JPRS L/9901

10 August 1981

# Japan Report

(FOUO 46/81)

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APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000400040013-9

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MILITARY

BASIC CONCEPTS OF JAPAN'S SEA DEFENSE ANALYZED

Tokyo KOKUBO in Japanese Jul 81 pp 39-40

[Article by Motomi Hori: "Defense of Seas Around Japan"]

[Excerpt] The observations made on the environment surrounding Japan have digressed somewhat, but if the basic concepts of Japan's sea defenses were formulated from the above observations (with the logic of thoughts somewhat abbreviated), the writer's opinions are roughly as follows:

(1) The USSR's decision to invade Japan is contingent on its decision to confront the United States. Of paramount importance is the exertion of efforts to prevent any Soviet decision to invade because to fight defensively after invasion operations have commenced is not in the best interest.

(2) In order to prevent the Soviets from engaging in confrontation, all available means must be exhausted to cope with the situation. On one hand the Western countries must strive for peaceful coexistence by paving the way for diplomatic dialogue so that the Soviets will not decide they have "exhausted their patience," while on the other hand the West must constantly maintain a joint military power that will serve as a reminder that the attainment of an objective through military action is folly.

(3) The excuse given by a segment of the Japanese of their inability to join in the collective defense organization deemed by various Western countries as necessary to maintain peace is only an adherence to the trivial matter of Constitutional interpretation which totally disregards the great spirit of the Constitution as a bulwark; and although the Japanese "trust the fairness and fidelity of the peoples of the world," their refusal to cooperate is nothing but plain cowardice.

(4) Although Japan's sea defense strength can be effective for a short period and over a limited range, alone it does not possess the strength to defend against a Soviet invasion. Since the Soviet attack inevitably would be executed as a phase of a grand design, unless this phase is considered to be a support campaign equivalent to a part of the grand strategy of the U.S.-Japan alliance, Japan does not have the strength to check the Soviet military.

(5) Thus, unless conceivable conditions, such as confronting the wide range activities of the Soviet Pacific fleet and neutralizing (counteracting and nullifying)

its effectiveness with the presence of the U.S.-Japan joint Pacific fleet, or minimizing the possibility of a successful offensive operation or any subsequent strategic advantages, are not mapped out, then an effective war deterrent cannot be realized.

(6) Planners of a war hope that as a result of war, all the situations existing before the war will definitely be "improved." Therefore, there is the need to clearly state that waging a war may not result necessarily in "improvement" and the way must be paved to show that "improvement" can be gained even without waging a war.

(7) This may sound somewhat like an idealistic theory, but by possessing a sizeable medium-scale military force, Japan would be in a position to reinforce the military power of the Western nations (United States et al), and serve to suppress Soviet war intentions. With this sizeable strength, it would be welcomed if Japan could make a stipulation that "unless Japan agrees to it," the Western camp cannot embark on a positively high-powered policy.

(8) In view of the above enumerated reasons, it is felt that the matter requiring immediate attention is the promotion without delay of some reinforcement of Japan's defense strength. However, on reviewing the present state of affairs in Japan, where formerly the military, with a complete lack of understanding of politics and economics, ruled rampantly, today, it is just the opposite, statesmen who should have a good understanding of and the ability to readily act on military power lack this awareness, and one can only say that a totally befogged politics is in force.

During the entire month of May, the confused stance of Prime Minister Suzuki's cabinet exposed its vacillation on military matters which doesn't even rate a commentary, and from the ruckus of the nuclear weapons problem utter confusion reigned as to what happened in what manner. I wonder what would happen if a state of emergency should arise during this sort of confusion?

As for developments hereafter, in all likelihood the United States will probably push forward, even by devious means, any military policy it deems necessary, regardless of what Japan might say, and the end result will probably be that Japan follows the American action in its wake. The Maritime Self Defense Force has no other course but to develop into a fully purposeful entity of the Japanese zone element within the Pacific combined fleet whose purpose is to deter war, by entering into complete mutual understanding with the U.S. Navy. As for advocating independent defense by one nation, there is none in the world, not even with the superpowers, the United States and USSR. The "divine country of Great Japan," the isolationist principle which is only a change of the same ideas, etc., of 100 years ago are totally irrelevant. The thought that Japan alone throughout the world is something special is indeed unwarranted.

The year 2,000 will very shortly be a reality.



9510
CSO: 4105/201

SCIENCE AND TECHNOLOGY

SALES COMPETITION OVER MTX, BADGE X, SAMX INTENSIFIES

Tokyo NIHON KEIZAI SHIMBUN in Japanese 8, 9, 10 Jul 81

/8 Jul 81 p 7/

/Text/ MTX, Next Generation Mid-Level Training Plane--Three Companies Compete with Respect to Their Overall Capabilities

Our defense budget is increasing in size at the request of the United States for a stronger self-defense. The defense-related industry is chuckling to itself at this "fair wind" trend. This being also the time to change the type of crafts, many large-scale projects are in the works. Major representatives of them are the three X's which are to patrol the skies of our country. The selection process for the MTX (Next Generation Mid-Level Trainer), Badge X (Base Air Defense Ground Environment) and SAMX (Surface-to-Air Missile) is in full stride. Let us now follow the movements of the Defense Agency and manufacturers in the industry that are seeking orders.

Total 250 Billion Yen

"We tried hard. We did all we could," says Iwao Shibuya of Fuji Heavy Industries, who is still a little excited. The MTX selection process is the farthest along of the three X's and is now right in the middle. Three aircraft makers, Fuji Heavy Industries, Mitsubishi Heavy Industries and Kawasaki Heavy Industries are competing for the position of a major contractor.

At the request of the Defense Agency, each manufacturer submitted a proposal at the end of May, indicating their prices and the type of mid-level training airplane they can develop. Mr Shibuya, who spearheaded the preparation of the proposal can only wait for the "announcement of pass or fail."

The MTX is an airplane to be used to train Air Defense Force pilots. Since the T 33 now in use has to be replaced soon, the MTX will be developed by 1987. The total development cost amounts to 37 billion in 1980 yen. The Defense Agency is planning to place an order for 200 aircraft after 1988.

Each aircraft costs about 1 to 1.5 billion yen. Actually, specific prices are indicated in each manufacturer's proposal but that is kept top secret. In any event, a total of approximately 250 billion yen in procurement costs is expected.

It has been a long 14 years since our industry last developed, on its own, aircraft for the Defense Agency, i.e., since the time of the development of the high level training plane T 2 (development started in 1967 and the production in 1973). The aircraft industry has a large workload owing to the on-going of F 15 (Next Generation Principal Fighter Plane) and YX (Boeing 767) projects, but they are either domestic licensing or subcontracting arrangements. Since a manufacturer has to design and develop on its own in order to train its in-house aircraft engineers, it is understandable why the three airplane manufacturers are extremely eager.

Fuji Heavy Industries has been preparing for this the longest. In the training aircraft field, their credentials include the development of the nation's first jet training plane T 1 at the start of the decade beginning with 1955. They are also manufacturing the first level training plane T 3 which pilots ride first in their training. As Fuji Heavy Industries is basically confident that small training planes belong to them, they are absolutely determined to get the MTX orders.

Kawasaki, which manufactures under license P3C, antisubmarine patrol aircraft, has had a large workload, but has never developed any aircraft on its own for the Defense Agency. As the Executive Managing Director Tomoaki Yamada puts it, they would like to "show that they can do well by manufacturing the MTX." Additional orders for the P3C are expected, but the MTX order will help them with their plans to increase the types of their production.

No Trespassing at "Gihon" (Gijutsu Kenkyu Honbu--Technical Research and Development Institute)

In the beginning it was expected that Fuji and Kawasaki would be the contenders for the MTX orders. However, Mitsubishi Heavy Industries did not keep quiet. Executive Managing Director Kenji Ikeda explains as follows. "If the MTX were strictly a training plane, we would not necessarily have to get involved, but actually it is a light fighter plane." This comment shows his obvious confidence coming from the Mitsubishi's development of high level training planes T 2 and the support fighter plane F 1, which is based on T 2. He stands absolutely firm that "at this rate, (unless Mitsubishi gets the order) the engineers for the fighter planes which we took the trouble to train will be lost."

The 3 airplane manufacturers with 3 different backgrounds compiled proposals that were about 400 pages long. All information, such as the specifications for aircraft body, the companies' developmental structures and production costs, is included.

The Defense Agency has brought together 30 to 40 senior people from the Technical Research and Development Institute, which handles development and the Air Defense Force, which is the user, in order to evaluate these proposals. They are divided up into groups of different areas of responsibility and are meeting almost everyday.

The leader of this technical evaluation team, General Tomoo Komata, engineer from Technical Research and Development Institute, was curt in describing the progress of the selection process and said, "We are right in the middle of 'grading.' We cannot say anything." Security around the Institute is extraordinarily tight, and, as one industry official says, "The Institute now is an area off-limits to us. Even in the case of personnel changes, we cannot go pay a visit."

Atsuhiko Bansho, Defense Agency Counsellor, has announced officially that the Defense Agency will "select a major contractor by fall for the MTX." It has been expected that the decision will be made by around the end of August or September, but actually it might come sooner. The Equipment Bureau of the Defense Agency says that the preliminary evaluation process, mainly carried by Technical Research and Development Institute, is almost finished.

From this point, the Equipment Bureau principally will undertake the final round of talks with the Air Defense Force and other departments within the Agency. Since the domestic development of airplanes has not taken place for some time, it also will be necessary to take MITI's (Ministry of International Trade and Industry) aircraft policy into consideration.

Now the deadline is drawing near, any slight comment by the Defense Agency bears much weight with the three manufacturers. An official from Air Defense Force lowers his voice and says, "Based on technical capabilities alone, Mitsubishi will be the one."

However, the MTX does not require the sophisticated technology that is called for in the case of most advanced fighter planes. Winning and losing will be determined not only by the technological aspect but also by overall capabilities, including cost management. Information from a Defense Agency source indicates that all three have surpassed the basic requirements. Therefore, the decisive factor will be what they can offer as a "plus alpha" in their programs.

Will the Last Decision Be Made by MITI?

Another focal point of the battle for the MTX is that if Fuji Heavy Industries fails to get the order, they will not be a major contractor of any aircraft for the Defense Agency after the termination of the production of T 3. (As a result of this,) Fuji will fall far behind Mitsubishi and Kawasaki and the aircraft industry, which has been supported by the three manufacturers, might in the future be supported by only two.

"How much of a part will the Defense Agency have in the final say? After all, will they leave much of it up to MITI?" ask people related to the aircraft industries, as they watch the conferences between the Defense Agency and MITI, which are coming to the decisive stage.

An exofficial from the Defense Agency who is informed on this aspect says frankly, "A maker has to be selected for a simple reason, such as the highest quality or the lowest cost." There is nothing the manufacturers can do now. They only can wait quietly for the day of the announcement of "pass or fail."

Inset: Japan's Major Aircraft Development for Defense Agency

| Start of Production | Type | Use | Developed by: |
|---|---|---|---|
| 1960 | T 1 | Mid-level training plane | Fuji Heavy Industries |
| 1971 | C 1 | Transport plane | Japan Aircraft Manufacturing |
| 1973 | T 2 | High-level training plane | Mitsubishi Heavy Industries |
| 1975 | F 1 | Supporting fighter plane | Mitsubishi Heavy Industries |

Note: The F 1 is a T 2 improved and developed as a support fighter plane.

/9 Jul 81 p 87/

/Text/ Badge X, Base Air Defense Ground Environment--Does Nippon Electric Company Have the Advantage of "Experience?" The Key Is to Employ Foreign Manufacturers.

"Badge X? It is just that people are making a fuss about it," said Tomio Tanatsugu, executive vice president of Toshiba Corp. Until a month or two ago, comments from the officials of electronics and electric equipment makers which are seeking Badge X orders have showed a sense of relaxation, but now the situation has changed. That is because the Defense Agency is expected to indicate to each manufacturer, the functional requirements for the Badge X. Each manufacturer, in response to this, will submit a proposal in 6 months. A major contractor will be selected by the time rough estimate for the 1983 budget is requested. The marketing war over the Badge X has started.

300 Billion Yen Including Related Costs

Five manufacturers that are seeking Badge X orders are Nippon Electric Co, Mitsubishi Electric Corp, Toshiba Corp, Hitachi Ltd and Fujitsu Ltd. It is not definite that the Defense Agency will contact those five manufacturers on this matter, but judging from their capabilities to work on Badge, which is a total system of electronics and communications technology, "those five seem to be the candidates," as an official from the Air Defense Force indicates.

Badge is a system by which an invading aircraft detected by various radar sites in the country can be identified as to whether it is an enemy aircraft or not, and whose computers can automatically guide fighter planes and surface-to-air missiles to enemy aircraft in order to destroy them.

The present Badge system was developed by Nippon Electric after importing the technology from Hughes of the United States. (A major contractor in their joint venture is Japan Avionics.) The Defense Agency started its operation in 1968. However, as the introduction of F 15, next generation principal fighter plane and early warning aircraft E2C progress, the present system will not be able to handle it. Upgrading of Badge is the most imminent question for our air defense system.

The construction fee for the present Badge system was about 25 billion yen including related costs. That was more than 10 years ago. Today it will be 200 or 300 billion yen. It is natural that the business people in charge of defense at electronics and electric equipment manufacturers have become extremely interested.

Osamu Ikutame, chief of staff at the Air Defense Force says, "We would like to place an order in 1983 and would like to start operations around 1987." Only the broadest schedule is available from the Defense Agency. People in charge of defense at each manufacturer are becoming impatient to collect information as to "what the Defense Agency's requirements would be."

"Many companies are raising their hands but I wonder how much they know about the Badge system," says Kiyoshi Murofuse, the president of Japan Avionics showing much confidence. Although they depended on Hughes' technology, Nippon Electric Co/Japan Avionics is the only one with experience in the Badge system. Badge is something

that requires more than just strength in computers and telecommunications. As it is basically a system that directly controls fighter planes and missiles, it is a big advantage that they are handling the maintenance and the repairs of the present Badge system and therefore are very knowledgeable about the system as a whole.

Late Starter Group Trying to Join In

It is a common view in the industry that "the more the new Badge is similar to the present one, the more advantageous it is for Nippon Electric Co." Their relation with their affiliate Hughes is close. And because they might be thinking they are ahead of the game, they have been extremely cautious about what they say.

Mitsubishi Electric, like Nippon Electric, is trying to win with their overall capabilities. They are advertising that they are strong in weapon control systems since they have handled not only various hardware but also radar, fire-control systems of fighter planes and ground-to-air missiles such as the Hawk. Last November, they opened a new "defense system project room" in order to combine the relevant technologies within the company and there are about 20 senior people preparing to answer any requirement the Defense Agency may come up with.

Also, Toshiba Corp is planning to get into the Badge race, as they ride the crest of the increased demand from the Defense Agency, such as in the development of a short-SAM (Short Distance Ground-to-Air Missile). However, it is reported that late starters, Hitachi and Fujitsu, are more active in their contact with the Defense Agency than the other three. "Defense field is the only door to high technology electronics," Susumi Isa, executive managing director says. For Hitachi, this Badge marketing battle will become a "test" of their plans to increase defense apparatus orders.

Fujitsu also has engaged in restructuring, such as separating their defense technology development department. They are now developing nigh speed computers to be used for calculations in science and technology. Other manufacturers argue that computers in Badge are only a tool for the system and that Badge does not need computers with extremely short processing time. Thus it has come to the point where the internal struggle in the industry becomes evident.

Manufacturers Groping for Ideas

At the moment, however, they are only preparing as they draw their imaginary Badge system. The Defense Agency is sure to cover 28 radar sites in the next system, including the 4 radar sites in Okinawa that are excluded under the present system. Also they will be sure to include mobile radar units. However it is not known how much of an upgrading they will undertake in computers and signal apparatus. The size of the market will change depending on this.

Utilization of the strength of foreign makers is also a key to winning a Badge order. Japan is so strong in communications and electronics equipment technology that the U.S. military is procuring from Japan but when it comes to software in the air defense system, Japan is still a developing nation. One marketing official says, "Using foreign makers is also one of the ideas of the manufacturers," indicating the possibility of some unrevealed plan. Once the Defense Agency decides on its requirements, we might see some "ultra C" ideas pop up.

/10 Jul 81 p 7/

/Text/ SAMX, Next Generation Surface-to-Air Missile--Contention Within Mitsubishi Group--Past Division of Fields No Longer Possible

The surface-to-air missile, Hawk (Ground Self Defense Force) and Nike J (Air Self Defense Force), which have been defending our skies, are approaching the time for replacement. Both Defense Forces are proceeding with the selection process of the following craft (SAMX--next generation of surface-to-air missile) and the most likely candidate is the Patriot by Raytheon of the United States. Mitsubishi Electric, which handled the Hawk and Mitsubishi Heavy Industries which handled the Nike J will be competing for the position of major contractor for domestic manufacturing under license.

Mitsubishi Heavy Industries is also proposing the independent development of a Nike Phoenix (an improved Nike based on the technology imported from Hughes of United States) which is another candidate for the next generation of missiles for the Air Defense Force. The battle between the two brother corporations for the SAMX order will last for a while, because of a delay in the Defense Agency's selection process among other reasons.

Our air defense on the foremost front is carried out by fighter planes: The Nike J (range about 130 km) provides high altitude defense and the Hawk (range about 35 km) low altitude.

Delay in Selection

Both missiles were first installed at the end of the decade of 1955 and are obviously obsolete.

The Hawk is being gradually replaced by an improved Hawk with upgraded capabilities. But in the case of the Nike J, the selection of a replacement is imminent because of its limited capabilities, which makes it unable to cope with fighters invading at a low altitude, and also because of the anticipated termination of parts supply from the United States.

The Defense Agency will decide on its future equipment plans during the period of the "Mid-term Operations Estimate" (1980-84) which is a plan for equipment and force organization. Originally, they were planned to make the selection before 1981 but this will be delayed. This is because the most likely candidate, "Patriot" is still at the stage of limited production. Also the fact that West Germany has been delaying its planned purchase has had some influence.

The official position of the Defense Agency is to "decide after studying the capabilities of both the Patriot and Nike Phoenix." The estimated budget request for 1982 includes research expenses for the purchase of the Patriot and indicates that the Technical Research and Development Institute is planning its own study on the independent development of the Nike Phoenix.

"The selection of missiles is the job of the Defense Agency. Our job is simply to arrange the conditions to make that decision-making easy," says Kenji Ikeda, executive managing director at Mitsubishi Heavy Industries, emphasizing that this is no time for the industry to interfere.

Total 1 Trillion Yen

However the total purchases for the next generation of Hawk and Nike J amount to as much as a trillion yen. The industry involved cannot remain quiet. Also in the case of the Hawk, in addition to Mitsubishi Electric, Toshiba Corp is also a major contractor in terms of its ground equipment. For the Nike J, Mitsubishi Heavy Industries is the major contractor but Nippon Electric Co was in charge of its guiding equipment.

Should the Ground and Air Defense Forces decide to purchase the Patriot to replace those two missiles, which manufacturer will be chosen as the major contractor for domestic manufacturing under license? There is the danger for these companies that not only will they not be chosen the major contractor but they also may lose other work that now belongs to them.

Mitsubishi Electric has manufactured under license, the Hawk and other missiles. Takeshi Abe, chief of the Electronics First Operations Division, showing ambition, says, "We have worked with Raytheon for 16 or 17 years. If the Patriot is selected, we would like to work on it," and emphasizes their strong ties with Raytheon.

This June, the Defense Agency selected Mitsubishi Heavy Industries to be the major contractor for the licensed domestic manufacturing of the "Sidewinder," Air-to-Air Missile AIM9L, which is to be mounted on the next generation mainstay fighter plane, the F 15. They fought a bitter war for this account with Mitsubishi Electric and Toshiba Corp. There was the possibility of Mitsubishi Electric receiving the order since its developer was Raytheon but since the system by which it chases the enemy plane was identical to that of air-to-air missile developed independently by Mitsubishi Heavy Industries, they won this battle.

Right after that decision concerning "Sidewinder" was made, the Defense Agency official in charge of missiles commented, "It is good for Raytheon to work with other Japanese missiles manufacturers, too." Of course he added, "In the case of the SAMX, the impact is large so we will treat manufacturer selection very carefully." But even with their close ties with Raytheon, Mitsubishi Electric might not easily be selected the licensed manufacturer.

Problems Still Exist for Domestic Development

Introduction of the Patriot is still at the stage of discussion between the U.S. and Japanese governments. Its actual introduction will not start until around 1984. On the other hand, it is predicted that the Defense Agency will request research funds for 1982 budget for the domestic development of the Nike Phoenix.

However, even the official in charge at the Technical Research and Development Institute is fairly indecisive and cautious and says, "We are not trying to upset those who support the Patriot." It does not seem that they will go right ahead with this development instead of Patriot.

It will still be a long time before this battle, centered around Mitsubishi Electric and Mitsubishi Heavy Industries, will come to an end. There existed a system by which Mitsubishi Electric handled licensed manufacturing, Mitsubishi Heavy Industries handled air-to-air and air-to-sea missiles launched from a plane and Toshiba, who developed short-SAM, handled short range ground-to-air missiles. However as far as this SAMX order is concerned, the past division of field will not apply.

Through this year and into next year, the long battle for orders, for success as a missile maker, will continue to be fought by the manufacturers.



9782
CSO: 4105/203

# MITI PLANS SPENDING BILLIONS FOR NEXT GENERATION TECHNOLOGIES

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 13

[Text]

The Ministry of International Trade & Industry's ambitious long-range project to develop, with Japanese industry, innovational technology for the next generation was recently finalized as MITI's basic policy line concerned was approved by the Next Generation Technology Development Division of the Industrial Technology Council. The latter is an official consultative body for MITI's Minister.

The policy line, subject to the national budget, calls for up to 10 years of official drives and a total of ¥104 billion to develop technology under three categories — New (Industrial) Materials, Biotechnology, and New Function (Electronic) Elements (semiconductors).

Under the three categories are 12 themes to develop pioneering technology.

The dozen themes are: 1) Fine ceramics, to be developed in 10 years at ¥13 billion in official cost; 2) High-efficiency substance-separating membrane materials, in 10 years, for ¥10 billion; 3) Electrically conductive high-polymer materials, in 10 years for ¥5 billion; 4) Highly-crystalline high-polymer materials, in 10 years for ¥6 billion; 5) High-efficiency crystallization-controlled alloys, in eight years for ¥8 billion; 6) Compound materials, in eight years for ¥11 billion; 7) Bioreactors, in 10 years for ¥11 billion; 8) Massive (biotechnical) cell cultures, in nine years for ¥5 billion; 9) Gene recombination application technology, in 10 years for ¥10 billion; 10) Super-lattice (exceptional atomic structure) (electronic) elements, in 10 years for ¥8 billion; 11) Three-dimensional (electronic) circuit elements, in 10 years for ¥9 billion; and 12) (Electronic) elements intensified in anti-environment resistance, in eight years for ¥8 billion.

The new policy line okayed by the council division, which was created recently and first met for its clearance, is essentially intended for development of industrially applicable new industrial material, biotechnological and new semiconductor element producing technology. Efforts to develop such technology is expected to bring extensive derivative benefits to many industrial areas in addition to their direct efficacy.

Introduction of the new project during fiscal 1981 ending next March, as scheduled, will complete MITI's current general program of nationally important major technology development projects, of which there are two outstanding since 1974 and 1978 respectively — the "Sunshine Project" to develop all sorts of non-oil energy sources, and the "Moonlight Project" to create all kinds of energy-saving methods.

MITI has also decided to create at its central office a promotion headquarters to propel the 12 kinds of research and development chiefly in the form of entrusting study jobs with different industrial enterprises. Such jobs will be placed in the latter care on competitive basis, and an evaluation committee to be also created in MITI's central office will screen the industrial participants in three to five-year checks by record of achievements.



CSO: 4120/284

SCIENCE AND TECHNOLOGY

# THEMES LISTED FOR EXTENSIVE STUDY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 13

[Text]

Research and development efforts to improve Japan's ability to predict earthquakes and also find out new values of deoxyribonucleic acid (DNA), have been officially chosen as part of seven nationally important scientific and technological study themes.

The selection was made by the Japanese Government's Council for Science and Technology in the presence of Prime Minister Zenko Suzuki, Science & Technology Agency Director-General Ichiro Nakagawa and five other ministers.

Scheduled to be implemented as it is, the recommendation established Japan's new basic national plan to promote research and development efforts to minimize the impacts of acts of God, and to name seven basic scientific and technological study themes, also of national significance.

Chosen, for immediate launching during this fiscal 1981, the seven kinds of study efforts, to be expected from not just governmental but academic and private circles with a time limit of three years set for quick efficacy, will be financially helped by partial allocation of a ¥3,350 million the Government has budgeted for the Science and Technology Promotion Control Expenditure.

The total of the budgeted expenditures for this fiscal 1981 divided into ¥1,350 million for entirely new study projects under the seven themes; ¥1,000 million for 10 study projects of other types already in progress as projects covered by a past special promotional control expenditure system (under the council's control); and ¥1.000 million for a research system and other drives to find out and foster embyros of innovational kinds of technology.

The seven study themes are:

1) Studies on prediction of (violent) earthquakes of directly underfoot type possible in the Tokyo Metropolitan Sphere, and a general (urban) disaster prevention system: There have been long-standing calls for such studies, but they have been technologically difficult to answer.

2) Studies on extraction, analysis and synthetization of DNA, the key to the development of the modern gene recombination technology, for their medical, agricultural, industrial and many other potentials.

3) Studies on controlling the surfaces and interfaces of substances for the purpose of development of innovational high-efficiency industrial materials.

4) Studies on utilization and demonstrative proving of remote-sensing types of technology, especially for oceanographic, agricultural, forestry, fishery and land developing-purpose utilization of artificial satellite observations.

5) Studies on production capacities of marine biological resources and on marine environments.

6) Studies on more sophisticated utilization of chemical compounds through wider joint use of scientific and technological information circulating networks.

7) Studies on general types of development and utilization technology concernning tropical and subtropical microorganisms and plants.



CSO: 4120/284

## MITI R&D PROJECT RESULTS SEEN NOT FULLY UTILIZED

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 12 Jun 81 p 14

[Article by editorial staff member Koji Sasaki]

[Text] The MITI Agency for Industrial Science and Technology has been carrying out large-scale projects (the large-scale industrial technology research and development system) since 1966; 1980 was the 15th anniversary of the start of the large projects. The agency took this year as the occasion to investigate seven projects which had been completed to find out how well the results were being utilized in the national economy and industry. The only result of the "national projects" being carried out under government guidance was being able to say: "We have developed such and such technology." There are few examples where it has actually been applied in industry. The same trend was seen in the results of the large-scale projects. The report on the investigation stated: "Strengthening of the system to promote the introduction of the first plant is very important in applying the next large-scale project system." As indicated in this example, the time has come for taking strong measures to disseminate research results.

### Long Term Research and Development

The large-scale project system is a system for research and development, under government leadership and with the cooperation of industry and educational institutions, for large-scale industrial technology which is urgently needed for the national economy and requires large amounts of money or time for development or entails a great deal of risk. Private industry cannot handle this kind of research, so the government foots the bill for research and development expenses.

When the large-scale project system was started, a budget of 100 million yen was set up for three projects. By the 15th year, the budget had grown to 16.7 billion yen for eight projects. During this time, 16 projects had been undertaken, and 120 billion in government money had been spent. The "manganese nodule mining system" and the "scientific and technical high-speed computer system" are new projects which will begin in 1981.

The projects based on this system are evaluated by the evaluation subcommittee of the Industrial Technology Council's Large-Scale Technology Development Committee, when research and development are completed, as to whether the technological development has been accomplished in accordance with the original goals. However,

there is no followup investigation of how this technology is applied afterward in the national economy. In other words, what happens to the technology developed at such great cost to the government is not clearly known. Therefore, the Agency for Industrial Science and Technology, on the occasion of the 15th anniversary of the large-scale project system, investigated what direct or indirect effect seven completed projects had had in industry and the national economy.

The seven projects investigated were 1) superhigh-performance electronic computer (1966 to 1971, approximately 10 billion yen); 2) desulfurization technology (1966 to 1971, approximately 2.6 billion yen); 3) new production techniques for olefins, etc (1967 to 1972, approximately 1.1 billion yen); 4) deep-water offshore remote-control oil drilling apparatus (1970 to 1975, approximately 4.5 billion yen); 5) sea-water desalinization and byproduct utilization (1969 to 1977, approximately 6.7 billion yen); 6) electric car (1971 to 1977, approximately 5.7 billion yen); and 7) automotive total control system technology (1973 to 1979, approximately 7.3 billion yen).

Practical Plants Lagging

Among these projects, the only one being fully utilized is the sea-water desalinization technology. In both Japan and overseas, 11 plants have been completed using the research results. The superhigh-performance computer research was helpful in building large-scale computers. The development of a high-speed computer for scientific and technical use is an extension of this project.

The development of new production techniques for olefins was suspended because of changes in the availability of raw materials. However, it has been continued in a large-scale project for production of olefins from heavy petroleum. The remote control apparatus for deep-water offshore oil drilling was found to be realizable with conventional technology so the project was ended after the initial period.

The results of the smoke emission desulfurization research were utilized in the desulfurization plants of Tokyo Electric and Chubu Electric. However, no direct desulfurization plant has been built. Practical application of the electric car is not making progress because of problems in economy. Also, there has been no practical application of the total control system for automobiles, just research on experimental systems.

Looking at only these seven projects, we see that while the technology was developed, the results generally have not been utilized. With respect to this, the investigative report suggests that it is important to promote the introduction of practical plants at the earliest opportunity after the research and development is complete in order to disseminate the research results. Even in the case of the electric car it was understood that it could not compete with the gasoline-powered automobile. The purpose of development was to prevent pollution. In such a case, drastic action may be necessary to introduce the research results, such as converting half of the cars used by the government officials in Kasumigaseki to electricity.

Another problem is that while the technology of the concrete kantai [phonetic] developed for desalinization of sea-water was the best in the world, the lack of

long-term operation experience caused hesitation in introducing the first plant. This is another reason for the slowness in disseminating research results and is something that deserves consideration.

Situation Changed by Technological Innovation

The themes chosen for large-scale projects were all responses to the needs of society at the time. However, there have been drastic changes in the domestic and foreign situation during long research and development periods, and some projects are no longer of use when the research and development is finished. Therefore, an interim evaluation becomes important. Project selection is an important issue for the future of the large-scale project system, but appropriate interim evaluation of the projects has also become important. Today, as the time necessary for development and the tempo of technological progress increase, it is important to evaluate the project at an intermediate stage with appropriate timing, and if necessary take strong action to change or suspend it. A flexible approach is called for.



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CSO: 4105/192

SCIENCE AND TECHNOLOGY

## PATENTS ON GOVERNMENT-PRIVATE JOINT R&D PROJECTS QUESTIONED

Tokyo NIHON KEIZAI SHIMBUN in Japanese 22 Jun 81 p 2

[Editorial Article]

[Text] Recently, there have been a growing number of public and private large-scale technology development projects. The technology under study includes atomic energy, space, nuclear fusion, coal liquefaction, VLSI, light, and fifth-generation computers. There are also some international joint development projects such as the SRC II and YXX projects. The patent rights derived from such development have become a matter of serious concern for the participating industries. The present system of national projects using government funds needs a thorough reevaluation, including a review of the principle that patents should be totally government owned.

Even though the government provides the funds in either case, there is a great difference in the handling of development results when funded through a subsidy as opposed to consignment expenses. For a subsidy, where the assistance amounts to 50 percent of the total costs, the participating enterprise is free to apply for a patent and take possession of the know-how. In the case of "consignment expenses," where the entire amount is borne by the national treasury, all patents for results are taken away by the government. Large-scale, long-term national projects involve a lot of risk, so they usually take the form of consignment projects. There has been an undercurrent of dissatisfaction on the part of companies that cooperate with national policy and commit talented manpower to these long-term projects, because of the lack of the benefits in comparison with their contribution.

The VLSI technology cooperative research group required a concentrated public and private investment of 70 billion yen and achieved a rare degree of success. Since the project was funded by a subsidy, the group was able to apply for and obtain over 1,000 patents. The subsidy of 28.5 billion yen will be returned in full to MITI after a 3-year deferment. The incentive of being able to retain the results of research undoubtedly spurred the participating industries to develop technology that would pay even if the subsidy were returned.

In the next 10 years, 2 trillion yen in government funds will be invested in the development of alternative energy sources such as coal liquefaction, geothermal,

and solar energy under the direction of the Alternative Energy Source Comprehensive Development Association. Another trillion yen will be spent in the next 10 years for the establishment of a nuclear fuel cycle, including uranium enrichment and plutonium recycling, in connection with the Power Reactor and Nuclear Fuel Development Corporation. For nuclear fusion, 200 billion yen will be spent in construction expenses for the JT 60 now being built by the Japan Nuclear Power Research Institute. An experimental reactor scheduled for completion in early 1996 will require 600 billion yen in development expenses and 6,700 man-years.

There are a large number of these large-scale, long-term national projects. If the goals are to be achieved successfully within the given time frame, it will not be enough to simply guarantee total financial backing from the government. New methods and systems must be found to fully mobilize the creativity and vitality of the private companies participating in development.

Measures To Stimulate Private Vitality

The Agency for Industrial Science and Technology started the Large-Scale Industrial Technology Research and Development System, commonly called the "large-scale projects," in 1966, so it already has a 15-year history. The budget for 1981 is 13.4 billion yen. Already 509 domestic patents have been obtained and applications for 766 more are pending. Under the Sunshine Plan for development of new energy, which was started recently, 717 new domestic patents were obtained and 303 are pending. The Moonlight Plan, for development of energy-saving technology, has led to 37 new patents and 52 pending. If the amount going to subsidiary research institutes and laboratories is included, the Agency for Industrial Science and Technology alone holds 3,822 patents and has 3,732 applications pending. When the share of the other ministries, agencies, public corporations, and special corporations is included, the number of patents held by government or semigovernment institutions is certainly much larger.

There are certain reasons behind this growing national holding of patents. One is the pretext of fairness, that since the projects are carried out with the people's tax money, the results should not be used by private enterprise but should revert to the country, even when the research and development is consigned to the private sector. Also, if an attempt is made to reward the enterprises participating in and contributing to the success of development, it is limited by the National Asset Law and Finance Law which prohibit the granting of licenses without compensation.

Although in principle there is no fixed form, this is handled under national finances and controlled and managed by the heads of the various ministries and agencies. Patent rights can be released through payment of a fee. The Power Reactor and Nuclear Fuel Development Corporation is carrying out a national project for uranium enrichment and plutonium recycling using an advanced thermal converter reactor, a fast breeder reactor, and a centrifugal separation process with a budget of 125.9 billion yen in 1981. It already has ownership of more than 200 patents. The Japan Telegraph and Telephone Public Corporation is being approached by IBM for a mutual opening up of their patents and know-how.

Utilizing Nationally Held Patents

In recent years, the idea has been advanced of building the country on the basis of technology and new systems for this purpose were instituted in 1981. These are the "flexible research system" of the Science and Technology Agency and MITI's "research and development system for next-generation basic industrial technolgoy. The former is using 500 million yen, out of the 3.35 billion yen in Science and Technology Development Coordination Expenses entrusted to the Science and Technology Council for distribution, for the advancement of creative science and technology. Its objective is to find the seeds of new technology. The latter has a budget of 2.7 billion yen for 1981. It is a system for cultivating next-generation industrial technology which will form the nucleus of Japanese technology in the 1990's. In creating these new vehicles for research, it is necessary to plan with sufficient foresight concerning the rights to patents and know-how.

The industrial sector wants a system under which the participating private enterprises could have joint ownership or make joint application for patent rights depending on the amount of their contribution to national projects. The government is proposing preferential licensing rights, a step short of what the private sector wants. It is imperative that the Science and Technology Council and the Industrial Technology Council deliberate this question seriously and make a decision as soon as possible. This decision should be designed to serve as a general guideline for the government ministries and agencies and the public corporations as well.

The most important condition is that a stimulus be provided to scientists and technicians to make these projects successful. For this purpose, Article 35 of the Patent Law should be strictly observed. The inventor himself should have a preferential right to apply for a patent, and institutions should obtain a license to use it. Also, when private enterprises are asked to participate in projects, specifications of performance and time should be fixed in detail and a flexible contract could be made by which the private organization would be able to retain the technology and know-how developed in return for doing its best to make the project succeed. The type of research contracts used by NASA and the Department of Defense in the United States should be studied in this respect.

Also, it is hoped that the patents already held and managed by the government will be released to the private sector and that active efforts will be made to make good use of them. In addition to the public-private joint technological development projects, the on-the-job inventions of personnel in the national universities, national research institutions, and special corporations are another rich source of nationally held patents. Stimulation of the desire for original discoveries in public research personnel would increase the efficiency of the 27.7 percent spent by the government in the total annual research expenditures of 4 trillion yen and expand the potential of cooperation between government, academia, and industry.

Twenty years have passed since new technological development organizations began to function in order to promote the development and industrialization of nationally

held patents; 36.6 billion yen have been spent on 192 projects, including ion-implantation, geothermal power generation, interferon, and amorphous metals. The rate of success in making the technology practical has been 90 percent. The plan for 1981 involves 15 projects with a total budget of 4.7 billion yen. However, compared to the British public corporation for research and development and France's new organization for the purpose, this is small scale. The results of investing government funds must be more effectively utilized and returned to society.



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CSO: 4105/191

SCIENCE AND TECHNOLOGY

SEMICONDUCTOR MANUFACTURERS COMPETE FOR 64 K RAM MARKET

Tokyo NIKKEI BUSINESS in Japanese 1 Jun 81 pp 118-121

[Text] "We are in a very difficult period for steering through the semiconductor market right now. Ordinarily, when the product price falls and profits are off, we hold back on plant and equipment investment. We cut costs and wait for the market to turn around. However, this will not work in today's semiconductor industry. We have to tighten our belts, build up the very latest equipment and increase our market share with a new product full of technological innovations. This is the only way to survive in this crucial period" (semiconductor company executive).

Companies Weak in 16 K Products May Recover

The semiconductor industry is entering a major technological revolution. An example is the dynamic RAM (random access memory), which is a representative semiconductor device widely used in computer memories. The main product was the 16 kilo bit RAM (memory capacity of 16,000 bits; a bit is a unit of information) but it is about to shift to 64 K bits. This 64 K bit product will have approximately 100,000 transistors packed into a single silicon chip just a few millimeters square. It is known as the entry product for VLSI (very large-scale integration).

The industry is moving frantically to produce and ship this 64 bit semiconductor. Let us look at Table 1. All the companies are conducting vigorous, bold investment in plant and equipment for the 64 K products. For example, the world's second largest semiconductor manufacturer, Nihon Electric Company, is planning to spend 35 billion yen, as an entire group, for plant and equipment (on a project base) in 1981. This is an increase of 20 percent over last year.

In addition, the plant and equipment investment of semiconductor manufacturers such as Mitsubishi Electric and Oki Electric, which did not perform well at the 16 K stage, is drawing attention. This year Mitsubishi is planning to invest 13 billion yen in its semiconductor division (a 30-percent increase over last year) and Oki is planning to invest 14.1 billion yen (an increase of 5 percent over last year). Oki will use this money to build a new manufacturing plant for 64 K products in a wholly owned subsidiary, Miyazaki Oki Electric. Right now, a test run is being conducted on an LSI production line with a capacity of 3 million units per month. Beginning in August of this year, it plans to ship approximately 300,000 64 K RAM's per month.

Table 1. Vigorous Effort by Semiconductor Companies to Produce the 64 K RAM

| | | Plant and Equipment Investment & Rate of Increase Over Previous Year (billion yen) | | Plant and Equipment Investment for 64 K Products (billion yen) | Monthly Production of 64 K Products | Monthly Production of 16 K Products | Peak Production of 16 K Products |
|---|---|---|---|---|---|---|---|
| Nihon Electric | 1981 | 35 | (19%) | -- | 100,000 units | 1,700,000 units | 2,700,000 units |
| | 1980 | 29 | (32%) | -- | | | |
| Hitachi, Ltd | 1981 | 28 | (22%) | -- | 150,000 units | -- | 1,100,000 units |
| | 1980 | 23 | (53%) | -- | | | |
| Toshiba Corp | 1981 | 15 | (15%) | -- | 50,000 to 70,000 units | 600,000 units | 1,000,000 units |
| | 1980 | 30 | (30%) | -- | | | |
| Fujitsu | 1981 | 27 | (0) | -- | 150,000 units | 2,000,000 units | 2,500,000 units |
| | 1980 | 27 | (69%) | -- | | | |
| Mitsubishi Electric | 1981 | 13 | (30%) | 5 | 30,000 to 50,000 units; 100,000 units in July | 300,000 units | 400,000 units |
| | 1980 | 10 | (25%) | 5 | | | |
| Oki Electric | 1981 | 14.1 | (5%) | 7 | 300,000 units since Aug | no outside sales | no outside sales |
| | 1980 | 13.4 | (2.4 times) | 6 | | | |

Note: Sales figures are for April 1981 unless otherwise specified.

Table 2. World Trends in the Production and Price of 16 K RAM's

| | | |
|---|---|---|
| Production | 1978 | 21 million units |
| | 1979 | 72 million units |
| | 1980 | 179 million units |
| | 1981 (estimate) | 250 million units |
| Price | 1978 (average) | $10.30 |
| | 1979 | $6.35 |
| | 1980 | $4.00 |
| | 1981 (estimate) | $2.00 |

Note: Taken from the data of Data Quest, a U.S. company (except for the 1981 price estimate). The price given is the unit price.

Mitsubishi Electric is building a second plant at its Kumamoto works to manufacture 64 K products. It will go into operation in July. It will begin manufacturing 100,000 64 K RAM's per month, and by the end of the year it is scheduled to increase this to 200,000 per month.

There are three reasons why these late-developing semiconductor manufacturers are focusing the entire company's efforts on investment in plant and equipment for 64 K products. First, even the semiconductor companies which did not do much with 16 K products could get a share of this market with more effort. Yoshio Masuda, executive managing director of Oki Electric, says: "The potential users are the all-purpose computer firms in the United States." Computer companies went through a period of grief due to a shortage of 16 K parts. It is possible that a shortage of 64 K parts will occur in the future, so the computer companies want to diversify their sources of supply. Therefore, they are gathering samples from many different semiconductor manufacturers and conducting an independent evaluation of performance.

"The computer firms are basically giving emphasis to past performance with 4 K and 16 K products in deciding on their semiconductor suppliers. However, if there are semiconductor manufacturers who can provide superior products at low cost, they are prepared to enter into new business relationships," says Mr Masuda. The readiness of computer companies to diversify their suppliers has given the late-developing semiconductor companies a chance to work their way into the market.

Demand Expanded for Small Machines Used in OA

The second reason is that new expansion of the semiconductor market has given the late-developing manufacturer new motivation. Hiroo Sato, Semiconductor Division manager at Mitsubishi Electric, says: "We cannot overlook the increased demand for 64 K products in OA (office automation) market." Due partially to innovations in software, the production and sales of personal computers, word processors, and terminal equipment has grown at a rapid pace the world over. The 64 K RAM is beginning to be actively used in memory parts of small computers as well as in multipurpose large computers.

Indeed, the shift from 16 K to 64 K memory devices is most influential for the small computer. The 64 K device density is four times that of the 16 K product.

Therefore, in making a small computer with the same memory capacity, the area required for memory with 64 K RAM's will be one-fourth that required with 16 K RAM's. The office computer that was once the size of a desk will become a desk-top unit, and the personal computer that once took up half a desk will become small and light enough to carry. So the demand for these products should expand tremendously.

An ambitious manufacturer of small hardware cannot ignore the attractiveness of the 64 K RAM. Among Japanese firms, Sord Computer Systems has announced a personal computer, the M20/23, which is advertised as "totally equipped with 64 K RAM's." Although the volume of semiconductors used in one unit is small, the overall volume will increase quite a bit. NEC, for example, is selling more than 10,000 PC-8001's a month.

Furthermore, since small hardware is a new field, the connections between semiconductor users (small hardware companies) and suppliers (semiconductor manufacturers) are still weak. So even the latecomers have plenty of opportunity to grab attractive sales prospects. Oki Electric Executive Managing Director Masuda says: "We are making special efforts to sell 64 K RAM's in the small hardware market. Our objective is to find new users."

The third reason for increased investment is that those who do not get a share of the 64 K market will have no more opportunities until the 256 K RAM appears in 5 or 6 years. "We must get a 15-percent share of the 64 K RAM market one way or another. Our share of the 16 K market is only 6-7 percent, so we want to double it" (Mr Sato). The late-developing manufacturers are making a terrific burst of speed to catch up.

On the other hand, the leading semiconductor manufacturers are not sitting by idly while latecomers like Mitsubishi and Oki make their attack. Fujitsu has been tackling the 64 K RAM even more vigorously than the latecomers. This company's semiconductor business is almost entirely specialized in RAM's for computer memory applications. However, they have begun shipping samples of 64 K RAM's ahead of other companies. Right now, they are producing 150,000 units a month, the largest volume of any company in Japan.

Reemergence of Friction in Semiconductors

Hitachi, Ltd is building a system to produce 64 K RAM's on the same level as Fujitsu: about 150,000 per month. Toshiba was producing 50,000 to 70,000 units per month at the end of April, but according to Hiroo Yoshie, Semiconductor Division deputy manager: "If we just decide to push the button, we have the facilities to produce over 100,000 units per month." The static RAM is easier to use and faster than the dynamic RAM. While increasing the range of these products along with ROM's (read only memory), these companies are making firm moves in the fight for the 64 K RAM market.

However, the battle between the Japanese semiconductor firms over the 64 K market is causing some waves. The biggest problem is that it is likely to cause renewed friction between the semiconductor industries of the United States and Japan. The U.S. semiconductor industry has been hard hit by a sluggish market. Following

the price of a main product, the 16 K RAM, we find that they were $6.00 apiece last summer but dropped to $2.00 as of the end of April this year. This is a drop to one-third the former price in 1 year.

The Japanese semiconductor industry is not directly connected to this deterioration of the market. IBM suddenly suspended its external procurement of semiconductors. This prompted the large-scale users of semiconductors to anticipate a future softening of the market and they rushed to adjust their inventories.

Problems in the relationship of supply and demand have made things worse. For example, at the end of the first quarter of 1981, Intel reported a 91-percent drop in income. Mostek, which had been the world leader in production of the 16 K RAM and the 4 K RAM, says that because of poor sales, it cannot squeeze out the funds needed for development and equipment investment for the 64 K RAM. Japanese manufacturers, on the other hand, incurred little damage in comparison with the U.S. semiconductor industry. Their productivity is higher than that of the United States and all of the companies involved have other business in addition to semiconductors.

In these circumstances, Fortune reports, "Japan will conquer 70 to 80 percent of the 64 K RAM market." The Japanese, according to Sadao Inoue, deputy general manager of Fujitsu's Semiconductor Division, "will not make contracts for exports of 16 K RAM's to the United States under $2.00." NEC Vice President Jungi Ouchi says: "We will avoid low-price spot sales and keep the production of 16 K RAM's under 60 percent of peak production." By such policies, Japanese companies are attempting to give support to the market and avert charges of dumping from the United States. However, because the 64 K RAM is a strategic product, a renewed flareup of trouble between Japan and the United States over semiconductors is feared if the Japanese products capture a large share of the market.

A second problem is that design standards for the 64 K RAM are not fixed yet. In the semiconductor industry, the company with the second largest share of the market routinely matches its pin configuration to that of the leading company. The Mostek company obtained the largest market share for the 4 K and 16 K RAM's, so its pin configuration became the standard. In the case of the 64 K RAM, Texas Instruments took the lead at first. However, Motorola attempted to overtake TI and appears to have come out on top. Mostek, as mentioned above, may be late getting into the 64 K market because of the rapid falling off of the 16 K RAM.

Furthermore, Intel has announced that it will use standby circuits and redundancy circuits to improve production yield. As a result of all this, the 64 K RAM specifications still have room for change.

Jumping Into Mass Production After Standardization

The most advanced company in Japan's semiconductor industry, NEC, is taking a posture of caution in shipping 64 K RAM's. NEC's monthly production of 64 K RAM's is about 100,000, a little less than Fujitsu or Hitachi, Ltd. One rumor has it that "They are having serious problems with improving yield at the mass-production stage."

However, Vice President Ouchi says: "The main reason for our production volume is that we are waiting for a rise in demand. The problem of specifications is also involved." If 64 K products were shipped in large volume now, customers would use them in designing their products. Afterward, if the 64 K design was modified, it would cause problems for the customer. "It is not necessarily desirable to be first in the initial shipping stage. We are purposely delaying production of 64 K RAM's. The time for mass production is after the design specifications are standardized. We will still have plenty of time to catch up," says Mr Ouchi. Each company has its own strategy for commercializing strategic products incorporating new technology and obtaining a larger market share.

So then, when will the 64 K RAM take over from the 16 K RAM as the main semiconductor product? Mr Ouchi reflects the opinion of most observers when he estimates "between the end of 1982 and 1983." Others feel that if the price alone is considered, the attention of users will shift from the 16 K to the 64 K product somewhat earlier. The basis for this view is the leveling off of the slump and a slight rally in the 16 K RAM market. The unit price for the 16 K RAM went below $2.00 at the beginning of the year but leveled off in the first quarter and has gone back to $2.00.

The price of the 64 K RAM dropped rapidly between last year and this, along with the falling price of the 16 K RAM. Because of the intense competition, companies in the U.S. market are reported to be battling each other by distributing free samples and selling cheap. The view has gained ground that, by the end of this year at the earliest or the beginning of next year, the per-bit prices of the 16 K and 64 K RAM will be about the same.

The price of the 64 K RAM at that time will be from $8.00 to $10,00 apiece. As one semiconductor manufacturer put it: "The companies which began first to mass produce the 16 K RAM were able to obtain founder's profits at a relatively stable price. However, because of the sudden drop in price and excessive competition, we may not be able to expect profits from the 64 K RAM comparable to those obtained with the 16 K RAM." The manufacturers are very concerned about renewed trouble between the U.S. and Japanese semiconductor industries as well as the market for technology-intensive semiconductors such as the 64 K RAM, which has required a huge investment.



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CSO: 4105/180

SCIENCE AND TECHNOLOGY

# HITACHI, TOSHIBA AND MITSUBISHI WILL BOOST R&D OUTLAY BY 14.8 PERCENT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 9

[Text]

Research and development expenditures by the three Japanese general electric machinery makers — Hitachi, Ltd., Toshiba Corp. and Mitsubishi Electric Corp. — increased an average of 14.8 per cent in the fiscal 1980 term, ended March 31, 1981.

R&D outlays accounted for 4 to 6 per cent of their sales.

These three companies are expected further to increase R&D expenditures as high technology is expected to determine their growth in the future.

Hitachi spent ¥115.6 billion in fiscal 1980, up 17.1 per cent from the preceding year, for research and development. The R&D value was the highest among Japanese electrical machinery makers. The R&D expenditures accounted for 5.9 per cent of Hitachi's sales, up 0.1 percentage point from the preceding year.

Toshiba's R&D outlays in fiscal 1980 stood at ¥74.3 billion, up 7.7 per cent. The share of R&D outlays in sales reached 4.8 per cent.

Mitsubishi raised R&D spending 20.9 per cent to ¥52 billion. The R&D-to-sales ratio came up to 4.3 per cent from fiscal 1979's 4.0 per cent.



CSO: 4120/284

## WEST GERMAN COMPANIES STARTING TO RUSH AFTER JAPANESE TECHNOLOGY, CAPITAL

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 3

[Text]

West German industries, which in the past had tended to regard Japan simply as an export market or a recipient of their technologies, lately have begun to seek Japanese capital and technologies.

Informants, citing such a "reverse" trend, ascribed this to the mounting rivalry between Japan and West Germany in the electronics and electromechanics fields, especially concerning autos, and growing instances of the Japanese wresting away past German dominance.

This was said to have prompted West German companies to consider, among other things, acquiring knowledge from the Japanese on management and quality control.

Specifically, the West Germans have begun to seek setting up of joint ventures in their countries, acquisition of Japanese technologies, and supply of Japanese products on an original equipment manufacturer (OEM) basis.

The informants said the Japanese were actively complying with the West German overtures not only from business reasons but for skirting trade frictions.

The Germans are said to have begun seriously sizing up the "capability" of Japanese companies from about a year ago. It was said that the visits of West German industrialist to inspect industries in Japan started becoming brisk from this year, with sort of a "rush of missions" setting in from this spring to early summer.

The informants noted that while the rising caution of the West Germans against the Japanese had led to intensifying competition between Japanese and West German firms in overseas markets, cases of their cooperation as to capital, technology and products also have increased.

For instance, Victor Company of Japan Ltd. (JVC) will shortly start joint production of video tape recorders in West Berlin with AEG-Telefunken. Matsushita Electric Industrial Co. also has reached an understanding with West Germany's Robert Bosch GmbH on VTR production based on a joint venture formula.

In the field of auto parts, Nippon Oil Seal Industry Co. has concluded three-way contract on forming a joint firm for producing and selling electronic auto parts with Carl Freudenberg of West Germany and Rogers Corp. of the U.S.

An out-of-ordinary case is the negotiations now between Nissin Food Products Co. and Birkel GmbH of Stuttgart on forming a joint venture to produce and sell instant cup noodles.

There are instances of West German firms recognizing the uniqueness of some Japanese products and then trying to secure OEM rights for them over a long term.

Nixdorf Computer is now reported seeking some Japanese from whom to secure parts and peripheral devices on an OEM basis.

Aside from them, Fujitsu Limited is going to supply its latest general-purpose computers to Siemens on an OEM basis.

Toshiba Corp. also is said to have received bids, such as from Standard Elektrik Lorenz AG of Stuttgart, for OEM supply of its high-speed plain paper copies.

As for technologies, there are instances of Japanese

firms offering technologies to those from which they originally received aid.

Recently, Matsushita Electric Works, Ltd. has concluded a blanket contract on offering Brown, Boveri & Cie. of West Germany its technologies on controlling electric facilities. Sumitomo Metal Industries, Ltd. also has given its technology on making its aluminum extruder to Schloemann-Siemag AG of Duesseldrof.

Misawa Homes Co. is reported intending mutually to exchange technologies on building prefab homes, sales practices and management know-how with OKAL.

Siemens is said to have recently expressed wish to Fuji Electric Co. of its desire to learn from it ways to boosts productivity and elevate quality control.

Fuji up to this time yearly had been sending its technicians to Siemens to receive technical training.



CSO: 4120/284

SCIENCE AND TECHNOLOGY

# GROWTH OF JAPANESE WORD PROCESSOR INDUSTRY DESCRIBED

Tokyo COMPUTOPIA in Japanese Jul 81 pp 97-101

/Text/ Japanese Word Processor Coming Into Popular Use

The Japanese language word processor /WP/, a heaven-sent product for the field of OA (office automation), is finally moving into a period of popular use. Since it was first commercialized by Toshiba in September, 1978, some 20 companies have entered the market.

Especially in the last few months, the number of manufacturers has almost doubled. Mitsubishi Electric Corporation and Hitachi, Ltd, announced their products, and new entrants such as Nippon Digital Laboratories and Yokogawa Electric Works continue to appear.

The Japanese word processor is a relatively new product, but sales in 1980 had already reached several hundred billion yen and more than 2,000 machines had been delivered. The market is likely to grow by several times in 1981. Attention is focused on how the marketing competition will develop in this promising market which can be called the nucleus of OA.

This is because sales performance in the next year or two is seen as the key to leadership in this market and, ultimately, in the OA market.

Therefore, in this article I would like to take a look at the Japanese word processor, which is building this "hot" market, examining the more unique new products from the various manufacturers as well as functions and features to be sought in future word processors and the future development of the market.

## Editing and Recording Are the Life of the WP

So what is the word processor? In brief, it is a machine that edits, prepares, stores, and prints documents. It is a document preparation machine with memory and editing functions added to a typewriting function. These three functions can be broken down as follows.

(1) Text Input Function

This is the input part of the machine. There are two main types of input system in today's Japanese word processors--the pen-touch all-character array system and the kana-kanji (from kana syllabary to Chinese character) conversion system.

(2) Text Editing and Correction Function

This function includes character correction insertion, and deletion; specification of line spacing; and display of ruled lines and graphs. Even if the original is imperfect, certain corrections can be made quickly.

(3) Text Printing and Transfer Function

This function includes printout of documents and transmission through connection with a facsimile machine. Document input is done by keyboard. The input document is then displayed and corrections and deletions are made through the correction and editing function. There is also a file function in which the input text is recorded on a floppy disk or other form of storage medium. Afterwards texts and standard documents can be called up from the file any number of times, speeding up the work of preparing documents. Printout of the documents is also a basic function.

Diversified Input Systems

The Japanese word processor can be thought of as a specialized computer for production of documents. A final feature is diversified input. As mentioned previously, this includes the pen-touch and kana kanji conversion systems. The former is the major system in use today.

The all-character array system is based on the same concept as the Japanese typewriter. Approximately 3,000 characters (including Chinese characters, the hiragana and katakana syllabaries, the Roman alphabet, and Arabic numerals) are arranged on one panel and the appropriate character is inputted by the touch of a pen or finger. With this system, an important factor is the arrangement of the characters on the board. Both Sharp and Oki Electric use the order of the 50-sound Japanese syllabary even for homonyms. NEC /Nippon Electric Co/ has four systems in addition to the regular syllabary order: The "iroha" order, the Tokyo Kanji limited system, and the NEC system. A special feature is the new mechanism whereby the "iroha" system can be converted to the 50-sound syllabary system by simply changing a sheet on the control panel.

The basic concept of the kana-kanji conversion system, on the other hand, is to input the phonetic reading of Chinese characters with kana syllabary keys. The machine then converts the kana back to Chinese characters. The attraction of this system is the reduction in the number of keys achieved by using the kana syllabary. A touch-type method similar to that used with an English typewriter then becomes feasible.

However, because of the homonyms found in words represented by Chinese characters, the machine is provided with a lexicon. There are a number of systems used for this purpose but we will just mention two here: the "dialogue system" (Fujitsu) and the "automatic conversion system" (Toshiba). In the dialogue system, the previously used lexical item appears first. If not appropriate, the operator pushes the conversion button until the correct character appears.

In the automatic conversion system, a "grammatical analysis function" is given to the machine. For example, if the input is "yoi suru" the characters "「用意する」" (prepare) will be selected. If the input is "yoi ni suru," the characters "「容易にする」"

(make simple) will be selected. In short, the machine will decide which is appropriate on the basis of the auxiliary word "ni." Homonyms which cannot be determined by this means are selected by a learning function called "use frequency control." In other words, the vocabulary item recorded as having the lowest initial frequency of use increases in order of frequency each time it is used. If it reaches the position of greatest frequency, it will appear first the next time.

In addition, there is the Romaji (Romanization of Japanese alphabet) input system (Canon) which is operated much the same as the kana-kanji conversion system. In this system, keys marked with the Roman alphabet are punched for input and the Romaji is automatically converted to a text composed partially of Chinese characters. It is as easy to use as the kana-kanji conversion and easier for operators skilled at English typing. In addition, there is an "association system" (Hitachi) where two characters from the kana syllabary are assigned to each Chinese character. For example, the character "漢" (kan) is associated with China so the two kana syllabary characters "chi" and "na" are pushed for input. The manufacturer emphasizes the speed of this system but it is a difficult task to learn the associated characters. This means that a special operator is necessary. It would be difficult for just anyone in the office to use it.

Broken down by type of input system, the all-character array system is used by NEC, Oki Electric, Sharp, Tokyo Juki Industrial Company, Matsushita Communication Industrial Company, Ito Chu Data Systems, and Pentel. The kana-kanji conversion system is used by Toshiba Corporation, Fujitsu, Mitsubishi Electric, Nippon Univac, and Canon. As mentioned previously, the system used most at present is the all-character array. However, all the manufacturers say that the user should determine which system is best. To back up this position, the manufacturers who have recently entered the market are using a combination of both systems on producing two different systems at the same time to allow the user a selection (Hitachi, Ricoh).

How Much Will the Processing Functions of the Japanese WP Expand?

Since clerical work in Japan involves handwriting of documents using both Chinese characters and the kana syllabary, the production of documents takes much more time than in the United States. If this function could be mechanized to make document preparation more efficient, it would mean dramatic progress in the streamlining of clerical work. The leading product for accomplishing this mechanization is the Japanese word processor.

Standard texts such as greetings or polite phrases can be inputted in advance and called up whenever necessary. Proper nouns can be inserted in the necessary places. Correction and deletions can be made and the ends of lines can be lined up. In this way, the Japanese word processor is just the machine for processing repetitive business documents.

However, if we examine the form of information inside business organizations, we find that 70 percent is text or graphs, nonnumerical information. Numerical data is concentrated in line functions such as sales, inventory control, purchasing, and manufacturing. In contrast, nonnumerical, linguistic information is concentrated in personnel, general affairs, documents, research, and secretarial functions. Previous computerization has not covered these sufficiently.

An important part of the work in these sections is the preparation of documents such as directories, plans, reports, and reference materials for conferences. Also, items like specifications, contracts, and manuals with lengthy texts, which have been sent out to a printer in the past, can be prepared nicely with the word processor.

Will Late-Developing Manufacturers Lead the Market?

The wide assortment of companies which make Japanese language word processors are shown in an accompanying table.

The central price range is from 2.5 million to 3 million yen. Nine of the 17 machines are in this range. Since most of the processors are in the 2-million-yen range, the next step, if the projected trend of market expansion continues, will be to get under the 2 million yen mark. At present, Oki Electric's "Lettermate 80" and Nippon Digital Laboratories' "Bunsaku" are in this category.

In the area of performance, we should consider the existence or lack of a display function, differences in printing technique, and existence or lack of a data transmission function in addition to the differences in input method. However, these differences will not lead to great divergence in sales competition. From the user's point of view there are many different models suited to different requirements and it is a matter of selecting the right machine for the job. In this respect, the market is expanded more by having many different machines with special features.

The 56th Business Show was held recently (13-16 May) at the Harumi International Trade Center in Tokyo. Word processors were displayed by 15 companies which had developed the products themselves. There were 22 companies represented altogether, if sales outlets are included, displaying a total of 25 machines. All the Japanese word processors on the market today seemed to be represented. The features of each are given in the accompanying table. Let us examine the features of four particular machines.

The Bunsaku (made by Nippon Digital Laboratories) is inexpensive and equipped with a computer function. This is the first Japanese language word processor equipped with display capability and a computer function that can handle arithmetic operations and costs less than 2 million yen. In addition to documents, it can also prepare numerical charts and estimates. Therefore, it can prepare sales reports containing statistical graphs as well as ordinary office documents. This machine has attracted the attention of competitors and, especially with respect to the computer function, is bound to have a great effect on products which will appear on the market from now on.

The RIPORT 600 (made by Ricoh) is equipped with facsimile in the printer. An "electronic mailing system" whereby documents are prepared and sent to distant destinations via connections with communications lines has already been tried with the word processor, but the RIPORT 600 carries this one step further. The word processor machine itself can transmit documents directly and there is no need to take the printout and place it in a facsimile machine.

The Wordix (made by Yokogawa Electric Works) can do finished light printing. The main feature of this machine is an automatic typewriter for WP use which is off-line but connectible. The documents prepared with the Wordix machine are stored on a small floppy disk which can be placed in the controller of the Chinese character typewriter and a large volume of documents can be typed automatically. The documents printed by this automatic typewriter can be used as finished copies for light printing so the machine has attracted the interest of the printing industry.

The "Panaword 1000" (made by Matsushita Communication Industrial Company) is equipped with a zooming function. The special feature of this machine is the zooming function which displays the layout of an entire page. Therefore, it is especially suited to greetings, invitations, and other documents where the layout is an important consideration.

There is a strong demand for efforts to improve functions as well as to lower the price of future Japanese language word processors.

Trend Toward Diversified Functions in Japanese Language WP

We can indentify five major characteristics of the present market for Japanese language word processors.

(1) Less than 3 years have passed since the first product appeared (Toshiba JW-10, September 1978) and the market has actually been formed only in the last year. The market itself is very young.

(2) of the 15 percent manufacturers who developed products themselves, 10, or more than half, announced their first product and entered the market during the last year. As is common during the formative period of a market, most of the manufacturers entered the market at the same time.

(3) As if to forecast the great potential of the OA market, there has been active participation by companies which until now had had little experience with computers or business machines. There is a marked interest among companies which had only handled sales, for example, OEM /Original Equipment Manufacturing/ suppliers, to expand into the computer field on the basis of that experience. In other words, they see WP as the key to the OA market (Suganuma Typewriter, Brother Industries, Plus).

(4) Since the product has just appeared, there is a great variation in price between manufacturers. This extends from 4.95 million yen for NEC's high-speed laser printer to 1.85 million yen for a model without display made by Oki Electric Industrial Company.

(5) In terms of function, more effort is being made by late-developing manufacturers than early manufacturers to add new features and create distinctions.

From these facts and the size of demand, we can conclude that the Japanese language word processor market will continue an overall expansion. According to the Japan Business Machine Makers Association, the market amounted to 200 million yen on a monetary basis in 1979. Sales of 500 million yen and 1 billion yen are expected for 1980 and 1981, and this figure is expected to reach 100 billion yen by 1985. Until now there was a great difference between the Japanese and the English word processor in both technology and dissemination because of the special problems of mechanizing the Japanese language. However, as electronics technology, such as LSI, was developed, it became possible to prepare beautiful Japanese texts with little difference in operation from the English word processor (especially using the kana-kanji conversion system). Although we cannot say which machine or manufacturer will rise to the top in the market, we can say with certainty that there is a large demand for the Japanese word processor as such.

On the other hand, what direction will the Japanese word processor take in terms of function? The market is new and many manufacturers of varying experience are coming out with a variety of products. Furthermore, there is plenty of overall market demand. In such a situation progress will take the direction of diversification of products to meet diverse needs.

In other words, there is a move toward more sophisticated machines with diverse functions (suited to continual processing of large volumes of work in the document sections of large industries) and miniaturized machines aimed at a wider, more personal demand. One example of the latter is the handy Japanese language word processor prototype exhibited by Sharp at the recent business show.

In addition to changes in separate word processor units, there will be a tendency to add word processing functions to office computers, personal computers, and other types of specialized computers (Nippon Digital Laboratories' JDL 208 model 9 and Nippon Business Computer's JBC 100).

Also, if we take a somewhat long-range view, we can expect that voice input, color printing, and color display will be built into word processors as improvements are made in peripheral equipment. In any case, the Japanese language word processor will undoubtedly secure an influential position for itself in the OA market along with facsimile and personal computers.

Table Representative Japanese Language Word Processors

| Company Name | | | Ito Chu Data System | Oki ELectric Industry | Casio Calculator |
|---|---|---|---|---|---|
| Machine Name | | | Wang OIS | Lettermate 80 | WP-1 |
| Input Function | Input System | | all-character array tablet | all-character array pen touch | all-character array page tablet |
| | Keyboard Arrangement | | 50-sound syllabary | 50-sound syllabary | 50-sound syllabary |
| Output Function | Display | Screen Size (in) | 12 | | 12 |
| | | No of Display Characters (Characters x Lines) | | | 40 x 25 |
| | | Character Pattern (Dots) | | | 24 x 24 |
| | Printer | Printing System | dot | wire dot | wire dot |
| | | Character Pattern | 24 x 24 | Ming Dynasty style 24 x 24 | Ming Dynasty style 24 x 24 |
| | | Character Size | ordinary | standard, variable (capital and small letters) | standard, variable (full size, half size) |
| | | Printing Speed Characters/sec | | 25 | 15 |
| | | Type of Paper | ordinary, roll | ordinary, roll, rice paper | ordinary |
| | | Paper Size | | B4, B5, A4 | B4, B5, A4, max. 364cm |
| | | Max. Characters per Line | | 80 | 90 |
| | | No of Copies | | 3 | |
| Characteristics | | No of Characters | 6,802 | 3,320 | |
| | | No of Foreign Characters | | 375 | |
| | | Storage Medium | | mini-floppy disk | floppy disk |
| | | Memory Capacity | A4, 2,000-24,000 pages | A4, 75 pages | A4, 250 pages |
| Data Transmission Function | | | none | none | |
| Date Sales Began | | | | 5/7/80 | 5/1/81 |
| Price (10,000 yen) | | | 1,000 | 185 | 295 |

Table - continued

| Canon Sales | Sharp | Toshiba | Tokyo Juki Industrial |
|---|---|---|---|
| Canoword 55 | WD-300 (Shoin) | JW-5 | Juki Japanese Language WP 3100 |
| Romaji, kana-kanji conversion | all-character array, pen touch | kana-kanji conversion | all-character array, pen touch |
| JIS combined English & kana | 50-sound syllabary | JIS array, 50-sound syllabary | 50-sound syllabary |
| 12 | 12 | 12 | 12 |
| 46 x 16 | 41 x 10 | 41 x 14 | 40 x 10 |
| heat transfer, ordinary paper printer | ink jet | wire dot | ink jet |
| Ming Dynasty style 24 x 24 | | Ming Dynasty style | Ming Dynasty style |
| standard, variable (full size, half size, double size) | ordinary | ordinary, variable (double size, half size) | standard, variable (capital and small letters) |
| 15 | 79 | 35 | 74 |
| ordinary cut paper | ordinary, roll, rice paper | ordinary, roll | ordinary, roll |
| A3 | B4, B5, A4 | | B4, B5, A4 |
| | 79 | | 79 |
| | | | |
| 3,500 | 3,581 | 6,802 | 3,644 |
| 376 | 63 | 128 | 63 |
| mini floppy disk | mini floppy disk | floppy disk | mini floppy disk |
| A4, 110 pages | A4, 24 pages | A4, 120 pages | A4, 29 pages |
| available | none | none | none |
| 11/1/80 | 9/20/79 | September 80 | |
| 260 | 295 | 260 | 295 |

Table - continued

| Nippon Digital Laboratories | Nippon Univac | NEC | Hitachi |
|---|---|---|---|
| Bunsaku | UW 10 | NWP-20N (Bungo) | BW-20 |
| all-character array code input | kana-kanji conversion | all-character array, pen touch | all-character array, pen touch |
| 50-sound syllabary | JIS array, 50-sound syllabary | 50-sound syllabary, iroha array, etc. | 50-sound syllabary |
| 12 | 14 | 14 | 12 |
| 40 x 17 | 41 x 25 | 40 x 25 | 46 x 11 |
| | 24 x 24 | | |
| dot | wire dot | laser system | wire dot |
| Ming Dynasty style 24 x 24 | 24 x 24 | Ming Dynasty style 24 x 24 | Ming Dynasty style 24 x 24 |
| standard, variable | standard, variable (half size, double size) | standard, variable | standard, variable (double size, full size, half size) |
| 35 | 60 | 60 | 35 |
| ordinary, roll, rice paper | ordinary paper | ordinary, roll | ordinary paper |
| B4, B5, A4 | B4, B5, A4 | B4, B5, A4, A5 | |
| | 90 | | |
| 2 | | | 3 |
| 6,000 | 6,800 | 7,739 | 6,802 |
| 3,500 | | 200 | 1,500 |
| floppy disk | floppy disk | | mini floppy disk |
| A4, 150 pages | A4, 150 pages | A4, 250 pages | A4, 80 pages |
| available | available | available | |
| 4/10/81 | 1981 | 5/6/80 | 5/10/81 |
| 198 | 293 | 495 | 250 |

Table - continued

| Fujitsu | Pentel | Matsushita | Mitsubishi |
|---|---|---|---|
| OASYS 100 | PW-802 Lettercon | Panaword 1000 | M8510 |
| kana-kanji conversion | all-character array pen touch | all-character array | kana-kanji conversion |
| thumb shift keyboard | 50-sound syllabary | 50-sound syllabary | JIS array, 50-sound syllabary arrangement |
| 14 | 12 | 12 | 14 |
| 48 x 32 | 42 x 16 | 32 x 12 | 41 x 25 |
| 16 x 16 | | 24 x 24 | 24 x 24 |
| wire dot | wire dot | ink jet | wire dot |
| 24 x 24 | 24 x 24 | Meichotai 24 x 24 | 24 x 24 |
| standard, variable (half size, double size) | | standard, variable | standard, variable |
| 40 | 40 | 74 | 60 |
| ordinary, roll | | ordinary paper | ordinary, roll |
| B4 | | max. width 364 mm | B4, B5, A4 |
| 90 | | 82 | 90 |
| max. 5 pages | 5 | | |
| 7,300 | 3,200 | 6,820 | 3,800 |
| 94 | | 4,361 | 188 |
| floppy disk | floppy disk | floppy disk | floppy disk |
| A4, 80 pages | A4, 216 pages | A4, 400 pages | A4, 150 pages |
| none | | none | available |
| 5/7/80 | | | 5/6/81 |
| 270 | | 350 | 293 |

Table - continued

| Yokogawa Electric Works | Ricoh |
|---|---|
| Wordix | RIPORT 600 |
| kanji stroke | 2-stroke system, cordless pen-touch system |
| 50-sound syllabary | kana A/N keyboard all-character array |
| 12 | 14 |
| 40 x 9 | 40 x 24 |
| 24 x 24 | 24 x 24 |
| heat transfer, type dots | dry statoelectric recording system |
| Meichotai 24 x 24 | Meichotai, Gothic 32 x 32 |
| standard, variable (double size, half size) | standard |
| 15 | 84 |
| ordinary, roll | statoelectric recording paper |
| A3, A4, B4, B5 | A4 |
| | 40 |
| 7,212 | 5,000 |
| 72 | 204 |
| mini floppy disk | floppy disk |
| A4, 100 pages | A4, 400 pages |
| none | available |
| June 1981 | September 1981 |
| 236 | 448 |



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CSO: 4105/197

SCIENCE AND TECHNOLOGY

# COMPUTER MAKERS SEE BIGGER BUSINESS WITH OFFICE AUTOMATION POPULARIZATION

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 9

[Text]

With Japanese businesses getting more enthusiastic about so-called "office automation," computer makers are optimistic about their performances in the current fiscal year.

Sales of computers and other information processing equipment by the eight major computer builders are estimated to rise 12 per cent to a total of ¥1,700 billion in fiscal 1981 from the ¥1,510 billion in the preceding year. The Big 8 are Fujitsu Limited, IBM Japan Ltd., Hitachi, Ltd., Nippon Electric Co. (NEC), Toshiba Corp., Oki Electric Industry Co., Nippon Univac Kaisha Ltd. and Mitsubishi Electric Corp., in the order of estimated sales for fiscal 1981.

Seven out of the eight companies expect that their sales will record double-digit gains in the current fiscal year, though the estimated rate of growth ranges from 10 per cent to 18 per cent. Nippon Univac, an affiliate of Sperry-Univac of the U.S., is the sole exception, with an outlook of an 8.1 per cent gain in fiscal 1981 sales.

These computer makers are pinning a big hope on the expanding office automation equipment market. They are ready to introduce a variety of OA equipment, ranging from personal computers to Japanese-language word processors. In an attempt to capitalize on the "OA boom," these computer makers are hurriedly consolidating their marketing channels.

In the field of general-purpose computers, the core of the computer industry, NEC, IBM Japan, Hitachi and Fujitsu have introduced large-size models in succession since last autumn. They will carry out marketing campaigns for such large-size mainframe computers this year.

Fujitsu, which announced the M-380 and M-382 models in late May, plans to sell 150 systems during the coming four - year period. Demand for such very large-size computers is strong at big banks and governmental agencies, says Fujitsu President Taiyu Kobayashi.

NEC recently revealed that orders for its very large-scale computer ACOS1000 already have reached 15 sets. Negotiations with customers on 30 more sets are now under way. NEC will start delivery of the super high-capacity computer in October.

IBM Japan, a wholly-owned subsidiary of International Business Machines Corp., recently announced that it would introduce the "3081" large-size computers in September, or one month earlier than the scheduled date. IBM Japan already has received orders for more than 100 units of "3081." Under the situation, possibility is strong that IBM Japan will record a double-digit increase in sales, though in the past few years its sales growth was confined to the single-digit level.

Hitachi, which introduced the M-280H model in

**Planned Computer Sales For Fiscal 1981**

(In billions of yen)

| | FY1981 | FY1980 |
|---|---|---|
| Fujitsu | 430.0 (+12.5) | 382.0 (+16.9) |
| Hitachi | 285.0 (+14.0) | 250.0 (+15.7) |
| NEC | 274.0 (+14.0) | 240.3 (+19.8) |
| Toshiba | 95.0 (+18.3) | 80.3 (+16.0) |
| Oki | 88.7 (+12.6) | 78.8 (+10.0) |
| Mitsubishi | 73.0 (+17.7) | 62.0 (+17.0) |
| IBM Japan | — (More than +10) | 338.3 (+ 4.3) |
| Nippon Univac | 85.0 (+ 8.1) | 78.6 (+ 6.8) |

Notes: (1) Percentage change from the preceding term in parentheses. — unavailable. (2) The term ended December for IBM Japan. The accounting term ends in March for other companies.

February, is pleased with favorable responses from potential customers. It expects over a score of M-280Hs will be sold in the coming four-year period.

Computer builders are more interested in the OA equipment market because the new market is expected to expand at an annual rate of 40-60 per cent in the combing several years and become a "several trillion yen business" in 10 years. In an attempt to take the initiative in marketing of OA equipment, computer makers are strengthening their marketing capabilities.

Toshiba plans to market 6,300 units of office computers in fiscal 1981 (up 43 per cent from the preceding year) and 2,100 units of Japanese word processors (up 102 per cent). The company expects sales of personal computers and distributed processing system units will increase sharply.

Oki plans to market in fiscal 1981 ¥20 billion worth of if-800 personal computers that it introduced last year. Mitsubishi hopes to boost sales of office computers 30 per cent this year.

Among general-purpose computer makers, Fujitsu and Nippon Univac started marketing personal computers this year, and Hitachi and Nippon Univac has introduced Japanese word processors.

NEC and Hitachi have introduced low-priced desk top business computers to further popularize computers at Japanese offices.



CSO: 4120/284

SCIENCE AND TECHNOLOGY

# DENITRATING PLANT FOR SPENT N-FUEL WILL BE CONSTRUCTED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 5

[Text]

Mitsubishi Metal Corp., of Tokyo, has landed a nearly ¥3 billion order of Japan's governmental Power Reactor and Nuclear Fuel Development Corp. to produce and build a plant to denitrate uranium nitrate, one of the most important functions of Japan's bourgeoning spent nuclear fuel reprocessing factory, the corporation recently desclosed.

According to the top-rate Japanese nonferrous metal mining-smelting corporation, the important order having much to do with the progress of Japan's used uranium fuel reprocessing technology has been placed with it in the wake of its recent development of its own spent uranium fuel denitration technology in the form of a complete integrated "system" (a set of facilities).

Its own software and hardware concerned is something unique in the world—a completely closed system free from every danger of environmental pollution and waste of uranium, Mitsubishi Metal said. France is said to be the only nation performing such denitration of uranium nitrate but the French method is said to be not entirely free from such danger or waste, said the corporation.

It is a second job of the kind Mitsubishi Metal has won from the public corporation. Mitsubishi Metal is now building a plant to denitrate plutonium nitrate at the public corporation's reprocessing factory experimentally doing reprocessing since 1977 at Tokai Village northeast of Tokyo. The new plant is also to be built in the factory. The construction work on the new plant would start before the end of this year and be completed by autumn 1983, if things go well, said Mitsubishi Metal.

According to Mitsubishi Metal, spent uranium fuel discharged from nuclear power stations is processed with nitric acid and by other means into a uranium nitrate solution and a plutonium nitrate solution. The plant now being built by Mitsubishi Metal is to denitrate the plutonium nitrate solution into plutonium powders usable in advanced nuclear power stations.

The prospective plant Mitsubishi Metal is to build will denitrate the uranium nitrate solution to reclaim uranium powders reusable for making the nuclear power station fuel.

The new plant capable of processing one ton of the uranium nitrate solution will be the first of its kind in the world for its mechanism to blow such solution into a denitrating tower of fluidized stratum type to produce uranium oxide powders and gasified nitric acid which later will be recycled to the primary reprocessing stage. The French technology is said to a sedimentation type leaving a little uranium in the discharge fluid. Allied Chemical Corp. of the U.S. was to have built a similar fluidized stratum type of plant in South Carolina, but the project has been stymied by Washington's past policy against reprocessing.



CSO: 4120/284

## GOVERNMENT PLANS TAKING OVERALL MEASURES FOR RELIEF OF OIL INDUSTRY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 p 5

[Text]

Plans are being formed by the Ministry of International Trade & Industry to bail the Japanese petroleum refining industry out of its serious financial problems.

A fundemental measure considered by MITI involves crude oil import duties and a new method to compute duties with the effect of increasing the duty paid by users of inexpensive oil, such as Saudi Arabia's.

Rokusuke Tanaka, who heads MITI, said: "It seems inevitable (for MITI) to set the standard prices." The Petroleum Industry Law authorizes MITI to decide prices for product oils to prevent skyrocketing or nosediving prices, as it did in 1962 and 1975.

MITI will try to adopt the new import duty system in fiscal 1982 (which will start in April 1982). It features computing quarterly average import prices for all crude oil and charging the same 3.5 per cent of the oil value as import duties. Under the present system, oil companies relying on expensive petroleum pay more import duties than others importing inexpensive crude oil via, say, members of Arabian American Oil Co.

The price difference runs to $3-4 per barrel, with Saudi's crude oil at the low end. That contributed to gaps in refiners' performances: Nippon Oil Co. reported more than ¥100 billion in profits, while Maruzen and Daikyo Oil Companies reported losses in fiscal 1980.

The standard oil policy irritated the petrochemical industry. Seven major ethylene producers, none of them subsidiaries of oil companies, decided that they "absolutely cannot accept naphtha price hikes by the (MITI's) standard price setting."

The seven chemical presidents will try to resist the MITI action jointly with automotive makers and electric utilities. The seven firms include Mitsubishi Petrochemical Co., Sumitomo Chemical Co. and Mitsui Petrochemical Industries, Ltd.

In the second quarter, 14 refiners have lost an estimated ¥165 billion as a result of the slow demand for product oils and weak yen against the dollar. MITI's earlier measure to help the industry was a 15 per cent production cut.

A high official at the Economic Planning Agency said that the MITI price action should wait until the effectiveness of the production cut, started on July 1, is confirmed.



CSO: 4120/284

SCIENCE AND TECHNOLOGY

# EXPORTS OF PLANTS RECOVER RAPIDLY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 pp 1, 11

[Text]

Japan's industrial plant exports, which plummeted last year in the wake of the Iran-Iraq war, economic sanctions against the Soviet Union and China's economic adjustment policy, have recovered very rapidly in recent months, a survey by the Nihon Keizai Shimbun revealed.

The survey also showed that the rapid recovery is attrituted mainly to the fact that Algeria, Nigeria, Saudi Arabia and other oil producing countries are resuming big industrialization programs.

The survey said contracted large-scale plant exports (exceeding ¥10 billion per case) since April this year totaled ¥940 billion or 18 cases, and International Trade and Industry Ministry officials speculated that certified plant exports in fiscal 1981 would certainly reach $10 billion for the second time in history.

Plant exports in fiscal 1980 reached $8,932 million, down 24.2 per cent over the previous year — a minus growth for the first time in 12 years. This drastic decline is in large part due to plunged exports to Communist nations ($1,280 million, down 70 per cent) and Middle East countries ($1,770 million, down 52 per cent).

Despite pessimistic views prevailing among the plant industry that this declining trend will continue this year, the environment surrounding plant exports suddenly became favorable in May.

What triggered this upsurge in plant exports was a contract (¥50 billion) to construct a cement plant in Jordan which Mitsubishi Corp. and Kobe Steel, Ltd. won over a West German maker in a bidding in May. Then followed such orders as a seawater desalination plant for Kuwait (¥85 billion), an oil burning power generation plant for Nigeria (¥180 billion) and a petrochemical plant for Saudi Arabia (¥100 billion) in June and July.

This sudden upsurge is, informed sources said, attributed to such factors as the exchange rate which has been maintained at ¥220 to a dollar and the fact that more and more countries, especially developing ones, now value Japan's technology and performance and tend to favor Japanese makers if the price is competitive. Another contributing factor is that Algeria, Nigeria and other oil producing countries have begun reimplementing their new economic programs with additional revenues generated by a doubling of oil prices.

MITI officials are very optimistic in predicting that plant exports will reach a level of $10 billion this fiscal year because, they said, U.S. and European plant builders are giving more orders to Japanese subcontractors for machinery, on top of the surging large-scale plant exports since April. For example, officials pointed out, a U.S. maker who won a contract to build oil refinery facilities in Indonesia has asked Japanese trading houses to purchase and export machinery worth $1 billion. Such subcontracted machinery is counted in statistics as certified exports. Thus, officials said, very brisk subcontracts contributed greatly to high-level certified exports which registered $2.6 billion in the April-May period, up 48 per cent over the corresponding period last year.

Some officials of the plant industry say that plant exports in fiscal 1981 might reach a record $15 billion exceeding $11.4 billion in fiscal 1979.



CSO: 4120/284

## MORE PLANTS OF UNMANNED TYPE BEING OPERATED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 963, 14 Jul 81 pp 1, 4

[Text]

Manufacturing plants in Japan are now undergoing a revolutionary change. Thanks to the drastic progress in electro-mechanics centering around numerical control machine tools and industrial robots, unmanned plants are making their debuts one after another. The primary reason for this development is the manufacturers' strong desire to minimize production costs by improving efficiency and saving labor in order to better meet growing competition both from within and without the country. If the present development is any indication, the day may not be too far away when electro-mechanics take over an astonishing portion of factory work from blue-collar employees.

"The robot revolution is on!" "NC machine tools will have their field day in the 1980s." Comments of these sorts are now enjoying wide currency in Japanese industrial circles.

Fully aware of the crucial role that electro-mechanics can play in cutting down on labor, improving product quality and raising production efficiency, many manufacturers are showing extraordinary enthusiasm in introducing NC machines and industrial robots into their plants in increasing numbers.

Sumitomo Electric Industries, Ltd., for example, established last year the world's first completely computerized and robotized plant in Naiemachi, Sorachi, Hokkaido for production of extra hard alloys. By fully automating stamping, coating and other processes formerly handled by blue-collar workers, Sumitomo Electric Industries claims that it is enjoying five times greater productivity at its new Hokkaido plant.

Toshiba Tungaloy Co.'s Kawasaki Works likewise has launched a completely unmanned cutting tool production line based on a bevy of NC machine tools installed at a total cost of ¥500 million. The plant has literally no one — even an overseer — at the plant from 10 at night through 8 the next morning. The plant, the first of its kind in the entire world, manufactures and processes some 4,000 extra hard alloy tool parts in the complete absence of human labor.

The Mizuho Works (in Nagoya City) of Brother Industries, Ltd. also has introduced a computer-run group control system of an army of NC machine tools for processing frameworks for industrial sewing machines. Although the whole system has set it back by some ¥300 million, Brother Industries claims that it has been able to reduce the necessary manpower to only one-12th of the former level.

Greatly emboldened by such success stories, many other companies are now pushing ahead with their own plant-automating programs. Particularly aggressive in this respect are makers of NC lathes and machining centers, the most representative of electro-mechanic items. They are now busy developing unmanned plant systems combining NC machine tools with industrial robots. They are hoping not only to greatly improve their own plants by introducing such systems but also to sell such systems to other corporations using their own plants as showcases.

Yamazaki Machining Works, Ltd. of Oguchi-machi, Aichi Pref., the leading manufacturer of machine tools, for example, is now building a new plant within the premises of its head office at a total cost of some ¥3,000 million. Upon completion, the new plant will have completely automated material feeding, processing and transportation systems through the use of 18 NC machine tools and

two giant industrial robots of its own making. Although eight workers are scheduled to man the plant in the first shift and five in the second, no one will be in the plant during the night—from midnight to 8 in the morning. President Yamazaki says that the unmanned plant will do work formerly handled by some 250 blue-collar workers. The new plant will start operating from next fall.

Hitachi Seiki K.K. also is now in the process of fully automating its mainstay Abiko Works in Chiba Pref. at a total cost of ¥1,500 million, while Okamoto Machine Tool Works Co. has acquired a new plant site and is now planning to establish a new unmanned plant there. Several other leading machine tool makers, including Makino Milling Machine Co. and Tsugami Corp., also are slated to establish unmanned plants.

Among companies in other industrial fields, Furukawa Co. has decided to introduce unmanned carrier systems based on machining centers and other NC machine tools at its construction and mining machinery sectors. The unmanned systems are expected to operate around the clock.

Riccar Co., on the other hand, has recently launched a new project team within its organization to make a detailed study on fully automating its entire production processes.

Introduction of electro-mechanical equipment is particularly brisk among makers of electronics equipment and automobiles, the leaders in automation and labor-saving efforts.

Pioneer Electronic Corp., for example, has started introducing a growing number of industrial robots at its plants as from last June. Hitachi, Ltd., Matsushita Electric Industrial Co. and Nippon Electric Co. (NEC) also show keen interest in fully automating their production processes through the liberal use of industrial robots.

Toyo Kogyo Co. among automobile manufacturers has decided to introduce some 140 painting and welding robots at its Hofu Works in Yamaguchi Pref. scheduled for completion in the fall of 1982.

The rush for plant automation has been touched off by manufacturers' growing belief that unmanned production facilities and efficient use of labor will be the crucial key to labor productivity improvement in the 1980s, the decade widely predicted for fierce international competition.

The fact that recruitment of superior blue-collar workers is becoming increasingly difficult also is contributing toward the extraordinary eagerness for plant automation on the part of manufacturing companies.

The primary reasons for the rapid increase in unmanned production facilities, however, are: 1) the products manufactured by electro-mechanical equipment are free of defects, and 2) a machining center or an industrial robot priced at some ¥10 million is cheaper, in the long run, than a blue-collar worker. Manufacturers are able to fully amortize such machines in less than two years and start making net profits after that. For this reason, not only big business but also medium- and small-sized corporations are eagerly taking advantage of electromechanical equipment.



CSO: 4120/284

SCIENCE AND TECHNOLOGY

## CURRENT STATUS, FUTURE OF MACHINE TOOL INDUSTRY DISCUSSED

Tokyo NIHON KOGYO SHIMBUN in Japanese 18 Jun 81 pp 13-15

[Text] Supported by vigorous private industry equipment investment, principally for rationalization and labor-saving efforts, the demand for machine tools has grown by leaps and bounds in the past several years. The major factors contributing to this unprecedented "boom in machine tools" are: 1) the enormous equipment investment made during the period of high growth has now entered a period of renewal; 2) the appearance of NC (numerical control) machine tools, a technological renovation, stimulated rationalization and labor-saving investments; 3) overseas demand has increased steadily due to active equipment investment in such major U.S. industries as automobiles and aircraft, while in European markets a trend toward NC is growing. The appearance of NC in particular is said to have had an impact to the extent of having altered the demand pattern for machine tools which previously was easily influenced by ups and downs in market conditions. As for this year's demand prospects, many predict that due to a slow market recovery, they would not rise at last year's rate. But the question remains as to how long the boom will last. What follows is a summary of the current status and future prospects of the Japanese machine tool industry.

### Rapidly Growing Machining Center

The machine tool industry, which had suffered a setback after the first oil shock, has made a remarkable recovery through restoration of equipment investments by private industry. In 1980, the actual production reached 683 billion yen (MITI's production vital statistics survey), an increase of 41 percent over the previous year and the highest recorded to date. Since machine tool production in 1976 had dropped to 228.6 billion yen due to the oil shock, the 1980 figure represents a tripling in value, a feat accomplished within the short span of only 4 years.

In terms of categories of tools, NC machines recorded the highest growth rate, 65 percent (339.3 billion yen); the ratio of NC to all machine tool production reached as high as 49.7 percent. This was followed by tools for the automobile industry, where competition for fuel efficiency is acute. These include grinding and gearing tools, which recorded increases of 47 percent (71.8 billion yen) and 44 percent (15.3 billion yen) respectively.

Among NC machines, the production of lathes reached 152.6 billion yen, an increase of 55 percent over last year; the lathe remains the major machine tool, as indicated by its 45-percent share of all NC machine production. In particular, the

increase in production of the "machining center" (MC) should be noted. It broke through the 100-billion-yen barrier, as it recorded 111.4 billion yen, or an increase of 83 percent over the previous year; this compares to the total production of NC lathes and even threatens to overtake the latter as the top machine tool product.

But in terms of quantity, NC production stopped at 179,322 units, an increase of 9 percent over the previous year. This is far from the record 256,694 units set immediately before the first oil shock. In other words, as represented by ordinary lathes, most machine tools in the past were manually operated; the increase in tool production the past several years can be attributed to more expensive NC tools. In this respect as well, the appearance of NC has had an impact on the structure of the machine tool industry.

In terms of orders received, domestic and export orders combined reached 621.5 billion yen, an increase of 42 percent over the previous year (based on 68 companies of the Japan Machine Tool Industry Association). As in total production, the figures for total orders received also represent record highs.

Of these, domestic orders received, excluding those from trading firms and agents, reached 425.2 billion yen, an increase of 44 percent; exports also showed steady growth, recording 164.6 billion yen, an increase of 40 percent. In the category of domestic demand by major types of industries, general machine industry orders climbed to 179.3 billion yen, an increase of 80 percent; both figures represent record highs. In the final analysis, the primary force behind the "boom in machine tools" came from healthy demands in three major areas: general machinery, automobiles and exports, where orders received surpassed the 150-billion-yen level. The three industries combined totaled nearly 90 percent of all orders received.

Accordingly, in the category of types of equipment, too, the following are all doing well: machines exclusively for automobile use (83.7 billion yen, an increase of 65 percent over the previous year), grinding machines (88.1 billion yen, 41 percent increase), NC lathes, which are strong in exports and among small and medium-size industries, (188.4 billion yen, 59 percent increase), and MC (108.2 billion yen, 71 percent increase). As in the production ratio, the ratio of NC machine orders to total orders received reached 49.9 percent, an increase of 6.7 points over the previous year.

How does Japan's machine tool industry rank worldwide?

The U.S. machinery publication, "American Machinist," annually reports on production and exports ranked by country. According to this, the worldwide production of machine tools (including molding machines) in 1980 was $26.335 billion, an increase of 16 percent over the previous year. Of these, Japan's share was $3.818 billion, an increase of 32 percent, the third highest worldwide, ranking behind the U.S. share of $4.82 billion and West Germany's $4.693 billion.

In terms of growth over the previous year, Japan recorded the highest rate, and Japan's share (market share) of world production was 14.4 percent, an increase of 1.8 points over the 12.6 percent of the previous year. Also, Japan's export of $1.456 billion, an increase of 18 percent, was second only to West Germany's $2.926 billion and far ahead of third place Switzerland's $901 million.

Supported by an excellent demand situation, the performance of machine tool manufacturers has naturally improved greatly.

The Japan Machine Tool Industry Association compiles a biannual report entitled, "A Survey of the Management Outlook of the Machine Tool Industry." According to survey results on various management indexes, such as gains, finances, and productivity, based on settlement account data of 22 member companies for the latter half of fiscal 1979 and the first half of 1980, both sales and orders received have increased over the previous year, reflecting a "boom in machine tools." The survey shows that the industry has in fact recovered from the recession that began in 1974 to the extent that there are no longer any companies operating in the red.

In terms of earnings, sales increased by 20 percent over the previous period, orders received by 23 percent, and balance of orders received by 26 percent. Recovery in earnings was remarkable: the working profit rate was up 9.9 percent, the sales net profit rate up 9.8 percent, and the total capital revolving rate up 1.09 percent. These rates approach the record levels set in the past.

In addition, the 30.3-percent equity capital ratio is a return to the level recorded during the first half of FY 64. Various revolving periods for inventory and loans have been shortened greatly due to the increase in sales and management efficiency based on reduction of labor. In finance as well, the trend is toward sound business.

Furthermore, in terms of productivity, added value productivity (monthly) reached 686,000 yen and sales per capita 2.004 million yen, both rewriting previous highs. On the other hand, as it has been since the first half of 1975 (45.3 percent), the added value rate was down to 3.4 percent. Although per capita labor cost was recorded at 162,000 yen, an increase of 46 percent over the previous period, the labor distribution rate was down due to the increase in sales. This decline cannot be attributed to the increase in sales alone; we must not overlook the fact that there was a clear reduction in labor: the number of fulltime employees in the industry, which during peak years stood at 50,000, was reduced to 34,000 by the end of last December.

On the other hand, the decline in added value rate was largely due to increased outside purchases of NC machines. It can be said that for the machine tool manufacturers who are intent on purchasing NC machines, the only disadvantage is the problem of declining added value rate. It is also a big challenge for the industry as a whole.

Trend Toward NC Progressing Rapidly

Attention Is Also Focused on MC, the Core of FMS

Reinforcement of industry structure is manifested in active equipment investment. In 1975 and 1976, as a direct result of the first oil shock, demand for machine tools declined radically. Because of this, the industry was struck by recession as cuts were made in personnel and assets were sold. The amount of equipment investment fell to a 4-5 billion yen level for the entire industry; the industry's desire to invest was so cool that the expression, "the shoemaker's wife goes barefoot," was appropriate.

However, since machine tool sales recovered rapidly in a V-shaped curve, from about 2 years ago, the equipment investment opportunities of all companies suddenly increased. According to a survey conducted by the Japan Machine Tool Industry Association, the actual results of 1978, on the basis of construction starts, reached 10.4 billion yen, an increase of 73 percent over the previous year. In other words, it recovered to the 10-billion-yen level for the first time in 4 years, since 1974. In the following year, 1979, it grew to 17.3 billion yen, an increase of 66 percent. Furthermore, during last year investment doubled, to an unprecedented 35 billion yen. Each company emphasized equipment renewal and investment for rationalization and labor-saving, all of which they had previously avoided. Since, however, mass production type NC machine tools with large "scale merit" constitute most of the demand, investments to increase production through such strategic equipment as NC lathes and MCs are outstanding.

In 1976, the production value of NC machines was only 51.3 billion yen, or 22 percent of all production. With great improvements in the quality of the NC system and supply structure of system manufacturers, and with added factors of booms in labor-saving and rationalization, production rose rapidly. In 1977, production was recorded at 80.5 billion yen, an increase of 50 percent over the previous year, and in 1978 it reached the 100-billion-yen level for the first time, as production was recorded at 107.6 billion yen, an increase of 30 percent.

Furthermore, in 1979, production came to 205.5 billion yen, an increase of 90 percent; 340 billion yen last year, an increase of 65 percent--a rapid growth of 100 billion yen annually. The share of NC utilization has also increased, from 26 percent in 1977 to 29 percent (1978) and 42 percent (1979).

The major NC equipment up to now has been the NC lathe; however, since last year, the share of MC has suddenly increased. Although there is no precise definition of MC, it is generally understood as a general term for an NC machine tool equipped with 1) at least three axis control functions and an ATC (automatic tool conversion); 2) a dividing table or a rotary table; and 3) a built-in NC system controlling the entire process. Since one unit is capable of lathe work, milling and boring, it has great merit for machine processing plants in terms of raising productivity, and saving labor and space.

The interest in MC by both machine tool manufacturers and users came in particular about the same time the move toward FMS (flexible manufacturing system) started. FMS literally refers to a new machine factory system which aims at unmanned operation that would provide "flexible structurization" of production. MC occupies a central position in the FMS system.

Before the idea of FMS was born, the term DNC was once widespread. This was a system which attempted to control several NC machine tools by one central computer; it was also called a "group control." This system aimed at mass production through central control, so there was hardly any attempt to apply it to either "small volume multivariety" production or "medium volume multivariety" production.

The basic difference between FMS and DNC, although both are automated, is that the latter made "central control" possible by using one computer. Because of this, it

could be applied to various types of machine processing and furthermore greatly improved operation rates, and naturally could be applied sufficiently to "small volume multivariety" production. In a sense, it represented a production system which responded to the needs of the machine processors in the transition from high economic growth to low growth.

For this reason, the suppliers' participation in machine tools and, moreover, in the MC field became active. At present the number of such companies is said to be 40 or 50. The reason for this boom lies in nothing more than the fact that each machine tool manufacturer has judged that the future trend in machine processing is in FMS-based flexible structuring and unmanned operation.

Two Models Make Up 63 Percent of All Exports

Strong Desire to Invest: Trillion-Yen Industry a Possibility

This concentration on MC has had not only a domestic effect but also, in no insignificant terms, an effect on exports. Last year's machine tool exports totaled 269.6 billion yen, an increase of 32 percent over the previous year and overturning the record set last year. Exports of NC machines alone totaled 172.8 billion yen, an increase of 74 percent; the ratio of these to all exports was 64 percent, an increase of 16 points over the 49 percent recorded last year [figures are as published].

Of the NC machines, exports of lathes surpassed the 100-billion-yen mark for the first time, reaching 108 billion yen, an increase of 66 percent; MC exports also doubled, recording 61.5 billion yen. Of all NC machine exports, 58 percent came from NC lathes, 36 percent from MC; in fact, these two models comprised 94 percent of NC machine exports, 63 percent of all machine tool exports.

Because exports are concentrated heavily on particular models, Japan naturally faces strong opposition from the United States and Europe, the major export destinations.

Since 1978, an export price cartel for these two models consigned to North America has been in effect. Because last year Europe also began voicing criticism of rapid increases in Japan's exports, a new export price cartel was enacted in January of this year applicable to 15 European countries, including England, West Germany, France and Italy. The direct cause of the European cartel was the summit meeting between Japan's Industry Association and the European Machine Tool Association (CECIMO) which took place during the International Machine Tool Fair held in Japan last fall. It is reported that during the meeting, the European side demanded a detailed explanation of Japan's torrential downpour-like export attitude, including its rebate system, payment terms, and excessive services. As a result, in order to set forth the industry's voluntary restriction, both MITI and the industry judged that, following the example of North America, the "enforcement of a cartel was inevitable" for Europe as well.

The new year opened with continued recession in Europe and America. Because of this, although both Japan and the IPI are moving toward shipping restrictions and

this has lessened the vicious mood of the past; the demand for export restrictions, as far as NC machines are concerned, is smoldering in the United States and Europe.

According to the FY 81 estimates announced by the Japan Machine Tool Industry Association, orders received will reach 620 billion yen (based on 68 companies), a decrease of 2 percent; production will total 780 billion yen, an increase of 8 percent (based on MITI's production vital statistics); and exports will amount to 290 billion yen, an increase of 4 percent (based on customs statistics). The estimates based on the calendar year for orders, production, and exports correspond to the above figures; the rates of increase over the previous year show that orders will level off, production will increase by 14 percent and exports by 7 percent. These rates, reflecting a cautious attitude toward the future, represent large decreases. Especially in regard to orders received, this attitude is based on plus and minus factors, with the latter overriding the former. The plus factors are: 1) demand for NC will remain strong both domestically and abroad; 2) strategic investments in the auto industry will continue; and 3) investments by some major demand industries such as shipbuilding will resume. The minus factors are: 1) stagnation in auto production due to trade friction and low domestic demand; 2) slowdown in exports due to yen revaluation; and 3) equipment investment restraints by small and medium-size industries.

Because of this, although a value of 690 billion yen, the highest as a "theoretical numerical value," was estimated for orders, the figures based on both calendar and fiscal years will level off to a high standard of 620 billion yen (820 billion yen converted nationally). Reflecting an "attitude of restriction" even stronger than that of last year, exports will increase by only 1 digit, to 290 billion yen. On the other hand, since the industry still has half a year's worth of balance of orders received, production alone is expected to reach relatively high rates of increase, an increase of 14 percent based on the calendar year, 8 percent based on the fiscal year.

But the overall belief within the industry is that such a relief in demand will be "extremely shortlived." Although the desire for equipment investment has cooled off domestically, especially among the small and medium-size industries, it remains strong for labor-saving and rationalization purposes. Furthermore, as far as NC machines are concerned, Japanese equipment continues to hold a superior position overseas. With respect to the popular "mechatronics," a combination of electronic and mechanical technologies, Japan's strength is not inferior to that of foreign forces. In terms of the vision for the 1980's, no one in the industry will deny that the industry will grow into a trillion-yen industry.

A Roundtable Discussion: Rapid Growth Achieved Through NC

Last Year's Orders Received Exceeds 600 Billion Yen

Participants: (random order)

Nobutaka Kengaku, director, Industrial Machinery Division, MITI
Masanobu Hisano, president, Toshiba Machine Co, Ltd

Rokuya Nagata, president, Ikegai Iron Works, Ltd
Koji Tatsuok, managing director of Hitachi Seiki Co, Ltd
Fumio Sato, managing director, Okuma Manufacturing Works, Ltd
Shigeru Ota, managing director, Osaka Kiko Co, Ltd
Takeshi Iwasaki, moderator, science and technology critic

The orders received for Japan's machine tools last year showed a large growth, in excess of 600 billion yen. This was due to an increase in overseas orders received, in addition to continuing favorable domestic demand. The Japanese machine tool industry is about to establish itself as a supply base for the world. This is because the high quality of machine tools achieved through technological renovations actively pursued by all manufacturers, short delivery terms, and proper pricing have been accepted by the users. In particular, Japan leads the world in NC machine tool production in terms of both quality and quantity. Today, we would like the participants to actively engage in discussion of the current status and prospect of the Japanese machine tool industry. (From the opening remarks of the moderator)

Moderator: In the past, the machine tool industry would go astray prior to a recession and it would take some time for it to recover even after the economy recovered. Recently, however, the industry is doing well and achieving significant results. What is its actual strength and what position does it occupy within Japan's industries?

Kengaku: Machine tools have always fluctuated with business conditions; they characteristically have been affected to a greater extent than the cycle of equipment investment. Be that as it may, various foreign countries say that Japan's economy is doing better than that of other advanced countries. This growth is supported by two major factors: one is the fact that Japanese labor-management relations are good; the other is that the attitude of Japanese industries toward new machinery, particularly industrial machinery, is a positive one throughout the industries.

Although the following statistics are a bit old, let us look at the growth rates of productivity between 1970 and 1977. The rates for the entire manufacturing industry were 5.5 percent for Japan, 3.3 percent for the United States, and 4.2 percent for West Germany. When we examine the rates for machinery and metals related production, the rates were 6.6 percent, 3.3 percent, and 3.1 percent, respectively. Such high productivity is what is supporting the Japanese economy, and we see that it is the machinery and metals that are pulling the rates up.

Among the machinery and metals, it is particularly the machine tools, the so-called "mother machines," that have grown strongly in recent years. The major reason for this lies in the utilization of NC, in which Japan leads the world. More basically, however, I believe it is because we have been positive about improving the performance of our tools by increasing their speed and precision.

MITI's recent prospectus, "Industrial Policies and Visions for the 1980's," shows an annual increase of 5.4 percent for all industry and 7.1 percent for the processing and assembly industry. MITI is thus anticipating the highest growth rate for the latter over basic materials, construction, household-related, and service industries.

Since, in order for a country without resources to establish itself, it must become a technology-based nation using wisdom and brains, I believe that our prospects in regard to the machine industry and its "mother," the machine tools, are great.

Steep Increases in NC Investment Due to Labor Reduction

Moderator: Because last year's orders received surpassed 600 billion yen, some say that a trillion-yen industry is approaching, while others express a more cautious view and doubt this. What would you say are the major factors contributing to the growth?

Hisano: As director Kengaku has already mentioned, I would say that it is because of a stable labor-management relationship. But prior to this, because of talk of oil crisis and restraint on total demand, heavy industry and the machine tool industry were obliged to reduce labor. For this reason, there was a time when the machine tool industry lost 40 percent of its work force and production decreased by 60 percent. That was a painful period.

Since then, during the course of business recovery, coinciding with the determination of each industry not to increase personnel, it so happened that the demand for NC devices grew rapidly. With conventional manual machines we could not have increased equipment investment at the same time as increasing personnel, even for the purpose of supporting Japan's economy. But thanks to the appearance of NC machines, equipment investment in NC machines became active because they enabled us to operate several machines without increasing personnel and without hiring skilled workers. I think that without a reduction in labor, NC machines would not have become as widespread, and without them productivity would not have increased either.

The sales record of 680 billion yen, which is an increase of 40 percent over the previous year, was due mostly to NC machine tools, which made up about half of all sales.

Accordingly, at the same time that Japan was making advances in machine tools, many in the United States and Europe were still producing outdated machines using technologies different from Japan's "mechatronics." Because of this we could meet the world demand, and consequently our exports increased, with NC machines as a major contributor. Therefore, without the cooperation of NC manufacturers, we would not be where we are now.

Deep-Rooted Demand Due to Lack of Skilled Workers

Moderator: Recently the term "mechatronics" has become popular, but machine tools have long incorporated electronics and have played a pioneering role. Speaking of 680 billion yen in sales, what will happen to this in the future?

Nagata: I think it will continue to increase at a certain pace. This is because even though at the bottom of all this there may be a view that in terms of volume our industry will suffer a recession when auto industry equipment settles down, from the worldwide perspective, I believe that a strong demand for NC machines

will continue, because the movement to activate the machine industry is strong and the problem of the lack of skilled workers is more severe abroad than in Japan.

I believe there are some negative aspects, such as competition in terms of technological development strength and international friction, but since Japan has a system of cooperation between government and private industry and the ability to handle these problems, these obstacles can somehow be eliminated.

The only concern I have is that this favorable condition will not last forever, and when various short-term recession phenomena appear, the industry naturally must be prepared to cope with such eventualities wisely.

Tatsuoka: Basically I agree with what has just been said, but I think that, judging from the figures, the rapid growth is supported largely by increases in exports. In any event, the growth rate has surpassed the 40-percent level in the past 2 or 3 years.

Another factor lies in the fact that demand generated by replacements in preparation for so-called labor-saving and rationalization moves, which took place after the period of labor reduction, coincided with this period.

Thus, domestically speaking, there is ample room for the increased use of NC's, in terms of number of sets and other considerations; and technologically, too, there is room for further development of NC machines.

The only problem is that because the impact of increased exports is so strong, if its tempo is raised too quickly it will cause various problems which we are all aware of. But the market is expanding and although it is true that NC's are popular in Japan and the United States, this is not the case in other countries.

Therefore, as long as adjustments are made skillfully, with consideration for individual problems, I believe that the present growth rates will continue.

Ota: I agree with Mr Tatsuoka. I believe there will be a steady domestic growth rate of about 10 percent. The problem is in exports; if the rate exceeds 40 percent, then the merits and demerits of exports will influence what is good and bad for the entire industry. At present, we could say that Japanese machine tools are a unique genre in the world, that in terms of what can be called as international division of labor we possess a particular type and size of machines, and that there is a worldwide shortage of machine tools. So when it comes to the question of the supplier, Japan would have to be that supplier. Also, in countries other than the United States, West Germany, and other advanced nations, there is an increasing desire among intermediate advanced countries and developing countries to use NC machines extensively. Therefore, the question is how the development of new markets will affect our role with regard to the advanced countries.

Accordingly, we must develop new markets that will eliminate frictions, and if this is possible our sales will not decline that much.

Sato: As everyone has said, the nature of domestic and overseas markets are different; in Japan, the machine tool industry, the auto and peripheral industries,

and the construction industry all know each other well through years of working together. A period of equipment renewal is approaching, and the more industries compete with one another, the greater the need for newer machines. So, speaking from our own standpoint, as long as we produce machines that meet the demands, and there is a great deal of potential demand, our industry will grow.

Concerning trade, particularly with the United States, Japanese machine tools are doing well without causing much friction, thanks to a great demand for equipment investment by the auto industry. My expectation is that if Japanese manufacturers and users and their counterparts in the United States and Europe will engage in talks and begin to understand each other, the problem of friction will certainly be resolved.

Another point is that the percentage of NC's used in rationalization is still low in Japan, and in the United States and Europe as well. From all of this, I believe there will be an overall demand.

Develop Trust Through Local Production

Moderator: In our talk thus far, the word "friction" has appeared frequently, and we also hear the expression, "orderly exports." One measure designed to cope with this problem is the establishment of Japanese enterprises overseas, in the United States and other countries. Let me begin with the representative from Hitachi Seiki, which has production facilities in the United States.

Tatsuoka: We have always provided after-sales service, but we began thinking about overseas production 2 years ago. I believe that reliability built on service will become a major factor in overseas markets. Since the cost of labor in Japan is rising, there must be merits in terms of cost, that is, in terms of total cost. When production is carried out abroad, it becomes that much more of a factor in gaining the users' reliability.

One other thing we must consider is the unstable foreign exchange rate. In exports, we naturally consider hedging, but this is not the primary factor. The major issue is to adapt to the ways of the host country and gain reliability through services.

Regarding the problem of trade friction, compared to the auto industry, the friction in the machine tool industry is smaller in scale. Our company decided to go ahead, well aware of the friction, small as it may be. So far, we haven't had any problems, including labor relations. There is the fact that Japanese management style has attracted greater interest in the United States than we had expected. Since our business is still on a small scale, we have not faced any problems, but we may in the future. In any event, I believe that what we need to consider is that the rate of added value in the United States should be raised as much as possible.

Sato: Our company is still at the planning stage. Of course, our intention is to benefit the people of the host country, however insignificant this may be. Although we are small compared with other larger enterprises, we would try to be of as much help as we can.

Tatsuoka: At present there is an active drive to entice Japanese enterprises to settle overseas, with preferential treatment in taxation and finance. I believe that an appropriate positive response would contribute to the easing of tension overseas.

Ota: I believe that, for the time being, there is no friction on an individual basis. In any event, there is the problem of visas, or instead of obtaining visas we are thinking about employing local people, but since it is difficult to find adequate personnel locally, we have yet to employ local people. But sooner or later we must move in that direction. One of the reasons why friction arises particularly in Europe is because the area is constricted, but I agree with the view expressed by Mr Nobuhiko Ushiba.

That is, let's consider how many machines we have bought from Europe since the Meiji era. As for Switzerland, Japan still imports more than it exports, and as for West Germany, it was only 3 years ago that we started to export more than import; therefore, there is no need to make this a big issue. In the midst of our success we have to engage in talks a bit more. It is necessary for us to investigate how our machines are used and how they contribute to the European and U.S. markets. It is not a question of taking in consumer goods indiscriminately; we are exporting producer goods which in turn produce various products. I believe we should have talks on how productivity and modernization would be delayed without the importation of these producer goods.

Even if there are some obstacles arising from our rapid growth within a short time, nevertheless, we can discuss ways to bring about a harmonious relationship. In addition, it is important for us not to reverse ourselves and pat the heads of host countries when we establish ourselves there.

Nagata: Let me speak from a slightly different perspective; that is, the machine tool industry manufactures facility goods and, moreover, they are known as "mother machines." Therefore I am wondering whether expansion in volume is truly a good thing. We produce so many.... Although I believe there still remains an aftereffect of having been encouraged to acquire foreign currency which took place some time ago, since the machine tool industry has grown to the present level, it is time for us to review and examine the basic policy of the future of the Japanese machine tool industry, and based on this, consider the problems of exports.

This is because the best thing that happened to the machine tool industry during the period of management by reduction of labor was that we had the time to engage in technological cooperation and make studies of machining centers and NC machines by introducing foreign technology. That was timely. If we expand our production under the present condition of management by reduction of labor, the production itself might be all right but it would cause an overload on the part of engineers in terms of technological development strength. I am afraid that despite the adknowledged need for research, engineers would be used for various other purposes connected with the expansion of sales.

For this reason, with respect to the quantitative expansion of machine tools, it shouldn't be done simply from the standpoint of management or because the sales

are good; it must, in addition, expand with a balanced consideration for technological development. Expressed in graphic terms, I anticipate that there will probably come a time when the brakes must be applied, when we must sit ourselves down and hope that an opportunity for putting more strength into quality will emerge naturally.

Trend Toward Deluxe Models In Progress

The Issue Is To Avoid Friction With the United States and Europe

Moderator: I believe that naturally the government is also studying the problem of exports.

Kengaku: As you know, exports emerged as one of the factors that saved the machine tool industry after the oil shock. But because of concern about increased exports to the United States, we instituted a floor price system in 1978. Subsequently, exports of NC lathes and machining centers to Europe were extremely high. Exports to EC countries alone, for example, recorded an increase of 108 percent in 1977, 203 percent in 1978, 168 percent in 1979, and 210 percent in 1980; the increases, in other words, doubled annually. Last fall, the EC Committee objected to our high growth rates and, in particular, unofficially and later officially, expressed its concern over discount sales and easy sales conditions. So we discussed this matter with the industry and decided to enforce a floor price system; starting this January, we have been regulating bargain sales.

With respect to the United States, the rate of increase has subsided. However, the production of U.S. machine tools is said to be in full swing, and it is said to hold about a year and half's worth of balance of orders received. And since the U.S. machine tool production is behind in orders, orders are being placed in Japan. Last year the U.S. business conditions were so favorable that its production, which was once the highest in the world around 1970 but was later outstripped by West Germany, was once again tops in the world. Consequently, the present situation is that we don't have any problems with regard to the United States.

On the other hand, with respect to Europe, the meeting of foreign ministers resulted in the setting up of a system of supervised items that included automobiles and television sets. It was decided that we should first observe the trend between January and March. According to the statistics for that period, the total of NC lathes and machining centers exported to EC countries recorded only a slight increase, 16 percent. The rate has been dropping gradually every quarter. The October-December period, too, recorded limited growth. We are of the opinion that growth rates for Europe will decrease significantly, but our present position is that the figures will be reasonable.

What European statistics show in the future will vary because what was shipped from Japan during the October-December period arrives in Europe between January and March; therefore, we predict that the figures recorded there will be higher than 16 percent. In any event, since machine tools are investment goods, if the rationale protective measures that apply to consumer goods were to apply also to investment goods, it would be a minus and would be unfortunate for the already declining European international competitive power. We would like to explain this to them.

A "Sense of Togetherness" with Various European Nations Needed

Moderator: Concerning this matter, I would like to ask Mr Hisano about the view of the Japan Machine Tool Industry Association....

Hisano: The other day, when Mr Francois Missoffe of France visited Japan, we had talks. Since Toshiba Machine does not manufacture NC lathes or machining centers in any great number, I am afraid I can only speak as a third person. With regard to the United States, at present there is no likelihood of great problems emerging between us, since the U.S. equipment investment in the auto industry will probably increase and its balance of orders received is great. We must be careful of Europe, which can be divided into two categories: one is Switzerland and West Germany, where exports are large; the other consists of France, England, and Italy where the economies are on the downside.

The Japanese machine tool industry is surrounded by favorable conditions, with a sense of togetherness among the manufacturers. We all believe that it is good for each company to prosper, but I think it is necessary for us to have the same kind of sense of togetherness with France and England, which are suffering, since we are all in the same business after all.

My fear is that if Japan overwhelms these countries with the strength of its NC machine tools, it might bring about an unfortunate result for Japanese industry as well.

As it has been said repeatedly that machine tools are "mother machines" and that the tool industry is a key industry, every government is extremely afraid of its own machine tool industry deteriorating. The cause might vary from a delay in introduction of NC's to outdated machines due to failure in equipment renewal and to labor problems, etc. But I believe the time has come for Japan, which has progressed thus far, to find a way to cooperate with these troubled countries so that their industries will be healthy again.

Second, as far as Toshiba Machine is concerned, we import a great many machine tools from West Germany, Switzerland and France for our facilities. When precision to the degree of microns is required, the NC machines are not omnifunctional, so that high-precision machines are needed. We must not forget the fact that these high-precision machines are produced in Europe.

Therefore, rather than increasing the volume, the time has come for us to move in the direction of high-precision models that are unique and original and whose brand names are known to all.

Solid Demand for Machine Tools Continues

Steady Equipment Investment Seen in Automobile and Other Industries

Moderator: Let us turn to the domestic market. It is said that at present domestic demand shows a slight sign of being overcast. Mr Kengaku, how would you analyze this situation?

Kengaku: It is true that in certain quarters there is a talk of an overcast in domestic demand, but as far as equipment investment is concerned, for the time being it seems to be moving steadily, and the economy in general is improving. So I don't believe that the overall situation is so bad. However, since equipment investment as a whole fluctuates greatly, I don't believe that the present steady growth will last 4 or 5 years. The talk of an overcast derives rather from the fact that production has increased a little too much. I don't think there's any sign of an overcast in the area of orders received. In the automobile industry, for example, equipment investment is growing steadily and I understand that investment in FF will be in high figures for the next year or two.

Ota: There will be no more high growth rates of 150 percent as in the past. At the same time, that is not what we anticipate. But since, unless total production increases steadily by about 10 percent, the industry will fall into minus figures, I believe that we can expect a steady growth of at least 10 percent.

Kengaku: I do think that many manufacturers who are now purchasing all-purpose machines, machining centers, or NC's are slightly overinvesting in an effort to increase their capacity.

Nagata: Because profits increased with the introduction of NC machines--I'm talking about profits of small and medium-size enterprises--everyone began to replace the manual machines. Then there followed a shift from the days when NC machines competed successfully against manual machines and now NC machines must compete against each other, since everyone owns one. Then the profits of small and medium-size industries using NC machines deteriorated rapidly in the past year; as a result, naturally, they put the brakes on purchases. On the other hand, medium-size and large plants, which previously had been observing the situation, decided to switch to NC's. I believe that there is the potential of these plants eventually converting to NC's and bringing large improvements in efficiency throughout the industry; only then will the demand become stabilized. The only concern is that, as we read in the papers, the companies are expanding their plant facilities, and I wonder what will happen when this is completed.

Kengaku: As for demand itself, small and medium-size industries are going through a modernization process and will be subject to energy-saving tax cuts for relatively sophisticated machine tools; we expect that this will create a steady demand.

Diversified Demand

Joint Research and Development Recommended

Moderator: Director Kengaku mentioned in the beginning that in the vision for the 1980's, metal processing and assembly will lead all growth; as a general theme of the vision, that of "nation of technology" is strongly advocated. Within this context, it is naturally desirable for the machine tool industry to respond to demands worldwide with equipment that is unique and of high added value that introduces new technology. I would like to have your opinion on some of the issues on the technological development of this equipment.

Tatsuoka: In terms of technological development, one of the major bases for development would be that new and unique equipment is created in the course of responding to the needs. Another, in contrast to the first, would be that a new product is created through application of developments in basic technology. In other words, there are two large categories: one coming from needs, the other from development of purely basic technology.

The demand based on needs would further speed up the tempo of technological development as products themselves become increasingly diversified. Accordingly, to the extent that life cycles of future products would probably be shorter, there would be a demand for machine tools whose productivity in terms of depreciation and other aspects is high. This would be one aspect of technological development.

Another aspect is purely technological, at the base of which lies the computer revolution, or computerization. With the development of super LSI, NC machines will probably become more compact and possess more functions. An NC device, for instance, can be either extremely deluxe or simple with limited purpose and cost. We believe that the polarization will be extreme.

In addition, the future trend will strongly favor producing machines half of which are hard and half soft; it will not be limited to hardware. At present, we are still producing software from hardware; in the future, however, the technology will advance to the extent that the process will be reversed.

In terms of exports, I think that Japanese "junior-types" hold a superior position in the world in terms of both cost and quality, but this is true only for extremely limited NC machines; as far as heavy duty, compact, and super precise models are concerned, unfortunately, we fall behind. These are some of the major issues in future development. Although there is a lot of talk now about FMS, I believe that hardware created from software rather than hardware itself will control the future.

Nagata: What I consider a problem is the fact that since software is developed to a greater extent by users, its development varies slightly from the conventional method of developing machine tools; we need to cooperate with technological groups of the users. But the focus of the relationship between the Japanese machine tool industry and the user is on purchase-sales only. It has always been the situation that customers are strong and we are weak. Unless we improve this situation, we will be defeated by foreign countries in the development of software. In foreign countries, since there are many industries that give priority to technology, such as the aircraft industry, there is a strong trend toward joint development with the machine tool industry. In Japan, on the other hand, there are only users who engage in development on a commercial basis. In this sense, this is what we must study when we confront problems regarding software and FMS. We will be in trouble when eventually the users who are at present buying NC machines in quantity, start proposing that they will provide their own software but will buy the hardware from us.

Kengaku: For the time being, in terms of the direction of new technological development, the Japanese machine tool industry unfortunately has an extremely low rate of profit that is put into R & D. The manufacturing industry profit rate

is low but it still manages to put in at least 1.8 percent of profits. The machine tool industry's rate is only 1 percent and is slightly behind the manufacturing industry. Since it happens that the tool industry is prospering, we urge the industry to put more effort into R & D.

Now, as far as the future direction of research is concerned, the present trend is toward diversification in demand, machinery, and merchandise. In the automobile industry, for example, Japan has the highest product development, and it is even making its affiliates fight among themselves to develop various types of merchandise. The question is how to respond to diversity. For instance, robots are used for spot-welding of automobiles; while many different models go through the same assembly line, they all have different welding spots. In order to deal with this situation more flexibly, there is now in process a change from conventional, specialized equipment to equipment that has a slightly wider application. FMS indeed meets this requirement. In either a generalized form of special equipment or a specialized form in combination with all-purpose equipment, FMS has been highlighted as a device to fill the gap between manually operated, small, conventional, all-purpose equipment and specialized equipment. This is one area in which president Hisano's company is taking the initiative with the formation of a research group. We would like to see such joint research work succeed.

Second, and this is a rather long-term project, we must cope with the emergence of new materials such as those that are difficult to grind. I have talked about two rather unique directions in research; other than these, we expect steady progress in such basics as increased speed and precision. There are many other areas of R & D where we urge you to invest.

Sato: Strictly speaking, what is broadly termed a "nation based on technology" means prosperity for all companies. As has already been mentioned, it is only natural to make the machines more "intelligent" than was attempted in the past. However, the question of how to develop "intelligent merchandise" depends on two sources: present needs and future requirements. At the same time, there are various ideas of individual machine manufacturers and various companies that use the machines--large, medium, small; some would use the machines in quantity and others would not. Although it would differ depending on what company was aiming for which source, if, as it is generally believed, "multiple but low production" holds a share as large as 70 or 80 percent, then as long as we are aiming at the machine tool industry, it is inevitable that we should strive for that kind of production.

For this, NC machine tools are most appropriate. Although we were not able to foresee the future, we have been involved in the production of NC's for the past 20 years. At first, we purchased NC devices, but later we invested a lot of time and money because we considered we had to make our own. The past several years have led us to think we did the right thing. In other words, we are moving from hardware-based machine tools to those which combine software.

In the era of FMS, since what is required is the ability to utilize multiple machines and yet have good manufacturing controls, the tie between hardware and software indeed becomes stronger. Both in Japan and overseas, the term FMS has become something of a "fad," indicating its potential as such.

However, there are various types of FMS, and foreign magazines report that investments are primarily made in large models worth 1-2 billion yen. Not many companies in Japan or abroad can match this. We must consider the possibility of producing truly useful FMS at the 100-million-yen level so we can serve the entire machine industry.

Trend Toward Systematization Intensified

Moderator: The original idea of FMS was that although its scale was small, it could be complete in itself as a subsystem that was flexible and sufficiently functional. For a large-scale FMS, all that is required is to connect several small FMS's. In the beginning, when the NC first began to appear, a central control system was used to operate it, but gradually a computer was built into the system. Then the NC's were combined to form a larger group. Likewise, it is inevitable for the FMS to follow a similar pattern.

Sato: I believe so. Also, when automation of individual or several machines progresses, it becomes the NC's turn to take over. But as the functions controlled by NC alone and those others utilized by various peripheral types of equipment such as conveyors principally run by robots become more and more technical, the percentage of peripheral equipment to that of the original NC becomes greater. At present the ratio stands at 55:45, but I believe it will soon be reversed, with the peripheral taking 65 to 70 percent.

Ota: As everyone has mentioned, there will be a demand for high precision, a trend toward higher speed, and hardness in high speed. In terms of problems of peripheral equipment, the issues, in connection with CNC, are the life-expectancy of tools, automatic replacement, detection of breakdowns, correction of positions, and measuring devices. These become the main issues, the main body only of secondary importance. This will apply also to FMS and since these issues will be regarded as more important, a trend toward systematization including robots will grow.

Efforts To Be Expended in R & D

One Approach Is To Form a Structure To Share Cooperative Work

Moderator: Recently it seems that a movement toward joint research has become active within the entire industry. President Hisano, would you like to comment on the new direction the Industry Association is aiming at?

Hisano: As in the case of FMS which was just mentioned, one machining center can perform various functions--we can increase the number of pallets, each attached with various shapes; we can have processing by robots or connect several machines in a single line. Instead of one manufacturer involved in all of these, it is more desirable to form a cooperative group within the industry, assigned lathes, grinding machines, machining centers, etc, to separate manufacturers.

Also, we must come up with tools that are harder and capable of more powerful cutting and grinding than conventional machines, that can handle hard-to-grind

materials, titanium, or aluminum which is used a great deal by the aircraft and space industries. At the same time, we must achieve higher speed. Also, if we require unmanned night operation by FMS, measuring technology, an automatic detection system, etc must be perfected. Whether or not high-speed spindles for raising the speed can be supplied sufficiently in Japan is another question. Therefore, we must seek the cooperation of machine tool manufacturers and heighten joint research and cooperative relationships between the latter and peripheral equipment manufacturers of tools, measuring equipment, automatic detection devices, high-speed spindles, etc. In this way, I believe we must engage in studies of grinding processes so as to maintain our top position in the world.

Development of New Export Markets Necessary

Moderator: Finally, Mr Kengaku, how do you see Japan's technological development level of new machine tools?

Kengaku: As I have already mentioned, the level of technological development suffers somewhat from a lack of investment in research. The development of NC is dependent on peripheral equipment manufacturers, although some manufacturers do conduct their own research. The latter, it would seem, have become "assemblers." Because of this, we believe more emphasis should be put into R & D.

I do not mean that the technological level itself is low; on the contrary, for example, the all-purpose equipment has improved tremendously in accuracy and speed compared to that 10 years ago. Therefore, we do not consider that our standards are low, but that more efforts should be invested in R & D.

Also, in terms of the international friction mentioned previously, the clinical approach called the "floor price" system in exports is one problem; however, regarding the second measure president Hisano mentioned, our posture is to actively import merchandise that is good. The present import dependency rate is about 8.5 percent, but it is desirable to achieve a better balance.

Third, we urge industrial cooperation. This would take various forms such as technology exports and overseas production.

Fourth, we would like to remind everyone about diversification in export markets. Especially in the so-called intermediate advanced countries, where the machine industry is emerging, we would like to see you establish yourselves firmly and promote exports to them. These are our present thoughts.

Moderator: Thank you very much.



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