technological development.

But when such a voluntary organization, which lacks a corporate status, carried out joint research, it was certain to entail problems and troubles, such as the responsibility for property management and accounting, possession of industrial property rights, and application of laws to issues concerning responsibility for security and personal relations. The "Research Association Act for Promotion of Mining and Manufacturing Technology" was enacted with the aim of eliminating these problems and promoting smooth joint research.

The purport of the law's enactment still retains many usable points.

Example 1: Research association for high-speed calculating system for scientific and technologicl use (MITI, big project)

4. Types of Organizations Implementing Cooperative Projects among Industries, Governmental Institutions and Universities

Contents

companies. Therefore, contracts stipulate almost nothing regarding their use.

Depending on research subjects, however, it is advisable to clarify the features of the expected achievement and stipulate a yardstick for license fees, thus working out specific arrangements on the use of the results of research.

(iv) Industrial Property Rights Resulting from Joint Research are Shared by Government and Company

Industrial property rights for inventions made under joint research between the government and a private company are shared by the two parties unless it can be proven that the invention was made by the company on its own.

(v) Company can Preferentially Exercise License to Use Joint Research Results during Limited Period of Time

As for the results of joint research between the government and a private company, the company can exercise a license to use them on a preferential basis within a period of time not longer than five years.

The period is set at five years uniformly from the day when research and development is completed. However, there are various joint research projects from basic ones to those in a development stage, and the lead time varies accordingly. Therefore, the period

(iii) Hardware as R&D Achievements Completes its Mission upon Completion of Development

Specimens manufactured in the course of research and development, machinery and other facilities acquired, products made on an experimental basis and other tangible items are considered to have completed their mission upon the completion of research and development, because they are means of obtaining and confirming the achievements of research and development.

II Contract with Government on Use of Research Results

The present situation of handling the achievements of research involving the government, shows the following characteristics:

(i) Industrial Property Rights Resulting from Research Entrusted by Government All Belong to Government

Industrial property rights resulting from research projects entrusted by the Agency of Science and Technology, MITI and other government agencies all belong to the government from a point of view that the results of such research should be shared by all the people as the research projects are entirely funded by the government.

But in reality, business corporations entrusted with such projects have to pay a certain percentage of all the necessary funds to cover shortages in many cases.

In the case of national research institutions, the patent applicant is always the director of the Agency of Industrial Science and Technology irrespective of the type of research -- independent research, entrusted research or joint research. Patent applications are never made by individuals, such as individual researchers, as is the case when research is handled by universities. Likewise, when MITI entrusts a private company with a research project, the patent applicant will be the director of the Agency of Industrial Science and Technology.

In view of motivation and independency of each national research institution, it seems advisable to allow a national research institution to file a patent application under the name of its president.

III <u>Application for Foreign Patents</u>

As for patents involving the government, the number of applications for foreign patents is severely restricted due to budgetary constraints. Positive governmental measures are desired on this score, such as the inclusion of foreign patent application costs in research contract expenses.

(2) <u>Handling of Research Results and Problems</u>

I <u>Characteristics of Research Results</u>

Research and development activities cover new scientific and technological discoveries and creations as well as all the processes leading to such discoveries. Characteristics of the achievements of research are as follows:

II <u>Sharing and "Take-Home" System</u>

Participating organizations take charge of their own share of research on a "home work" basis, so to speak, rather than conducting joint research at one place. This system is often used for MITI's big projects and by the Research Association for Promotion of Mining and Manufacturing Technology.

III <u>Unified System</u>

Researchers of participating organizations get together at one place and promote research and development as an entity. A leader is generally needed under this system to propel the project.

Patent rights as the results of such joint research projects will either be shared by the participating parties or belong to one of them.

Favorable measures for participating businesses are not taken into account much in joint reseach programs involving the government.

companies need to comply with the government's policy regarding patent applications and use of the results of such guidance.

(2) Research Assistance Contract

Under this contract, a private business makes a monetary contribution to a specific university professor or a faculty without specifying research themes and utilizes research results on a preferential basis.

In many cases, a Japanese company or group of companies conclude such a contract with a foreign university or foreign universtity professor.

Most notable foreign partner of such contracts is the Massachusetts Institute of Technology (MIT).

At MIT, there are several professorial posts funded by the industrial sector. Not a few professors concurrently serve as president or executive at a venture business in the high technology field.

Such professorial posts include those funded by Toyota Motor Corp. (Toyota Chair Professor), the Mitsui MIT Association, Nippon Steel Corp. and Matsushita Electric Industrial Co.

(3) Research Entrusting Contract

Under this contract, a private enterprise totally entrusts a university or national research institute with research by providing necessary research and development funds, while the entrusted organization assumes responsibility for implementing the research. Types of entrusted research vary from various performance tests, analyses, measurement and evaluation to the synthesis of a new material.

While it is true that fulfillment of a contract stipulating only basic points may well procede smoothly, there are risks in the event of non-fulfillment of the contract. In this case, it is unclear where responsibility lies.

3.1 Characteristics of Japan's Contract System

Following are characteristics of Japan's contract system when seen from the viewpoint of interaction among industry, governmental institutes and universities:

(1) Flexible Contract Provisions

Unlike the European and American people who make much of contracts, the Japanese have relatively little understanding of contracts. Therefore, the contents of the Japanese contract are limited to absolute basics and vague enough to leave ample latitude in working out details. This enables flexible implementation of the contract versus rigid adherence to detailed stipulations.

Thus latitude of interaction among industry, governmental institutes and universities varies widely in accordance with the partners' capability.

(2) Uniform Contract Pattern

As for contracts between the government and private businesses, the government usually takes the initiative, establishing various systems within each ministry for development of new technologies in wide-ranging industrial fields. These systems can be broadly classified into the grant system and the contract research system.

A research and development subsidizing system under the Law for Acceleration of Rationalization of Enterprises serves as the basis for the grant system and a large-scale industrial technology development system (so-called large-scale national projects) for the research contract incentives, such as profits allowed in contract money and the acquisition of patent rights and patent licenses.

By contrast, one-third of governmental funds to the industrial sector are provided in the form of grants and two-thirds in the form of research contracts. In the case of grants, the recipient is required to pay part of its profit accruing from the research concerned and repay the grants upon successful development.

The United States provides a wide variety of research contracts to mitigate the burden of recipients, but there are few variations in Japan.

The two countires are implementing tax incentive measures based on the same principles, howver, U.S. measures are a little more advantageous for private companies than Japanese measures.

2.4 Comparison of Japanese and U.S. Research and Development Policies

Japan and the United States share some of the same basic technology policies as research and development promotion measures. They are:

- Maximum utilization of the private sector's vitality.
- Government financing of long-range and risky research.
- Stepped-up interaction among industry, governmental institutes and universities.
- Improvement of the infrastructure for research and development.

However, there are following differences.

(1) Dependence on Private Sector's Vitality and Government's Role

As clearly shown by the fact that the government spends only 5% to 6% of its funds for assisting the private sector in Japan as against 50% in the United States, the private sector takes the initiative in Japan in research and development.

The extraordinarily small assistance to the private sector in Japan has apparently encouraged self-reliance of research and development-oriented private companies, resulting in remarkable achievements based on the principle of competition.

Meanwhile, the United States has made an about-face in its policy of fostering private firms under the Reagan Administration. Judging that direct assistance measures by the federal government were inefficient and even hampered the formation of new markets, the government is now moving toward curring down on direct assistance to research and development of products demand geared chiefly at the private sector.

V Financial Incentives

(i) Financing Systems for Promotion of Technology by Japan Development Bank

- System to provide funds for the promotion of domestic technology
- Financing system for the promotion of computers
- Financing system for advancing the electronics and machinery industries

The Japan Development Bank is providing low-interest loans in order to improve the level of mining and manufacturing technology and make Japan's industrial structure more knowledge-intensive.

(ii) Financing by Small Business Finance Corporation

- Financing system for commercializaton of new technologies by small businesses
- Financing system for the promotion of advancing the electronics and machinery industries

(iii) Guarantee of Obligations by Venture Business Promotions Center

The center guarantees research and development expenses by venture businesses, eliminating mortgage borrowing.

VI Research Association System

Under this system, private enterprises form a technology research association to be entrusted with governmental research, centering on specific experiments and research, in order to promote joint research

II Grant

Main grants for science and technology research are as follows:

. Encouragement of scientific research:

Grants for scientific research expenses (Ministry of Education)

Grants for current expenses of private universities and others (Ministry of Education)

. Promotion of medical science and technology:

Grants for scientific experiment and research expenses (Ministry of Health and Welfare)

. Development of industrial technology:

Grants for research and development expenses for important technologies (MITI)

III Adjustment Works Expenses for Promotion of Science and Technology

Replacing the account for adjustment works expenses for promotion of special research, this account was created in 1981 in order to conduct overall promotion and coordination of important research activities necessary for the promotion of science and technology.

IV Tax Incentives

Following are Japan's major tax incentives for the promotion of science and technology.

(i) Tax Deduction for Increased Experiment and Research Expenses

When experiment and research expenses surpass an all-time high annual level, 20% of the exceeded amount will be deducted from tax.

(2) Specific R&D Assisting Measures in Japan

I Research Contract

Entrustment of major scientific and technological research to the private sector is done as follows. Nearly 70% of such research contracts are financed by the budget for research and development contracts of the Misistry of International Trade and Industry (MITI).

(i) Entrusted Development System

Under the system implemented by the Research Development Corporation of Japan, development expenses are provided to companies, on condition that they will be paid upon successful development, for excellent but risky development projects.

Under the system, activities to diffuse the results of entrusted development will also be carried out.

The corporation also promotes the transfer of government-held patents and unused patents held by businesses.

(ii) Research and Development System for Large-Scale Industrial Technology (MITI)

When the development of urgently-needed large-scale industrial technology that is important for the national economy requires large funds and a long period of time, and is too risky for a private company to take the initiative, the government will shoulder all the necessary funds and promote the development under an interactive system among industries and universities.

II Basic Thinking of Japanese Government on R&D

(i) Basic Principles of Science and Technology Policy

As the former Japanese Prime Minister Zenko Suzuki said at the Versaille Summit of seven insustrial democracies in 1982, the basic principle of the Japanese government's science and technology policy is that although development of science and technology should basically depend on vitality of the private secotor, the government should play an important role in fields where risks are too high due to long lead time and the amount of necessary funds. The government's shouldering of research and development funds clearly reflects this policy.

In other words, the government's thinking on research and development is based on the following principles:

. The initiative of technological innovation should be taken by the private sector.

. The government should sponsor basic research, and proficts involving technologies, development of which is uncertain despite their possible wide applications, and technologies whose social benefits will not become available on a commercial basis within a short period of time.

(ii) The World's Science and Technology-based Countries

According to trade and industry policy vision for the 1980s, the government advocates development of nations of the world on the basis of technology on the grounds that technological development is investment for the future that can be shared by civilizations to come, a common fortune of the world. The following three points are the government's basic ideas:

(iii) Breakdown of R&D Expenses by Type of Research

It has long been pointed out that Japan is putting emphasis on development of applied and processing technologies based on technologies introduced from Europe and the United States while making insufficient efforts to develop basic technologies involving high creativity and high risks.

But Figs. 2.8 and 2.9 on breakdowns of research and development investment by the three research types of basic, applied and development research show that there is not so large a difference between Japan and European countries and the United States, which invest 15% to 20% of total research and development funds in basic research.

A breakdown by organization in Fig. 2.8 shows that basic research expenses of universities and development research expenses of private companies remained almost constant in the past several years at less than 60% and 80%, respectively, of their total research and development investment. The government's share in total basic research expenses exceeds 70%.

Fig. 2.5: Comparison of government's share in research expenses (1979; 1978 figures for Britain alone)

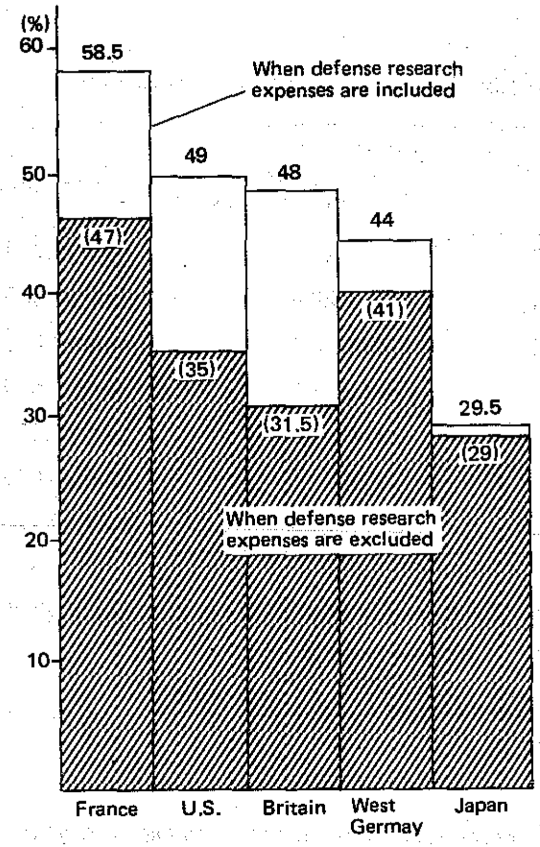
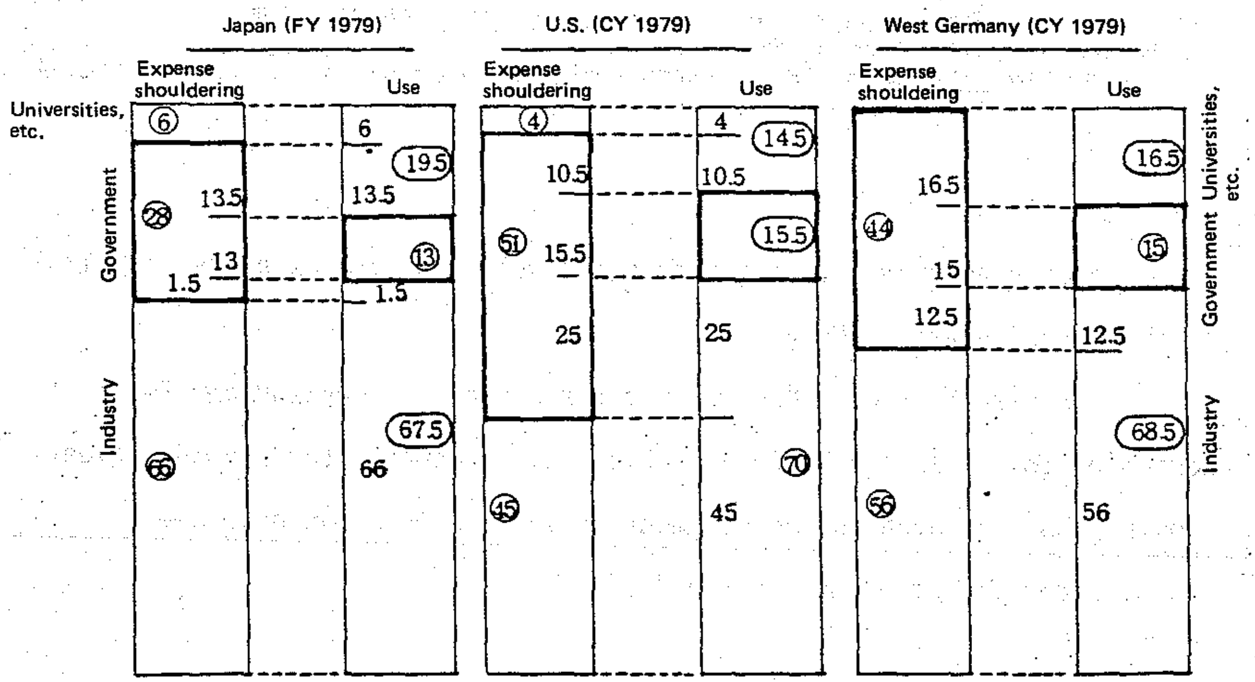


Fig. 2.7: Comparison of research expense shouldering and use in Japan, U.S. and Germany (%)



Notes: 1. Non-profit research institutions are included in the government, universities and industry categories.
2. U.S. figures include research expenses in cultural and social sciences.

Sources: International Statistical Year 1977, OECD
Survey Report on Science and Technology Research, Prime Minister's Office

2.3 R&D Assisting Measures in Japan

(1) Industrial Technology Policy of Japanese Government

I R&D Expenses

(i) Total R&D Investment

Japan's research and development investment has steadily been expanding since the second half of the 1960s. It stood at 27 billion dollars in 1981, ranking second only after the United States in the free world. In terms of the ratio of such investment to GNP, Japan placed second together with the United States with 2.36%, following West Germany. (Figs. 2.1 and 2.3)

(ii) Government's Share in R&D Expenses

The government's share in research and development expenses in Japan is remarkably low at less than 30% as against around 50% for industrialized countries in Europe and the United States (Table 2.3). There is not much difference in the figure even when research and developnment expenses in defense are excluded (Fig. 2.5).

In 1980, government-funded research and development accounted for 25.8% or 1,209.6 billion yen of the total research and development expenses of 4,683.0 billion yen as shown in Fig. 2.6, which illustrates a breakdown of uses of Japan's research and development budget.

Of the sum, govermental grants to the private sector accounted for a low 5.9% (1.5% of the total research and development expenses), far smaller than 50% for the United States and 25% for West Germany.

shortened from five years to three years.

The depreciation term for similar equipment ranges from four to seven years in Japan.

(iv) <u>Various Tax Incentives for Research-Oriented Small Businesses</u>

When a small business investment company (SBIC) continues to invest in a venture business (VB) profit accruing from its investment in the VB, an amount proportional to the invested amount will be exempted from corporate tax.

SBIC is a small business investment company licensed by the Small Business Administration and has funds of 500,000 dollars or more. Under institutional financing, an SBIC can borrow money four times as much as its funds on hand and invest it in venture businesses.

IV Patent Policy

As for patents involved in research and development related to the government, the Carter Administration sharply improved the patent system with the "Uniform Federal Patent Policy Act of 1980", enabling small businesses with employees of 500 or less, and universities and other non-profit organizations to obtain patent rights or exclusive patent licenses. Futher, the Reagan Administration, with a presidential order in Feburary 1983, made the law to cover big enterprises as well. Thus the government makes no claim to patents accruing from experiments and research it has subsidized or entrusted to private companies, either small or large,

II Grant

To encourage basic research, the NIH and NSF widely provide grants. Recipients of grants from these organizations are usually universities and non-profit organizations, and do not include private companies The term of the NSF's grant supply is generally one year, which will be extended if the recipient yields satisfactory results in its research.

About 70% of the NSF's grants are provided to universities.

The NIH supplies grants to about 5,000 recipients a year and most of the biomedicine research projects in the United States are financed by NIH's grants. The term of grant supply is usually one to two years.

III Taxation System

To promote technological innovation, the United States introduced the following tax incentives in its "Economic Recovery Act of 1981".

(i) Tax Deduction System for Experiment and Research Expense Increase

When research and development expenses of a year exceed an annual average for the base period (generally the past three years), a 25% tax deduction is available for the exceeded amount.

Under the Japanese system, when annual research and development expenses surpass the company's highest ever annual research and development expenses, a 20% tax deduction is available for the exceeded amount. Research and development expenses subject to the tax deduction include the following:

(iv) Assistance to High-Tech Field

According to research and development estimates for 1982 in the high technology field, the U.S. government invested 900 million dollars in biotechnology, 200 million dollars in new materials and 600 million dollars in electronics. Projects being carried out under the government's initiatives include a VHLSI project, gallium arsenide project and integrated computer-aided manufacture (I-CAM) project of the Department of Defense and a project to widen the use of computer-aided design/manufacture (CAD/CAM) systems of the National Aeronautics and Space Administration (NASA). That is, the Department of Defense and NASA are the major proponents of projects in such high-tech fields as electronics and new materials, excepting biotechnology.

(2) Specific R&D Assisting Measures in U.S. (incentive measures)

I Research Contract

This is a measure used by the Department of Defense and NASA, under which a single company becomes a main contractor and is entrusted by the government with research. The research contract system is chiefly used in applied and development research.

In many cases, the research contract shifts to a production contract upon its expiration.

Following are incentives provided by the research contract system:

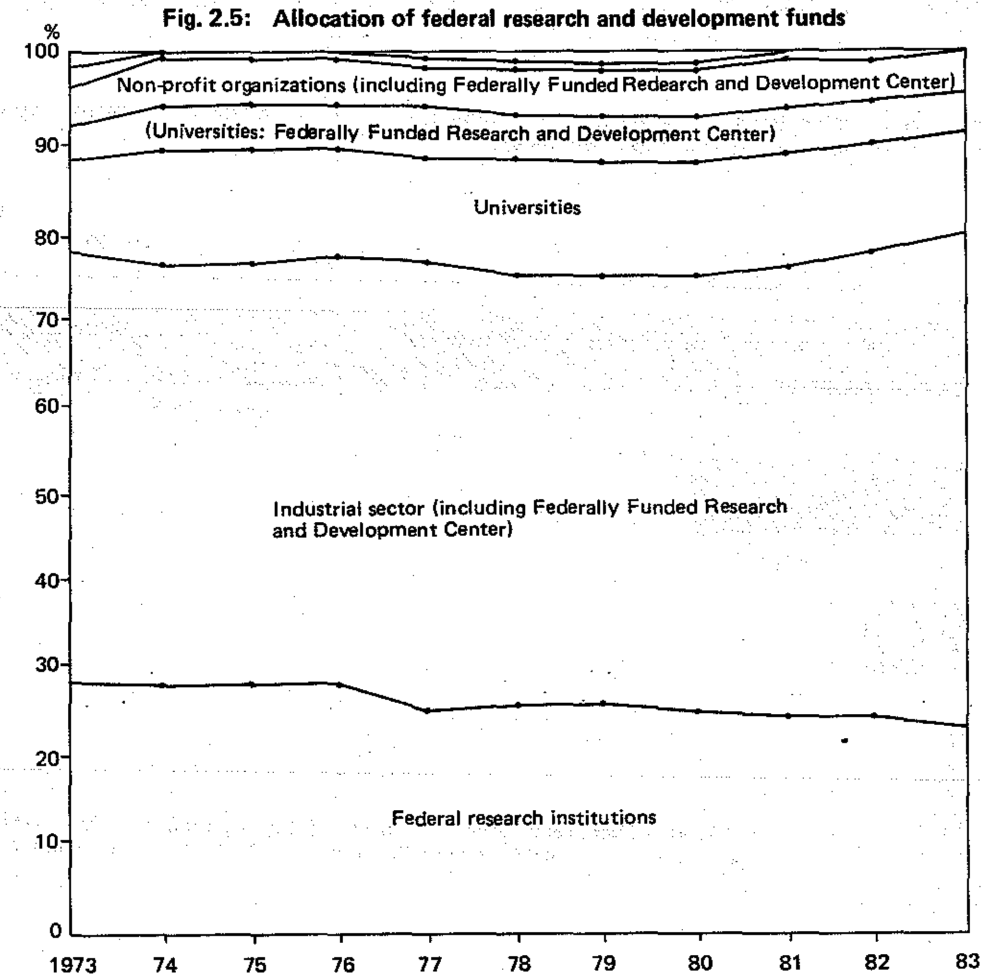
(i) Variety contract methods are provided for research contracts between the govenment and private businesses. As an appropriate contract

(ii) Governmental Research and Development Funds

Fig. 2.4 shows department-wise allocations of research and development funds of the federal government to the industries, governmental institutes and universities.

The industrial sector's investment in research and development amounted to 55.7 billion dollars in 1982, of which 32% was supplied from governmental funds as research contract fees and subsidies. In other words, more than 50% of the government's total research and development funds were funneled to the industrial sector. (Fig. 2.5)

Fig. 2.5: Allocation of federal research and development funds



Source: Overseas Survey Report by Sceience and Technology Council for FY 1982

Table 2.2: Research and development investment in U.S. and breakdown (1981)

(Unit: million dollars)

	Total	Government	Industrial circles	Universities, etc.	FFRDC*	Other non-profit organizations
Breakdown by organizations implementing research and development						
Basic	8,772	1,172	1,550	4,300	900	850
Applied	15,290	2,805	9,350	1,675	675	785
Development	45,003	4,988	38,250	325	725	715
Total	69,065	8,965	49,150	6,300	2,300	2,350
Breakdown by organizations investing in research and development						
Basic	8,772	5,922	1,445	885	–	520
Applied	15,290	6,950	7,455	500	–	385
Development	45,003	19,793	24,965	100	–	145
Total	69,065	32,665	33,865	1,485	–	1,050

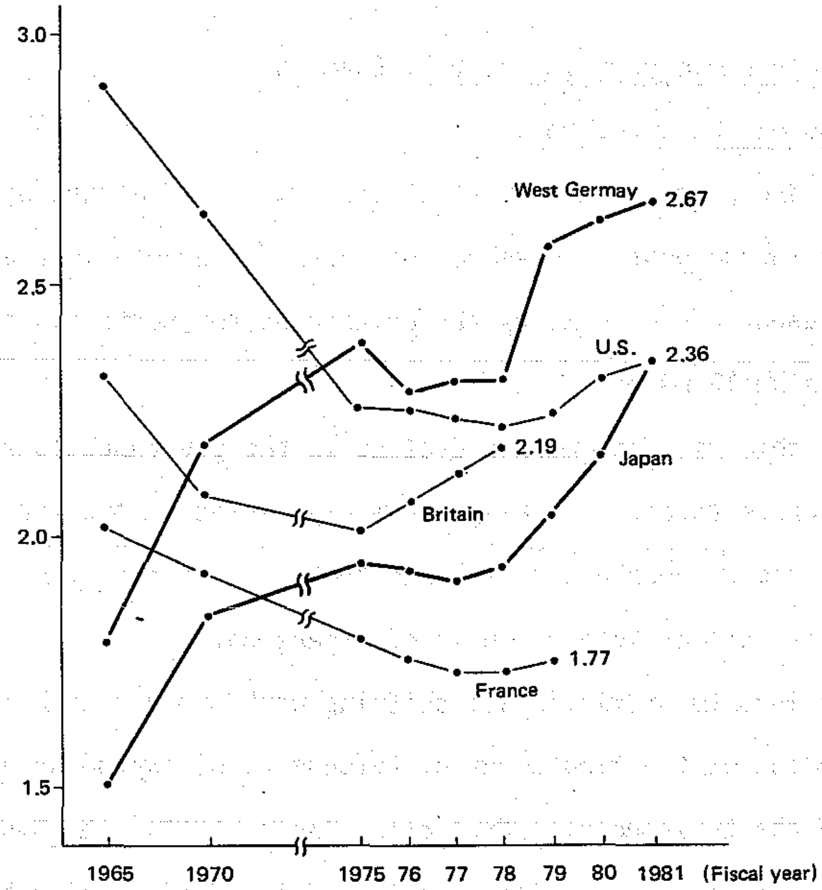
Note: * Federally Funded Research and Development Center

Source: Compiled from National Patterns of Science and Technology Resources 1981 (National Sceince Foundation 1981)

(i) Assistance to Basic Research

Of the total U.S. research and development investment for 1981, 12.7% was made in basic research, 22.1% in applied research and 65.2% in development research. As for the ratios of investment among industries, governmental institutes and universities (Table 2.2), the government shouldered 70% of the total investment in basic research. In applied research, the government shouldered approximately 50% and in development research, the private sector bore 50%.

Fig. 2.3: Research expense ratios to GNP



II <u>Basic Thinking of U.S. Government on R&D</u>

Basic thoughts of the Reagan Administration on measures to promote research and development are as follows:

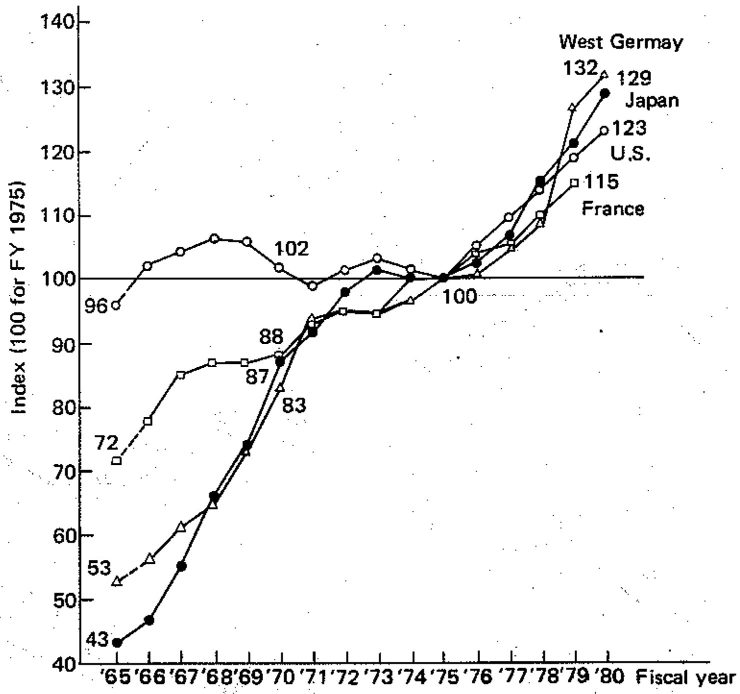
- The roles of industrial and government circles should be made clearer than in the past.
- Direct incentive measures (technology push action) for research and development by industrial circles should be limited to the fields in which the government is a direct customer and direct incentives should be cut in the fields where major customers exist in the private sector.

Notes: 1. * stands for preliminary figures and ※ estimates.
2. Research expenses of the United States, the Soviet Union and France include those for cultural and social sciences.
3. Britain's reserch expenses for 1978 include those for cultural and social sciences.

Sources:

U.S.:	National Patterns of Science and Technology Resources 1981, NSF
Britain:	International Statistical Year, OECD
Soviet Union:	Annual of Soviet National Economic Statistics, Central Statistics Bureau
West Germany:	Faktenbericht 1981 zum Bundesbericht Forschung, Federal Research and Technology Ministry
Japan:	Survey Report on Science and Technology Research, Statistics Bureau of Prime Minister's Office
France:	Paper annexed to budget bill

Fig. 2.2: Real-term growth of R&D expenditures in major countries



Notes: 1. The deflator: GNP deflator.
2. Growth as against the base figure of 100 for FY 1975.

Sources: Sources used for Fig. 2.1 and International Comparative Statistics, the Bank of Japan.

Comparison of Japanese and U.S. Incentive Policies for R&D

2.1 Foreword

The United States leads Japan by far in terms of research expenses as shown in Fig. 2.1. But in terms of real-term growth of research expenses, Japan records remarkable growth as shown in Fig. 2.2. Fig. 2.3 shows that there is no difference between Japan and the United States in the ratio of research expenses to gross national product (GNP) due partly to a drop in the U.S. ratio.

While it would appear that the United States is losing its one-time absolute edge, there are signs of a "new U.S. industrial policy" aimed at actively promoting, assisting and encouraging future growth industries, centering on high-tech industries. This becomes apparent when viewing the moves of the U.S. government and Congress in recent years, especially in 1980 and thereafter.

As regards the U.S. R&D effort, research expenses alone cannot reflect the contents of research and development activities correctly. Although the United States appears to be moving toward a new industrial policy chiefly in response to Japan's industrial policy, many of these moves are instructive for Japan.

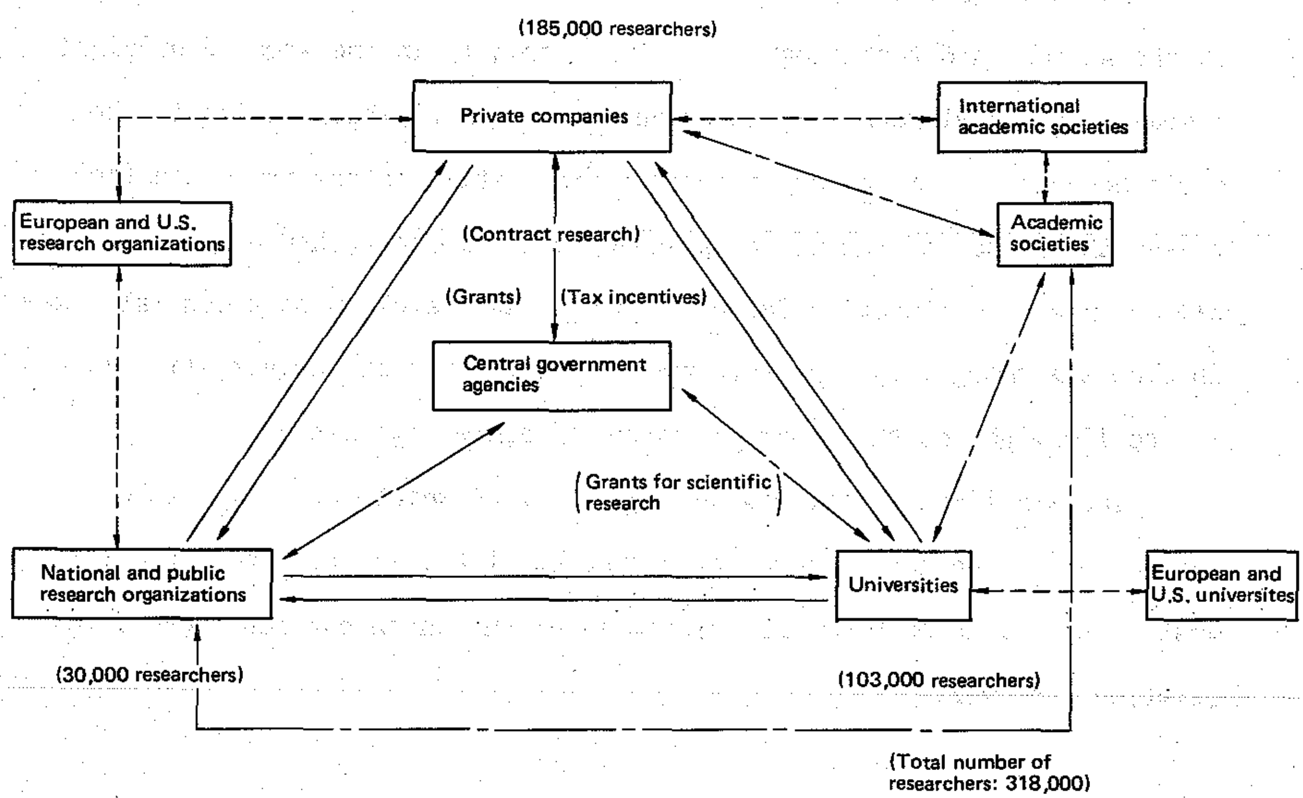
In Japan, too, great hope is pinned on technological development as one of the means of solving myriad problems existing under the present severe economic situation both at home and abroad, and various measures for

2. Comparison of Japanese and U.S. Incentive Policies for Research and Development

Contents

Fig. 1.1 shows the positioning of researchers of Japan's private companies, governmental institutes and universities. There are 318,000 such researchers in Japan, or 27 per 10,000 people. This compares with 644,000, or 29 per 10,000 people, for the United States and 122,000, or 20 per 10,000 people, for West Germany.

Fig. 1.1: Positioning of Japan's private companies, governmental institutes and universities in technological development



(3) Effective R&D Investment

The third goal is to optimize effective use of the research and development investment. This entails efficient use of research and development capability to cope with a decrease in distributable resources which runs counter to the increasing research and development investment.

Japan and other industrialized contries are faced with severe economic conditions, such as the worldwide recession, a low rate of economic growth, treasury deficits and galloping inflation. Thus it is urgent that these countries carry out administrative reforms for rationalizing administrative organizations.

Meanwhile, private companies are increasingly making active investment in research of high technologies geared for practical use in around the year 2000. Such investment is unabated despite increasingly limited distributable resources because it gives rise to new growth industries and, at the same time, revitalizes fully-grown industries. In view of these circumstances, measures for new organic interaction among industry, governmental institutes and universities being sought for effective and efficient use of Japan's total research and development capability.

(4) International Contribution in Science and Technology Field

The fourth goal behind Japan's R&D effort is to expand its contribution in the field of science and technology to bring it in line with the internationalization of its economic activities. The country has come under strong pressure to do so.

private companies and universities, a goal which involves both problems and restrictions. The industry-university interaction problem is an issue that is old yet still new in many respects. A historical review of the problem certainly reflects the background of the times.

So what is the background surrounding the renewed emphasis that private companies are placing upon technological development through interaction with universities? The following several points can be noted:

(1) Switch in Technological Development Policy

The first point that is worthy of note is a switch in technological development policy from improvement of technologies introduced from abroad to development of Japanese original technologies.

Japan's technological levels have rapidly been improving recently and its technological development capability has also been strengthening remarkably. Some Japanese technologies now surpass European and U.S. levels, and Japan's ranking in terms of global technological power is further rising. However, Japan, which has traditionally focused upon improving technologies introduced from European countries and the United States, is inexperienced in certain development areas and methods. The country lacks significant achievements in developing technology integrally from original "seeds" to commercialization.

The introduction of new technologies from Europe and the United States will become difficult in the future unless it is done on the so-called "cross license" basis, which requires Japan to provide new