JPRS L/10086

2 November 1981

Japan Report

(FOUO 63/81)

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APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000400070001-9

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CONTENTS

SCIENCE AND TECHNOLOGY

FOREIGN FIRMS COOPERATE IN DEVELOPING NUCLEAR REACTOR

CANDU Reactor

Tokyo NIHON KOGYO SHIMBUN in Japanese 4 Aug 81 p 11

[Text] The Electric Power Development Co Ltd (president, Yoshihiko Morozumi) announced on the 3d that it will enter into a comprehensive technological survey on the introduction of the CANDU reactor starting the next fiscal year. This comprehensive technological survey will be continued for 2 years, and the company has requested a 1.5-billion-yen allotment from the nuclear power development survey funds to cover next year's fiscal needs, by which means it expects to conduct a safety demonstration of the fuel exchanger sent by the AECL (Canadian Nuclear Power Company) as one of its projects. The move on the part of this company to bypass the execution of the basic design necessary to the safety inspection and conduct a "comprehensive technological survey extending over 2 years" is thought to represent a switch away from the early introduction of this reactor to a long-term acquisition strategy. It appears that the construction problems associated with the new converter reactor (ATR) are causing some strange effects.

The Electric Power Development Company started its efforts to introduce the CANDU reactor in February 1976 and has concluded that "there are no technological problems," but the Atomic Energy Commission in its decision of August 1979 said that "if there is an improvement in the economic situation and it becomes necessary to reassess this country's nuclear power development program, another look will be taken at this reactor at that stage," thereby putting a stop to its introduction for the time being.

Since then, the Electric Power Development Company, reacting to the Three Mile Island nuclear power plant incident in the United States (March 1979), has apprehensively conducted (1) earthquake-resistant tests on imported samples of pressure tubes and control devices at Hitachi Limited and (2) a safety analysis of AECL taking into account a coolant loss incident. There has been no "change in the economic situation" that could trigger an overturn of the Atomic Energy Commission's decision, and the company has decided for the time being to discontinue execution of the basic design, which is the premise to introduction.

In this regard, the Ministry of International Trade and Industry stated: "A comprehensive evaluation should be made on the safety of the CANDU reactor as

a system in the event this reactor is introduced into Japan within the framework of the technological surveys conducted to date" (Nuclear Power Development Department, Resources and Energy Agency). As long as there is no "pressure for introduction" on the part of Canada, the CANDU reactor introduction problem will most likely fall into a "change in compartment" state.

West German Reactor

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 7 Aug 81 p 1

[Text] Three Japanese nuclear power plant makers--Hitachi Limited, Toshiba Corporation, and Fuji Electric--and the West German nuclear reactor maker Krautwerke Union (KWU, fully owned subsidiary of Siemens) have entered into a technology agreement by which it was basically agreed that the Japanese companies will engage in "domestic" development of the KWU type PWR (pressurized light water reactor), and details are now being ironed out. Toshiba and Hitachi are large-volume makers of the model BWR (boiling water reactor) which follows the lines of the General Electric (GE) light water reactor, but because of the worldwide favorable evaluation of the KWU type PWR, they decided to introduce the PWR technology of KWU and enter into the development of a safer and more reliable Japanese type light water reactor. The Ministry of International Trade and Industry and the electric power companies consider this new move to be a forward looking one in line with this country's long-range policy of handling multiple types of reactors, but Japan's nuclear power industry, which has been overwhelmingly tied in with the United States, considers that ripples from this unusual development, both domestic and international, cannot be avoided.

Disengagement From Completely American Associations

KWU not only is almost the sole supplier of nuclear reactors within West Germany but is the largest West European nuclear reactor maker with an abundant export record. In 1969, AEG Telefunken which was a BWR maker and Siemens which was a PWR and heavy water reactor maker joined forces, and each contributed half of the capital to form KWU, but in 1977 AEG withdrew from the field completely, so this is now a 100-percent Siemens organization.

KWU handles both BWR and PWR, making it a very unique member of the nuclear reactor industry, with the P operating in the line of the American Westinghouse (WH) and the B in the line of GE.

Now the technological atmosphere inherent in West Germany has crept in, and both P and B have strayed from their parents to the extent that this company is now developing a strictly KWU type reactor which is highly evaluated throughout the world, and KWU has been making great strides, especially as a PWR maker, ever since the AEG withdrawal.

On the other hand, both Toshiba and Hitachi have been involved in the line of GE, and they recently worked together with GE in joint development of an A-BWR (advanced BWR) which outperforms the present BWR, and this is indicative of their very close relationship with GE.

At the outset of this international joint development of the A-BWR, GE, Hitachi, and Toshiba invited KWU to join them in this project, but they were not successful. This was because both the B and P of KWU incorporated the technology of very high reliability intrinsic in the Germans, and KWU had become a maker which none of the world's nuclear reactor makers could overlook.

In another direction, the Ministry of International Trade and Industry considered that maintaining this completely American connection might, in the long run, become a minus factor in assuring this country's international economic safety, and set about gradually diversifying its associations. At the same time, the power companies began to react to the line of thought they had been following, and there was a shift in thinking to approach KWU, which resulted in the recent agreement with KWU.

Fuji Electric was the maker of the gas reactor (GCR) which was this country's first nuclear power reactor directed at power production built for Japan Atomic Power at Tokai, but it was unable to come forth with an effective policy during the BWR boom which followed, as a result of which it was downgraded in its position in Japan's nuclear reactor industry. On the other hand, in this present series of activities, Fujitsu was asked to participate in this joint research on the strength of its deep ties with Siemens (capital cooperative relationship).

There is another major current in the Japanese light water reactor picture. This is the line of the PWR of Mitsubishi Heavy Industries and Mitsubishi Electric, which have close ties with WH. The divergences concerning BWR championed by GE, Toshiba, and Hitachi and this reactor have split this country's nuclear power industry. There is even an attempt to follow along the lines of the A-BWR development to come up with an A-PWR development, and the B versus P conflict which besets Japan's nuclear power industry is becoming more and more fierce.

It is certain that raising the flag for this new PWR is going to create some waves in the Japanese nuclear reactor market. At the same time, these movements will probably have various effects on the export problems of the domestically produced light water reactor which is expected to be developed.

2267
CSO: 4105/237

SCIENCE AND TECHNOLOGY

NEW DEVELOPMENTS IN BIOTECHNOLOGY INDUSTRY NOTED

Hayashibara Biochemical Laboratory

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 5 Aug 81 p 6

[Text] Okayama--Hayashibara Biochemical Laboratory (Shimo Ishii, Okayama-shi; president, Ken Hayashibara; telephone, 0862--24--4311 plans to double its production of interferon (IF) from 300 billion units per year to 600 billion units with the use of hamsters, and for this purpose it plans to invest about 1 billion yen in phase three of its program to reinforce its Fujizaki Laboratory (Fujizaki, Okayama-shi), which should be ready by the summer of next year at the latest. The accumulation of the various types of analytical equipment is taking place in an orderly manner, and it is expected to start on phase two construction within the year.

Last summer, the company initiated the construction of the Fujizaki Laboratory with an overall expenditure of 700 million yen for research and production of IF, and it started production on the scale of 300 billion units per year. The Phase two construction will expand these production facilities. In addition to the production of IF, the separation and purification of various physiologically active materials (linihokain [phonetic]) are performed, and it is expected that this will be expanded in its phase three research and production facility. The construction and internal equipment for this is said to require 1 billion yen.

This company had previously entered into a cooperative agreement with the two pharmaceutical companies, Mochida and Otsuka, by which means its development tempo went into orbit, and it is conducting "preclinical tests" at the request of the Ministry of Health and Welfare as part of the preliminary tests necessary to the initiation of clincial tests. These tests will involve the use of animals in acute, subacute, and chronic toxicity tests and will check all phases of safety, and it is expected to that the results of these studies will be announced by the end of the year.

The increased production of IF through the phase two construction will increase production to 600 billion units per year, which will be the largest scale production in the world, and this will be accomplished without having to increase the number of hamsters by means of: 1) expanding proliferating cells (kobu [possibly a lump, swelling, knot]), 2) improving dissection technology, 3) raising induction efficiency and 4) eliminating purification losses. By these means a doubling of capacity should be readily feasible, and these practices are expected within a few years to enable production to reach a fivefold or higher level, according to this company's estimates.

Almost all of the IF presently produced will be used in the "preclinical tests," and they cannot all be carried out at the same time, but as the result of increased production and of the clinical tests, by next year it may be possible to effect wider distribution: "We have finally come to see the possibility of meeting the wishes of patients, physicians, and researchers to whom this agent has thus far been denied." (Managing Director Yasu Hayashibara, head of the business office)

Biotechnology Research Association

Tokyo MAINICHI SHIMBUN in Japanese 12 Aug 81 p 3

[Text] Fourteen chemical and food industries, such as Mitsubishi Chemical Industry, formed the "Biotechnology Development Technology Research Association" (director, Eiji Suzuki, president of Mitsubishi Chemical Industry) on the 11th to promote biotechnology, which has come to the forefront as a leading technology. Starting in September, this association will take over joint research and development centered on basic technology as well as participating in biotechnology research for the next-generation industrial basic technology development system under the 10-year plan initiated this year by the Ministry of International Trade and Industry in order to make every effort to close the gap between Japan and the Western nations which are several years ahead of this country in biotechnological matters.

Biotechnology is the technology by which gene combinations are altered, and fusion of differing cells is utilized to exploit life functions of living matter in the industrial area. Microorganisms and enzymes are cultured in large volume in order to decompose organic compounds such as petroleum and to develop new plants high in protein. The areas of application are countless, and the subject of the present research under way in Japan ranges from interferon type medical agents to agents in the agricultural, energy, and chemical areas, with several hundred companies involved in research and development programs.

The Ministry of International Trade and Industry has incorporated biotechnology research as one of the pillars in its next-generation industrial basic technology development system and plans to fund 26 billion yen over the next 10 years in research contracted to private industry.

The association applied for participation in this next-generation system program on the above date to seek government aid in biotechnology research in three basic areas--"gene manipulation" to create new microorganisms to be used by the 14 member chemical and food product companies, "bioreactor" (microorganism reaction vessel) development for energy conservation and highly efficient chemical processes, and "large volume cell culture" to enable more efficient production of certain medical products--and thereby to realize early practical application of biotechnology.

Biotechnology research in Japan is way behind the level of the Western countries, where research was started early in the 1970's, and of the 24 Japanese patents made known thus far on gene manipulation, 19 have been the work of Western industries.

The industries participating in this research association other than Mitsubishi Chemical Industry include Sumitomo Chemical Industry, Mitsui Toatsu Chemicals, Mitsubishi Chemical and Life Science Laboratory, Kao Soap, Daicel Chemical Industry, Electro Chemical Industrial, Mitsui Petrochemical Industries, Mitsubishi Gas and Chemicals, Asahi Chemical Industry, Ajinomoto, Kyowa Hakko Kogyo, Takeda Chemical Industries, and Toyo Jozo.

Kubota Ltd

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 18 Aug 81 p 1

[Text] Kubota Ltd (president, Taro Hiroyasu) will initiate full-scale research on biotechnology (life engineering) to look into utilization of new microorganisms and new technology on natural and animal products use. This company proposes to branch out from its original function as a maker of agricultural equipment and environmental equipment to pursue the possibilities of gene maniupulation and cell fusion and is soon expected to set up a "biotechnological research committee", using its environmental equipment research department as the parent unit. This is an indication that the approach to biotechnology, which thus far has been the realm of chemical and food product industries, has now spread to the machine makers, and the results obtained by this group will be awaited with great interest.

Kubota Ltd is the top industry in the area of agricultural machinery which has deep ties with biotechnology. It is a large maker of engines and environmental equipment, and it is adequately equipped for the various conditions and needs of biotechnology. Furthermore, its 90 years of history are replete with expansion and development of industries tied in with "water."

The Environmental Equipment Laboratory (about 50 staff members) of its Environment Plant Industry Department has more than 10 microbiological specialists who have already been engaging in biotechnological research. The application of biotechnology to environmental equipment involves, first of all, the creation of "new species" of microorganisms--ones which can operate even with a small volume of air on a large volume of sludge and speedily "chew up" the sludge to develop a new activated sludge treatment facility are a possibility which comes to mind. This company has already formed a project team with these microbiological research staff members which has started on specific research and development.

The next research objective will be the area of food. It may be said that this company has accumulated technology which comes close to biotechnology in the matter of developing new seeds, new fermentation technology, and cell fusion.

Takeda, Sumitomo Chemical

Tokyo TOKYO SHIMBUN in Japanese 24 Aug 81 p 2

[Text] Osaka--Takeda Chemical Industries will conduct clinical tests with interferon (IF) produced by gene manipulation of colon bacilli at about 10 facilities throughout the country, such as Osaka University, starting at the end of September. This is a joint project with the world's largest pharmaceutical producer, Hoffmann-La Roche (Switzerland), and this will be the first time in Japan that a medical agent produced by gene manipulation will be used in the human body.

Sumitomo Chemical Industry is expected soon to enter into clinical studies on the growth hormone for very small children which was jointly developed by the Swedish Kabi Drug and American industry, in addition to which it is promoting the marketing of Yuei Drugs and Midori Juji products, and gene engineering will see its practical use begin in the area of medical products.

What Takeda will use in its clinical studies is the alpha type IF jointly developed by Hoffmann-La Roche and the American gene industry firm Genentech Company. Clinical tests were begun in the middle of January in the United States. Clinical tests will be initiated in Japan under the direction of the Special IF Research Section of the Ministry of Health and Welfare, in which Takeda and the National Institute of Health will use the same IF on animals to establish its safety.

According to Takeda, specific clinical plans such as the dose and number of subjects will be decided by the middle of September, and 10 facilities throughout the country centered on Osaka University will study the application of this agent on stomach cancer, skin cancer, and malignant brain tumors.

Along with these clinical tests, Takeda is collecting facilities for a production system and expects to initiate independent production about the beginning of next year. Director Einosuke Omura (director of the central laboratory) said: "Once production is initiatied, we will be able to supply 1.2 trillion units a year of 98 percent purity" (an ordinary dose requires some 3-10 million units).

In another direction, Sumitomo Chemical Industry is also planned clinical tests at the Tokyo Women's Medical College and Osaka University, and it will use the results of the clinical studies being conducted in Sweden by the Kabi company to initiate growth studies using hormone produced by colon bacilli as early as the end of October.

Gene manipulation is the technology which involves the artificial removal or synthesis of a portion of the genes, which are the storehouses of information of living cells, to be incorporated into the genes of easily cultured microorganisms. By this approach it is possible to produce hormones and IF, which heretofore had to be extracted from humans or animals in their natural state in trace amounts at high costs, through the use of microorganisms in large volume at low cost.

This is why the government has classed this study as a national project and is supporting development through the Science and Technology Agency. Along with the start of the application of this new medication to humans, the Ministry of Health and Welfare is setting up new manufacturing permit inspection standards which are expected to promote the practical application of bioengineering.

Toray, Kyowa Hakko Kogyo

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 25 Aug 81 p 1

[Text] Toray (president, Masatoshi Ito) and Kyowa Hakko Kogyo (president, Shukuro Kinoshita) announced on the 24th that they will engage in industrial production of "interferon" and will produce "inteferon by the recombination of DNA (deoxy nucleic acid)" by the method developed by the Cancer Research Institute's Cancer Laboratory (director, Haruo Sugano), for which a license has been obtained. Interferon production technology by recombinant DNA technology had previously been developed by the Genentech Company of the United States and Biogene Company of Switzerland, and the Swiss drug firm of Hoffmann-La Roche has been promoting its industrialization, as a result of which they have a wide lead over Japan. This recent industrialization announcement by these two Japanese companies is an effort to bite into one corner of this lead, and this represents the first attempt in Japan to use domestically produced technology to this end. Furthermore, the interferon which these companies propose to industrialize is the so-called "B type" which is considered highly effective against chronic tumors produced by fibrocytes and is a product that is solely Japanese. Its production by recombinant DNA technology is the first of its kind in the world.

Interferon is sometimes called a virus suppression factor. It is a substance produced by animal cells when they are infected with a virus. It is not only effective in treating viral diseases but also serves to suppress propagation and has sometimes been dubbed the "dream medicine." Research has proceeded to the stage that three types of interferon have been discovered: the A type, produced by mature leucocytes and lumph cells; the Y type, produced by T lymph cells; and the B type, produced by fibrocytes. Research and development on the industrial production of all three types is under way.

The A type is being produced from mature leucocytes by Midori Juji, while production from cancerous lymph cells is being developed by Sumitomo Chemical Industry and Midori Juji. In addition, Hayashibara Biochemical Laboratory is conducting research on producing A type with the use of mice.

Toray is conducting research on the production of the A type from fibrocytes, and the interferon produced by Midori Juji, Toray, and Sumitomo Chemical Industry is already at the clinical testing stage. These method suffer from the need to propagate cells and form cancerous materials which require considerable time, and there are limitations to mass production. So the use of recombinant DNA technology to overcome these difficulties has been under study. The technology to produce the A type has already been well established in the Western countries.

The interferon which Toray and Kyowa Hakko Kogyo hope to handle in this new venture is the "B type" which the Cancer Institute developed, and its technique is to extract messenger RNA produced by interferon in fibrocytes, use this messenger RNA to synthesize DNA, which is then incorporated into the plasmids (extra-nuclear genes) of colon bacteria, and thereby produce produce interferon in large quantity exploiting the high propagation rate of colon bacilli.

The industrialization of this technology has made Japan a participant in the world's competitive efforts to develop methods of producing recombinant DNA for the ensuing production of interferon, and the results of this venture are being eagerly awaited.

2267
CSO: 4105/228

SCIENCE AND TECHNOLOGY

NEW TECHNOLOGIES DEVELOPED IN AUTOMOBILE INDUSTRY NOTED

Tokyo SHUKAN ORU TOSHI in Japanese No 449, 2 Jul 81 pp 12-21

[Text] Car Electronics: New Weapon in World Automobile War

The introduction of electronic technology into automobiles is progressing rapdily. Car electronics is being emphasized as a selling point for new models.

At present electronic parts, including audio equipment, make up about 6 percent of the manufacturing cost of passenger cars, but this will expand to 15 percent by the latter half of the 1980's. There are studies which indicate that the automobile industry is already investing some 30 million yen yearly in IC's (integrated circuits) and LSI's (large-scale integrated circuits). This is twice the amount invested by the watch or NC (numerically controlled machine tool) industries and is the greatest expenditure of any industry except computers and other electronics.

Automobiles are a mamoth industry of nearly 6 billion yen per year. Although electronic parts make up a small part of the cost, they are of great value, and automobiles are considered a huge market for the electronics industry.

Dominant Factor in Small Car War

It is well known that since the first oil crisis in 1973, the Japanese automobile industry, to the displeasure of groaning U.S. and European manufacturers, has steadily increased its share of the world market. In 1980 the Japanese industry produced 11.04 million vehicles, compared with America's 8.01 million. Japan has actually replaced the United States as automobile king, by a margin of some 3.03 million vehicles.

It is not easy to say, however, how long this Japanese automobile superiority will continue. Last year's takeover was almost a fluke--a matter of striking the soft spot of American auto makers, who had fallen behind in their small car strategy. As the leaders of GM and the others keep saying, their true worth will be seen in the clash between Japan and the United States brought on by small cars.

One point determining the outcome of the Japanese-U.S. small car war electronics. At present America has the lead in car electronics. America's proportion of micro-computer cars is far greater than Japan's, as seen in GM's intention to equip all models. While America furiously invested in electronic technology in order to improve the fuel efficiency of large cars, Japan put its effort into small cars which were already fuel-efficient and didn't worry about electronic technology. But now both countries are in the small car arena, and the victory will go to car electronics.

Car electronics developed in the United States because of growing social and economic demands for improved fuel efficiency, based on the new U.S. energy bill and emission control regulations represented in the Muskie Act. The search for safety and comfort is another point which cannot be overlooked. The "roots" of American car electronics for the purpose of improving fuel efficiency lie in the electronic fuel injection (EFI) device using vacuum tubes developed by Bendix in 1959. The following year Chrysler decided to make this EFI an option in its 1960 models.

The EFI developed by Bendix was just a start, and was followed by the diode alternator, transistorized ignition, the mixed IC regulator and other electronic devices for the engine.

There is, incidentally, a trade-off between the emission control and the improved fuel efficiency being asked of auto makers. Although theoretically there are a number of ways to simultaneously solve these mutually contradictory tasks (such as adoption of diesel engines), it was generally concluded that use of electronics was the proper solution. That is, electronic controls could optimize engine ignition timing and the air-fuel mixture (AF ratio), increasing fuel efficiency, and more complete combustion would result in cleaner exhaust. This idea was given practical application in an electronic fuel injection device using semiconductors (mixed IC) jointly developed in 1967 by West Germany's Bosch and VW.

Entering the Era of Microcomputers

The demand for cleaner exhaust applied equally to Japanese cars. Most manufacturers cleared regulations by changing engine types and adopting catalytic converters, but after 1970 more and more Japanese auto makers joined the United States by adopting EFI.

EFI was first adopted by Isuzu's Isuzu 117 coupe in 1970. The following year it was adopted by Nissan's Bluebird U and Toyota's Mark II. About 10 percent of Japanese cars are said to use EFI at present.

The primary reason that EFI (which Nissan calls EGI--electronic gasoline injection) is not used in most Japanese cars is the cost. The average cost of EFI is 60,000 or 70,000 yen, and it sometimes exceeds 100,000 yen. The truth is that the switchover has not been made because of the desire to keep the unit cost of cars down.

The cost-performance problem is always present, but the issue of car electronics itself has already entered the era of the personal computer.

Circuit integration is progressing--from IC to LSI to super-LSI--at an ever-increasing rate. Prices are dropping rapidly and capabilities are increasing in geometric progression. Super-LSI's are not used in automobiles at present, but the microcomputer capacity is already too great to use just for engine controls, and efforts are being made to systematize devices and parts which have previously worked independently.

A single microcomputer can now control everything from EFI, an electronic carburetor, and ignition control device and EGR (exhaust gas recycling device) that deal with the engine, to safety and drive elements like an antiskid device, a malfuction diagnosis

device (OK monitor), an automatic speed control, and electronic locking seatbelts. And even such comfort items as fully automatic air-conditioning and drive computers can now be included.

Sensors Hold the Key

A complete computer car has not yet come into being. So-called "computer cars" are being sold by Nissan, Mitsubishi Motors, Toyota and Isuzu, but although they have added secondary systems like drive computers, basically they have all just concentrated engine controls. They do not have total system controls with sensors on each cylinder, and are well behind in terms of electronification of the power chain. The bottleneck is sensors. All the auto makers are now struggling to develop sensors that can sense changes in the external environment and elicit flexible responses from engine and other controls.

The equipment within the passenger compartment, on the other hand, is becoming more and more electronic. Instrument panels have meters that spell out their readings. These are developed around light emitting diodes (LED) and other electronic displays.

There are differences from manufacturer to manfacturer and from model to model, but all have electronic speedometers, fuel gauges, water temperature gauges and tachometers. Speedometers have digital displays with Arabic numerals, and many of the others have zone displays (changes shown against colored zones) or segment displays (which light when a certain level is reached.

This equipment is limited to specialty cars or luxury cars, but it is only the cost that prevents their spread to popular models.

Of course, the "mission" of car electronics is to improve fuel consumption, safety, comfort and convenience. Work will be done to introduce safety measures such as radar to prevent collisions, optimum control of suspension and levelling, and traffic information/route guidance. Development of these systems cannot be overlooked as elements of investment in social capital from the perspective of development of traffic systems, but the use of integrated circuits, which have progressed from LSI to super-LSI, is indispensable, and tie-ups between auto makers and semiconductor manufacturers can be expected to become closer.

New Materials: Meeting the Challenge To Reduce Weight and Fuel Use

The worldwide war to develop cars which use less fuel--this will require emphasis on development and use of new materials as well as on car electronics. Reduction of fuel use will depend on development of both more efficient engines and lighter chassis; it is hoped that new materials will be effective in the development of both. But while electronics concentrates mostly on improving engine efficiency, the value of new materials will be felt more in the area of weight reduction.

Increasing Importance of High-Tensible Steel

The flow of innovations in automobile materials has been from ordinary steel to speciality steels to light metals to nonmetallic materials. But of course cost has been a factor in this flow, and such difficult problems as how to bring down the high prices of aluminum and organic materials and whether stable procurement is possible are involved. The shift to new materials has been slow.

Within this flow, the changeover from ordinary steel to high-tensible steel has been most rapid. Steel makes up 50 to 60 percent of the weight of an automobile, but most of that is the cold-rolled steel sheet of the body. If this is replaced by high-tensile steel, the thickness of the sheet can be reduced 0.8 mm to 0.7 mm with no loss of strength. Formerly, high-tensile steel was hard to work with in such things as presses, but that drawback has been overcome by the large steel makers lately. At present, high-tensile steel makes up about 20 percent of the total steel in those models which use it most, but this proportion can be expected to increase to 40 or 50 percent.

Moreover, technology has been developed for dual-phase steel, which is soft while being formed, then hardened afterward; this will be introduced on a large scale in the near future. This steel is also stronger than ordinary steel, and serves to reduce weight.

What about making the body out of light metals like aluminum? Procurement of materials is no problem, but auto makers are not interested because the cost of electricity in Japan makes aluminum expensive. Instead, they dream of fiber-reinforced plastics (FRP) and carbon fiber-reinforced plastics (CFRP). The so-called "plastic car" is on the scene.

There are, however, many difficulties in making this practical. First of all, the cost is high. CFRP is nearly 100 times the cost of steel. Moreover, it takes time to form, and productivity must be slower than for steel formed in presses. Thus for the near future, reduction of body weight will depend largely on improved steels.

In the case of engines, on the other hand, there has been steady progress in reduction of weight. Many engines today are cast iron, but moves to use aluminum alloys or thinner castings are seen everywhere. For example, the method of reducing thickness by inserting a liner (or sleeve) is being considered. The partial use of aluminum alloys in the transmission is also going forward. In other words, it appears that aluminum alloys, rather than plastics, will be used in drive machinery which requires strength.

Trimming in Every Area

Thus weight reduction is an accumulation of weight saved on small parts. Interior and exterior trim has all been made lighter. The bumpers are an example. The weight was reduced about 20 percent by using urethane, but that has disadvantages in that it weakens at high temperatures, and it absorbs water so a surface treatment is needed. Judging from present technology, it is only a matter of time before the absorption and heat-resistance problems are overcome.

The only way to make window glass lighter is to make it thinner; research to improve it is being carried out. There is a trend toward headlights of a different shape which are actually heavier; the possibility of replacing the glass with plastic is being studied. In the case of tires, weight could be saved by getting along without a spare, and plastic tires which do not go flat are wanted. Plastics are also being used for meters, interior paneling and various tanks. Smaller bearings with the strength to withstand weight are needed, and finding stronger bearing steel is another task for materials manufacturers. There has also been progress toward refinements like replacing camshaft chains with rubber belts and making plastic cooling fans.

Plastics for automobiles include vinyl chloride, polyurethane, ABS resins and polypropylene, and also such "engineering plastics" as nylon and polyester. Japanese manufactueres have fallen behind European and American chemical companies in the development of the materials known as automotive polymers. It is estimated in some quarters the development gap is nearly 5 years.

The chemical companies have, however, taken a very active stance in regard to development. There would be great advantages in terms of total supply if automobile and parts manufacturers would join in developing materials. In practice, there have come to be makers who supply materials secretly, without seeking patents. In these cases traditional ties like financial groupings are almost meaningless, and transactions are strictly on the basis of product development.

That is, almost all new materials are developed through technology belonging to the materials manufacturers; the technology is seldom that of the auto makers. In this regard, the basic technology of Japanese auto makers lags far behind that of GM. It was to overcome this lag that Toyota Motors decided this January to introduce resin-forming technology from GE.

Structural Changes

Development of new materials is one way to make cars lighter, but design and structural streamlining must also be mentioned.

This aspect is greatly influenced by design technology in respect to the strength of steel sheet for the auto body. Computers have long been used in America in aircraft design. In Japan, though, this idea got a late start, and has just reached the top levels. The result is structures which have strength in themselves rather than relying on the strength of the framework. (The principle is that which makes an eggshell hard to crush.) In these designs, strength is affected by the accuracy of welds; this requires the development of accurate welding robots and steels with strength which does not change after welding.

As a part of structural streamlining, the FF method (front engine, front wheel drive) is well suited to the present demand for lighter cars. The FF method brings together the engine and the transmission, of course, and also the differential and the driveshaft. And because the left and right rear axles are independent, it is possible to put the gas tank and spare tire beneath the rear seat and trunk, making the car lighter and giving more room inside. No propeller shaft is needed to drive the rear wheels; in addition to eliminating the weight of the shaft, this will making the outside dimensions more compact without reducing passenger comfort.

This FF method has not been accompanied by too much in the way of new materials development. There have been technological improvements in the rubber parts of equal speed ball joints, and improvements have been made in power steering in connection with the front wheels bearing the load. And as the car becomes lighter, it will be possible to replace the rear leaf springs with lighter coil springs. Weight reduction will be all the greater if carbon fiber can be used in springs. The technology has already been developed; the problem is bringing the cost down to make it practical.

Carbon fibers may well be more useful for structural materials of this sort than in body parts.

Full Use of Ceramics

New materials are making great strides in improvement of engine efficiency. There has been a particularly sharp rise in the use of ceramics to improve the cooling system.

The heat efficiency of the present reciprocating engines is low--30 percent--and if losses from friction are included it is less than 20 percent. This is because water is used to cool the cylinders. If new, high-temperature ceramics are used for the cylinders, pistons, valves and pre-chamber, there is no need for coolant and heat efficiency can be raised above 30 percent.

The new ceramics are compounds of silicon with nitrogen, carbon, aluminum oxide or other materials. Their strength is competitive with that of the superalloys.

The new ceramics are almost ready for practical application, and they will be put to use surprisingly quickly, once the remaining problems of volume production and workability are solved.

In practice, the parts subjected to high temperatures of 1000°C or above will be replaced first, and in this process the radiator and other parts of the cooling system will be reduced in size. Once the replacement with ceramics is complete the cooling system will become unnecessary, and the dream of a "ceramic engine" will have become a reality.

Because reduced friction is another characteristic of ceramics, there will be other great advantages in that lubricating oil will become unnecessary.

Of course the study of ceramic engines is not restricted to gasoline engines. The possibility of using ceramics for the increasingly popular diesel engines is another challenge to be met.

Diesels are superior in terms of fuel economy. The fuel efficiency of reciprocating engines can be improved by increasing the compression, but this also increases the harmful oxidation products of nitrogen (NOx) and tends to produce knocking, so of course there are limits on increases of compression. But in a diesel engine the compression ratio can be raised to three times that of a gasoline engine. This improves fuel efficiency: fuel consumption is improved by nearly 30 percent.

The explosive power of diesels are excessive for passenger cars, though; the problems of engine weight and vibration could not be elminated. The solution came in 1951 when VW developed a small, 1500 cc engine. New technology such as valve-type fuel injection pumps and forced coolant pistons was developed and mounted on a golf cart.

As in the case of the gasoline engine, there is the danger that oxidation and wear of metal parts will be hastened in metallic diesel engines. As in the reciprocating engine, cooling is necessary, and there are moves to use ceramics in diesel engines to eliminate that necessity.

The plan is to make the engine's combustion chamber of ceramics able to withstand its high temperatures. And there is research on switching other high-temperature parts, now made of high-grade alloys, to ceramics.

The gas turbine engine can be mentioned as the latest attempt to use ceramics in new engines. Because combustion is continuous, this engine can develop 5 to 10 times the power of a reciprocating engine of equal weight. Actual use will be delayed because of poor fuel consumption at present, but fuel consumption can be improved by raising the turbine's intake temperature. This will require making the turbine chamber of ceramics rather than heat-resistant alloys.

Technology has been able to increase the turbine chamber intake temperature to 1,400°C, so now the pressing task is the development of materials which can withstand such temperatures for long periods. Research is going forward under the guidance of the Ministry of International Trade and Industry and the Agency for Industrial Science and Technology, and this research focuses on the development of new ceramics. It appears that this research will bear fruit in the 1990's.

Car Technology: Study of the Companies Involved

Toshiba Corp

Toshiba entered the car electronics field in 1971 in cooperation with America's Ford. Its first product, the EEC I (Electronic engine control), was used on Ford's 1978 models. The latest version, the EEC IV, is used on 1981 models. The semiconductors used in these EEC modules are 12-bit NMOS LSI's.

In Japan, EEC modules are used by Toyota Motors for its car computer, and they are supplied directly or indirectly to all auto makers. Car computer sales through March 1981 came to 25 billion yen. Sales to Ford were down, but annual growth was still 20 percent. In addition to computer chips, Toshiba holds a full 50 percent of the world market for electronic rectifier elements. In 1979 a separate automotive semiconductor technology department was established within the semiconductor department to make full-scale development possible.

Toshiba's "car electronics" strategy is limited to the EEC series of engine control computer chips. Unlike Hitachi, it does not deal with automotive equipment or sensors.

Hitachi, Ltd

Hitachi, which is tops in the electric appliance field, is deeply involved with Nissan Motors and is thus a major producer of electrical equipment for automobiles. Sales of automotive equipment reached 160 billion yen in 1980. Growth has continued at an annual rate of 15 to 16 percent for the last few years.

The first "car electronics" device sold by Hitachi was a 1963 electronic ignition which introduced IC's. Although electronic equipment makes up only a small part of total sales of electrical automotive equipment, Hitachi has a positive policy of making it strong and long lasting. It takes a broad approach to car electronics, encompassing such things as LED instrumentation and sensors that measure temperature, fuel mixture, pressure, etc. Like Toshiba, it has naturally put the greatest effort into the engine control sector, with the goal of building a total system around that.

Production facilities are being built up steadily. An electronics plant to produce IC's and LSI's was completed at the Sawa automotive equipment plant in 1980. At the same time, the software firm Hitachi Automotive Engineering separated and became independent. Hitachi is now ready to go forward on both the hardware and software fronts.

Nippon Denso Co

As a general automotive parts manufacturer for the Toyota group, Nippon Denso is a leader in car electronics strategy. As a start, it set up the world's first IC laboratory in 1968. It also brought out EFI and such things as OK monitors, autodrive, the cruise computer and TCCS (Toyota computer control system). The company has not revealed the details, but sales of car electronics are over 5 percent the largest in Japan.

Last December it set up an "electronics headquarters" of some 1,200 persons. This is an integrated organization which goes from development through production. It is unique in the automobile industry in that it produces its own IC's and LSI's (computer chips). Almost all its products are used within the Toyota group, but there will be future sales to overseas auto makers and to non-Toyota companies like Nissan Motors. Competition with existing semiconductor manufacturers will be a problem, but Nippon Denso's strength is its "thorough knowledge of automobiles." Its accumulation of knowhow and data cannot be matched by mere semiconductor manufacturuers. Nippon Denso's name for car electronics is "motoronics"; the fact that it has this different name is an indication of its self-confidence.

Diesel Kiki Co

Diesel Kiki has investment and technical ties with a worldwide automotive parts maker, Robert Bosch of West Germany, and can be said to hold the key to electronification of diesel cars. It is the major producer of injection pumps, which are the heart of diesel cars, and its stockholders include Isuzu (22 percent) and Nissan (9.7 percent), as well as Bosch (12 percent).

Under the fuel economy trend of recent years, diesel engines have come to be used in passenger cars as well as trucks, and sales of Diesel Kiki's small VE injection pump (for passenger cars) have expanded markedly. The company has strengthened ties with Bosch--including the exchange of executives--for the purpose of acquiring electronic technology. Promoting electronic control of fuel injection devices should further enhance the fuel economy of diesel engines.

Last year the electronic development department of the research and development headquarters was divided into two specialized departments: fuel injection devices (Department 1) and car air-conditioning (Department 2). This was done in order to respond to the demand of auto makers for electronic diesel engines, and to create an independent realm like that of domestic semiconductor manufacturers.

Mitsubishi Electric Corp

Mitshubishi Electric is capitalized by sources such as Mitsubishi Motors and deals in such parts as electrical equipment for engines, pollution control devices and chassis control devices (for a steady ride). In addition to Mitsubishi, customers include auto makers like Toyo Kogyo Co.

The core of Mitsubishi Electric's car electronics strategy is the engine control module. At present its microprocessors are made by Nippon Denso, but it inaugurated its Automobile Electronics Development Group in July 1978, and has now begun to develop its own microcomputers. In response to Mitsubishi Motors' avid desire for an "electronic car," Mitsubishi Electric began volume production of such things as trip computers and electronic fuel injection devices in April 1980.

Stanley Electric Co

This company is the largest manufacturer of lamps for automobiles, but recently it has pursued the theme of "fusion of light and semiconductors." It has put its effort into bright light emitting diodes and colored liquid crystal diodes as electronic parts suited for microcomputer cars.

Particular attention should be paid to the two-way colored liquid crystal displays, for which the company has developed its own technology. They share the LED characteristics of 1) near-permanence, not burning out like light bulbs; 2) not producing heat; 3) glowing with rapid pulses; and 4) saving energy by drawing little current. But their greatest characteristic is the sharp clean image and wide angle of visibility in comparison with the standard color liquid crystal displays. They are most highly rated for brightness. They can be expected to be used in a broad range of applications, including automation equipment, measuring devices, audio equipment and automotive instrumentation. Red, green, yellow and orange are already commercially available. The company is now working to develop blue, and plans to have a lineup of seven colors.

Stanley Electric has built up LED sales of 500 million yen per month; semiconductors and related quipment make up 20 percent of its total sales now.

Kanto Seiki Co

Advances in automotive electronics are being made in the engine compartment, but even more so on the instrument panel. It is in this field that Kanto Seiki is a key supplier to Nissan Motors.

For example, the TCU (time control unit) adopted for Nissan's Cedric and Gloria models use Hitachi microprocessors, but assembly is by Kanto Seiki. The TCU provides pulses regulated by a quartz oscillator to control the drive computer, intermittent windshield wipers, turn signals and so on. Of course, it can be used to control audio equipment, the speedometer and odometer, and Kanto Seiki will put further effort into this field. The company has already succeeded in creating an automoative central warning device, and its next big task is a commercially viable liquid crystal display panel for automobiles.

Nissan Motors considers the company a valuable member of its group, saying: "Kanto Seiki will be ranked as a strategic company in the Nissan group, along with companies like Nippon Denshi Kiki (fuel injection pumps), Nippon Automatic Transmissions, and Ikeda Bussan (seats)."

Other Suppliers

Jidosha Denki Co of the Nissan group supplies speed controllers. The Toyota group's Aisan Industries has developed an electronic carburetor which is less expensive than EFI. Yushin Seiki, which wants to unify mechanical and electrical components, is eagerly working on an electronically controlled automatic transmission.

It can thus be seen that there is a crowded field of participants in the car electronics revolution.

Table 1

Total Car Electronics

Driving Environment:	
	Sunroof
	Automatic air-conditioning (temperature, humidity, air cleaner, acidity control)
	Automatic control of seat position (front/back, up/down, memory, cushion)
	Exhaust Gas Recyclying--EGR (catalyst temperatures warning, ignition timing, O_2 sensor)
Displays:	
	Trip computer (fuel consumption volumn rate, arrival time and remaining time and distance, cruising range, temperature, air pressure, central processing and display of acceleration)
	Digital instrumentation
Engine:	
	Total engine control system (drivability, optimization controls)
	Automatic idle and choke controls
	Ignition timing (knock prevention)
	Air-to-fuel ratio control (electronic carburetor)
	Electronic ignition (all IC--no contact points)
	Semiconductor rectifier and voltage regulator
Safety:	
	Seatbelts (alarm, controls)
	Light controls (automatic headlights, high/low beam control, open circuit monitor)
	Intermittent windshield wipers
	Defroster (timer, automatic)
	Mirror control (field of vision, antifogging)
	Automatic door locks (when in motion)
	Power windows
	Road condition warming (ice sensor, external temperature)
	Collision (radar controlled brakes)
	Antilocking (antislip when braking)
	Tire pressure warning and automatic control (sensors)
	Monitors and warning (lights, etc)
	Speed warning and control

Driving:

Suspension and levelling (vehicle attitude control)
Lock-up type automatic transmission (fuel control)
Transmission shift (optimum gear ratio control)
Cruise (set speed) control fuel and brakes)
Power train (total system of engine and drive mechanism)

Other:

Electronic horn
Theft alarm and prevention (doors, ignition switch, steering)
Rain guidance and traffic guidance (a step toward automatic driving)

Table 2

Electronics Suppliers to Major Manufactuers

Toyota Motors: microprocessor engine control system, electronic fuel injection, solid state ignition, IC regulator, emission controls, cruise computer, autodrive device, antiskid control, electronic automatic transmission, power windows, automatic door locks, central warning device--Nippon Denso; tachometer--Nippon Denso and Yazaki Corp; intermittent wipers--Nippon Denso and Fujitsu Ten; liquid crystal car clocks--Jeco Co; car audio--Fujitsu Ten, Matsushita Electric and others.

Nissan Motors: engine central control system, electronic fuel injection--Nippon Denshi Kiki; electronic carburetor--Nippon Denshi Kiki and Hitachi; ignition device without points, alternator with IC regulator, emission controls--Hitachi and Mitsubishi Electric; drive computer, tachometer, central warning device--Kanto Seiki; auto speed control, power windows, automatic door locks--Jidosha Denki; antiskid control, electronic transmission--Hitachi; intermittent wipers--Mitsuba Electric, Jidosha Denki and Niles Parts Co; car air-conditioning--Nippon Radiators, Diesel Kiki and Hitachi; liquid crystal car clocks--Kanto Seiki and Niles parts; car audio--Clarion, Matsushita Electric and others.

Mitsubishi Motors: Electronic fuel injection, ignition device without points, alternator with IC regulator, emission controls, drive computer, warning system--Mitsubishi Electric; tachometer--Yazaki Corp and Nippon Denso; Intermittent wipers--Niles Parts and Nippon Denso; car air-conditioning--Mitsubishi Heavy Industries; liquid crystal car clocks--Jeco Co, Yazaki Corp, Nippon Denso, Mitsubishi Electric and Niles Parts; car audio--Mitsubishi Electric, Clarion, Matsushita and others.

Toyo Kogyo: electronic fuel infection--Nippon Denso; ignition device without points, alternator with IC regulator, emission controls--Mitsubishi Electric; tachometer, central warning device--Yushin Seiki; intermittent wipers--Asumo; car air-conditioning--Nippon Denso, Diesel Kiki and Hitachi; liquid crystal car clock--Jeco and Copal Co; car audio--Clarion, Matsushita, Pioneer, Veltik, Fujitsu Ten and others.

Honda Motors: electronic fuel injection for motorcycles, ignition without points, car air-conditioning--Nippon Denso; tachometer--Nippon Seiki; intermittent wipers--Mitsuba Electric; liquid crystal car clocks--Jeco; central warning device--Stanley; car audio--Matsushita, Fujitsu Ten, Pioneer, Albion and others.

Isuzu Motors: electronic fuel injection--Nippon Denshi Kiki; emission controls--Nippon Denso; tachometer--Yazaki; intermittent wipers--Mitsuba Electric and Jidosha Denki; car air-conditioning--Diesel Kiki; liquid crystal car clock--Yazaki, Jeco; car audio--Clarion, Fujitsu Ten and others.

Table 3

Weight in American Four-Passenger Cars (in pounds)

	1977	1980's	1990's
Steel	1,000 to 1,170	925 to 1,100	875 to 1,075
High-tensile steel	40 to 180	50 to 200	75 to 250
Cast iron	190 to 210	70 to 200	70 to 175
Cast aluminum	55 to 85	80 to 125	75 to 115
Other aluminum	0 to 30	25 to 65	15 to 25
Copper and brass	10 to 25	15 to 25	20 to 30
Lead	15 to 20	15 to 20	15 to 20
Zinc	5 to 10	1 to 5	0 to 5
Rubber	40 to 80	35 to 45	35 to 45
Polymers	90 to 125	100 to 125	125 to 250
Pasteboard	15 to 25	15 to 25	15 to 25
Glass	55 to 65	25 to 50	15 to 45
Tires	60	50	45
Other	100 to 150	65 to 240	30 to 120
Total	1,700 to 2,150	1,800 to 1,950	1,500 to 1,900

(Arthur D. Little, Inc estimates. Underline shows peak use.

Table 4

Earnings of Automotive Electronics Suppliers (million yen) and yen

Company	Date	Sales	Current Profit	Net Profit	Earnings per share	Dividend
Toshiba	Mar 81	1,547,611	82,816	44,238	19.9	7
	Mar 82	1,740,000	90,000	44,000	19.6	7
Hitachi	Mar 81	1,947,029	117,738	61,846	23.2	7
	Mar 82	2,200,000	135,000	72,000	26.9	7
Nippon Denso	Dec 80	517,360	48,681	24,599	85.2	11
	Dec 81	540,000	49,000	25,000	78.7	11
Diesel Kiki	Oct 80	139,792	8,566	3,173	19.5	5
	Oct 81	138,000	8,000	3,400	17.4	5
Stanley	Mar 81	73,772	5,045	2,535	28.5	7
	Mar 82	79,000	5,000	2,500	28.1	7

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SCIENCE AND TECHNOLOGY

MACHINERY, INFORMATION INDUSTRIES '81 PROGRAMS OUTLINED

Industrial Technology, Computers

Tokyo KIKAI SHINKO in Japanese No 2, Feb 81 pp 14-31

[Article by the General Affairs Division of the Machinery and Information Industries Bureau of the International Trade and Industry Ministry: "Measures To Be Taken on Priority Basis by Machinery and Information Industries Bureau in Fiscal 1981"]

[Text] Foreword

The machinery and information industries are given a position as typical knowledge-intensive industries, whose products have great added value, and whose technology spreads rapidly to other industries. Also, they are energy-saving industries with high energy-consumption efficiency. We must establish an advanced industrial structure, if we want to build an affluent economic society, in spite of the restrictions imposed on us by limited resources and energy supply. For the establishment of such an industrial structure, very big expectations are placed on the machinery and information industries.

With such a vision, the Machinery and Information Industries Bureau is endeavoring to accelerate the positive development of technology and secure technological independence for the machinery and information industries, so that these industries can truly lead the development of technology in industrial circles. Also, it has been taking various measures to give these industries a solid foundation in accordance with the social requirements.

From such a basic point of view, this Bureau will vigorously push the following measures in fiscal 1981, as heretofore.

I. Fostering of Up-to-Date Industrial Technology

1. Promotion of electronic computer industry.

(A) Acceleration of the development of basic technology for next-generation electronic computers.

The electronic computer industry is destined to play an important role in the processes of informationalization hereafter, to meet the increasingly diversified and advanced needs among the people under the growing restrictions, such

as the shortage of resources and energy supply. Moreover, it occupies a position as a strategic industry to play a key role in the establishment of an advanced industrial structure in Japan.

MITI, therefore, holds that it is one of the important problems for its policies to build an independent, stabilized electronic computer industry, and has been taking various measures in this direction. As a result of the efforts made by MITI and by the manufacturers at home as well, Japan's electronic computer industry is now gaining independence as an industry. For instance, the liberalization of hard-ware imports was carried out in December, 1975, and that of soft-ware imports in April, 1976. Nevertheless, the share of indigenous products on the home market remains at a level slightly higher than 50 percent, owing to the success in such efforts as the development of those kinds of machinery which can rival foreign products.

However, IBM, which holds a share of about 60 percent in the world's electronic computer markets, announced its completion of a big electronic computer of a new type (3081), whose cost performance far excels those of the conventional computers, in November last year. As a result, the development of electronic computers, entered upon a new era (4th period). It is expected that this period will see the introduction of new, epoch-making technology concerning hard- and soft-ware, to be accompanied by a drastic improvement in cost performance, a beginning of new functions and a sudden increase in the range of the use of computers. In such a situation, the urgent necessity of developing a new system of electronic computers for the next generation is growing steadily in Japan, as well as in other countries.

A very large-scale integrated circuit, which is more advanced and speedier than the present large-scale integrated circuit (LSI), is to play a leading technological role in the development of the hard-ware for the next-generation electronic computer. This kind of LSI must be developed earlier than soft-ware technology. With a subsidiary from the Government, its development was stepped up smoothly from fiscal 1976 under a 4-year plan. The plan was carried out, as scheduled, by the end of fiscal 1979.

For the development of a new system of electronic computers for the next generation, however, new and extremely epoch-making functions are demanded of not only hard-ware but also soft-ware and peripheral and terminal apparatuses. It has been said that the gap in soft-ware technology between Japan and other nations is even wider than that in the case of hard-ware technology. So, it is indispensable for Japan to develop advanced technology in such fields as control programs and super-high-level language processors. In regard to peripheral and terminal apparatuses, it is strongly hoped that the technology for processing in Japanese will be developed in place of the present processing technology centered on English, so that the processing facilities will become easier for the Japanese to handle. Therefore, it is necessary to accelerate, by all means, the development of such advanced technological devices as the Japanese-language input-output device, a super-big storage capacity and external storage.

In view of this necessity, MITI decided to develop technology for the basic soft-ware, or Operating System (OS), which constitutes the core of soft-ware technology, and the new peripheral and terminal apparatuses the technological renewal of which is remarkable, under a unified study system covering all

manufacturers (a union for the study of basic electronic computer technology), and with funds totaling ¥47 billion, according to a 5-year plan for the period from fiscal 1979 through fiscal 1983. It will grant a subsidy equal to 50 percent of the total expenses for development. In fiscal 1981, which is the third year of this 5-year plan, it will push efforts for development even more vigorously than before.

(1) Items for study and development.

(i) Basic soft-ware (OS).

(a) Basic technology (such as control of large-scale memory, RASIS, etc.).

(b) Network control technology (such as diversification of functions and that of load).

(c) Data base control technology (technology for high-efficiency control of data base, such as control of data base machine and mass storing and checking of information).

(d) Virtual machine technology (technology for strengthening the diversity of systems).

(e) Super-high-level language processor technology (program language technology which is extremely convenient and usable in character).

(f) Japanese-language data-processor technology.

(ii) New peripheral and terminal apparatus technology.

(a) Kana and kanji conversion input apparatus technology.

(b) Japanese pronunciation input apparatus technology.

(c) Japanese-language OCR technology.

(d) Japanese-language printer technology.

(e) Big-capacity magnetic disk apparatus technology.

(f) Big-capacity magnetic bubble apparatus technology.

(2) Expenses for study and development.

Subsidy--¥23,500 million.

Subsidies from the General Account:

Subsidy for the promotion of the development of basic technology for electronic computers--¥6,200 million (¥5,785 million).

Subsidy for the promotion of the development of basic soft-ware technology--¥5,150 million (¥4,910 million).

Subsidy for the promotion of the development of new peripheral and terminal apparatus technology--¥1,050 million (¥875 million).

(B) Research and study concerning the development of basic technology for electronic computers (research and study for the development of 5th-generation computers).

It is expected that the environment around computers will undergo an even greater change than before in 10 years to come, with the progress of informationalization. Also, it can be thought that the range of the use of computers will expand drastically, to lead to development in such a field as office automation, which is a combination between communications and data processing, the progress of informationalization of education, and the emergence of a distribution system and data bank enterprises.

The computers, which presently are in use, are computers of the so-called Neumann type. It cannot necessarily be said that they represent the best kind of computers. It is said that a new kind of computer based on a new theory and technology, or what is called the 5th-generation computer, will make its debut at the beginning of the 1990's. In foreign countries, efforts have already been started for study and development of a computer of a new type. As a nation to live by technology, Japan must give top importance to computer-related technology, and develop new technology ahead of other nations.

Additional remark

The following can be cited as instances of the conceivable functions of the 5th-generation computers:

(i) Functions as a computer with such advantages as everyday-language input and output, conversation-type processing, and direct processing of figures, images and sentences.

(ii) Functions to be discharged in place of man, including the making of decisions.

(iii) Function of combining together the computers, which are used for different purposes, into a unified system.

(iv) Programming as a function of the computer itself.

(v) Further development of high-speed computers.

(vi) Self-repairing function to minimize the effects to be produced by an accident to the computer.

The following can be cited as instances of the technological problems for the 5th-generation computers:

(i) Device technology: the technology for designing, manufacturing and testing new elements, which technology is best fit for the theories of the 5th-generation computer, and especially, the design automation technology, which can automatically design the circuit for elements.

(ii) Hard-ware and architectural technology: the technology concerning the architecture of the non-Neumann type, which architecture can make the fullest use of the functions of hard-ware by parallel calculation, as compared with the present formula of successive processing, the function-diversifying system architecture, which can build a system for the diversification of the fittest functions of a plural number of processors, the architecture for advanced man-machine communications, the associative memory and reasoning and learning apparatuses, * which will make it possible to make advanced use of computers as artificial brains, and automatic detection and repair of a part out of order.

(iii) Soft-ware technology: the technology of making programs automatically to answer the inquiries made in everyday language (natural language) or compiler language, the multi-function data base technology which can handle figures, images and photos as well, and the data base control technology.

* Association--The function to take out the related information already memorized, on the basis of one piece of information.

Reasoning--The function to produce a conclusion on a given piece of information by inferring an unknown problem from information already memorized.

Learning--The function to memorize the contents of the measures to meet a new problem in a highly usable form.

In view of such a situation, fundamental research will be conducted on the problems concerning the development of technology for the 5th-generation computers, and the schedule and systems for study and development of these computers.

Subsidy to be granted from the General Account to help the study and research concerning the development of basic technology for electronic computers (study and research for the development of 5th-generation computers)--¥15,044,000 (¥0).

(C) Strengthening of the sales structure.

Electronic computers have entered a new generation (4th generation), with IBM's announcement of its completion of a new kind of computer. It is expected that the hard-ware price will fall drastically in this generation. It is unavoidable, therefore, that sales competition will become fiercer than ever.

In the recent multilateral trade negotiations (Tokyo Round), an agreement was reached on a drastic reduction in the tariff rate for electronic computers. So, it is expected that the market environment will become even severer than before for the Japanese manufacturers, whose sales structure is vulnerable.

To secure a foundation for the lasting development of Japan's electronic computer industry under such a situation, the advancement of Development Bank loans bearing the most favorable interest rate to Japan Electronic Computer Company (JECC), which is a joint leasing enterprise, will be continued. At the same

time, the specified period for the maintenance of the system of reserve funds to cover the losses incurred by the repurchase of electronic computers, which system was established against the losses due to the returning of rented electronic computers, will be extended. The advancement of Development Bank loans to the manufacturers of electronic computers, too, will be continued, for the improvement of the industrial structure.

Government investments: investments in the enterprises for the promotion of home production of electronic computers (including JECC and enterprises for structural improvement)--¥46 billion (¥48 billion).

Tax system: extension by 2 years, of the period for the maintenance of the system of reserve funds to cover the losses incurred by the repurchase of electronic computers.

(Note)--JECC's leasing system.

JECC leases a system of computers, which the user has decided to hire, as its own asset, at the request and on behalf of the manufacturer of this system. The following is a summary of the leasing procedures:

(i) The user selects, jointly with the manufacturer, the kind of computer to hire, determines the composition of the system, and exchanges with JECC written contracts concerning necessary matters, such as rent, the scheduled date for the completion of the delivery and the site for installation.

(ii) On the basis of these written contracts, JECC concludes a leasing contract with the user in accordance with the stipulations concerned.

(iii) The manufacturer delivers the system to the user on the basis of the written contracts, and JECC purchases it from the manufacturer.

(iv) The manufacturer delivers the system to the user, after necessary adjustments for its use by the user. The ownership of the system is transferred from the manufacturer to JECC on the day of delivery.

(v) The user pays rent to JECC by the specified day of every month.

(vi) JECC will maintain the system in a way to keep it in normal operation, and provide fundamental systems engineering (SE) and educational and program services. All such efforts will be made by the manufacturer at the request of JECC.

(vii) When the user wants to return the system to JECC, he shall notify JECC of his intention by taking procedures in accordance with the stipulations concerned. The ownership of the system will be transferred back to the manufacturer from JECC on the day after the cancellation of the leasing contract, and the manufacturer thereupon will remove the system.

(D) Promotion of the development of and transactions in general-purpose soft-ware.

The period for the maintenance of the system of program reserve funds, which system aims at stepping up the efforts of the Japanese information industries for the development of general-purpose soft-ware, putting this kind of soft-ware on a paying basis and establishing a practical standard for soft-ware trade, will be extended.

Tax system: The period for the maintenance of the system of program reserve funds will be extended by 2 years (The rate of accumulation, presently fixed at 50 percent, will be reduced to 40 percent).

(Note)--Outline of the system of program reserve funds: It has become certain that computers will enter a 4th-generation period. One of the important characteristics of the new period is expected to be a sudden increase in the weight of soft-ware, which increase will follow the decline of the cost of hard-ware due to renewal of technology. Furthermore, hard-ware (especially the main body and the peripheral equipment and terminal unit) and soft-ware will be separated from and become interchangeable with each other. Consequently, it will become indispensable for the manufacturers of computers and the data-processing enterprises to make soft-ware marketable as a commodity. It is no exaggeration to say that the destiny of the computer enterprises in the 4th-generation period depends on the success or failure in making soft-ware with a high ratio of efficiency to the cost on a paying basis and marketing it as a commodity.

Those enterprises, which have superior soft-ware technology and are in a superior position in the market, can meet the requirements of the new era by the complete transformation of soft-ware into a commodity. For the Japanese computer manufacturers and data-processing enterprises, however, it is difficult to make soft-ware on a paying basis and market it as a commodity, because they are technologically backward and because they have maintained a sales policy treating soft-ware as an "addition."

To improve such a situation and make it possible for the Japanese information industries to make soft-ware on a paying basis and market it as a commodity, soft-ware of good quality, especially general-purpose soft-ware of high productivity, must be developed as early as possible.

In view of this necessity, a system of reserve funds for the development of general-purpose soft-ware was established as a part of tax reform in fiscal 1979. This system, whereby the limit on the accumulation of funds is calculated in connection with the income accruing from the transactions in soft-ware, aims at offering an effective incentive to the efforts for two purposes, that is, strengthening of the ability of Japanese information industries to develop general-purpose soft-ware and establishment of practical standards for making and marketing soft-ware as a commodity. The outline of this system is as follows:

a. Objects of the system: individuals and corporations engaged in soft-ware business (including those doing it as a side business).

b. Programs covered by the system: programs developed at home and registered with IPA as general-purpose programs, the dissemination of which is considered desirable.

c. Limit on accumulation: 40 percent of the income accruing from the transactions in programs and accompanying technological services.

d. Method of using accumulated funds: annual use of an equal amount for 4 years, after 4 years of deferment.

2. Promotion of aircraft and aircraft engine industries.

The aircraft industry and the aircraft engine industry are typical knowledge-intensive industries, whose products have great added value, and whose technology is most advanced and has extremely big effects on that of other industries. It is expected, therefore, that they will play an important role in the efforts to be made by Japan, as a nation to live by technology, for the establishment of a knowledge-intensive industrial structure in a creative way. In reality, however, Japan's aircraft industry is far behind those of the United States and Europe. Moreover, it is extremely dependent on defense demand. So, it is urgently necessary to endeavor to promote study and development in the field of civilian aircraft production, above all. To this end, the following measures will be taken:

(i) Promotion of the development of the next mainstay civilian transport (YX):

For the development of the aircraft industry, efforts will be made to promote smoothly the development of the next mainstay civilian transport (YX), which is expected to be in big demand in the civilian aircraft market hereafter.

The YX project aims at developing a 200-seat wide-body passenger plane, the 767 (twin-engined), as a joint enterprise of Japan, the United States and Italy, in accordance with the expected trends of the market in the 1980's. This project has been progressing smoothly, since the trial production of the plane was started in October, 1978. To Japan is assigned the task of developing about 15 percent of the plane as a whole, and this share of work is centered on the fuselage. Besides, Japan is taking part in the work in the general technological field.

In fiscal 1981, the Government will continue to subsidize such efforts for development as trial production of the YX and the manufacturing of a strength-testing plane, as in the preceding fiscal year.

The parts developed in Japan will be sent to Boeing of the United States, which is scheduled to start trial flights in September, 1981. It is expected that a certificate concerning the type of the new plane will be obtained in the summer of 1982.

The subsidy will be paid back to the National Treasury, if a profit accrues from this project.

Subsidy to be released from the General Account for the development of civilian transport (YX)--¥2,043,040,000 (¥6,943,040,000).

(ii) Conducting of research concerning the development of post-YX civilian transport (YXX).

For further development of Japan's aircraft industry, it is necessary to push development of the post YX civilian transport (YXX) in a positive way. From such a point of view, the Policy Subcommittee of the Aircraft Industry Department of the Aircraft and Machinery Industry Deliberation Council proposed, in its second interim report presented in August, 1980, positive efforts to develop, jointly with other nations, a civilian transport of the 130-seat class or a little larger by the middle of the 1980's, in accordance with the future trends of the market.

Since last year, European and U.S. aircraft manufacturers, too, have proposed to Japan joint development of this kind of civilian transport, or joint research in the form of exchange of information on a noncommittal basis, as a step preceding joint development.

The Government has decided to start such efforts as preliminary designing and testing of designs in fiscal 1981, and grant a part of the necessary expenses for these undertakings, in view of the necessity of establishing Japan's own view on the aircraft to be developed, prior to the starting of joint development with other nations.

Subsidy to be released from the General Account for research on the development of civilian transport (YXX)--¥352,973,000 (¥0).

(iii) Promotion of the development of jet engines for civilian transports (XJB).

In view of the trends of the market, it can be expected that strong demand will arise, in the middle of the 1980's, for new-type engines with a thrust of the 9-ton class, which engines will be used for civilian planes of the 130-seat class or a little larger (including the replacement of the engines of the existing planes). So, efforts will be made to push the joint project of Japan and Britain for the development of jet engines for civilian aircraft (XJB Development Project), on the basis of the results produced by the study and development of jet engines for aircraft under the big industrial technology research and development system. The XJB Project is to develop, according to an 8-year plan from fiscal 1980 through fiscal 1987, a high bypass jet engine, which is characterized by less noise, less fuel expense and less pollution than other jet engines and which is expected to be in great demand hereafter. It is an international project to be carried out jointly with Rolls Royce of Britain, on the basis of equal shares.

The contract concerning the execution of this joint project was concluded in December, 1979, and went into force in late January, 1980. In fiscal 1980, basic designing and tests were carried out, and the designing of particulars and the manufacturing of the tools for the engine, which will be made on an experimental basis, were started.

In fiscal 1981, designing of the particulars of the engines for trial production, tests of various kinds and the manufacturing of the tools for the engine for trial production will be continued. At the same time, the trial production of the engine will be started.

This project is the first project started by Japan for the development of a civilian aircraft jet engine for practical use. It is to be carried out by Japan and Britain jointly, on the basis of equal shares. Moreover, the development of engines requires extremely advanced technology, huge funds and a long period of time, and involves big risks, because the funds used for such a project must be recovered over a long time. The Government, therefore, will grant a subsidy to help the Japanese side pay the expenses for this project.

The subsidy will be paid back to the National Treasury, if a profit accrues from this project in the future.

Subsidy to be released from the General Account for the development of jet engines for civilian aircraft--¥4,722,157,000 (¥1,787,157,000).

Limit on the obligation to be borne by the National Treasury (in fiscal 1982)--¥3,819,640,000.

3. Promotion of data-processing industry.

(i) Strengthening of the enterprises of the Data-Processing Promotion Enterprises Association.

The demand for the promotion of informationalization has become stronger than ever, at this time when the nation must switch to a knowledge-intensive industrial structure. Also, the development of the data-processing industry, which must shoulder the burden of pushing informationalization, has become an important policy problem for the Government, because the technological gap between Japan and the United States in this industrial field remains to be eliminated.

In view of such a situation, the Government will endeavor to expand and strengthen the activities of the Data-Processing Promotion Enterprises Association, which was founded in 1970 for the purpose of pushing informationalization and fostering the data-processing industry in Japan, with major emphasis on the enterprises to be mentioned below.

Subsidy to be released from the General Account to meet the operational expenses of the enterprises of the Data-Processing Promotion Enterprises Association (including the expenses for special commissioning of the development

of soft-ware production technology and of soft-ware maintenance technology, and the expenses for the promotion of the development of advanced data-processing technology)--¥2,658,000,000 (¥2,781,000,000).

(Note)--The Data-Processing Promotion Enterprises Association: This Association is the only national organization for the promotion of soft-ware. It was founded in 1970 on the basis of the "Law Concerning the Data-Processing Promotion Enterprises Association, Etc" (Law No 90, 1970), as an organization to promote the development and utilization of programs and foster data-processing service enterprises. It is dependent on investments by the Government and private circles, donations from private circles and Government subsidies, for the operation of its enterprises.

(ii) Promotion of the plan for the development of soft-ware production technology.

The modernization or rationalization of the soft-ware production method, which at present is labor-intensive in character, is an extremely important problem which must be tackled in improving the productivity and reliability of indigenous soft-ware drastically. Especially, it has come to be demanded strongly, with the growth of such trends as an increase in the soft-ware cost in recent years.

With consideration for such a situation, this project aims at improving the technology-developing ability and production structure of Japan's soft-ware industry drastically to reach the American level, by switchover from the traditional hand-operated soft-ware production formula to a formula of automatic production with the use of electronic computers. It is expected to produce various effects, including (a) the improvement of productivity and (b) an increase in the reliability of the program.

This project is a long-term project which was started in fiscal 1976. It will be brought to a successful conclusion in fiscal 1981, which is its scheduled last year.

The sum to be earmarked for special commissioning of the development of soft-ware production technology, out of the subsidy to be released from the General Account to meet the operational expenses of the enterprises of the Data-Processing Promotion Enterprises Assocation--¥970,000,000 (¥1,672,000,000).

(iii) Promotion of the plan for the development of soft-ware maintenance technology.

Soft-ware, in its nature, requires maintenance work, to meet the changes in the environment for processing, such as the operating system, and the demands of the users. The maintenance cost accounts for about 70 percent of the total cost of soft-ware. On the other hand, the maintenance work is almost totally hand-operated, and accordingly, is not very productive or reliable. It is a principal factor for the rise in the soft-ware cost.

A 5-year plan will be started in fiscal 1981 for the development of a comprehensive system, which will overcome such a situation and increase the productivity and reliability of maintenance work by rationalization and automatization (at a total cost of about ¥5 billion).

The sum to be earmarked for special commissioning of the development of software maintenance technology, out of the subsidy to be released from the General Account to meet the operational expenses of the enterprises of the Data-Processing Promotion Enterprises Association--¥140,000,000 (¥0).

(iv) Promotion of the development of advanced data-processing technology.

To secure the progress of informationalization in Japan hereafter, it is necessary and indispensable to develop an advanced, complex data-processing technology by the fusion of soft-ware technology with other kinds of technology, in accordance with the progress of data processing. It has become difficult, however, for the existing development organizations to carry out such a development project. So, it is indispensable for the State to promote the development of technology.

For the development of such an advanced, complex data-processing technology, it is necessary to make a comprehensive survey of the elemental technology of diversified kinds. The technicians, who are well versed in elemental technology in their respective fields, belong to different organs or organizations. For the development of these kinds of technology, therefore, excellent technicians will be secured from various organs and organizations, such as data-processing enterprises, computer-manufacturing enterprises, computer-using enterprises and research institutes, to organize them into an ad hoc project team for the development of technology. Because the technicians, who are to take part in this project team, have their respective social foundations, it becomes necessary for a public organ to coordinate and guide the operations of the team. To meet this necessity, a soft-ware technology center (tentative title), which is to serve as a theater of activity, will be established within the Data-Processing Promotion Enterprises Association, which is the only public organization for the promotion of data processing.

The sum to be earmarked for the promotion of the development of advanced data-processing technology, out of the subsidy to be released from the General Account to meet the operational expenses of the enterprises of the Data-Processing Promotion Enterprises Association--¥395,434,000 (¥31,912,000).

(v) Development of specific programs on a greater scale.

For the advanced use of computers and the promotion of the distribution of programs, the Data-Processing Promotion Enterprises Association has entrusted the development of those advanced, general-purpose programs, which it is difficult for this Association to develop by its own efforts, to other organizations concerned, and has been endeavoring for the dissemination of the programs developed by these organizations. In fiscal 1981, it will step up its efforts to have package programs developed by other organizations on commission, with a view to promoting the distribution of soft-ware.

The sum to be earmarked for the development and purchase of programs, out of the subsidy to be released from the General Account to meet the operational expenses of the enterprises of the Data-Processing Promotion Enterprises Association--¥1,350,838,000 (¥1,200,838,000), of which ¥300,000,000 (¥150,000,000) is reserved for package programs.

(vi) Strengthening of the financial foundation of the data-processing industry.

The data-processing industry is given a position as a strategic industry which is to play an important role in the improvement of the people's livelihood and the establishment of a knowledge-intensive industrial structure. In reality, however, its technological power and production capacity are still small. The scale of enterprises in this industrial field, too, is smaller than those in the United States and Europe. So, it is considered necessary for the Government to take effective measures to bolster this industry. Especially, it is difficult for the data-processing industry to secure smoothly the amount of funds it needs under favorable terms from private banking institutions, because it is only a short time since this industry came into existence, and because this industry cannot provide enough security on which to borrow loans.

In view of such a situation, the Government began to guarantee the debts owed by the Data-Processing Promotion Enterprises Association in 1970. It has also taken "financial measures for the promotion of data processing," in the form of advancement of loans from three long-term credit banks on the basis of acceptance of bank debentures by the Trust Fund Bureau. These measures have been playing an important role in the development of data processing in Japan.

In fiscal 1981, too, the Trust Fund Bureau will accept bank debentures, to make it possible to supply the necessary funds for the enforcement of these measures, which have proved effective.

The Government will also make facilities investments necessary for the development of soft-ware and education and training of data-processing technicians by computer manufacturers and soft-ware enterprises and those necessary for the on-line data-processing system to be established by the data-processing service enterprises and others by the advancement of Development Bank loans.

Furthermore, the data-processing service is an industry of public nature, because it handles data concerning local public entities and others. In view of such a character, the Government will continue efforts to guarantee the safety of the electronic computer system of the data-processing service industry, for the prevention of such accidents as stoppage of the operation of this system and the damaging or leakage of data. It will also record and clarify to the public the state of implementation of the safety measures in this industrial field.

Subsidy to be released from the General Account for the promotion of safety measures for the data-processing service industry--¥2,438,000 (¥2,438,000).

Government investments for the enforcement of financial measures for the promotion of data processing (acceptance of bank debentures)--¥5 billion (¥5 billion).

Government investments in facilities for the development of soft-ware (Development Bank loans)--to be disbursed within the framework of ¥46 billion (¥48 billion) for the development of electronic computers.

Government investments for the promotion of the establishment of data-processing systems (Development Bank loans)--to be disbursed within the framework of ¥46 billion (¥48 billion) for the development of electronic computers.

4. Promotion of atomic energy apparatus industry.

(i) Acceleration of the introduction of atomic energy apparatuses.

The atomic energy apparatus industry is to play an important role in the establishment of an advanced, knowledge-intensive industrial structure in Japan, and in the development of atomic power generation, which is expected to become the principal source of energy supply to take the place of oil in the future. The Government wants to increase the technological power of this industry by helping the manufacturers of these apparatuses accumulate constructive experiences. To this end, it will increase the amount of funds for advancement to this industry.

Government investments in atomic power generation apparatuses (Development Bank loans)--to be disbursed within the framework of ¥145 billion (¥115 billion) for the atomic energy industry.

(ii) Improvement of the safety and reliability of atomic power generation apparatuses.

To remove the uneasy feeling harbored by the people about the safety of atomic reactors and push the construction of atomic power plants smoothly, greater efforts must be made to improve the safety and reliability of atomic power generation apparatuses. Also, it is necessary to endeavor to secure the understanding of the people about the safety and reliability of these apparatuses.

For this purpose, the formula for the analysis of safety will be improved, and demonstrative tests will be conducted on the aseismatic structure of reactors, the nature of fuel and the efficiency of valves, steam generators and pumps. The results of these tests will be conducted also for the development of a light-water reactor of the Japanese type, on the basis of the results produced by the first and second rounds of improvement and standardization.

Furthermore, it must be made easier to control the operations and facilities at the atomic power plants, so that the people's trust in atomic power generation will become complete. Efforts in this direction will be made in such ways as follows: (a) to discover, as early as possible, any abnormality which may lead to trouble; (b) to make it easier for the operator to recognize the existence of such an abnormality and take proper measures to cope

with it; and (c) to ease the burdens of the operator and inspectors in their everyday control of operations and facilities and regular inspections, and help private enterprises develop a support system conducive to the reduction of even those minor defects, which are still discovered at present, by granting a subsidy amounting to two-thirds of the expenses necessary for these purposes.

Subsidy to be released from the Electric Power Resources Development Special Account for commissioning of the demonstrative tests on the reliability of the atomic power generation facilities--¥7,780 million (¥7,176 million), of which ¥1,241 million (¥521 million) will be earmarked for tests on the reliability of pumps, and ¥730 million (¥642 million) for tests on the reliability of valves.

Subsidy to be released from the General Account for study and research concerning the standard system for atomic power generation apparatuses--¥420,000 (¥420,000).

Subsidy to be released from the Electric Power Resources Diversification Section of the Electric Power Resources Development Promotion Measures Special Account for the development of an atomic power generation support system--¥1,104,078,000 (¥850,580,000).

(Note)--Contents of the development of an atomic power generation support system.

The atomic power generation support system aims at easing the burdens of the operators, examiners and inspectors and decreasing the damage to be caused by accidents or trouble. For this purpose, the development of the (a) instruction system, and that of the (b) automatic inspection system inside the container, will be undertaken.

(a) Instruction system: This is a system to grasp comprehensively, with the aid of an electronic computer, the information concerning the state of the apparatuses, which constitute an atomic power plant, and their operations, acquaint those in charge of the operations of these apparatuses with the normality of the apparatuses and their operations correctly, and give them proper instructions concerning operations.

(b) Automatic inspection system inside container: This is a system to inspect the state of the various apparatuses inside the container by moving a detector on a rail or on the floor, under intense radiation.

5. Promotion of space industry.

The growing shortage of resources and energy supply has become an extremely big problem for Japan, which is a small country, as far as indigenous resources are concerned.

On the other hand, foundations have already been consolidated for the utilization of space, and it has become necessary to make active use of space for

experimental, observational and other purposes. With consideration for such a situation, we must endeavor to implement Japan's resources and energy policy in a positive way, and at the same time, study and develop the technology for exploring for oil and other resources with the aid of resources satellites, with a view to improving the technology connected with space development. For this purpose, the system and technology for processing the data to be obtained from such apparatuses as the synthetic aperture radar, which will be carried by a resources satellite, will be studied and developed. Also, the most suitable total system will be studied.

Subsidy to be released from the General Account budget of the Resources and Energy Agency for the development of technology for exploration with the use of resources satellites--¥53,305,000 (¥0).

(Note)--In fiscal 1980, a budget of ¥55,809,000 was given the Agency of Industrial Science and Technology for the study of artificial satellites to be used for the exploration of resources.

Subsidy to be released from the Coal, Oil and Substitute Energy Measures Special Account for the development of technology for remote detection of oil resources--¥1,016,931,000 (¥0).

Additional remark: Significance of fostering space industry.

(1) Foundation for space utilization.

(a) The utilization of space already has close bearing on the people's livelihood, as can be seen from transmission via satellite in TV broadcasts, the use of meteorological satellites for meteorological observation and that of LANDSAT satellites for earth observation.

(b) It is expected that the role of space utilization will become extremely big in economic life hereafter, with the expansion of these fields for space utilization and the opening of such new fields as construction of space plants.

(c) The space industry is an industry to provide necessary means for the utilization of space in these ways. It therefore is to constitute the basis for space utilization.

(d) For the development of the utilization of space in the future, it is necessary to improve, both qualitatively and quantitatively, the level of the space industry, which holds a key to the materialization of this purpose.

(2) Effects of spread of technology.

(a) The technology for the utilization of space is a large-scale system technology, which requires the fruit borne by diversified technological efforts. Especially for the apparatuses to be used in such a special environment as space, it is necessary to meet such requirements as follows: (i) adaptation to environment; (ii) reduction of the scale and weight; and (iii) high reliability. This means that high quality is demanded of these apparatuses.

Consequently, it becomes necessary to improve the quality and extreme character of these apparatuses, and an extremely high technological level will be needed for their production.

(b) The space industry is an up-to-date industry which makes free use of such advanced technology. This industry, therefore, is expected to play the role of motive power for the improvement of the technological level of Japanese industries.

(3) Industry of the next generation.

(a) The space industry is typical of the creative, knowledge-intensive industries which represent the concentration of advanced technologies, as is pointed out in the Vision for the Trade and Industrial Policies in the 1980's.

(b) It can be expected that the demand for the activities of this industry will increase throughout the world hereafter, with the development of the use of space. Also, it is expected that the space industry will serve as a nucleus for the development of Japan as a nation dependent on technology.

6. Promotion of engineering industry.

The engineering industry is an industry which takes charge of all the processes from the planning and construction to the delivery and operation of plants. Characteristically, this industry has an "integrating function," a soft function whereby many industries necessary for the construction of plants are organized systematically, as its sales point. In character, therefore, the engineering industry is largely an industry to provide services of advanced nature. It is a typical knowledge-intensive industry which requires comprehensive technology covering all kinds of science, including civil engineering, chemistry, mechanical engineering, metal engineering and environmental engineering.

Also, the engineering industry has been developing since the 1960's, with the construction of petro-chemical, oil-refining and other plants in accordance with the policy of expanding heavy and chemical industries. It has been making a contribution to the development of Japan's basic material industries. At present, it is making positive efforts for overseas development by means of plant exports. It is helping Japanese enterprises start activity abroad, and at the same time, is making a contribution to the industrial development of the developing nations.

As can be seen from this, the engineering industry is an important industry, which holds a key to the development and utilization of the social systems necessary for the establishment of an advanced welfare society through the integration and concentration of human wisdom in diversified fields, and the harmonious development of external economic relations through economic and technological cooperation on the private level. Japan's engineering industry, however, has only a short history, and there is a big gap with those of Europe and the United States in regard to the technology-developing capacity and the foundations of enterprises. Therefore, efforts will be continued, as in fiscal 1980, for the establishment of the measures necessary for the development

of the engineering industry, such as the collection and compilation of information concerning this industry, establishment of common standards for engineering, including those for the conclusion of contracts and the calculation of prices, and the formulation of the measures for the training of project managers.

Sum to be earmarked for research on the engineering industry, out of the General Account budget for research on the trends for the development of technology of the machinery industry--¥3,095,000 (¥3,439,000).

7. Promotion of robot industry

The robot industry is an industry requiring up-to-date technology, which combines in itself machinery, electronics and information. All nations are making positive efforts for the technological development of this industry as an important strategic industry in the future.

Industrial robots will make it possible to automatize the production of diversified kinds of goods in small quantities, and make a contribution to the drastic improvement of productivity. Besides, they will produce big economic and social effects, such as prevention of vocational disease, mechanization of hazardous work and other kinds of work to be done under unfavorable conditions, and the establishment of measures to meet the increasing ratio of old people to the total population and the rise in the educational level of the people.

Because of the importance of the robot industry, concerted efforts of the Government and people have been made, in a positive way, in Japan as well, to develop and strengthen this industry. As a result, Japan's robot industry has reached one of the highest standards in the world. It has become an urgent problem to promote the spread of industrial robots hereafter, and establish an advanced system for the supply of these robots. Because of such circumstances, the following measures will be taken to promote the spread of robots in a positive way:

Framework for Government investments (Development Bank loans) for the expansion of the leasing business of the companies engaged in the leasing of robots for private use--¥30,500 million (¥43,000 million).

Robotization of hazardous work and work under unfavorable environment will be pushed, with the use of the system for the advancement of special loans for the protection of industrial workers and the improvement of sanitary facilities.

Framework for the advancement of loans by the Medium and Small Enterprises Finance Corporation for the protection of workers and the prevention of environmental pollution--¥88,000 million (¥84,400 million).

Framework for the advancement of loans by the People's Finance Corporation for the protection of workers and the prevention of environmental pollution--¥14,000 million (¥12,500 million).

8. Promotion of technological development.

(1) Promotion of the study and development of large-scale industrial technology, etc.

Efforts for the development of "jet engines for aircraft," a "compound production system using laser of ultra-high efficiency" and a "meter control system using light" will be continued under the system for the study and development of large-scale industrial technology. Also, efforts will be started for the development of a "high-speed calculating system for scientific and technological use." Besides, the development of "magnetohydrodynamic (MHD) power generation" and "high-efficiency gas turbines" will be continued under the system for the study and development of energy-saving technology (Moonlight Project).

Out of the General Account budget for the Agency of Industrial Science and Technology, appropriations will be made for the following projects:

Development of a high-speed calculating system for scientific and technological use (big project)--¥30 million (¥0).

Development of jet engines for aircraft (big project)--¥1,901,156,000 (¥2,062,795,000): The operation of an engine, made on an experimental basis, will be studied, with major emphasis on the long endurance test, high-altitude landing tests conducted in Britain and tests for comprehensive valuation.

Development of a complex production system using laser of ultra-high efficiency (big project)--¥2,745,154,000 (¥2,825,047,000): An earnest study will be made of technology for such elements as materials and optical machine parts, as in the previous fiscal year. Also, the designing and construction of experimental plants will be studied.

Meter control system using light (big project)--¥2,418,648,000 (¥926,873,000): A full-scale study will be made of light element technology, and of the total system and subsystems of different functions.

Magnetohydrodynamic (MHD) power generation (Moonlight Project)--¥623,844,000 (¥1,321,871,000): MHD power generation, which is characterized by a high generating efficiency and the direct burning of coal, will be studied and developed.

MHD power generation is a method of generating electric power by passing combustion gas of high temperature (2,700 C.), which can be obtained by burning such kinds of fuel as heavy oil, natural gas and coal, through an intense magnetic field at high speed. The gas will be used to drive thermal power generation turbines, for the generation of electric power. In this way, electric power can be generated by the combination of MHD and steam power. This method makes thermal efficiency higher than that in the case of conventional thermal power generation. If thermal efficiency is raised from 40 percent to 50 percent, fuel can be saved by 20 percent, and exhaust gas can be decreased by 33 percent.

Development of high-efficiency gas turbines (Moonlight Project)--¥5,919,818,000, including ¥4,949,460,000 from the Electric Power Resources Development Promotion Measures Special Account (¥4,280,829,000, including ¥3,503,875,000 from the Electric Power Resources Development Promotion Measures Special Account): To increase the thermal efficiency of the power-generating gas turbine, a complex power-generating system will be built, with the combination of a high-temperature, high-pressure steam turbine using the high-temperature exhaust gas of the gas turbine, with a high-efficiency, reheated gas turbine with a high entrance temperature. This system will increase thermal efficiency from 40 percent to 50 percent, and, if combined with central heating and cooling apparatuses, will make community power generation possible. If thermal efficiency is increased from 40 percent to 55 percent, fuel consumption can be cut about 27 percent.

Outline of the study and development of the high-speed calculating system for scientific and technological use.

In the field of science and technology, ultra-high-speed calculation is strongly desired for such purposes as high-speed processing of the images sent from space satellites, simulation of nuclear fusion reactors and meteorological analysis. To do this kind of calculation which is beyond the capacity of the conventional electronic computers, it is necessary to have a computer with the efficiency of more than 10 BFLOPS (Billion Floating Operation Per Second). Such a computer will make it possible to widen the horizon of the various branches of science.

In reality, however, there are bounds established by elements and architecture, and it is impossible to meet the aforementioned requirements with conventional technology. To break this deadlock, the following are necessary: (i) such elements as Josephson junction (JJ), HEMT and GaAaFET: and (ii) an architecture like the formula of parallel processing, with the use of many basic processors. In carrying out this project, these items will be studied and developed, for the materialization of a high-speed calculating system for scientific and technological use.

(2) Promotion of the development of heavy machinery and trial production of new kinds of machinery on commercial basis.

For the promotion of the establishment of an advanced industrial structure in Japan, it is necessary to improve the technological level of industries, with major emphasis on heavy industries, especially heavy machinery production. So, efforts will be made for the effective operation of the system for promotion of the development of heavy machinery (created in 1964), whereby loans are advanced to provide equipment funds for those enterprises which purchase new kinds of heavy machines turned out in Japan, for the first time, with the use of new technology and design developed at home, and the system for trial production of new kinds of machinery on a commercial basis (created in 1968), whereby loans are advanced to provide the funds (equipment funds, etc) needed by the enterprises which undertake trial production of mechanical equipment to be turned out in Japan on a commercial basis, for the first time, with the use of new technology and design developed at home.

Framework for Government investments (Development Bank loans) for trial production of new kinds of machinery on a commercial basis and development of indigenous technology--¥44 billion (¥47 billion).

Outline of the system.

(a) Development of heavy machinery.

This is a system for the advancement of loans to provide equipment funds needed by those enterprises, which purchase heavy machinery turned out in Japan for the first time, with the use of new technology developed at home.

While the machinery industry developed rapidly after the War's end, the production of new kinds of machines, which have been developed by new technology, on a commercial basis has not yet made satisfactory progress, in spite of the strong desire for the development and spread of such machines, for the following reasons: (i) Trial production cannot be repeated easily, because the cost of production per machine is too high; (ii) a large amount of funds must be tied up for a long period, for trial production of a heavy machine which has not been known at all; and (iii) users, too, feel uneasy and become reluctant to issue an order for such an unknown machine.

In view of such a situation, MITI in fiscal 1964 established a system for the advancement of long-term, low-interest-bearing loans to provide for users the necessary funds for the purchase of heavy machines turned out for the first time in Japan with the use of new technology developed at home, for the promotion of the development and spread of heavy machinery.

(b) Trial production of new kinds of machinery on commercial basis.

To put the production of those multi-purpose machines, which are to be sold on the market, on a commercial basis, it is necessary to make a considerable number of machines on an experimental basis in advance, and examine and improve them from the standpoint of technology and design. In practice, this requires huge funds. So, the manufacturers cannot afford to undertake production on an experimental basis sufficiently.

MITI, therefore, established in fiscal 1968 a system for the advancement of long-term, low-interest-bearing loans to help those enterprises, which undertake trial production of those new machines to be turned out in Japan for the first time, with the use of new technology developed at home, meet the expenses necessary for the procurement of machines turned out on an experimental basis, and other items which are to become their own equipment, for the promotion of the development and spread of such machines.

(3) Promotion of the development of basic technology for the establishment of next-generation industries.

For the development of technology as the foundation for Japan's survival as a nation, it is necessary to improve the level of basic industrial technology,

which level in Japan is lower than those of the United States and Europe. The spread of basic industrial technology produces extremely big effects, and is to serve as a pillar for the renewal of technology for a long time to come. On the other hand, it is expected that various risks will have to be met in putting the basic industrial technology of revolutionary character to practical use. So, it is necessary to push its study and development by the combined strength of industrial and academic circles and the Government. In view of this necessity, a system for the study and development of basic technology for next-generation industries will be created, as a step to strengthen drastically the basic technology indispensable for the establishment of the next-generation industries, which are expected to come into bloom in the 1990's. Under this system, study and development will be pushed vigorously by combining together the following: (i) the vitality and potential of private circles; (ii) large funds; and (iii) an effective formula for development on a planned basis. As themes to be studied, problems concerning the development of basic technology in such fields as new materials and new functional elements will be selected, and private enterprises will be asked to develop this kind of technology.

Sum to be earmarked for the study and development of basic technology for next-generation industries, out of the General Account budget for the Agency of Industrial Science and Technology--¥2,714,437,000 (¥0); of this sum, ¥1,356,442,000 (¥0) will be used for the development of new materials, and ¥673,250,000 (¥0) for the development of new functional elements.

II. Development of Social System, Etc.

(1) Development of health care network system.

In Japan, many problems have arisen in the field of medical service, such as the imperfect system of medical treatment, a regional gap in medical services, the incomplete system of first-aid treatment and the increasing medical expenses of the people as a whole. The development of a medical information system, which makes use of computer technology and medical instrument technology, will provide an effective solution for these problems.

Efforts have been made, therefore, since 1978, under a 6-year plan, for the development of a "health care network system," whereby the medical institutions, such as hospitals, clinics and health-screening and medical inspection centers, will be connected together, for joint use of advanced medical information and advanced medical materials and unified use of health control data, and for the establishment of advanced, rational regional medical systems. In fiscal 1981, the development of a basic network and an application program will be continued, as in fiscal 1980.

Sum to be earmarked for the development of a health care network system, out of the General Account budget--¥221,849,000 (¥221,849,000).

In Japan, there are various problems in the field of medical service, such as the regional gap in medical services, an incomplete system for first-aid treatment, and the necessity for patients to wait for 3 hours to receive a

3-minute medical examination or treatment. For the solution of these medical problems and curbing of the rise in medical expenses, it is indispensable to develop and introduce a medical information system consisting of computers and new medical instruments. In Europe and the United States, a large amount of funds has been poured into the enterprises for this purpose. From this point of view, efforts have been made to develop a health care network system by combining together such medical institutions as hospitals and health-screening and medical inspection centers, with a view to making possible the joint use of advanced medical information and materials and the unified use of health control data, and making a contribution to the establishment of advanced, rational medical systems in the respection regions.

Functions of the health care network system: (a) use of health control data; (b) joint use of advanced medical instruments and materials; (c) improvement of the data-processing precision of hospitals and clinics; and (d) use of advanced medical information.

(2) Research and study of a community energy system using substitute energy.

Energy-saving efforts must be pushed in the cities as well. For this, the city as a whole must be treated as an integrated system covering the whole process from production to consumption in the field of energy, for reduction of the total energy consumption.

From this point of view, the feasibility of the "energy-saving urban mechanical system," which will be constituted by three subsystems--regional energy center (CEC), urban-system integrated circuit (IUC) and terminal for domestic use, was studied in fiscal 1978 and fiscal 1979, in connection with the present project. In fiscal 1980, a "community energy system using substitute energy," which system will use coal as the primary energy source, was studied on the basis of the results of the study in the preceding years, for switchover to the use of substitute energy. Also, the selection of model communities and basic research were carried out. In fiscal 1981, precise studies and basic plans will be made to put this system on a paying basis.

Sum to be earmarked for the study of the plan for the development of a community energy system using substitute energy, out of the Coal, Oil and Substitute Energy Measures Special Account--¥45,292,000 (¥42,167,000).

(Note)--In fiscal 1978 and in fiscal 1979, however, "research and study for the development of an energy-saving mechanical system" were made with an appropriation from the General Account budget.

The community energy system, which uses substitute energy, can increase energy efficiency drastically without the use of oil. Furthermore, it makes it possible to cut the cost of construction and the expenses for control and management drastically, by the effective and comprehensive use and reuse of water and various kinds of energy on a community scale, and by the establishment of a unified, concentrated channel for the delivery of information concerning water and energy.

(3) Promotion of the implementation of a new automobile running system.

The progress of motorization has been accompanied by the growth of such problems as frequent occurrence of accidents due to traffic congestion, environmental pollution and a decline in the running efficiency of automobiles. As an effective means of solving these problems, it has become urgently necessary to implement a new automobile running system, which will give a simultaneous solution to these problems, by the use of technology for comprehensive automobile control, which technology has been developed by a big project system.

For the smooth implementation of such a system, it is indispensable to study not only measures for the dissemination of the comprehensive automobile control system, but also how to coordinate this system with other systems (such as the existing road traffic information system and signal control system) and secure the proper functions of the apparatuses to be carried by automobiles for coordination, in order to establish a comprehensive vision. Questionnaires will be sent to experts on automobiles and electronic information technology, to seek their opinions on a new automobile running system. At the same time, a committee will be formed with persons of learning and experience, officials of ministries and agencies concerned and representatives of organizations concerned as members, to study such a system.

Sum to be earmarked for the promotion of the implementation of a new automobile running system, out of the General Account budget for the study and promotion of pollution-free automobiles--¥2,819,000 (¥2,819,000).

III. Positive Measures To Meet Social Requirements.

1. Promotion of energy- and resources-saving measures.

(a) Creation of new tax system for the promotion of investments in energy measures.

A tax system for the promotion of investments in energy measures will be created, to establish the energy foundations of industries by the acceleration of investments in the energy-saving projects and enterprises for the introduction of substitute energy, and overcome the rigid restrictions imposed on Japan by the energy problem.

Outline of the new tax system.

(i) The taxpayer will be asked to choose between the deduction of 7 percent of the cost of acquisition from taxation and the refunding of 30 percent of this cost as an extraordinary step in the first year.

(ii) One-year carry-over will be permitted in regard to tax deduction and extraordinary refunding.

(iii) The period for the application of these measures is 3 years.

(b) Promotion of energy-saving and substitute-energy-developing measures for such industries as casting and forging.

The casting and forging industries are unique in character, because they must use a large quantity of energy to melt metal into a sand mold or heat and plasticize metal for processing. To meet in a positive way the social requirement of saving energy and developing substitute energy hereafter, it is necessary to promote the introduction of energy-saving equipment, such as industrial reactors of the energy-saving type, automatic burning control apparatuses, cupolas of the divided blast formula, heat exchangers and molding equipment of the energy-saving type, and that of substitute-energy-using equipment, such as industrial reactors using substitute energy. To meet this necessity, financial and tax measures will be taken.

The Government will make investments in the form of the following loans:

Development Bank loans within the framework of ¥31 billion (¥23 billion) for resources- and energy-saving measures.

Medium and Small Enterprises Finance Corporation loans within the framework of ¥93.7 billion (¥75 billion) for other purposes.

People's Finance Corporation loans within the framework of ¥146.5 billion (¥137.5 billion) for other purposes.

The period for the application of the exceptional measures concerning the standard for the levying of the fixed assets tax on the energy-saving equipment, such as industrial reactors of the energy-saving type and cold box molding machines, will be extended.

(c) Promotion of the resources-saving measures for domestic electric appliances.

The reproduction of domestic electric appliances has important significance for the effective use of resources and the smooth disposal of large-scale refuse. Necessary research, therefore, will be continued in fiscal 1981, for the reproduction of domestic electric appliances.

Also, the reality of after-service for broken domestic electric appliances and the state of repaired domestic electric appliances in use will be surveyed.

Sum to be earmarked for the reproduction of domestic electric appliances out of the General Account budget--¥3,544,000 (¥3,544,000).

(d) Promotion of the energy-saving measures for electronic and electric appliances.

To make energy-saving electronic and electric appliances, efforts have been made for the acceleration of the improvement of the efficiency of energy consumption, in accordance with what is called the "Energy-Saving Law." For further reduction of energy consumption, technology of decreasing refrigerators' energy consumption will be studied and developed under the system for the study and development of energy-saving technology (Moonlight Project).

Sum to be earmarked for the study and development of energy-saving refrigerators out of the appropriation made by the General Account budget of the Agency of Industrial Science and Technology for subsidizing trial production of energy-saving machines and equipment for civilian use (Moonlight Project)-- ¥75 million (included in the framework of ¥108,000,000).

(e) Promotion of the energy-saving measures for automobiles.

To save automobiles' energy consumption, such measures as the establishment of guidelines for fuel expenses have been taken on the basis of the "Law Concerning the Rationalization of Energy Consumption." The automobile manufacturers are to step up their efforts for the reduction of fuel expenses in accordance with these measures. The medium- and long-term energy supply situation, however, is becoming more and more stringent, as can be seen from the establishment of a maximum limit- for oil imports at the Tokyo Summit. In view of such a situation, it is requested of the automobile industry to start long-range efforts for the development of epoch-making automobiles of energy-saving or post-oil character beyond the framework of conventional technology. In fiscal 1981, therefore, the value of such new-type engines as pure alcohol engines, hydrogen engines and Sterling engines and that of technology concerning automobile materials and for the prevention of wear and tear will be assessed from an overall point of view covering such technological problems as reliability, safety, freedom from pollution and fitness for driving and such economic problems as the possibility of supply of substitute fuel, with consideration for the trends of study at home and abroad, for the establishment of guidelines for the development of energy-saving automobiles and decreasing of the dependence on oil.

Sum to be earmarked for entrusting the study of energy-saving automobiles to private organizations, out of the appropriation made by the General Account budget for the study and development of pollution-free automobiles, etc.-- ¥3,602,000 (¥3,602,000).

(f) Promotion of measures for the disposal of scrapped cars.

As of the end of fiscal 1979, there were 36,390,000 automobiles in use in the country. The number had increased by 3.3 times in ten years. It is expected to continue increasing hereafter.

Parallel with such an increase in the number of automobiles in use, the number of scrapped cars, too, has been increasing, year by year (In fiscal 1979, 3,137,000 cars were scrapped). As a result, it has become necessary to establish rational systems for such purposes as follows: (i) disposal of the scrapped cars abandoned on roads or vacant land; and (ii) proper collection of scrapped cars for the prevention of pollution accompanying the growth of the scrapped car disposal industry. So, the study of measures necessary for the establishment of a comprehensive plan for the disposal of scrapped cars will be continued.

Also, the advancement of Development Bank loans to the scrapped car disposal enterprises will be continued, as in the previous fiscal year.

Sum to be earmarked for the promotion of scrapped car disposal measures, out of the appropriation made by the General Account budget for the measures to be taken to guarantee the safety of automobiles and prevent pollution--¥2,394,000 (¥2,394,000).

Government investments (Development Bank loans) in scrapped car disposal facilities will be made within the framework of ¥31 billion (¥19 billion) to be used for resources- and energy-saving measures.

2. Promotion of safety measures.

(a) Promotion of the safety of vending machines, etc.

Automatic vending machines have spread rapidly in recent years, and have become indispensable for smooth consumer activities. Most of these machines, however, are controlled by petty retail enterprises. As a result, the knowledge necessary for the maintenance of the safety of the machines has not permeated among the public, and such accidents as tipping over have occurred. Such a situation has made it a big problem to take necessary measures for the safety of automatic vending machines.

So, the month of October every year will be designated "month for the promotion of the safety of vending machines," with a view to spreading knowledge concerning the safety of these machines.

Sum to be earmarked for the promotion of the safety of vending machines, out of the General Account budget--¥2,989,000 (¥2,989,000).

(b) Study of the measures for the development and spread of machinery for the protection of the safety of industrial labor.

Efforts will be made to prevent casualties and pollution from occurring in industrial fields due to the structure of machinery, in such ways as to survey the reality of the machinery for the protection of the safety of industrial labor and establish the goals to be attained by the efforts for safety.

Also, a survey will be conducted over the cases of accidents caused by machinery, criteria for safety and safety apparatuses, to establish common principles for the protection of safety in all fields of machinery production. On the basis of the results of such a survey, efforts will be made to extract the danger in the respective fields, study measures for the prevention of danger and confirm the safety by tests, for the establishment of JIS safety rules in the respective fields.

Sum to be earmarked out of the General Account budget for the development and spread of machinery for the protection of industrial labor--¥1,909,000 (¥1,909,000).

Sum to be earmarked for the research and study necessary for the standardization of agricultural machinery, out of the General Account budget for the Agency of Industrial Science and Technology--¥20,645,000 (¥20,460,000).

(c) Promotion of safety measures for casting and forging industries.

About 6,000 cases of labor casualties occur every year in the field of production of pressed metal goods. So, it is necessary to promote the spread of the pressing machines having safety apparatuses for the protection of the safety of labor in this field. Measures have been taken for the advancement of loans for this purpose through the Medium and Small Enterprises Finance Corporation and the People's Finance Corporation (in Okinawa Prefecture, the Okinawa Development Finance Corporation).

Of the pig-iron casting processes, the finishing process consists almost solely of handwork, and therefore, involves the danger of workers contracting Raynaud's disease. So, efforts will be continued, as in fiscal 1980, to develop an automatic finishing process for the casting industry.

Furthermore, the spread of automatic forging apparatuses, which have been developed by the use of computers for the automatization of the work of heating materials and that of exchanging models, must be accelerated, for the prevention of casualties accompanying work under high temperature, handling of materials and the work of exchanging models in the manufacturing of hot forged products. So, tax measures will be taken, as in fiscal 1980, to keep these apparatuses as objects of the special refunding system for important complex machines.

Sum to be earmarked for the study and development of the system for the automatization of the finishing casting process, out of the General Account budget for the Medium and Small Enterprises Agency (Medium and Small Enterprises Promotion Corporation's expenses for special study and development)--¥72,657,000 (¥58,936,000).

Government investments for the acquisition and installation of the pressing machines containing safety apparatuses:

Loans will be advanced by the Medium and Small Enterprises Finance Corporation within the framework of ¥88 billion (¥84.4 billion) earmarked for the advancement of loans for the protection of safety and the prevention of pollution.

Loans will be advanced by the People's Finance Corporation within the framework of ¥14 billion (¥12.5 billion) earmarked for the advancement of loans for the protection of safety and the prevention of pollution.

(d) Promotion of measures for the consumers of domestic electric appliances.

With the rapid spread of domestic electric appliances, the importance of the measures to be taken for consumers is increasing steadily. So, various measures have been taken for consumers, including guidance about the period for the maintenance of parts. For further promotion of these measures, the number of the items to be covered by the system of reserve funds for guaranteeing the quality of products will be increased.

Tax reform: VTR and the electronic cooking range will be added to the list of the items to be covered by the system of reserve funds for guaranteeing the quality of products.

3. Promotion of environmental protection measures.

(a) Promotion of the spread of electric automobiles.

With the rapid spread of automobiles, automobile pollution has become a big social problem. From the energy-saving point of view, too, it has come to be requested that the way of automobile traffic should be reexamined.

To provide a fundamental solution for these problems, the study and development of electric automobiles have been pushed under a big project system. As a result, a technological foundation has been virtually established for the improvement of the efficiency of electric automobiles. However, the technological problems, which must be solved for the practical use of the results of the studies made until now, still remain unsolved. The conditions necessary for the spread of electric automobiles, too, have not yet been established. Research will be continued, therefore, for the promotion of the spread of electric automobiles, and the measures for this purpose, too, will be extended.

Sum to be earmarked for entrusting research on the promotion of the use of pollution-free automobiles and that on the conditions for the spread of electric automobiles to private organizations, out of the appropriation made by the General Account budget for research on the promotion of the elimination of automobile pollution, etc.--¥16,040,000 (¥16,040,000).

(Note)--Under the system for the development of technology for big industries, a sum of about ¥5.7 billion was spent on research and development in the 6-year period from fiscal 1971 through fiscal 1976, mainly for the development of electric automobiles to be used in the cities by concerted efforts of private organizations, academic circles and the Government.

(b) Promotion of environmental protection measures in the field of casting and forging industries.

The casting and forging industries are bound by their special character as industries to turn out goods on order. They must meet the problems arising from this character, and supply materials of high quality on a stabilized basis, under a production structure free from pollution. So, a "comprehensive committee on the problem of materials" will be set up as a theater for the study of such problems as environmental pollution, demand and supply and labor force, and the measures to meet these problems. Furthermore, financial and tax measures will be taken to encourage the establishment of facilities and equipment for the prevention of pollution.

Sum to be earmarked from the General Account budget for guiding the efforts to be made by casting and forging industries for the prevention of environmental pollution, etc.--¥5,300,000 (¥5,300,000).

Government investments in the facilities and equipment for the prevention of environmental pollution in the field of casting and forging industries (such as molding machines, foundation for the prevention of vibration and equipment for the disposal of waste foundry sand).

Development Bank loans will be released within the framework of ¥82 billion (¥82 billion), which will be used by MITI and other ministries as well for the prevention of environmental pollution.

Medium and Small Enterprises Finance Corporation loans will be released within the framework of ¥88 billion (¥84.4 billion) earmarked for the protection of workers and the prevention of pollution.

People's Finance Corporation Loans will be released within the framework of ¥14 billion (¥12.5 billion) earmarked for the protection of workers and the prevention of pollution.

Tax system.

Equipment for the disposal of waste foundry sand will be added to the list of items covered by the special refunding system for the facilities and equipment for the prevention of environmental pollution. Also, the period of application of this system will be extended in regard to such items as the hanging foundation.

(c) Promotion of measures for the elimination of PCB from electric machines.

The PCB Elimination Measures Committee will study measures for the removal and elimination of PCB contained in such electric machines as transformers and condensers. MITI has been supervising and guiding, through the Regional International Trade and Industry Bureaus, the private enterprises handling electric machines containing PCB, so that these machines will be used and maintained properly. It will continue to strengthen such efforts.

Sum to be earmarked from the General Account budget for the study of measures for the elimination of PCB from electric machines--¥11,874,000 (¥11,874,000).

(d) Promotion of environmental measurement administration.

Examinations will be given by the State to the applicants for the status of licensed environmental measurer. For the establishment of a proper system for environmental measurement, such efforts as the establishment of standards for the inspection of low-density air pollution meters, study and development of standard gas of low density and the study of the measures for the rationalization of the system for the examination of clinical thermometers, all of which efforts are to be made by private organizations on commission, and on-the-spot inspection of the plants making environmental meters, will be continued, as in the previous fiscal year.

Furthermore, training materials (standard gas and chemical reagent), which are used by the measurers' training institute in giving lessons on environmental measurement, and electro-chemical meters, will be improved.

Sum to be earmarked from the General Account budget for state examinations on the applicants for the status of licensed measurer--¥21,099,000 (¥21,099,000).

Sum to be earmarked from the General Account budget for environmental measurement administration and measures to guarantee the safety of measurement--¥28,137,000 (¥20,065,000); of this amount, ¥3,321,000 (¥3,460,000) will be used for entrusting the establishment of standards for environmental inspection, such as environmental pollution meters, to private enterprises, ¥8,438,000 (¥8,438,000) for entrusting the development of standard gas of low density to private enterprises, and ¥4,171,000 (¥4,172,000) for entrusting the study of the measures for the rationalization of the system for the examination of meters.

Sum to be earmarked from the General Account budget for the measurers' training institute--¥28,370,000 (¥27,902,000); of this amount, ¥21,264,000 (¥20,976,000) will be used for instruction on environmental measurement, etc.

4. Promotion of regional development measures.

(a) Development of a mechanical system for settled habitation zones.

It has come to be desired that regional communities, which have serenity and vitality, will be formed in accordance with the idea of settled habitation zones. There has been a serious delay, however, in the extension of the sewer system for the improvement of living environment and in the creation of opportunities to secure attractive positions in the provinces. How to overcome this delay has become an important problem.

In view of such a situation, a "small, mechanical system for waste water disposal," which can be built at a cost of about two-thirds of that of the existing sewerage, and which can also be operated and maintained at smaller expense, will be developed, to improve living environment in the provinces (under a 5-year plan covering the period from fiscal 1980 through fiscal 1984, with funds totaling ¥1.8 billion).

Furthermore, a "system for production and processing of food" will be developed as a new, mechanical system necessary for the combination of agriculture, forestry and livestock production, which are the major local industries, with the food-processing industry, with a view to creating opportunities for local residents to secure attractive positions in their districts.

Sum to be earmarked from the General Account budget for the development of a mechanical system for settled habitation zones--¥30,023,000 (¥20,517,000).

(b) Promotion of the spread of welfare-related equipment.

The Government will endeavor to improve the system for the advancement of loans to the enterprises engaged in the leasing of welfare-related equipment, with a view to encouraging the use of the equipment necessary for medical treatment, nursing and social comeback of the physically- or mentally-handicapped persons and victims of serious diseases, and at the same time, improving the regional systems for medical treatment.

Equipment for the welfare of handicapped persons consists of extremely multifarious items, and their functions, too, are diversified. Furthermore, its manufacturers consist mainly of medium and small enterprises which can give publicity to their products only within a certain quantitative limit and in limited areas. Under the present situation, therefore, it cannot be said that equipment of excellent efficiency and quality is in circulation to meet the elaborate needs of the users. To meet such a situation, and with consideration for the designation of the year 1981 as the International Year for Handicapped Persons, the Government will commend the excellent items to be used for the welfare of the handicapped persons, so that these items will be known and used widely among these persons. It will also endeavor to help the manufacturers' efforts for the development of technology and the improvement of the quality and efficiency of their products.

Sum to be earmarked from the General Account budget for the commendation of excellent equipment for the welfare of physically-handicapped persons--¥2,008,000 (¥0).

Framework for Government investments (Development Bank loans) in the enterprises leasing welfare-related equipment, etc.--¥30.5 billion (¥43 billion).

IV. Promotion of Strengthening of Foundations.

(a) Improvement and strengthening of materials industry.

Measures will be taken to secure the stabilized, lasting supply of materials, make the quality of materials reliable, step up energy-saving efforts and secure manpower. At the same time, such problems as demand and supply, saving of energy and labor will be taken up for discussion at the "committee on the problem of materials in general," with a view to establishing immediate and medium-range measures to meet business fluctuations and external factors, for the improvement and strengthening of the materials industry.

The Government will also continue to strengthen its guidance for the prevention of pollution and the maintenance of security.

An appropriation will be made from the General Account budget for the prevention of environmental pollution in the field of casting and forging industries.

(b) Promotion of measurement administration.

The system for measurement, like the coinage system, is one of the most fundamental systems in social life. The establishment of a uniform, reasonable system for measurement is indispensable for the development of social economy.

The Measurement Law aims at establishing standards for measurement and carrying out proper measurement. It contains provisions calling for such steps as unification of the measuring units, securing of the supply of proper measuring apparatuses, maintenance of proper standards for the weight of commodities

and the promotion of controls over measurement. On the basis of this Law, the Government will give tests to the candidates for licensed measurer and make efforts for such purposes as dissemination of the idea of correct measurement.

With the development of advanced industrial technology, there are increasing cases which require standards to be relied upon for high-precision measurement. So, a system for designation of the organs to provide measuring standards will be established in fiscal 1981, to improve the system for tracing the standards within enterprises to national standards. Under the new system, hardness and other quantitative elements of materials will be added to the list of objects of measurement. At the same time, the organs to provide intermediate measuring standards will be examined.

Furthermore, such events as an exhibition on the history of measurement will be held in commemoration of the 30th anniversary of the promulgation of the Measurement Law, which anniversary falls on 7 June 1981.

Sum to be earmarked from the General Account budget for measurement administration in general--¥26,333,000 (¥26,333,000).

Sum to be earmarked from the General Account budget for environmental measurement administration and the measures for securing the safety of measurement--¥28,137,000 (¥20,065,000); of this sum, ¥2,752,000 (¥2,280,000) will be used for the improvement of the system of industrial measurement standards, and ¥5,289,000 (¥0) will be used for the events to be held by private organizations, at the request of the Government, in commemoration of the 30th anniversary of the promulgation of the Measurement Law.

Sum to be earmarked from the General Account budget for the measurers' training institutes--¥28,370,000 (¥27,902,000).

(c) Expansion of Machinery Credit Insurance Special Account.

To secure the smooth operation of the machinery credit insurance system which is to play an important role in the modernization of the equipment of medium and small enterprises, the funds, which are necessary for keeping the special account for this insurance system on a sound basis, will be increased. Also, the maximum limit for insurance contracts (provided for in the general rules concerning budgets) will be raised, to meet the increase in the amount of insurance.

Machinery Credit Insurance Special Account

Revenues and expenses--¥9,404,583,000 (¥7,308,117,000)
Amount of insurance money paid--¥2,599,061,000 (¥1,860,459,000)
Limit for insurance contracts--¥570 billion (¥430 billion)
Limit for temporary borrowing--¥1 billion (¥1 billion)
Amount of capital--¥2,170 million (¥1,670 million)

V. Positive Measures To Meet Internationalization.

(a) Promotion of heavy machinery technology consulting business.

With the increase in the weight of Japan in world trade, it has become necessary to build an advanced export structure on the basis of international cooperation. Plant exports, which are system exports representing the concentration of technology and knowledge in a wide range of fields, can meet this necessity. They can also serve as a kind of economic cooperation with the developing nations. So, it is necessary to continue efforts for the sound development of plant exports.

At present, however, Japan's plant exports are in a state of stagnation, partly because of the violent fluctuations on the foreign exchange market. As a result, plant exports now need even more multilateral assistance than before. Especially, the strengthening of activity in the field of consulting business, where Japan is left far behind Europe and the United States in spite of the importance of this business as a forerunner of plant exports, is strongly requested.

In view of such a situation, the Government will continue heavy machinery technology consulting business, such as to provide consulting service for the developing nations and invite foreign leaders concerned to Japan, through the Japan Plant Association, as in the preceding fiscal year.

Sum to be earmarked from the General Account budget as a subsidy to heavy machinery technology consulting business--¥36,402,000 (¥36,402,000).

(b) Promotion of measures for the adjustment of machinery exports.

Machinery today accounts for more than 60 percent of Japan's total exports. So, the adjustment of machinery exports, or more concretely, the sound development of plant exports and the prevention of trade friction over the respective export items, has become an important problem for trade and industrial policies.

The environment for plant exports has changed greatly, as can be seen from the problems related to the international competitive power of Japanese industries, which problems have been caused by the drastic fluctuations on the foreign exchange market, the problem of accumulation of debts in the developing countries, which problem has now come to the fore, stagnation of the demand for plants due to political unrest and the measures taken to meet the request for cooperation among the advanced nations.

To secure the sound development of plant exports under these circumstances, the Government will survey and grasp correctly the reality of the problems confronting Japan's plant exports, and at the same time, set up a committee of experts representing various circles, to study these problems from an overall, multilateral point of view and establish a guidepost to be relied upon in guiding industrial circles. Besides, it will establish a structure for guiding industrial circles on national and local levels combined, in order to expand plant exports of medium and small enterprises.

Furthermore, the export of such simple items as domestic electric appliances and automobiles has led to the occurrence of what is called trade friction, as in the case of sudden expansion of exports to the advanced countries. To prevent the occurrence of this kind of trouble, efforts will be made to grasp the trends of exports correctly, and necessary measures will be taken to promote orderly marketing.

Sum to be earmarked from the General Account budget--¥5,503,000 (¥6,114,000).

(c) Promotion of the internationalization of measurement administration.

In May, 1980, an "agreement on the technical obstacles to trade" (Standards Code) went into effect. As a result, it became obligatory on Japan to "accept foreign inspection data," as is provided for in this Code.

For the acceptance of foreign inspection data, a committee will be established to conduct research on the measurement systems, inspection systems and the capabilities of inspection organs in foreign countries, with a view to stepping up the internationalization of measurement administration.

Sum to be earmarked for the promotion of internationalization of measurement administration, out of the appropriation made by the General Account budget for environmental measurement administration and measures to guarantee the safety of measurement--¥3,309,000 (¥0).

CSO: 4129/1818-F

References for Article

Tokyo KIKAI SHINKO in Japanese No 2, Feb 81 pp 32-56

[Text] (Reference #1)

Computers are the "central nervous system of the economic world" which play a key role in an advanced and diversified society.

Some examples of the wide range of computer use:

Functions:	Fields in which employed:
Business:	*Production control, inventory control, sales management, personnel management, salary tabulation, accounting processing.
	*On-line system of banks, reservation system for trains and airplanes.
	*Drivers' license and election monitoring.
	*Horse racing and boat racing.

Scientific and Technological Calculations:	*Designing of machinery and atomic reactors, airplanes, buildings and roads. City planning, ocean development, designing and launching of satellites.
Management Science:	Management analysis, management planning, demand forecast, economic forecast, operations·research.
Information Service:	*Information on stock market, buildings and land, labor and occupation, used cars, opinion polls.
Information Search:	*Searches information on patent, court cases and publications.
General Information System:	*System for traffic control, weather forecast, pollution information, medical information, home screen image information system.
Control:	*Automation of manufacturing machinery (number control), manufacturing process control, automated operation.

(Reference #2)

Liberalization of hardware in December, 1975 and of soft-ware in April, 1976 completed liberalization of electronics calculator field.

(参考2) 自由化措置の推移

	A 品名		B 資本自由化 50%	B 資本自由化 100%	C 輸入自由化	D 技術導入自由化
i	電子計算機	2 本体	a 49年8月4日 (コンピュータ用ICを含む)	b 50年12月1日 (コンピュータ用ICを含む)	c 50年12月24日	d 49年7月1日
		3 周辺装置 4 記憶機・端末機			50年12月24日	
		3 周辺装置 5 それ以外のもの※			47年2月1日	
		6 部品			50年12月24日	
	7 ソフトウェア		e 49年12月1日	f 51年4月1日		g 49年7月1日
8	集積回路	素子数 9 100未満のもの	h 46年8月4日 (コンピュータ用ICを除く)	i 49年12月1日 (コンピュータ用ICを除く)	j 45年9月1日	k 43年6月1日
		10 200未満のもの			48年4月19日	
		11 200以上のもの			49年12月25日	

※入力装置，出力装置，通信制御装置等

Key:
History of Liberalization:

A. Item
B. Liberalization of capital
C. Import liberalization
D. Liberalization of technology imports

1. Computer
2. Main frame
3. Peripheral equipment
4. Memory and terminal equipment
5. Others*
6. Parts
7. Soft-ware
8. Integrated circuit
9. Number of elements-- 1-99
10. --100-199
11. --over 200

a. 4 August 1974 (includes IC for computers)

b. 1 December 1975 (includes IC for computers)

c. 24 December 1975
24 December 1975
1 February 1972
24 December 1975

d. 1 July 1974
e. 1 December 1974
f. 1 April 1976
g. 1 July 1974
h. 4 August 1971 (Excludes IC for computers)
i. 1 December 1974 (Excludes IC for computers)
j. 1 September 1970
19 April 1973
25 December 1974
k. 1 June 1978

* Input, output and transmission control devices

(Reference #3)

Computers, in response to technological advancement of elements used, go through a wide range of model changes every 5 to 6 years. This time span of 5 to 6 years is called a "generation." Generation changes have been led by IBM. And for the domestic manufacturers, the central tactical issue has been to develop a new system in step with generations changes.

The next generation system will see the super LSI in the center of hardware, equipped with epoch-making basic soft-ware (OS: operating system) aiming at a drastic improvement in cost performance as well as the dramatic increase in number of functions.

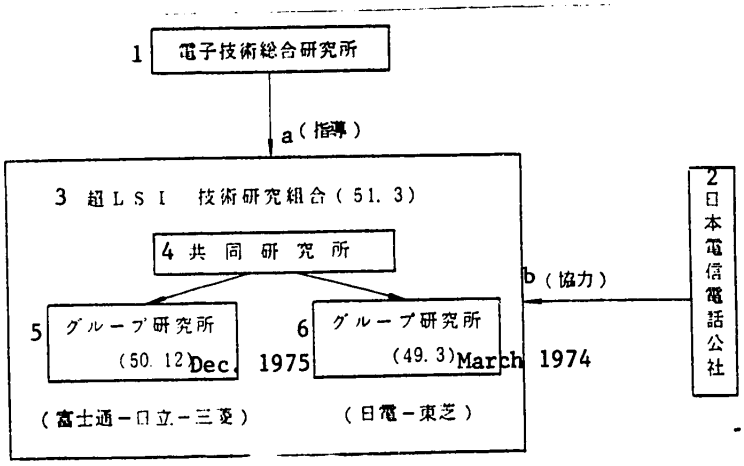
History of the revolution in semi-conductor technology:

Basic hardware: (computer generation)	Vacuum tube 1st	Transistor 2nd	IC 3rd	LSI 3.5th	Super LSI 4th	Human brains
Time period:	1906-	1960-	1965-	1970-	1980-	
Complexity (Number of elements)	1	1	30-50	1,000-10,000	several million	
Capacity: (In terms of memory)	under 1 bit	under 1 bit	10 bits	4,000 bits	several million bits	10 billion bits
Impact:	radio	transis-tor radio	satellite	micro-com-puter	FS computer	
How many can fit into $10cm^3$ cube: (No of parts)	4-5	- 150	5 million	100 million	several 10 billion	several 10 billions
IBM model:	701	7,090	360	370 303 X	FS (Future System)	

(Reference #4)

Development of a very large-scale integrated circuit (Super LSI), which is to be the core of the hardware technology of next-generation computers, was carried out for 4 years between 1976 and 1979 with a government subsidy of about 29 billion yen.

System for Super LSI Development



Key:
1. General Institute for Electronics Technology: a) Guidance
2. Nippon Telegraph and Telephone Public Corporation: b) Cooperation
3. Super LSI technology research group
4. Joint research institute
5. Group lab (Fujitsu-Hitachi-Mitsubishi)
6. Group lab (Nippon Electric-Toshiba)

What is Super LSI? Electronics computers are made of 10 thousand to 100 million transistors and resistors. If those many parts were used separately and in their original form for construction, the finished product would be so large it would be impossible to put to use.

It has been possible to make small computers owing to integrated circuits (IC: 10-30 transistors integrated) and large-scale integrated circuits (LSI: 1 to several thousand integrated). At present, computers can be built using 10 to 20 thousand LSIs.

Furthermore, a super LSI for future system (FS) use has tens of thousands to several hundred thousand transistors (tens to hundreds times more than LSI) making the density 100 times more than at present. It will take only several hundred SLSIs to build a present day computer, thus minimizing the size and accelerating the speed even more.

Capacity:	Present situation:	Super LSI:
Memory:	4,000 bits	several million bits
Logic circuit:	100 circuits	several 10 thousand circuits
Speed:	8/10 million second	2/10 million second
Size and Weight:	size of a locker	size of a desk-top calculator
Price:	1 yen/bit	0.05 yen/bit
Reliability:		malfunction rate 1/1000

(Reference #5)

Generation:	Processing Method:	Soft-ware (Operating System):
1st	Through access	Loader (read commands in computer language and operate). Assembler programming system (symbolize computer commands and translate a language). FORTRAN programming system (translation of scientific language and execution management).
2nd	Local, batch processing	Continuous processing of jobs. ALGOL compiler (translation of scientific language). COBOL compiler (translation of business computer language). IOCS (input-output control).
3rd	Multi-programming processing	Multiple processing of jobs (parallel processing of jobs). Time-sharing processing (time-sharing language processing). PL/1 compiler (translation of general-purpose language).
3.5th	On-line processing	On-line management (control of various terminals). Virtual memory control (technology which makes execution of programs larger than actual memory possible).
4th	Multiple distributed processing for end users	Virtual machine function (virtula computer function). Network control (transaction of large data among many systems). Data base control (centralized control of large data). Processing of characters, patterns, image and Japanese language (from "data" processing to "information" processing). Super-high-level language processing technology (anyone can use high-level computers).

(Reference #6)

New Computer Development Abroad: Present stage of virtual processors, data base machines and parallel processing machines abroad.

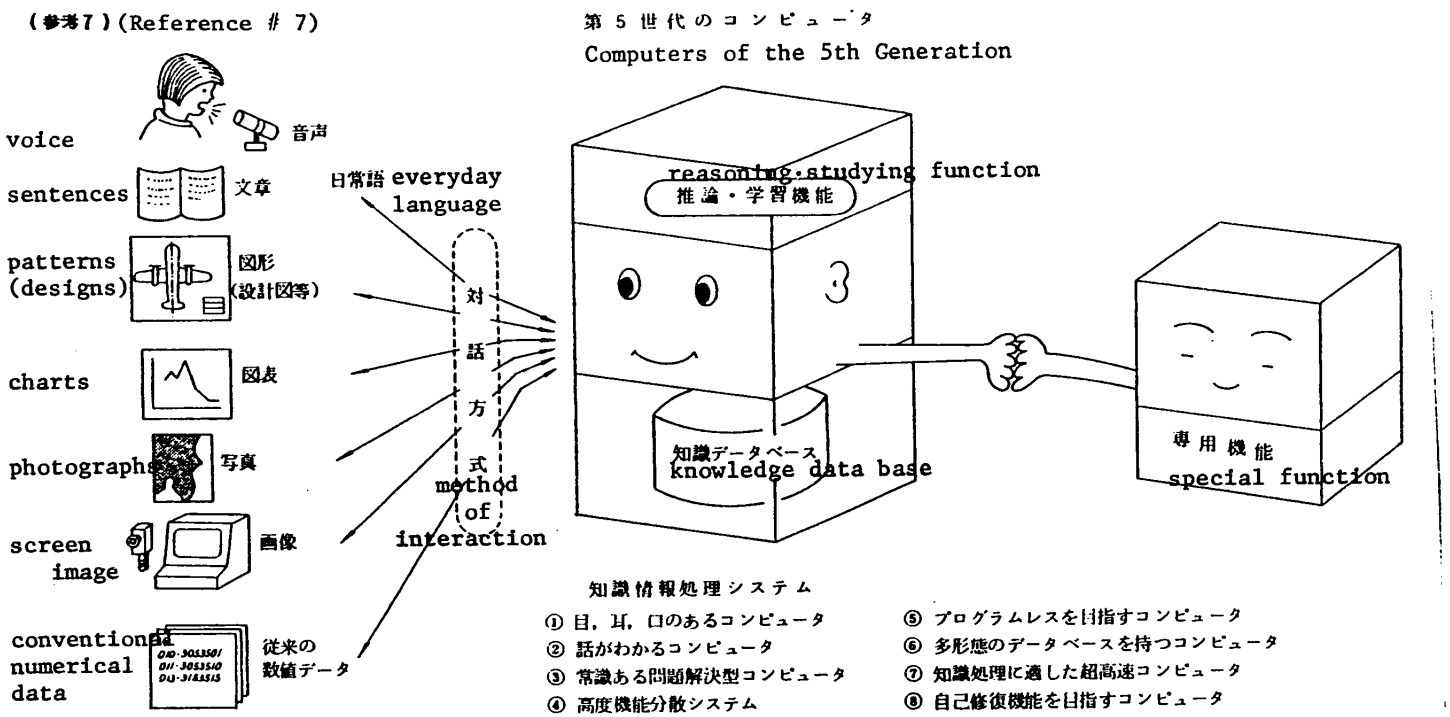
Developer:	System:	Type of machine:
Bell Research Institute	XDMS	Data-base machine
University of Toronto	RAP	Data-base machine
University of Florida	CASSM	Data-base machine
Univac	DBP	Data-base machine
IBM	DBC	Data-base machine
Goodyear	STARAN	Association processor
CMU	C.mmP, Cm*	Parallel processing machine
Bell Research Institute	PEPE	Parallel processing machine
Seimens	SMS	Parallel processing machine
Purdue University	PM^4	Parallel processing machine

Data-flow processors abroad:

Developer:	Stage of development:
Toulouse University (France)	experimental stage
TI (U.S.A.)	experimental stage
University of Manchester (U.K.)	planning stage
MIT (U.S.A.) (Dennis)	preliminary discussion stage
University of New Castle (U.K.)	preliminary discussion stage
University of California (U.S.A.)	preliminary discussion stage
MIT (U.S.A.) (Abington)	preliminary discussion stage
University of Utah (U.S.A.) (Davis) University	experimental stage
University of Utah (U.S.A.) (Keller)	preliminary discussion stage

(Reference #7)

Knowledge Information Processing System:



Key:
1. Computers with eyes, ears and mouth.
2. Computers that understand what you say.
3. Sensible, problem-solving computers.
4. High-level distributed function systems
5. Computers aiming toward the elimination of programming.
6. Computers with various types of data bases.
7. Extremely high-speed computer fit for knowledge processing.
8. Computers aiming toward self-restoration function.

(Reference #8)

Tariff rate: Japan has continuously lowered tariff.

Tariff record for computer related equipment: (percent)

	A 事項	B 年・月 (昭和)	C 電子計算機本体 a 実行税率	C b (協定税率)	D 周辺装置 a 実行税率	D b (協定税率)	E I C a 実行税率	E I C b (協定税率)
1	協定税率			15		25		15
2	日米経済交渉	47.4/'72	13.5	15	22.5	25	12	15
3	「一括前倒し引下げ」	53.3/78	10.5	15	17.5	25	12	15
4	「ジュネーブ議定書」署名	54.7/79						
5	「協定税引上げ	55.1/80	10.5	13.7	17.5	22.6	* 12※	13.7
6	「関税定率法」改正	55.4/80	9.8	13.7	16.1	22.6	10.1	13.7
7	段階的引下げ (毎年1/8逓減)	(56.1)/81	9.1	12.5	14.6	20.3	10.1	12.3
		(57.1)/82	8.4	11.2	13.2	17.9	9.1	11.0
		(58.1)/83	7.7	10.0	11.8	15.5	8.1	9.6
		(59.1)/84	7.0	8.7	10.3	13.1	7.1	8.3
		(60.1)/85	未定	7.4	未定	10.8	未定	6.9
		(61.1)/86	未定	6.2	未定	8.4	未定	5.6
8	引下げ後税率	62.1 /87	4.9	4.9	6.0	6.0	4.2	4.2
9	(参考) 引下げ後税率 (米)	62.1 /87		3.9		3.9		4.2
10	〃 (EC)	62.1 /87		4.9		4.9		17.0

Key:

A. Item
B. Date
C. Computer main frame
D. Peripheral equipment
E. IC

a. working rate
b. conventional tariff

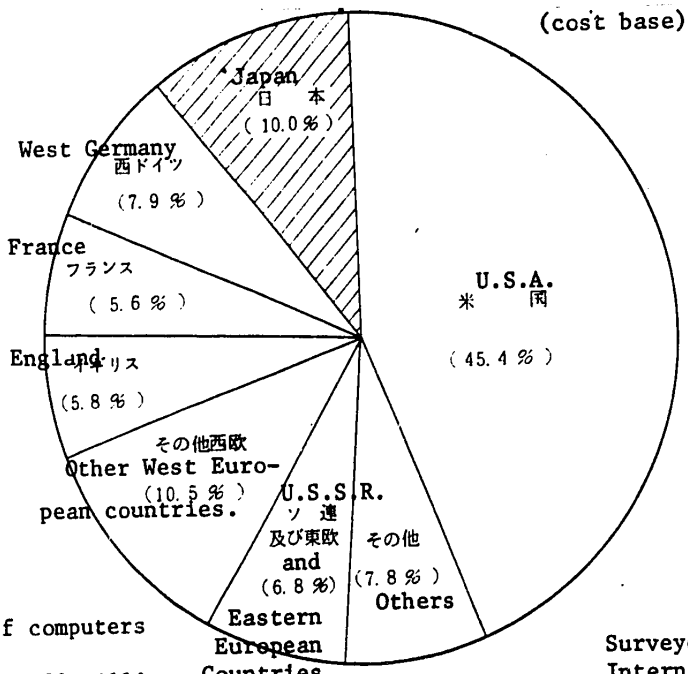
1. Conventional tariff
2. U.S.-Japan negotiated rate
3. Across the board reduction in tariff
4. Signing of "Geneva Agreement"
5. Raising of conventional tariff
6. Revision of customs tariff law
7. Step-by-step reduction of tariff (at the rate of 1/8th each year
8. Results of above reductions
9. Results of above reductions in U.S.
10. Results of above reductions in E.C.

*front loading

(Reference) 1. At the time of Tokyo round talks on tariff reduction, participating countries decided to gradually reduce starting in 1980, from the GATT rates. On 1 January 1987 the new reduced rate will be effective.
2. Aside from the above decision, Japan has also decided to reduce voluntarily its working tariff rate.

(Reference #9)

Shares of Computers Installed in Major Countries:



Total cost of computers installed: 92,723 million dollars as of the end of December, 1977.

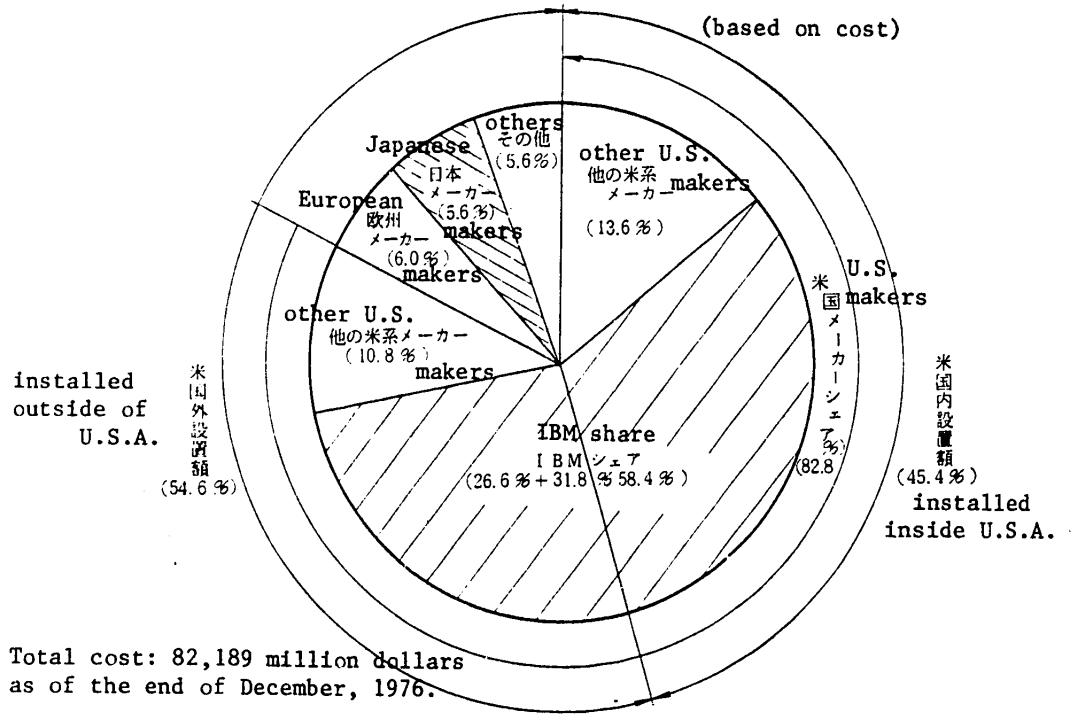
(設置金額92,723百万ドル, 1977年12月末現在)

Surveyed by: International Data Co.

International Data Co. (IDC)調べ

(Reference #10)

Share of Different Computer Manufactures by Countries:



Total cost: 82,189 million dollars
as of the end of December, 1976.

(Reference #11)

Comparison of U.S. and Japanese Plans (unit: 10 million yen)

Item	IBM (1979) (A)	Japanese maker A. Fujitsu (1979) (B)	(B)/(A) (percent)	(reference) IBM Japan (1979)
capital	8,722	370	4.2	750
sales	50,177	5,010	10.0	3,242
profit before tax	12,187	334	2.7	730
profit rate	24.3%	6.7%	---	22.5%
debt/equity ratio	61.0%	25.6%	---	62.6%
research & development	2,985	475	15.9	--

The above figures include all sections of the companies. When limited to computer department, differences become greater.
Debt/equity ratio = capital/total assets x 100
219.47 yen to a dollar was used as an exchange rate which was the 1979 average.

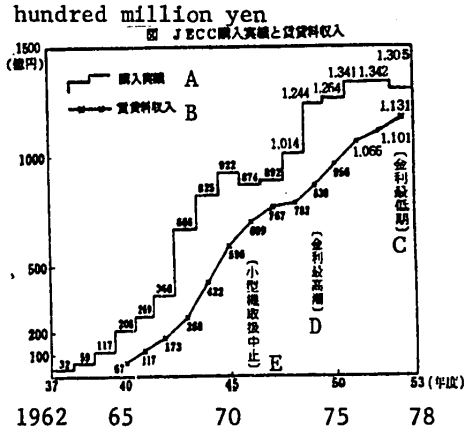
(Reference #12)

JECC's performance on rentals:

The JECC system runs on the following two wheels; 1) government financial funds drawn in through the Development Bank and 2) unified rental contracts based on a registered price decided by a basic agreement with stockholder manufacturers. This is a very unique system in the computer rental field. As the rental system diversified, as mentioned earlier, each manufacturer set up a similar subsidiary for rental purposes. However, JECC is the only company with the above-operational characteristics, which played a major role in the development of indigenous models. The figure shows the rental performance of JECC.

Purchases and Rental Income of JECC:

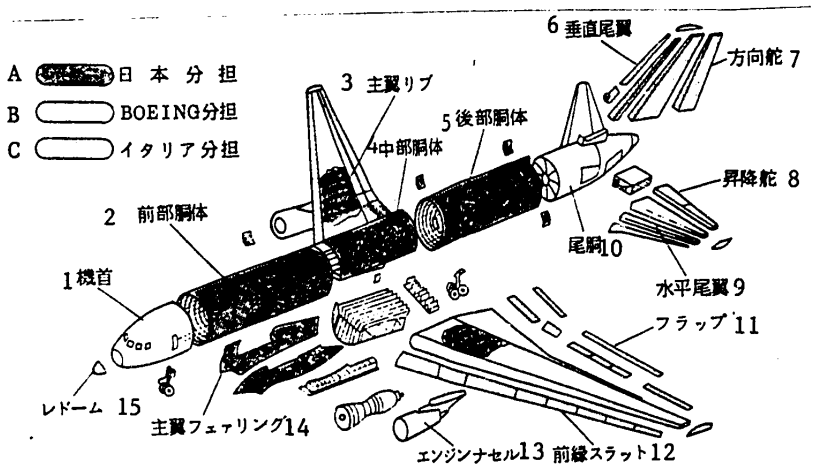
hundred million yen



Key:
A. Purchases
B. Rental income
C. Period of the lowest prime rate
D. Period of the highest prime rate
E. Termination of small model involvement

(Reference #13)

Development of YX--breakdown:

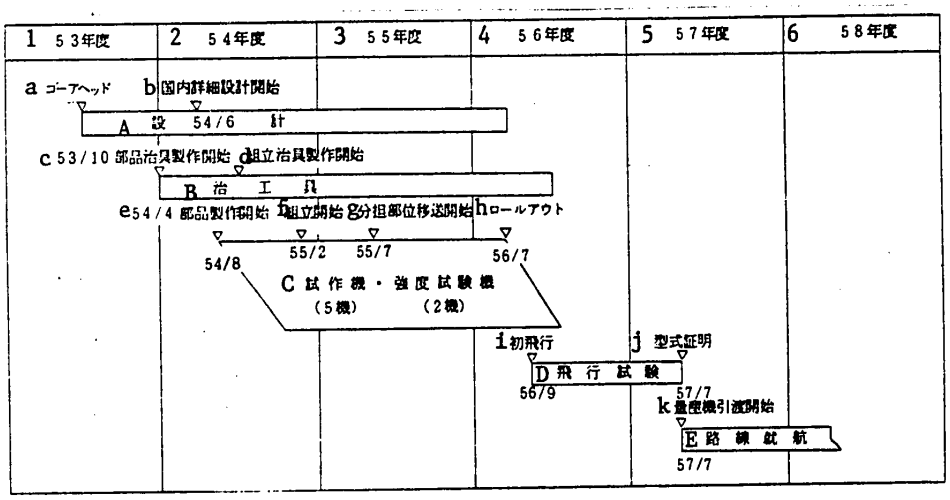


Key: A. Developed by Japan
B. Developed by Boeing
C. Developed by Italy

1. nose
2. front body
3. wing rib
4. middle body
5. back body
6. vertical tail
7. vertical rudder
8. elevator
9. horizontal tail
10. tail
11. flap
12. front edge slot
13. engine nozzle
14. wing fairing
15. radar cone

(Reference #14)

Schedule of Development:



54/8=August 1979
55/7=July 1980, etc

Key:

1. Year 53=1978
2. Year 54=1979
3. Year 55=1980
4. Year 56=1981
5. Year 57=1982
6. Year 58=1983

a. Go ahead
b. Commencement of domestic designing of specifications
c. Start manufacturing parts
d. Equipment assembly
e. Parts manufacturing

A. Design
B. Equipment
C. Test planes, plane for vigorous testing
D. Test flight
E. Put to service

f. Assembly
g. Transfer of parts
h. Roll out
i. Initial test flight
j. Model proof
k. Start delivery on manufactured planes

(Reference #15)

YXX Project: Estimated Schedule

1980	1981	After 1982
Research on future demand according to models and areas. (computation)	Research on future demand from each airline companies and their design requirements. (field research)	Negotiation for joint development (partner selection)
	Analysis and report on design requirements.	(tentative agreement) Decide specifics of joint development·marketing.
	Preliminary design.	(final agreement) Start development (go ahead)
	Preliminary design approval test using a wind tunnel.	

Exchange of information with foreign airlines concerning future demands.

(Reference # 16)

The Second Interim Report: By Policy Subcommittee of the Aircraft Industry Division of the Council on Aircraft and Machinery Industry.

Aircraft Industry's Future--Its Capabilities and Problems

Japan's aircraft industry is gradually becoming stronger as seen in its development and sale of the YS-11 and the development of the YX. Nevertheless, it still lags behind U.S. and Western European nations in sales, marketing and technology. To overcome this gap, although a hard task, and to become fairly competitive with those nations by raising capabilities is the immediate task of the Japanese industry. What should be done to accomplish this?

The first thing that should be done is to carry out a developmental project on civilian aircraft and to create capabilities that will lead to profitable business. For this purpose, active development, manufacturing and sales of serviceable civilian aircraft is essential.

The second thing that has to be done is to raise capabilities for technological development. This requires active basic and applied research and coordination between the two.

(1) Developmental project on civilian aircraft: The following is the forecast on projects before year 2000, as judged from the civilian aircraft market of the future.

1. It is generally understood that only very limited number of models will be involved in the new developmental projects on existing aircraft unless, although unlikely, the engine power becomes dramatically larger. It is likely that after mid-1980's, a new model with about 100 to 150 seats will be developed since the demand for that size aircraft is estimated to increase around that time.

2. There will be developmental projects on all size crafts, except for types with 100 seats or less, in order to create modified models based on the existing ones.

3. There also will be projects, from the end of this century to the beginning of the 21st century, aimed at developing future type aircraft, such as the STOL Aircraft (short airstrip for take off and landing), high-speed turboprop craft, hydrogen airplane and new type of supersonic airplanes.

Based on the above forecast, it seems appropriate to develop, among existing models, one with around 130 seats. Incidentally, Japanese aircraft manufacturers have received a proposal for joint development of civilian aircraft with 130 seats or a little larger from the following manufacturers: Fokker of Holland; Airbus Industry, a joint organization of France, West Germany, Britain and Spain; Dassault-Bureqee [phonetic] of France; and MacDonald-Douglas. Of these companies, Fokker, Airbus Industry and Boeing of the United States have proposed conducting joint research aimed at information exchange on a noncommittal basis in order to investigate the possibilities of joint development.

Therefore, it will prove beneficial for Japan and for the development of the YXX, a civilian aircraft to follow the YX, to aggressively pursue joint development, on an international basis, of a craft with 130-seat-capacity or a little larger with the mid-1980's as the target period.

Also, Japan should not neglect to work to develop a new model craft, modified craft based on the existing models and future crafts as the future demand rises.

(Reference #17)

Characteristics of Jet Engine Development:

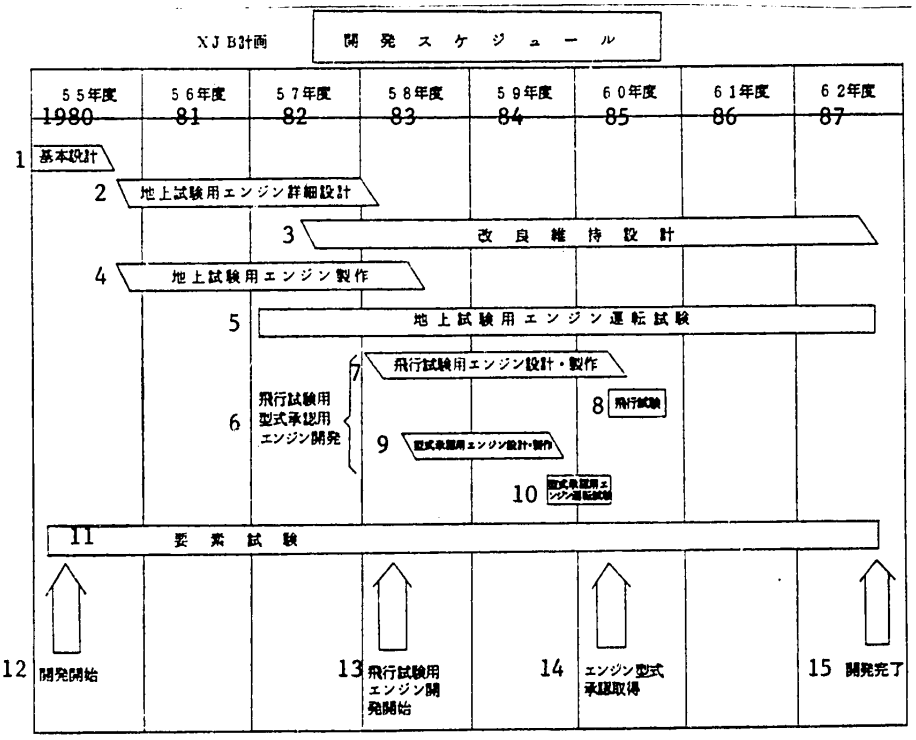
1. Jet engine development is a high-risk project. It takes 8 years to develop an engine and 4-5 years for an aircraft. Research and development requires a large sum of money which is several hundred times larger than the selling price.

2. Recently, there have been many cases of joint development on an international basis. The U.S. and many West European governments directly and indirectly extend their all-out support to the industry.

3. The Industrial Technology Institute has engaged itself since 1971 in a huge project which includes research and development of a fan jet engine with a 4.5-5.5 ton thrust impellent force and the establishment of basic technology needed.

(Reference #18)

Schedule of Development



Key:

1. Basic design
2. Specification design of ground testing engine
3. Revised maintenance design
4. Manufacturing of ground testing engine
5. Test drive of engine for ground testing
6. Development of engines for test flight and model approval
7. Design and manufacturing of engine for test flights
8. Test flight
9. Design and manufacture of engine for model approval
10. Test drive of engine for model approval
11. Elements testing
12. Begin development
13. Begin development on test flight engine
14. Get engine model approval
15. End of development

(Reference #19)

(1) Status Quo of Data Processing Industry in Japan

Number of offices and employees, annual sales.
More than 1,000 companies engage in data processing

	a事業所数	b従業者数	c年間売上高	d 1事業所当り 1従業者数	d 1事業所当り 2年間売上高	1人当り e年間売上高
49年	1,322	59千人	2,453億円	44人	186百万円	4.2百万円
50年	1,276	57	2,751	45	216	4.8
51年	1,276	59	3,070	46	241	5.2
52年	1,640	72	4,126	44	252	5.8
53年	1,672	77	4,602	46	275	6.0
* 53/49の平均伸び率	6.0%	6.9%	17.0%	—	—	—

Source: MITI "Report on Statistical Survey on Specific Service Industry."

Key:

a. number of offices
b. Number of employees (thousand)
c. Annual sales (100 million yen)
d. Per office
   1. number of employees
   2. annual sales
e. Per capita annual sales

*Average growth rate

(2) Breakdown of Offices According to the Size of Sales

More than half of the offices have less than 100 million yen sale annually.

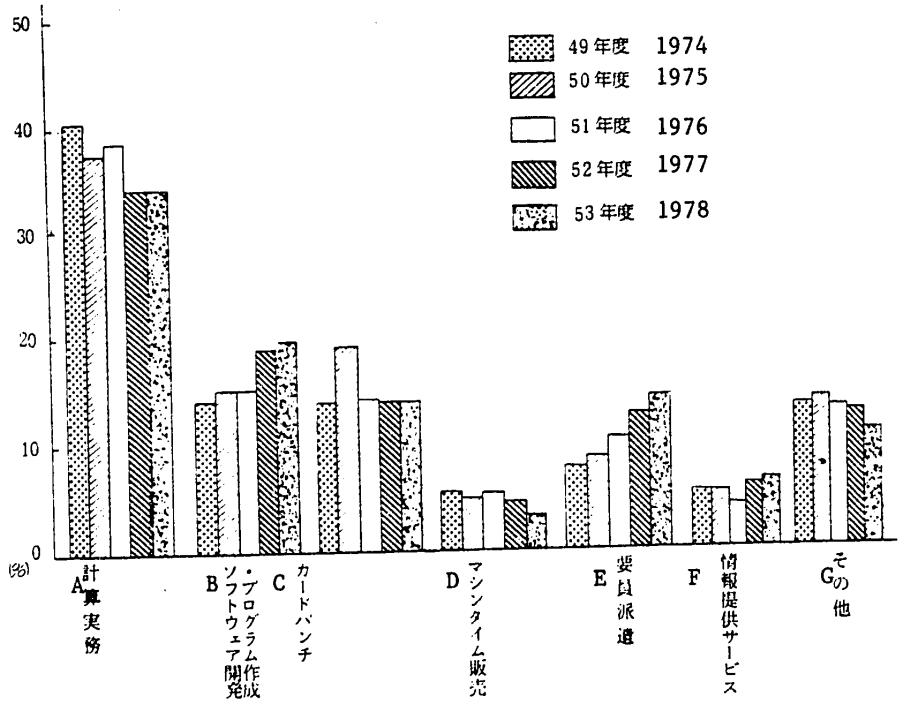
Year	Less than 100 million yen (percent)	100 million to 1 billion yen (percent)	More than 1 billion yen (percent)	Total (percent)
1974	62.6	34.2	3.1	100
1975	57.8	37.7	4.5	100
1976	53.7	41.4	4.9	100
1977	51.3	43.9	4.8	100
1978	49.9	44.8	5.3	100

Source: MITI "Report on Statistical Survey on Specific Service Industry."

(Reference #19) [continued]

(3) Percentage of Different Types of Services.

Soft-ware development, program writing and sending out of computer personnel have increased.



Key:

A. Computing
B. Soft-ware development/Program writing
C. Cardpunch
D. Machine time sale
E. Sending out of computer personnel
F. Information provision service
G. Others

Source: MITI "Report on Statistical Survey on Specific Service Industry."

(Reference #19) [continued]

(4) Overall Comparison of U.S. and Japanese Data-Processing Industries. (1978)

There is a wide difference between the size of U.S. and Japanese data-processing industries.

Item	U.S.A.(A)	Japan (B)	Ratio (B/A)
Number of companies	3,391	1,336	0.39
Total sales (100 million yen)	15,382	4,602	0.30
Sales per company (100 million yen)	4.54	3.44	0.76

Source: INPUT Company, Report on Survey on Specific Service Industry.

(5) Comparison of Major U.S. and Japanese Soft-ware Industries. (1978)

Major Japanese soft-ware industry is about one-tenth the size of that in the United States.

Item	U.S. A (Note 1)	Japan B (Note 2)
Sales (100 million yen)	423	55
Operating income (100 million yen)	48	2
Employees	6,149	474

Note 1: Average of 5 major U.S. companies. (Computer Science Corporation, Planning Research Corporation, Automatic Data Processing Inc, Informatics, System Development Corporation.

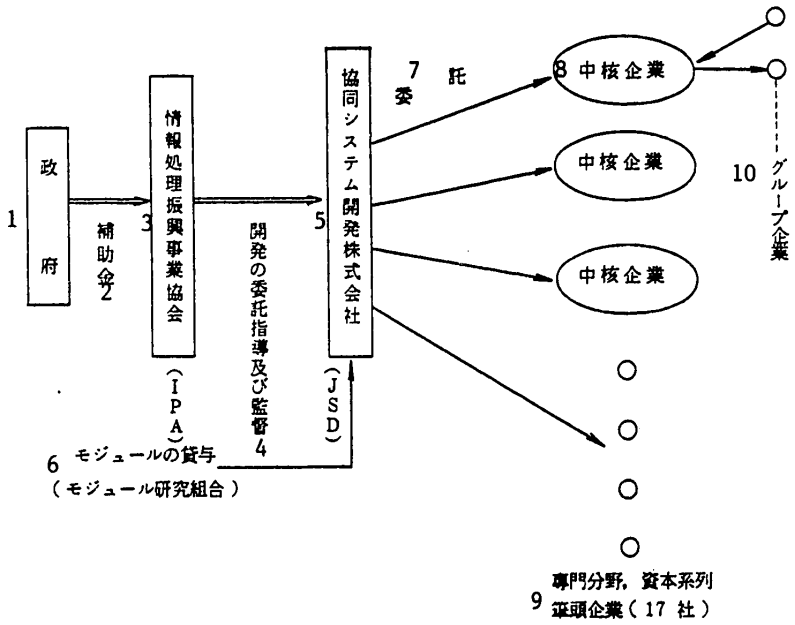
Note 2: Figures for Japan are the average of 17 major soft-ware companies that contribute to the Joint System Development, Inc.

(Reference #20)

Promotion of Projects To Develop Soft-Ware Production Technology:

Program production is presently carried out manually. These projects are aimed at developing a new system capable of automated production by organizing and assemblying the program modules mechanically. This new system will be the basis for the establishment of soft-ware industry as an independent industry with a modern production mechanism.

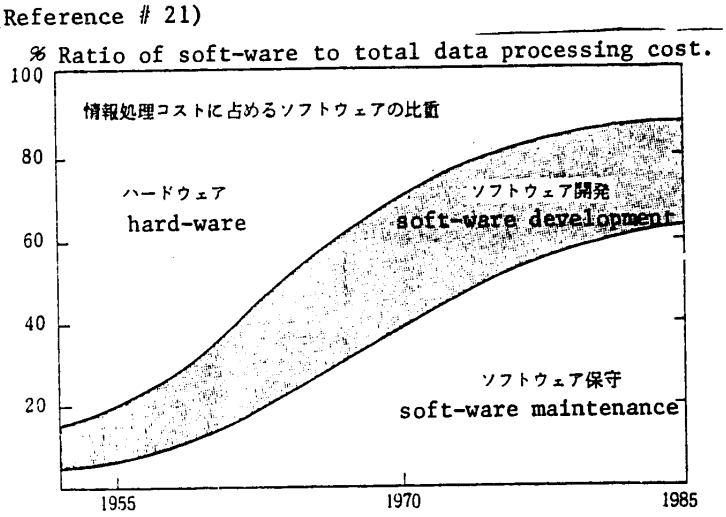
Development Relations:



Key:

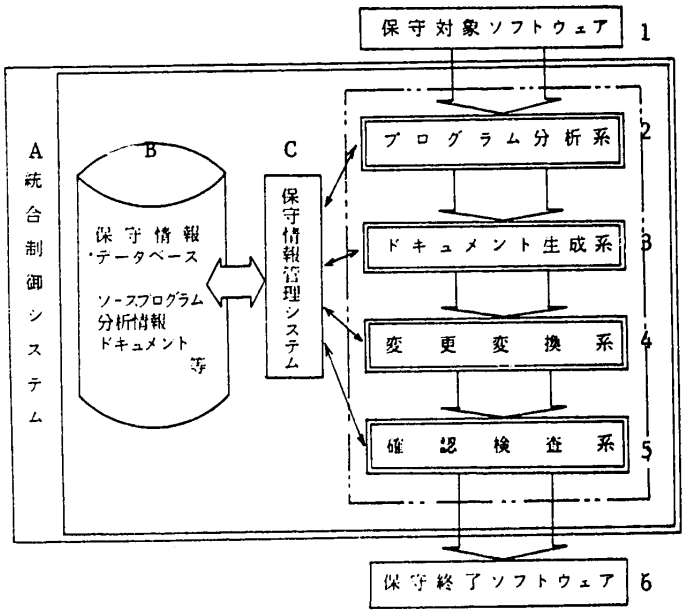
1. Government
2. Subsidy
3. Data Processing Promotion Association (IPA)
4. Guidance and supervision of development
5. Joint System Development Company (JSD)
6. Leasing of modules (Module Research Group)
7. Subcontracting
8. Core industry
9. 17 major corporations in the field
10. Group industry

(Reference # 21)



(Reference # 22)

Overall system of soft-ware maintenance technology development project:



1. Soft-ware to be maintained.
2. Program analysis group.
3. Document production group.
4. Revision and exchange group.
5. Verification and examination group.
6. Soft-ware after maintenance process.

A. Unified control system.

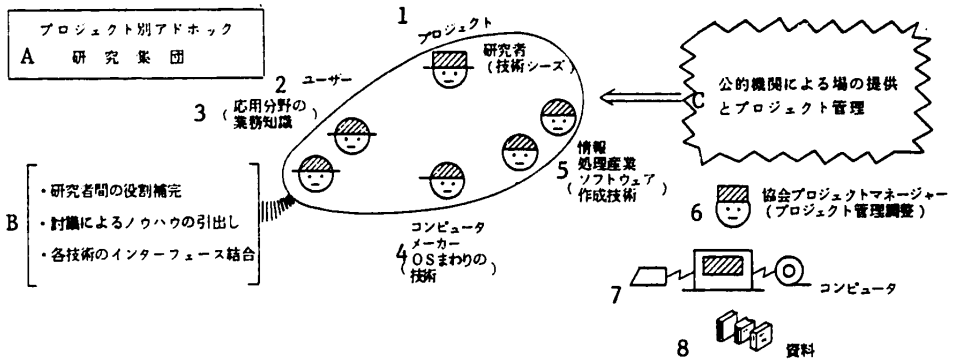
B. Maintenance information, data-base.

Source program, analyzed information, document, etc.

C. Maintenance information management system.

(Reference #23)

Development of Advanced Data Processing Technology at the "Soft-Ware Technology Center" (a tentative name) of the Information Processing Promotion Association:



Key:

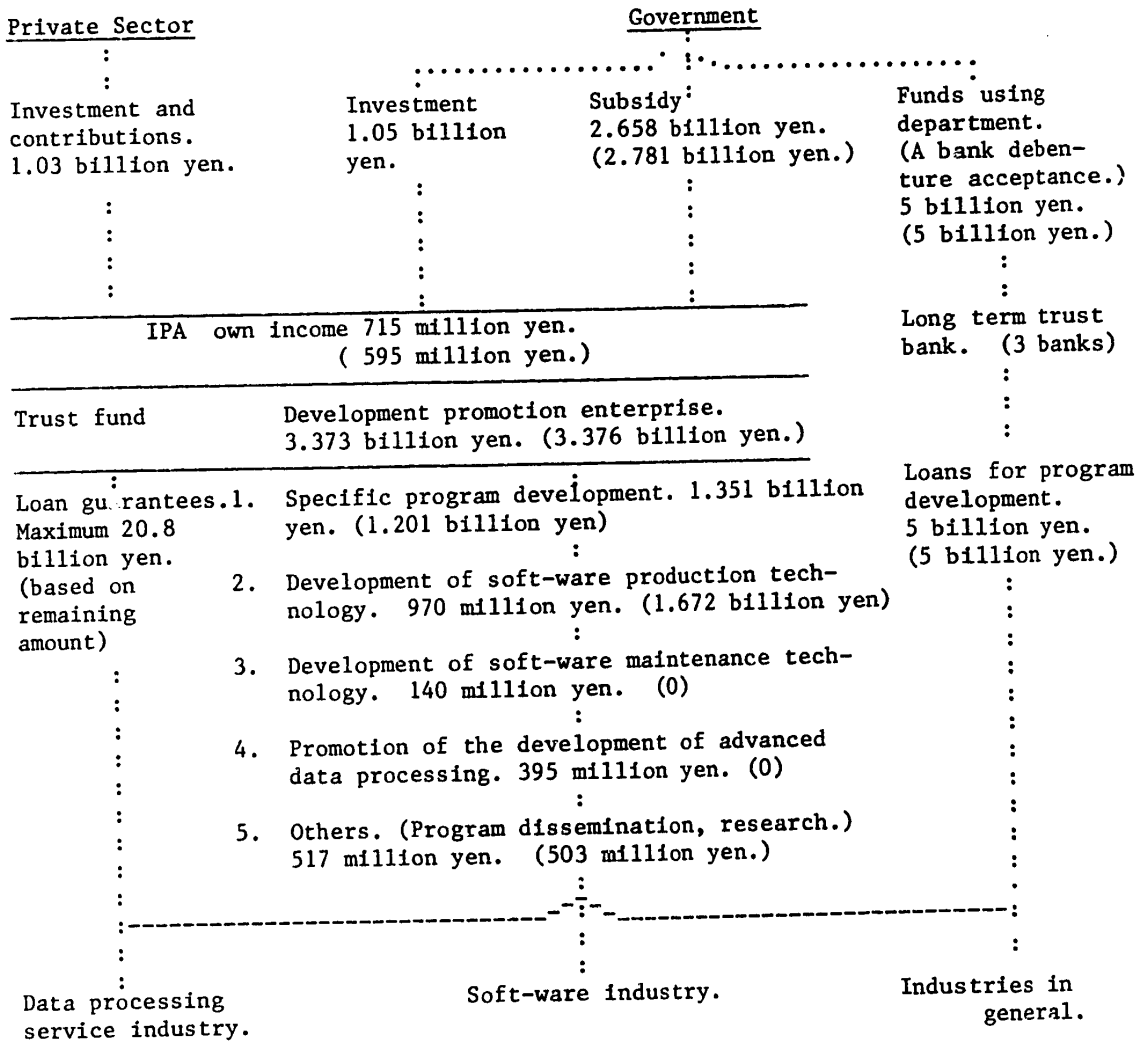
A. Ad-hoc research group for different projects
B. Division of labor among researchers
   Extraction of know-how through discussions
   Interfacing linkage among different technologies
C. Space and project management offered by a public organization

1. Project: researchers (technicians)
2. Users
3. (Operational knowledge in applied fields)
4. Computer manufacturers (OS related technology)
5. Data processing industry (soft-ware production technology)
6. Project manager of the Association (project management and control
7. Computers
8. Source material

(Reference # 24)

Breakdown of Operating Budget at Information Processing Promotion Association (IPA--1981)

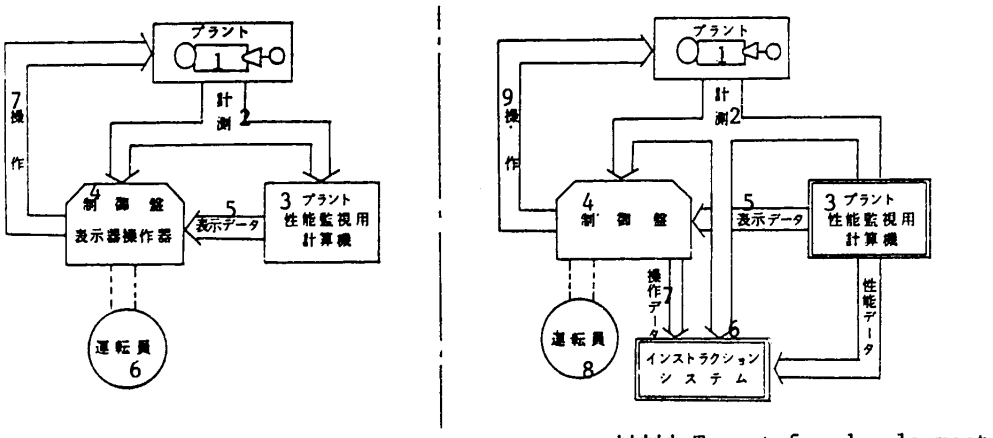
( ) = 1980 figure. Investment and contributions are from 1970, 71 and 72.



(Reference #25)

Instruction System:

Basic Concept



***** Target for development

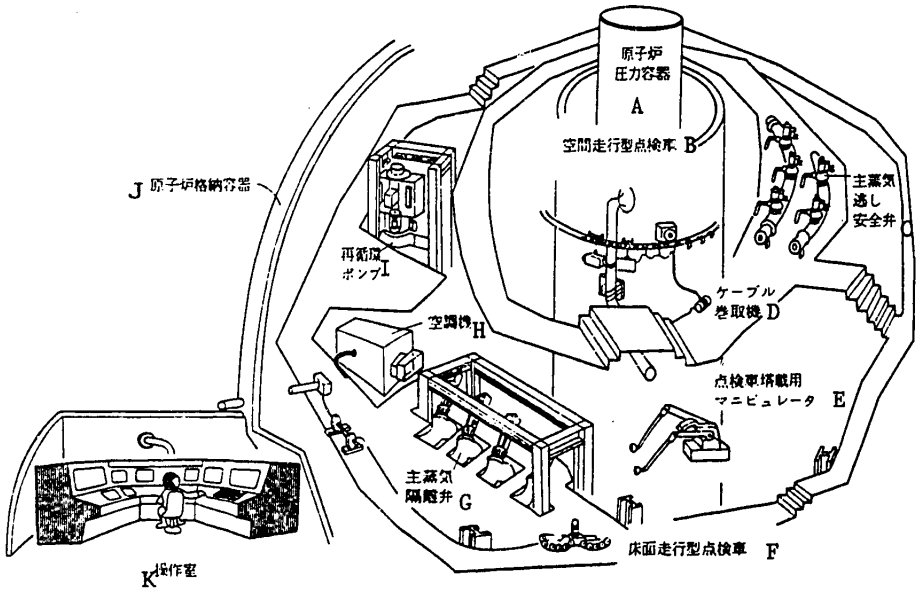
Key:

1. Plant
2. Measuring
3. Computer to supervise plant capabilities
4. Control panel/display operating machine
5. Data display
6 Operator
7. Operation

1. Plant
2. Measuring
3. Computer to supervise plant capabilities
4. Control panel
5. Data display
6. Instruction system
7. Operational data
8. Operator
9. Operation

(Reference #26)

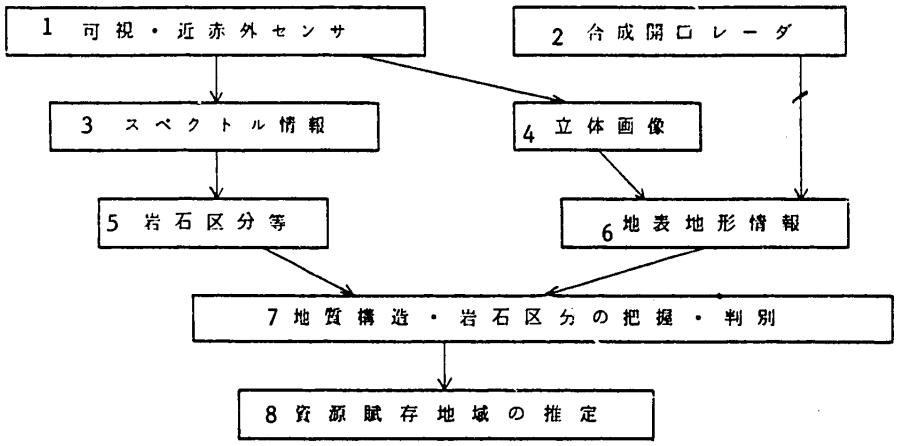
Self-Inspection System Inside the Container:



Key:
A. Atomic reactor pressure vessel
B. Inspection vehicle (runs up and down)
C. Main safety valve to let steam out
D. Cable winder
E. Manipulator for mounting inspection vehicle
F. Mobile inspection vehicle (runs on the ground)
G. Main steam segregation valve
H. Air conditioning system
I. Recycling pump
J. Reactor container
K. Operation room

(Reference #27)

Utilization of Satellite Data:



Key:

1. Visible near--infra-red sensor
2. Synthetic aperture radar
3. Spector data
4. Three dimensional image
5. Rock classification
6. Ground surface--topography data
7. Geological formation--rock identification and classification
8. Prediction of areas of undiscovered resources

Utilization of Space in Universe and Its Effects:

Area used in: Communication--Communication among fixed ground stations.

Method: First, orbit geostationary communication satellite equipped with a repeater. Through the satellite, effective communication and broadcasting using microwave and quasi milliwave among ground stations throughout a wide area is possible.

Effect: It is more effective, in terms of long distance communication and network communication, than building undersea communication cable or ground micro link system.

Area used in: Communication--Communication among mobile stations.

Method: Conduct effective communication among ship, plane and automobile using milliwave and quasi milliwave through geostationary communication satellite equipped with many repeaters.

(Reference #27) [continued]

Effect: It can investigate the state of land use in urban and other wide areas. It will also make effective crop survey of agricultural products. The system can supervise the state of environmental protection of land, areas of water inland and the sea around Japan.

Area used in: Earth observation--Observation of the ocean surface.

Method: Observation satellite, at a low to mid altitude with various radars and VNIR capable of observing ocean surface movements such as waves and current, will observe the area and send back information through an image data.

Effect: Information on ocean current and the ocean wind will enable ships to choose the most effective route in terms of time and fuel. Data will be also available on the movement of the schools of fish which will prove beneficial to marine product affairs.

Area used in: Earth observation--Land observation.

Method: Land observation satellite will be observed simultaneously from various points on the ground using waves and laser. This enables the precise measuring of the distance change between two points and the topographical change in certain areas.

Effect: It will increase the scientific knowledge of earth and contribute to the forecast of earthquakes.

Area used in: Scientific observation.

Method: By using satellites with observation equipment such as optic and wave telescope and others, astronomical observation can be conducted. Also probe ship will investigate planets far from the earth.

Effect: It will increase scientific knowledge of space.

Area used in: Space plant.

Method: Satellite with equipment such as solar reactor and culture equipment manufacture special material in high altitude vacuum and no gravity.

Effect: Through this system, manufacturing and processing of material, utilization of resources hard to get on earth becomes possible.

Area used in: Space power generation.

Method: Solar power generation using power generation satellite. The satellite has a large frame filled with solar batteries.

Effect: Extremely large amount of regenerative energy can become available.

(Reference #27) [continued]

Effect: It is possible to communicate with any mobile stations on the ground surface at any time. Also it enlarges the transmission capacity of the line, upgrading the quality of communication.

Area used in: Communication--Navigation method if airplanes and ship.

Method: Marine and air satellite with a repeater or a transmitter can offer, to ships and planes, information needed to insure safe operation and compute the most appropriate route.

Effect: Airplanes and ships can have access to navigational information at any time, ensuring safe journey and energy conservation.

Area used in: Broadcasting.

Method: Make available to people spread in a wide area, high quality broadcasting through geostationary broadcasting satellite equipped with a high-power repeater.

Effect: Higher quality reception is available regardless of location or topography of the area.

Area used in: Weather forecast.

Method: Weather satellite, equipped with a spector sensor which captures ground phenomena, observes the weather of a designated area and sends information to the ground as image data. In addition, it repeats weather data collected by ground equipment or transmits a weather map to users.

Effect: Quality of daily forecast will become higher. At the same time, it will contribute to disaster prevention and minimization of damage by predicting typhoons, heavy rain and others.

Area used in: Earth observation--Resource probe.

Method: Resource probing satellite equipped with SAR, VNIR and others capable of investigating geological characteristics is orbited to low and mid altitude. It will observe the area and will send back information by image data.

Effect: It promotes effective resource probe by sorting out the areas of possible mineral deposits.

Area used in: Earth observation--Ground surface observation.

Method: Observation satellite, located at low to mid altitude equipped with optical sensor capable of detecting plants on the ground surface, will observe the area and send back information through an image data.

(Reference #27) [continued]

Area used in: Space medicine.

Method: A patient is transferred from earth to space under low gravity and is treated in no gravity atmosphere.

Effect: This is convenient for the treatment of the circulatory or skeletal system ailments.

Area used in: Utilization of ore resources in space.

Method: Send to the moon surface the resource excavating equipment in order to find useful elements and minerals. Bring small planets with the reserve in useful resources close to the earth for excavation.

Effect: Resources needed for space development can be obtained in space. It can also provide the earth with resources needed.

Area used in: Space tourism.

Method: Transport tourists to space.

Effect: Demand for transportation to and utilization of the space in universe can be accomplished.

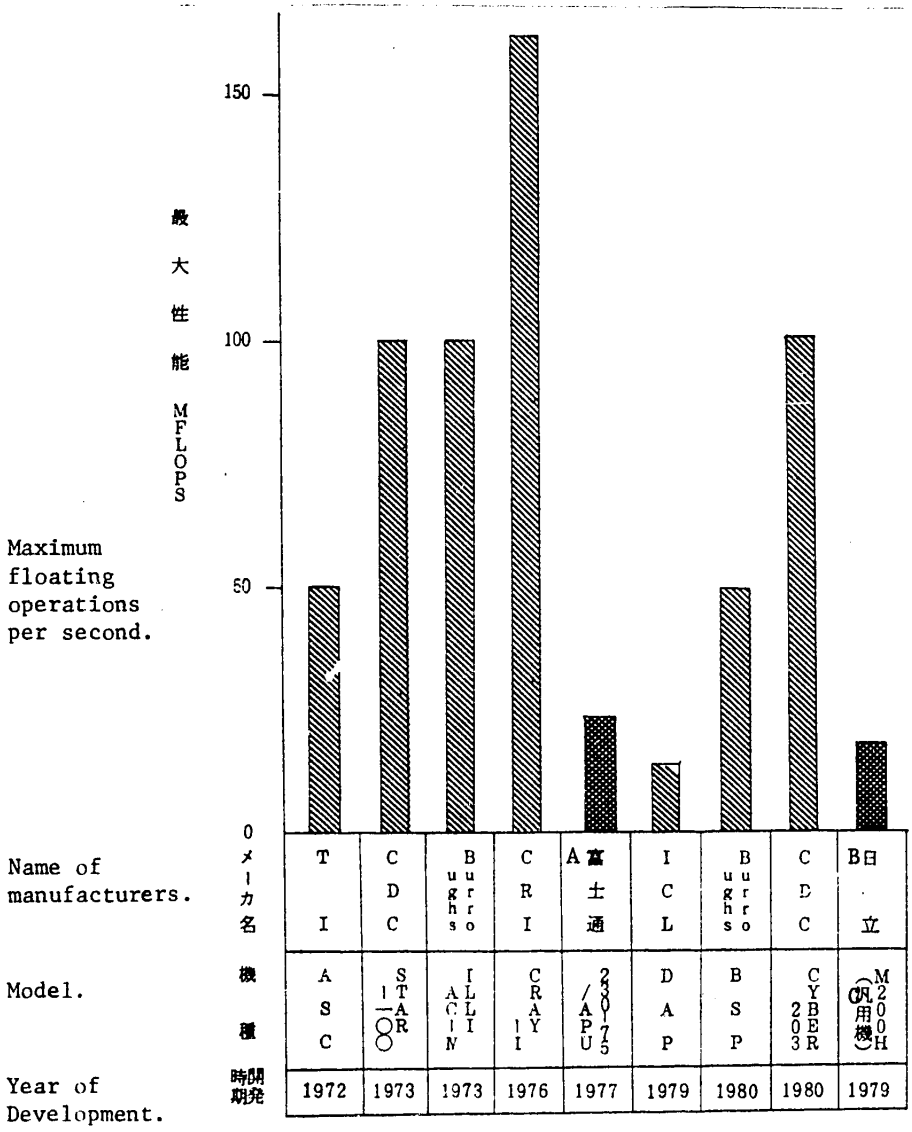
Area used in: Processing of waste material using space.

Method: Pollution causing waste material difficult to process on earth is discarded into space.

Effect: Better environmental protection is attained on earth.

(Reference #28)

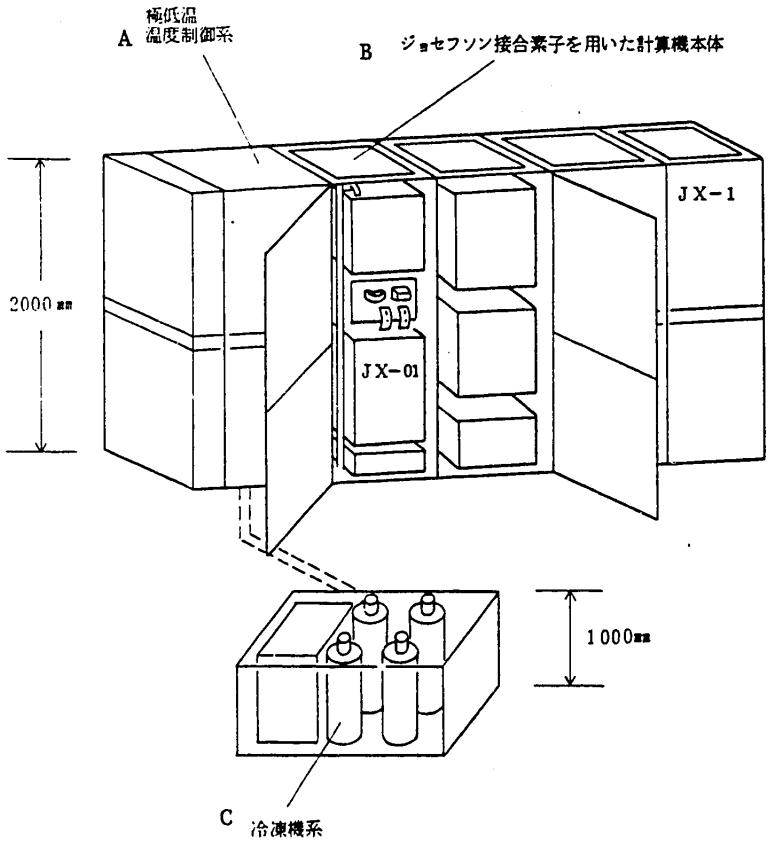
The Present State of Development of Computers for Scientific and Technological Use:



A. Fujitsu B. Hitachi C. General-purpose type.

(Reference #29)

High-Speed Calculating System for Scientific and Technological Use:
Illustration of its concept. (When Josephson junction element is used.)



Key:

A. Extremely low temperature control system.
B. Main frame computer using Josephson junction element.
C. Freezer system.

(Reference #30)

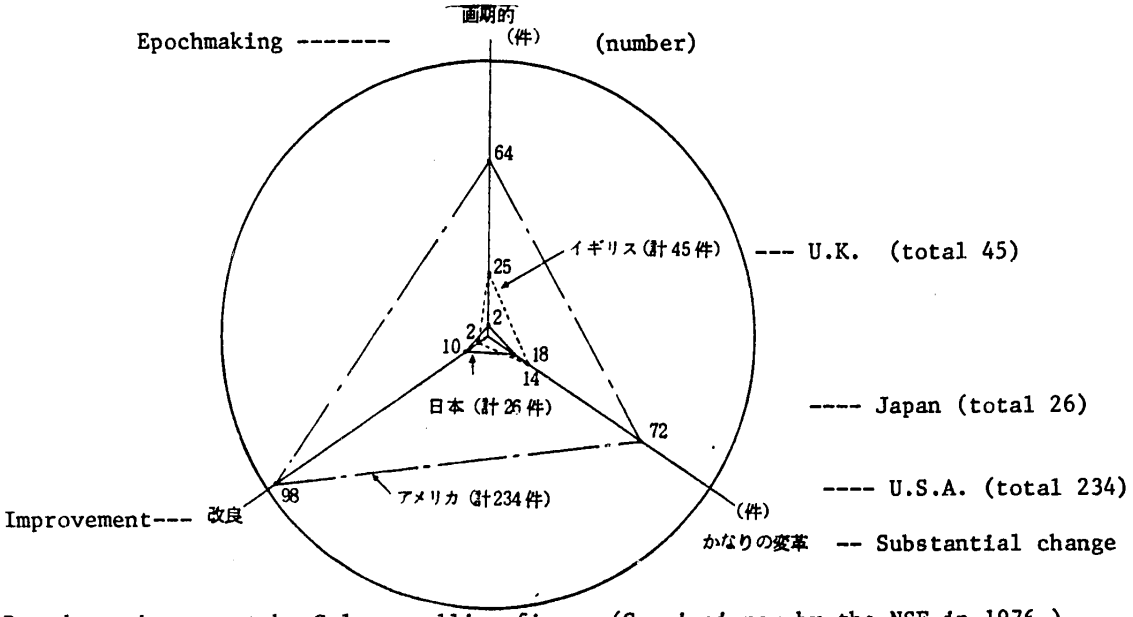
The Status of Technological Development in Japan and the Trend in the United States and Europe.

1. Today's industry and technology.

Efforts in technological development in Japan, compared with Europe and the United States, have so far produced less in quantity and in quality as well since Japan has concentrated its efforts on improving on existing technology rather than developing epochmaking ones.

Unless this trend is corrected, Japan will always have to submit itself to following the paths of those countries.

Innovativeness of research and development in United Kingdom, United States and Japan:

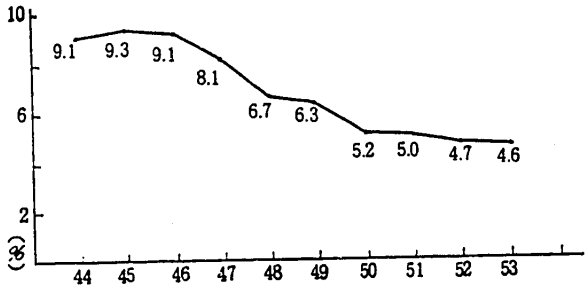


Based on the report by Gelman polling firm. (Commissioned by the NSF in 1976.)

Note: 500 developments of new technology which resulted in manufactured products between 1953 and 1973 were sorted according to the countries and the degree of innovativeness.

(Reference #30) [continued]

The percentage of money used for basic research in Japanese industries is decreasing every year.

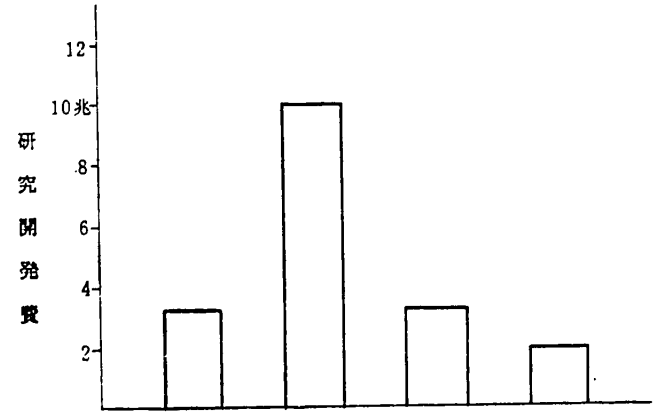


(Reference #31)

Comparison of Amounts Spent on Research and Development Among Countries:

For total R&D, Japan spends a little less than one-third the amount the United States spends. Japan's ratio of money spent on R&D against GNP is lower than West Germany and France.

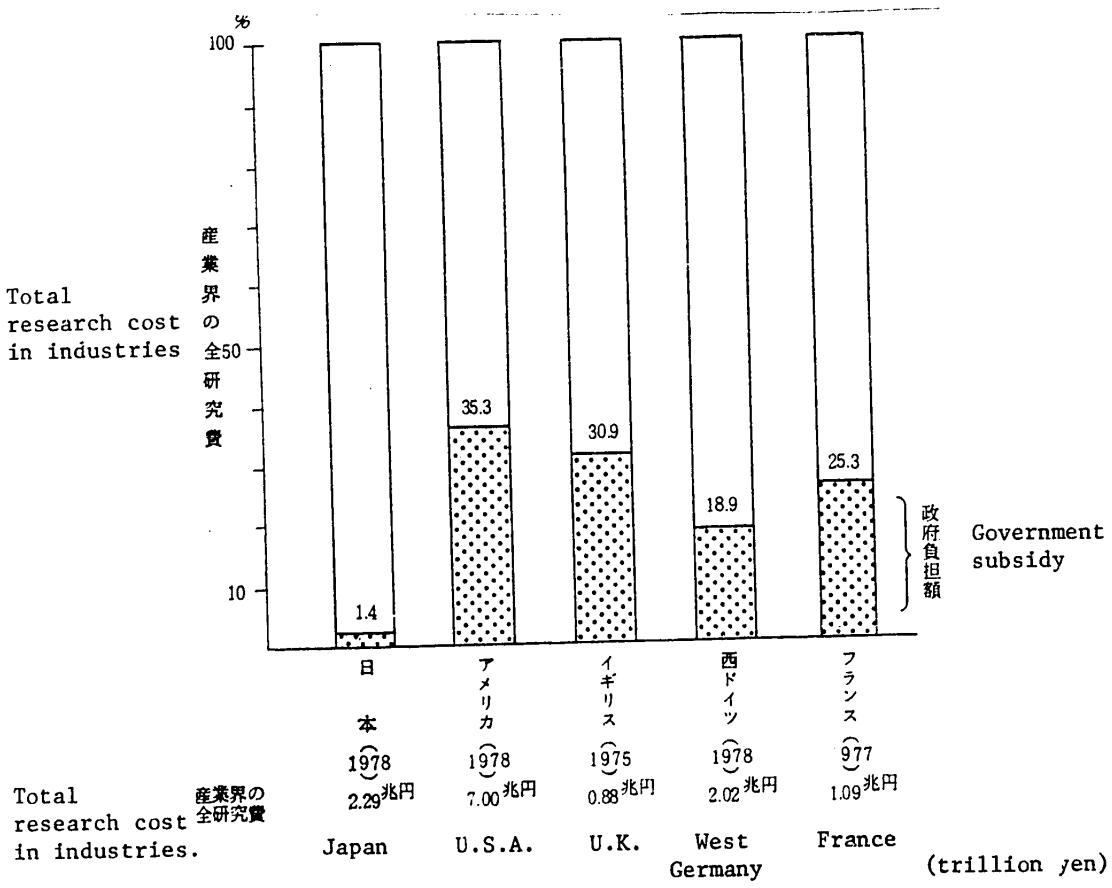
R & D cost (trillion)



		Japan	U.S.A.	West Germany	France
Ratio of R & D cost against GNP	研究開発費対GNP比(%)	1.7 (1978)	2.4 (1978)	2.0 (1978)	1.8 (1977)
Total research cost	研究費総額(億円)	35,700	99,556	31,556	18,308

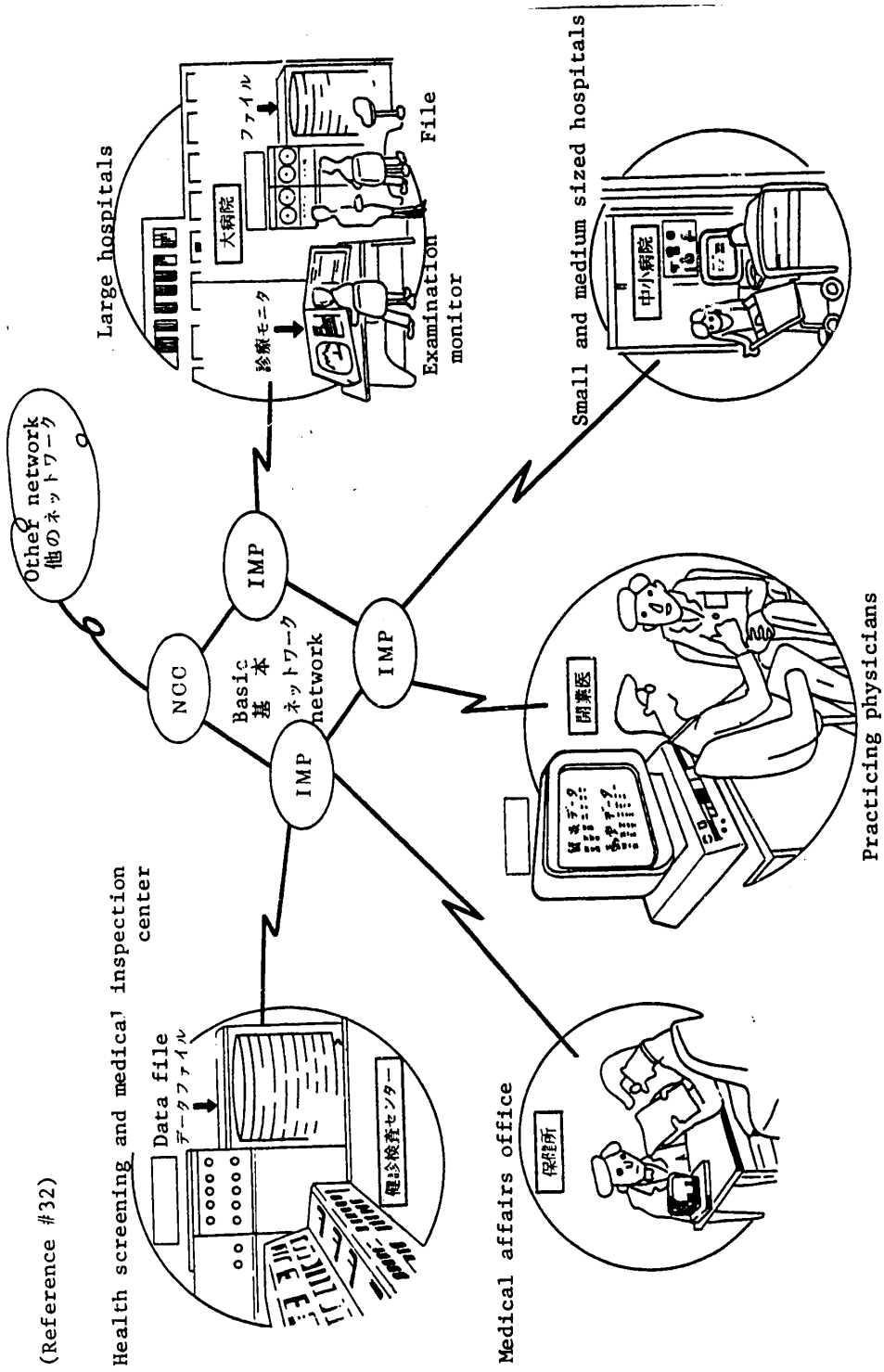
(Reference #31) [continued]

Of the total R&D cost, the percentage of government subsidy is dramatically lower in Japan than other developed nations.



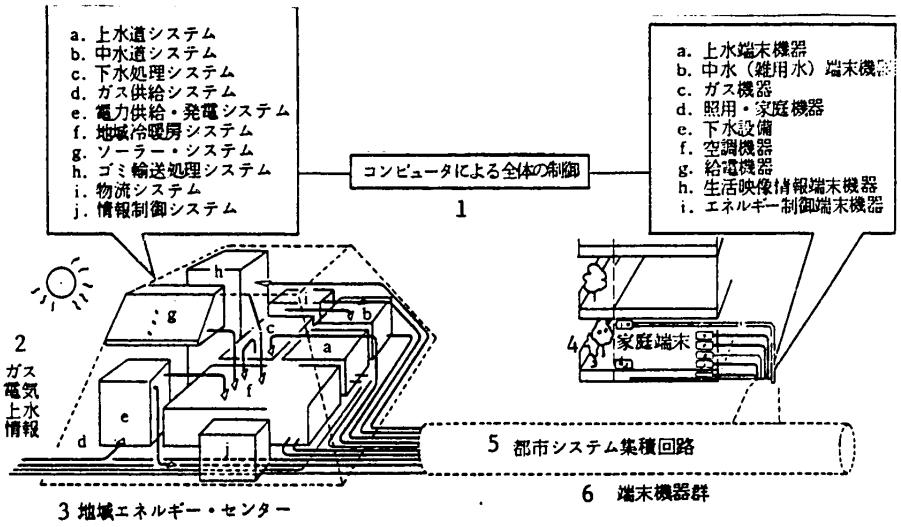
From: Kagaku Gijutsu Yōran (Scientific technology handbook.)

(Reference #32)



(Reference #33)

Illustration of Community Energy System Using Substitute Energy:



Key:

1. Total control by computers
2. Data on gas, electricity and water supplies
3. Local energy center
4. Household terminals
5. Urban system integrated circuit
6. Group of terminal equipment

a. Water supply system
b. Multipurpose water system
c. Sewer processing system
d. Gas provision system
e. Power provision and generation system
f. Local heating and cooling system
g. Solar system
h. Garbage transport and processing system
i. Flow system
j. Data control system

a. Water supply terminal equipment
b. Multipurpose water terminal equipment
c. Gas equipment
d. Lighting and household equipment
e. Sewer system
f. Air conditioning equipment
g. Power provision
h. Everyday life image data terminal equipment
i. Energy control terminal equipment

(Reference #34)

Exhaust Gas Comparison:

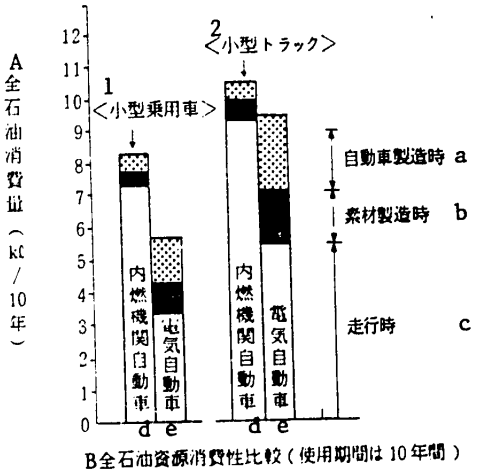
Passenger cars:	Cars that meet 1975 regulations	(10 mode) 1976 regulations	1979 regulations	Electric car
CO	2.1g/Km	Same	Same	0
HC	1.25g/Km	Same	Same	0
NOx	1.2g/Km	0.6 0.85	0.25	0

Comparison of noise on acceleration:

		Present regulation	Unit: dB(A) Plans for future*	Unit: dB(A) Electric car
Truck	:Over 3.5 tons :Over 200 horsepower	86	83	70-75
Bus	:Over 3.5 tons :Under 200 horsepower			
	:Under 3.5 tons			
Passenger car		81	78	60-65

*Proposal made by Central Commission on Pollution in May, 1976.

Electric car and energy conservation:



B全石油資源消費性比較（使用期間は10年間）

Key:
A. Total oil consumption (kl/10 years)
B. Comparison of total oil resource consumption (10 years)

1. Small passenger car
2. Small truck

a. Car manufacturing period
b. Material manufacturing period
c. Operation period
d. Internal combustion engine
e. Electric car

(Reference #35)

Specification and Performance of Cars Developed on an Experimental Basis in a Large-Scale Project:

B	諸元 A 車種	a軽量乗用電気自動車	b小型乗用電気自動車	c軽量電気トラック	d小型電気トラック	*e 連絡線用電気バス
1	全長 (mm)	3,165	3,410	3,140	4,690	9,380
2	全幅 (mm)	1,420	1,500	1,355	1,695	2,490
3	全高 (mm)	1,430	1,480	1,605	1,860	3,060
4	車両総重両 (Kg)	1,427	1,467	1,538	3,595	14,045
5	乗車定員 (名) 最大積載量 (Kg)	4	4	2 300	2 1,000	70
6	最高速度(Km/h)	101	83	78	90	61.2
7	一充電走行距離 (Km)(40Km/h定速)	259	455	205	496	186.6
8	加速能力(sec) (0−40Km/h)	6.0	3.6	8.1	4.9	(6.9)
9	登坂能力(Km/h) (7%の勾配)	10 40以上	10 40以上	10 40以上	10 40以上	(29.5)

Key: A. Model
B. Specifications

a. Subcompact electric car
b. Compact electric car
c. Subcompact electric truck
d. Compact truck
e. Mass-transit electric bus

1. Length (mm)
2. Width (mm)
3. Height (mm)
4. Weight (kg)
5. Maximum number of passengers (persons)
   Maximum capacity (kg)
6. Maximum speed (km/h)
7. Mileage (km) on one charge (at 40 km/h)
8. Acceleration capability (sec) (0-40 km/h)
9. Capability to go uphill (km/h) (7 percent slope)
10. Over 40 km/h

*A revised model from the first developmental project. Acceleration capability is based on 0-30 km/h and the capability to go uphill was measured on a 6° slope.

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END