Newsletter Index

1985-1986 JSIS Newsletter Index

The 1985-1986 JSIS Newsletter Index is a quick reference guide to the EIEJ and JSIA newsletters. It is structured as follows:

- Titles are organized by both keyword and company.
  - Pages 2 to 3 are a company list, e.g., LSI Logic.
  - Pages 4 to 9 are a subject list, e.g., Economy.
- The newsletter type, month, and year follow each title listing in the index. Refer to the EIEJ or JSIA tab, month, and year to locate a specific newsletter.

This index is updated quarterly.

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: EIEJ Newsletters

THE U.S. ECONOMY: BOOM OR BUST?

In a recent visit to DATAQUEST, Joseph W. Duncan, Corporate Economist and Chief Statistician of the Dun & Bradstreet Corporation, shared some of his views on the future of the U.S. economy. Due to the universal nature of the subject matter and the impressive credentials of Mr. Duncan, we believe that his views would be of interest to our clients. Mr. Duncan worked eight years as the chief statistician for the Office of Information and Regulatory Affairs of the U.S. Office of Management and Budget. Previously, he was a research and management specialist at Battelle Memorial Institute where he spent 13 years. Mr. Duncan's education includes receiving a B.S.M.E. degree from Case Institute of Technology, an M.B.A. degree from Harvard Graduate School of Business Administration, and a Ph.D. degree in Economics from Ohio State University. He also attended the London School of Economics.

KEY ECONOMIC ISSUES

With respect to the health of the U.S. economy, Mr. Duncan identified three key questions:

- Will there be a recession in the near future?
- Will activity continue in capital markets?
- Will Congress act to reduce the budget deficit?

Recession

In order to address the likelihood of a recession, one must address the health of principal components of the economy. These vital components are consumer spending—which makes up approximately two-thirds of the GNP—housing starts, business starts/failures, unemployment, capital spending, and inflation.

Consumer spending is expected to remain strong. Contrary to widely held beliefs, Mr. Duncan believes that consumers are not over-extended because monthly payments remain a small percentage of disposable income. The housing market appears to be garnering pent-up demand, as mortgage rates have remained at the pivotal 12 percent for some time now. Rates are expected to drift down below 12 percent, however, which should trigger a very strong housing market.

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Business starts are at an all-time high. This bears no correlation to interest rates; rather, it is attributed to a more entrepreneurial spirit and willingness to take risks. While business starts are up, so too are business failures. There are several reasons for this: small businesses pay very high interest rates and are at high risk for failure. Also, liberalized personal bankruptcy laws have made it more acceptable to file bankruptcy claims.

Employment has grown continuously during the last five years. Import activity, which would seem to adversely affect the health of the economy, does, in fact, add jobs in the United States. Thus, import activity together with strengthened demand from overseas markets for U.S. exports, should be bolstered.

Capital Market Activity

Capital spending has been depressed due to uncertainty of its treatment under proposed tax reforms. Yet, Mr. Duncan believes that tax reform will not occur until 1987. Spending is expected to pick up in 1986, along with corporate profits. Corporate cash flow will be up 5 percent in 1985, while profits will be down 5 percent. Inflation will increase as well, but is not expected to exceed a 5 percent annual rate.

We believe that there are two sides to the U.S. economy: production, expressed as gross national product (GNP) and consumption, which we refer to as gross final domestic demand (GFDD). To get a good view of the economy, one should look at both. GFDD measures the strength of demand in the economy by factoring net exports and inventory change out of GNP: GFDD = GNP - change in inventory + imports - exports. As shown in Figure 1, the GFDD points to a healthy market with 3.3 percent growth between the fourth quarter of 1984 and the third quarter of 1985. Forecasts of real GNP identify growth of 2.7 percent for 1985, 3.5 percent for 1986, and 4.5 percent for 1987. Growth in GFDD is forecast to remain higher than GNP growth through the end of 1985.

Congressional Action

It is highly probable that the U.S. economy will not experience another recession until 1989. If Congress acts to pass a budget balancing bill, the economy should experience moderate growth for several years. However, if the deficit is not reduced, interest rates could start spiraling as early as spring of 1986, and a recession would soon follow. We believe Congress will act to balance the budget.

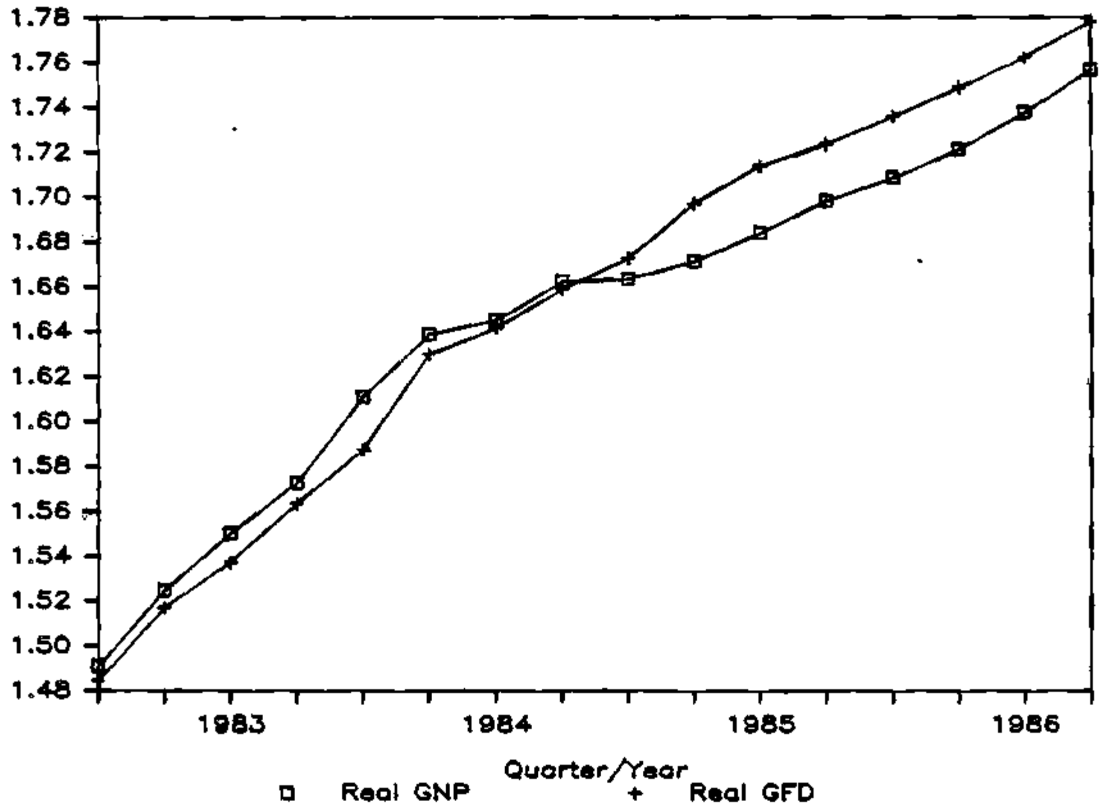
SUMMARY

Mr. Duncan identifies a healthy U.S. market. DATAQUEST concurs with his assessment and agrees that 1986 will be a healthy year. Our forecast for semiconductor growth assumes light growth in the first quarter of 1986 with more robust growth in the latter quarters. Our long-range forecast also identifies a recessionary period in 1989. While it is not clear that the semiconductor market clearly follows the GNP, we believe that the overall economy sets the general trend for the health of our industry.

Patricia S. Cox
Barbara A. Van

Figure 1

Real U.S. GNP Versus Real Gross Final Domestic Demand
(Trillions of 1972 Dollars)



Source: Wharton Econometric Forecasting Associates
DATAQUEST

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RESEARCH BULLETIN

JSIS Code: EIEJ Newsletters

SEVENTH ANNUAL GaAs SYMPOSIUM
NOVEMBER 12-14, 1985

Interest in gallium arsenide (GaAs) ICs has grown rapidly in recent years. Attendance at the IEEE-sponsored GaAs IC symposium has grown more than 30 percent annually since 1982, reaching 850 at this year's meeting in Monterey, California. Abstract submittals increased 24 percent over 1984, indicating substantial growth in development activity.

HIGHLIGHTS

General

- Forty-nine papers, approximately evenly split among analog ICs, digital ICs, and technology topics
- Authors from 26 companies, 5 universities, and 2 other organizations
- Three panel discussions covering millimeter-wave ICs, LSI issues, foundry operations, and standardization

Key Papers

- A GaAs, 12-bit, 1-GHz digital-to-analog converter (DAC)--Hewlett-Packard Labs
- A 115-GHz, monolithic, GaAs, FET oscillator--Texas Instruments
- A 2.6ns, t_{aa}, 1K x 4 SRAM using enhancement/depletion MESFETs (two papers)--Hitachi
- An ECL-compatible, 1K SRAM (with smallest cell reported to date)--Texas Instruments

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- A 400-MHz band prescaler (for hand-held radio)--Toshiba

- An 8 x 8 multiplier (5.6ns at 1.45V) with 20-bit accumulator--Sony

- A high-temperature (180 degrees C) GaAs hall-effect sensor--Siemens

OBSERVATIONS AND CONCLUSIONS

GaAs IC technology is extending semiconductors to new frontiers of speed, speed/power efficiency, temperature extremes, and radiation resistance. Analog GaAs ICs are already commercially viable, with free-world market shipments exceeding $50 million annually.

However, present merchant market activities in GaAs digital ICs are severely limited by quality of starting material, threshold control, lack of test equipment for use in a production environment, chip interface/packaging standardization, and other restrictions. DATAQUEST believes that the 1985 GaAs digital IC market will be less than $15 million worldwide.

Explosive merchant market growth rates exceeding 100 percent a year for SRAMs, gate arrays, and other LSI devices are achievable as the restrictions mentioned above are resolved. At such time, demand will rapidly grow to more than $1 billion annually. The wafer-processing capacity required to support such a business level is quickly achievable, and the technical expertise is available, as demonstrated by this year's papers.

Gene Miles

Nielsen Dataquest RESEARCH BULLETIN

JSIS Code: EIEJ Newsletters

SEMICONDUCTOR MANUFACTURING EQUIPMENT: CAN THE UNITED STATES REMAIN COMPETITIVE?

INTRODUCTION

The U.S. Department of Commerce (DOC) published a report in March 1985 entitled "A Competitive Assessment of the U.S. Semiconductor Manufacturing Equipment Industry." The report, issued under the auspices of the DOC's International Trade Administration, was authored by the Science and Electronics Office of Microelectronics and Instrumentation and the Assistant Secretary for Trade Development.

The report is an attempt by the Office of Microelectronics and Instrumentation (OMI) to assess the competitiveness of the U.S. semiconductor manufacturing equipment industry. Sources used for the report include officials from the National Bureau of Standards and the Census Bureau, U.S. and European manufacturers, several agencies and associations, publicly available information, and market research companies (including DATAQUEST).

HIGHLIGHTS OF THE REPORT

The report presents historical and forecast market demand by geographic region for wafer processing, assembly, and test equipment. It examines competitive strengths and weaknesses by manufacturing region (United States, Japan, and Europe). The sales figures shown for the major U.S., Japanese, and European semiconductor equipment firms show Japanese manufacturers gaining worldwide market share.

Also examined are the close relationships that exist between major Japanese semiconductor equipment manufacturers and the major Japanese semiconductor suppliers. These relationships can result in preferential treatment for the equipment manufacturers.

Other topics discussed include R&D and sources of funding, government policies and incentives to industry, government procurement, and tariffs and other trade barriers.

The report concludes by calling for the U.S. government to take the following five measures to aid U.S. competitiveness in the semiconductor manufacturing equipment industry:

- Encourage increased investment in R&D
- Expand the pool of technical expertise available to the industry
- Improve industry/government cooperation
- Increase export opportunities for the semiconductor equipment industry
- Create an official data base for the semiconductor equipment industry

DATAQUEST CONCLUSIONS

We believe that this report is extremely significant to both the semiconductor equipment industry and the semiconductor component industry. We anticipate that it will spur the government to take steps to increase available information on the industry, specifically, by assigning SIC codes to semiconductor equipment and by developing 5-digit export and import code classifications for this industry.

The report may be ordered from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402
Phone (202) 275-2051

The cost of the report is $425; it may be ordered by phone and charged on Visa or MasterCard. The report number is 1985-461-105/20066.

Patricia S. Cox

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

EIEJ Code: Newsletters

NTT PURSUES PATENT SALES AND JOINT R&D

SUMMARY

At a recent presentation at Stanford University's U.S.-Asia Forum, Hideaki Toda, Director General of the New York office of Nippon Telegraph and Telephone (NTT), discussed forthcoming changes in NTT policies that DATAQUEST believes will have a major impact on the semiconductor industry. The discussion focused on three key issues:

- NTT privatization (entry into the commercial market)
- Patent sales and joint R&D
- Business opportunities in the value-added network (VAN) market

NTT PRIVATIZATION

Currently, the Japanese Diet is considering the NTT Company Limited Bill that would allow NTT to compete in the Japanese telecommunications market as a privately owned company. NTT is now a government-controlled monopoly. Known as "privatization," the bill would make the following changes in NTT management:

- Government stock ownership limited to one-third
- Limited government regulation
- No government control over NTT budget
- No restrictions on investments
- No government financial assistance; free access to the capital market

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- Strikes allowed under certain restrictions

- Government review of NTT operations within five years to ensure compliance with legislative goals

Mr. Toda noted that NTT privatization differs from AT&T divestiture because NTT will remain intact and will not be broken up into separate operating companies. Nevertheless, NTT expects to encounter strong competition from the newly formed Second NTT Planning Company (see our EIEJ newsletter dated May 30 1984, "A Second NTT Takes Shape") and from members of the "NTT Family," such as NEC, Fujitsu, and Hitachi. Mr. Toda also believes that foreign companies will play increasingly important roles as suppliers and competitors in this market. Under Hisashi Shinto, president of NTT, the company increased procurement of foreign-produced equipment to $140 million in 1983.

PATENT SALES AND JOINT R&D

A major policy change is NTT's decision to sell its patents and to conduct joint R&D with non-Japanese companies. NTT recently established a subsidiary called NTech, which sent letters to U.S. companies offering to sell NTT patents. There was little response, however, despite NTT's high level of expertise in Japanese semiconductor technology. DATAQUEST believes that this is an excellent opportunity for semiconductor companies interested in securing NTT technology. For advanced technologies, such as megabit DRAMs, GaAs digital ICs, and semiconductor lasers, NTT will conduct joint R&D through its Track III procurement procedure (see our JSIA newsletter dated February 22, 1984, "NTT Discloses its Adoption Standards to Foreign Semiconductor Suppliers"). NTT also will provide publicly available technical documents and encourage technical exchanges with researchers at its four laboratories.

BUSINESS OPPORTUNITIES IN THE VAN MARKET

The Telecommunications Bill, which would deregulate the Japanese telecommunications market, is expected to pass in the Diet next year. The legislation would abolish the primary telephone concept and deregulate value-added network (VAN) services, thus opening the market to domestic and foreign competition. Under the bill, three types of carriers would be recognized by the Ministry of Posts and Telecommunications, as shown in Table 1.

Non-Japanese companies such as AT&T, IBM, and GTE-Telenet have entered the market as resellers to provide VAN services and are working with their Japanese partners (see our JSIA newsletter dated October 19, 1984, "The Next Generation: Japan's Information Network System (INS)"). DATAQUEST believes that this area will open numerous opportunities for semiconductor makers selling telecommunications, ICs, logic and memory devices, and optoelectronics.

FOR MORE INFORMATION

For more information about NTT procurement procedures, joint R&D opportunities, or patent sales, please contact the following offices:

- Head Office

  - Nippon Telegraph & Telephone
    1-6, Uchisaiwaicho 1-chome, Chiyoda-ku
    Tokyo 100
    Japan
    Tel: (03) 509-5111

- Overseas Offices

  - NTT New York Office
    Pan American Building, Suite 2905
    200 Park Avenue, New York, NY 10166
    U.S.A.
    Tel: (212) 867-1511

  - NTT Silicon Valley Office
    4962 El Camino Real, Suite 230
    Los Altos, CA 94022
    U.S.A.
    Tel: (415) 940-1414

  - NTT London Office
    2nd Floor, Adelaide House, London Bridge
    London, EC4R 9BU, United Kingdom
    Tel: 623-8340

  - NTT Office de Geneve
    30 Chemin du Pommier, 1218 Grand-Saconnex
    Geneva, Switzerland
    Tel: 98-3840

Sheridan Tatsuno

Table 1

CARRIERS RECOGNIZED BY THE MINISTRY OF POSTS AND COMMUNICATIONS

Carriers	Features	MPT Requirement	Foreign Ownership
First Category	Own facilities, full service	Mandatory approval	Less than one-third foreign capital
Second Category	Resellers		
Special	Large-scale nationwide or international networks	Registration	No restrictions
General	Small-scale networks	Notification	No restrictions

Source: Nippon Telegraph and Telephone

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RESEARCH BULLETIN

EIEJ Code: Newsletters

HITACHI ANNOUNCES CAD SYSTEM FOR THREE-DIMENSIONAL ANALYSIS

REVOLUTIONARY DEVELOPMENT

The era of three-dimensional computer-aided design (CAD) has arrived. On October 19, Hitachi became the first Japanese semiconductor maker to announce CAD equipment and software for developing next-generation VLSI devices such as 1Mb to 64Mb DRAMs and high-function MPUs. Announced by Hitachi's Central Research Laboratory, the CADDETH software program is capable of displaying 3-dimensional color images of the electrical and physical properties of VLSI circuits. The software can be run on Hitachi's supercomputer, the Hitac S-810/20, which has a peak operating speed of 360 megaflops (million floating-point operations per second). Running the program on existing computers takes at least a day, or one hundred times as long.

Unlike current CAD systems, which are only able to display two-dimensional images of devices with geometries of over 1 micron, the Hitachi system can visually display the following conditions:

- Electrical characteristics of CMOS and bipolar circuits
- Effects of external heat buildup
- CMOS latch-up analysis
- PN junction destruction phenomena
- High-speed reliability tests
- High- and low-temperature conditions

According to Dempa Shimbun, Japan's daily electronics journal, other Japanese semiconductor makers are racing to develop comparable systems, but they are encountering the problems of long processing times and displaying the analysis results in an easy-to-understand format.

VERTICAL INTEGRATION REVISITED

DATAQUEST observes that Hitachi is making a strong push into semiconductor equipment. We have determined that during 1983, Hitachi applied for 58 patents for semiconductor manufacturing equipment, second only to Fujitsu, which had 75. (See the JSIA newsletter "Japanese Semiconductor Technology Review, Second Quarter 1984," dated August 17, 1984, for the complete story on Japanese semiconductor equipment patents.)

Furthermore, on June 1, the company established a new company, Hitachi VLSI Engineering, at its Central Research Laboratory in Kokubunji to develop next-generation semiconductor technology. In June, Hitachi announced a transmission electron microscope capable of ultrahigh resolution photography up to 0.72 angstroms. The microscope will be used for developing superlattice-structure semiconductors, amorphous metal, fine ceramics, and other new materials.

In June, Hitachi also announced plans to invest ¥110 billion ($460 million) in its semiconductor divisions in fiscal 1984, 75 percent ($83 million) of which will be spent on semiconductor manufacturing equipment, including clean rooms. Hitachi plans to produce 60 percent of all the semiconductor equipment used in-house, or about ¥50 billion ($206 million), up from 40 percent in fiscal 1983. A new building is being constructed at its Naka plant to produce semiconductor manufacturing equipment.

CONCLUSIONS

DATAQUEST believes that Hitachi's recent announcement is significant because of its potential impact on the development of next-generation semiconductor technology. Not only can the new software be used for developing megabit DRAMs and high-function MPUs, but also superlattice devices, three-dimensional ICs, optoelectronic ICs, and possibly GaAs heterojunction devices in the future. Since Hitachi is a participant in MITI's New Semiconductor Functions Project, we believe that it will use three-dimensional display CAD software for developing three-dimensional ICs. Hitachi's CADDETH software also underscores the growing role of supercomputers in next-generation semiconductor research.

Sheridan Tatsuno

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JAPANESE RESEARCH NEWSLETTER

EIEJ Code: Newsletters

MITI'S TAKE-LEAD STRATEGY SHIFTS INTO HIGH GEAR

SUMMARY

Despite denials to the contrary, Japanese industrial policies are alive and well. In an effort to regain its former influence over the electronics industry, the Ministry of International Trade and Industry (MITI) has issued a series of industrial policies designed to promote public and private research in high-technology industries. As shown in Figure 1, DATAQUEST believes that these policies are part of MITI's overall strategy to give Japanese industry a competitive advantage over the West and rapidly emerging South Korea, while at the same time trying to reduce trade conflicts. This year, MITI has announced policies that we believe will have a major impact on the semiconductor industry. These policies cover the following areas:

- High-Technology Policies
  - Overall MITI policy direction
  - MITI fiscal 1985 budget proposal
- Financial Incentives
  - Tax breaks for high-technology industries
  - Venture Business Promotion Law
  - Japan Development Bank loans
  - Export-Import Bank of Japan loans
  - New media loan program
- Government R&D Activities
  - Sale of MITI patents
  - 100-Mbyte DRAM project proposed

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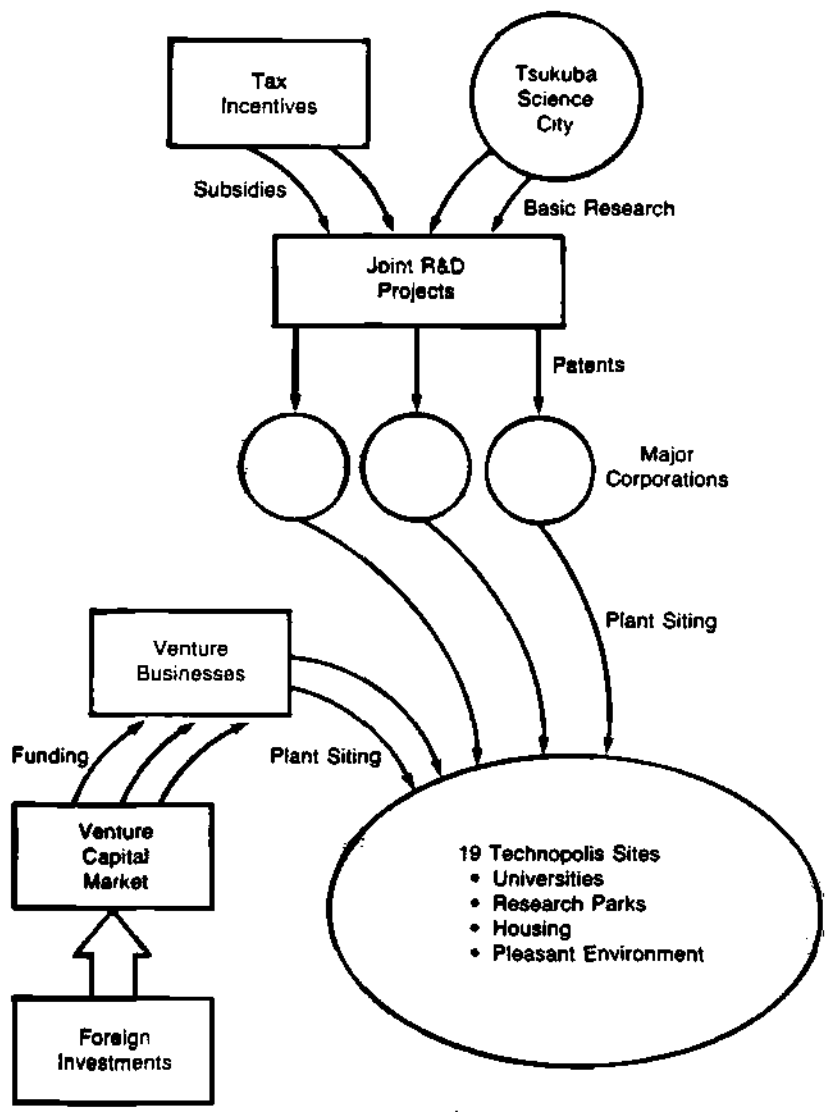
- Opening of MITI laboratories to private industry
- New high-technology university
- Next-generation semiconductor equipment project

- Plant Siting and Expansion
  - Technopolis program
  - Matchmaking service for foreign companies

Figure 1

MITI'S TAKE-LEAD STRATEGY



Source: DATAQUEST

HIGH-TECHNOLOGY POLICIES

Overall MITI Policy Direction

"High technology" is the buzzword at MITI this year. Based on private industry surveys, MITI has identified three industries for accelerated development: microelectronics, new materials, and biotechnology. In a recent interview with the Japan Economic Journal, new MITI vice minister Keisuke Konaga emphasized Japan's need for innovative research: "Up to now, Japan's technological development has relied heavily on using foreign technology. Such a pattern will not be allowed to continue. We will have to make original developments on our own. We will push technological advances with creative and problem-solving type people. This will involve a greater risk, a longer development period, and far more financial resources than in the past. While the main propellant of technological development is the private sector, the government needs to cooperate under an appropriate scheme of burden-sharing."

DATAQUEST observes that Japan's top semiconductor makers are already focusing on the development of original 32-bit MPUs, advanced VLSI, gate arrays, standard cell libraries, CAD software, GaAs digital ICs and microwave devices, optoelectronics, three-dimensional ICs, and bioelectronics. MITI is supporting these private efforts with its R&D projects, 7.1 percent Japan Development Bank loans for high-risk research, and investment tax breaks from the treasury's Fiscal Investment and Loan Program (FILP).

In fiscal 1985, MITI plans to introduce a new law to establish joint R&D projects. Tentatively called the Law for Preparing the Foundation for Technology Development, the law will replace the old "Kijoho" law (Specific Machinery and Information Industries Promotion Law), which was passed in 1978 to allow MITI to set national R&D goals and funding policies. DATAQUEST observes that this new law will surpass the 1978 law by promoting new materials, fine ceramics, and biotechnology.

MITI Fiscal 1985 Budget Proposal

For fiscal 1985 (April 1985 through May 1986), MITI has requested a budget of $3.43 billion (¥824 billion), up 2.8 percent from fiscal 1984. Projected outlays include $250 million (¥60.2 billion), an increase of 0.8 percent over fiscal 1984, for its Agency for Industrial Science and Technology (AIST), which is responsible for R&D at MITI laboratories in the Tsukuba Science City. This is the first AIST increase in three years; the AIST budget declined from $263 million (¥63.5 billion) in fiscal 1982 to $258 million (¥62.1 billion) in fiscal 1983 and

$249 million (¥59.7 billion) in fiscal 1984. In fiscal 1984, MITI's budget accounted for 1.5 percent of Japanese government spending. Major semiconductor and computer projects include:

- $26 million for the Next-Generation Industries project, which is developing three-dimensional ICs, superlattice devices, hardened ICs, and biochips
- $22 million for the Fifth-Generation Computer project
- $10 million for the Optoelectronics project
- $10 million for the Supercomputer project
- $24 million for software development
- $0.1 million for computer security

In addition, MITI plans to spend $125 million (¥60 billion) during the next 6 to 10 years on three large-scale projects that will begin in fiscal 1985. These projects include $125 million (¥30 billion) for a superprecision energy beam processing technology for semiconductor manufacturing (1985 through 1993), $83 million (¥20 billion) for an interoperable software data base system for different computer systems, and $54 million (¥13 billion) for the "Aqua-Renaissance 90" water recycling system.

In August 1984, AIST recommended that Japan increase its R&D budget to develop next-generation technologies. Specifically, an AIST committee proposed the following goals:

- Increasing government R&D funding from 2.44 percent of the GNP in fiscal 1982 to 3 percent in fiscal 1985
- Increasing the government's share of R&D funding from 30 percent to 40 percent

The committee noted that Japan is behind the United States in the energy, space, and medical fields, and that the strategy for the 1990s should be to boost R&D in basic areas such as electronics, new materials, and biotechnology.

FINANCIAL INCENTIVES

Tax Breaks for High-Technology Industries

On August 10, MITI announced a new tax incentive plan that calls for expanding present tax programs to encourage research in emerging new technologies. If passed, the plan will cost about $125 million (¥30 billion) in tax reductions and will include the following provisions:

- Raising the current 20 percent tax credit for R&D spending to 30 percent
- Raising the R&D tax credit ceiling from 10 percent of corporate taxes paid to 20 percent
- Calculating the change in R&D expenditures on the basis of a three-year moving average (similar to that used in the United States) instead of the "past peak" base currently used
- Applying the new depreciation allowance to 50 percent of new R&D equipment and 30 percent of manufacturing facilities
- Creating a special account to finance up to 30 percent of R&D spending by small and medium-size companies
- Exempting from taxes 20 percent of the capital gains accruing from venture capital investments
- Offering tax credits of up to 7 percent (10 percent for small and medium-size firms) of the cost of R&D equipment and facilities

However, this plan is opposed by the Ministry of Finance (MOF), which has proposed increasing the five-year amortization for semiconductor equipment to seven years and eliminating altogether the special tax status in order to increase revenues. The Japan Electronics Industry Association has lobbied vigorously against MOF's proposal, arguing that the seven-year amortization period is too long in the rapidly moving semiconductor industry. Currently, Japan's deficit runs about 25 percent of its $220 billion annual budget. To overcome MOF's objections, MITI is proposing a three-stage effort to help semiconductor producers:

- Exempting R&D projects from MOF's 6.9 percent spending cap
- Improving tax incentives for new "venture businesses"
- Establishing a "high-technology bank," financed partly by the sale of Nippon Telegraph and Telephone next April

DATAQUEST observes that, as in the United States, Japanese semiconductor makers have been calling for an extension of R&D tax credits. The proposed 30 percent R&D tax credit, if approved, would give Japanese companies a 5 percent advantage over U.S. firms, which are pushing for continuation of the present 25 percent R&D tax credit.

Venture Business Promotion Law

In an effort to replicate Silicon Valley's start-up activity, MITI's Small and Medium Enterprise has proposed new legislation, the Small Businesses' New Technology Promotion Law, to promote high-technology "venture businesses." Under the proposed bill, MITI would grant a buildup of investment loss reserves and preferential tax treatment to venture businesses designated by prefectural governors as "high-tech oriented ventures." In addition, the Small Business Credit Insurance Law would be revised to allow venture businesses to obtain unsecured loans. Currently, MITI officials are considering four criteria to qualify firms for these tax incentives:

- Research in electronics, electromechanics (mechatronics), new materials, biotechnology, or computer software
- R&D spending over 3 percent of total sales
- Founded or moved into high-technology field within the last 10 years
- Plan to be listed on over-the-counter (OTC) stock exchange in the future

Presently, MITI estimates that 3,000 to 5,000 companies would qualify under these criteria.

The proposed bill includes two provisions to promote the venture capital market. First, the law would grant venture capital firms a buildup of tax-free investment loss reserves. Second, MITI is urging the Fair Trade Commission to remove its ban on the assignment of venture capital executives to start-up companies for the purpose of strengthening the management of these start-ups.

The details of the Venture Business Promotion Law, as it is properly called, still have to be hammered out. MITI plans to introduce it to the next Diet session for approval.

Japan Development Bank Loans

In July, MITI and the Japan Development Bank (JDB) announced a low-interest financing program for high-technology research projects. Under the program, which will begin in April 1985, the JDB will offer government-funded venture capital at an interest rate of 4.3 percent. The repayment period will be 10 years and the financing will cover between 50 and 70 percent of total project costs. Unlike the JDB's standard rate of 8.4 percent for less risky, established technologies, the new program is aimed at high-technology projects in the early R&D stages. Based on a preliminary survey, MITI and the JDB found 10 possible projects for funding, including projects for developing gallium phosphorus single crystals ($2 million in funding) and new heat stress-resistant ceramics. For more information on JDB loans, see our EIEJ newsletter "Japan Development Bank Loans Available to Foreign Companies," dated February 1, 1984.

Since fiscal 1984, the Japan Development Bank has also offered loans for other high-technology areas, including:

- Value-added networks (VAN) and cable TV
- Flexible manufacturing systems leased by the Nippon Robot Leasing Company
- Foreign capital investment in high-technology companies
- Plant siting in 14 designated Technopoli
- Importation of computers, peripherals, medical equipment, and machine tools

Export-Import Bank of Japan Loans

To help Japanese companies open R&D facilities abroad, MITI has decided to establish a special finance program to be operated by the Export-Import Bank of Japan. The program will finance up to 70 percent of facilities costs at an interest rate of 6 to 6.5 percent, lower than loans for ordinary investments, which have interest rates of between 7.6 and 7.9 percent. MITI hopes this program will accelerate technological development by encouraging companies to employ non-Japanese staff.

Recently, Japanese companies have been opening R&D centers in the United States, as shown in Table 1, to take advantage of local talent. A MITI survey indicates that 20 of the 130 large firms interviewed have similar plans.

Table 1

JAPANESE COMPANIES WITH R&D CENTERS IN THE UNITED STATES

Company	Location	Activity
Kyocera	Vancouver, Washington	New ceramics R&D lab by summer 1986
Sumitomo Electric	Research Triangle, North Carolina	Optical fiber and GaAs R&D; 30 to 40 researchers planned
TDK Corporation	Not Decided	Pilot plant to manufacture parts for telecommunications; 40 researchers planned
Honda Motor Company	Not Decided	Product development lab by 1985
Toshiba	Not Decided	IC research lab planned

Source: Japan Economic Journal

New Media Loan Program

"New Media" is one of the hottest high-technology fields in Japan today. Referring to the latest communications services such as videotex, teletext, cable TV, and satellite broadcasting, new media services are attracting large investments by Japan's major electronics companies. To assist this emerging industry, MITI and the Ministry of Posts and Telecommunications (MPT) are developing two separate programs. MITI plans to establish a Japan Development Bank loan program that will offer 3 to 4 percent loans with a repayment period of 10 years to finance 50 percent of basic R&D projects. MITI also plans to designate 32 cities as "New Model Cities" that will be offered special tax incentives and R&D subsidies; nearly 135 cities have applied for the program.

To keep up with MITI, the MPT is designating "Teletopia Model Cities" throughout Japan and plans to establish a "New Media Promotion Fund" to finance private investment in cable TV and value-added networks (VANs). This program will be designed to leverage commercial bank loans.

GOVERNMENT R&D ACTIVITIES

Sale of MITI Patents Proposed

Due to budget limits, MITI announced in July that it plans to sell patent rights to private industry in order to produce new revenues. Since its founding in 1949, MITI has been granted more than 11,000 patents. Profits will be used to fund operating expenses, which are down 10 percent from fiscal 1983, and investment in MITI laboratories, which is down 5 percent. The proposal is being reviewed by the Ministry of Finance, but prospects look good because of growing calls for selling government patents to reduce the budget deficit. In mid-October, the Japan Industrial Technology Promotion Association sent a mission to the United States and Canada to sell 30 MITI-owned patents in new ceramics, electronics, mechatronics, and biotechnology. The mission will visit Montreal, San Antonio, Chicago, and various research institutes. To date, only 590 of the 11,000 patents have been licensed to private firms. MITI has not announced whether it will license its patents for advanced semiconductor technologies, such as GaAs, Josephson junctions, three-dimensional ICs, and optoelectronics.

100-Megabit DRAM Project Proposed

In March 1984, a group of Japanese semiconductor makers and university researchers headed by Professor Shoji Tanaka of Tokyo University proposed a $210 million, five-year project to develop a 100-megabit dynamic RAM using 0.25-micron geometries. Although no decision has been made yet, MITI officials are discussing the proposal. DATAQUEST believes that MITI officials are seeking a program to compete with Nippon Telegraph and Telephone (NTT), which is developing 4Mb and 16Mb DRAMs for its Information Network System (INS), a nationwide telecommunications network of fiber optics and satellites. Professor Tanaka was coordinator of the well-known VLSI Project (1976-1980), which developed the 64K DRAM as well as process equipment that is beginning to enter the U.S. market.

Opening of MITI Laboratories

In early August, MITI launched a new joint research system designed to promote joint government-industry research. Beginning in fiscal 1985, MITI's nine research facilities at the Tsukuba Science City, which is located 30 miles northeast of Tokyo, will accept researchers from Japanese companies and allow them to bring in private equipment as well as to take advantage of MITI's highly sophisticated equipment. This is a major policy shift, since private researchers were prohibited from entering MITI labs in the past. Immediately scheduled for joint R&D ventures are radiation application technologies using electron accumulation equipment at MITI's Electrotechnical Laboratory and new materials development at the National Chemical Laboratory for Industry. The new R&D system is designed to reduce the financial and technological risks of basic research for private companies who cannot afford to invest in expensive research equipment. Table 2 lists semiconductor-related research at MITI's nine laboratories. In the near future, we will issue a list of the 150 semiconductor R&D projects currently being conducted at MITI's Electrotechnical Laboratory.

Table 2

SEMICONDUCTOR-RELATED RESEARCH AT MITI LABORATORIES IN THE TSUKUBA SCIENCE CITY

Laboratory	Research Staff	FY83 Budget	Research Activities
Electrotechnical Laboratory	560	$ 39.6M	Supercomputers, optoelectronics, GaAs, Josephson junctions, 3-D ICs, sensors, VLSI pattern processing, lasers, optical fibers, crystal growth, bioelectronics (bionics), amorphous silicon, others
National Metrology Research Lab	131	8.2	Measurement standards, lasers, X-rays
Mechanical Engineering Lab	222	12.8	Bioelectronics, optical measuring, robotics (lasers, sensors), CAD/CAM software
National Chemical Lab for Industry	297	18.0	Superconductive materials
Fermentation Research Institute	64	3.8	Synthetic membranes for bioelectronics
Polymer and Textiles Research Institute	107	5.7	High-quality crystals, IC lithography
Industrial Products Research Institute	107	5.1	Sensors, speech synthesizers, CAD/CAM, bioelectronics
Geological Survey of Japan	254	19.7	None
Pollution and Resources Research Institute	257	17.4	New mining and mineral process technologies (for GaAs and other rare materials)
Total	1,999	$130.3M	

Source: MITI, Agency for Industrial Science and Technology
DATAQUEST

New High-Technology University

In July 1984, MITI announced that it will support development of a new private university in the Tsukuba Science City to train high-technology engineers and researchers. Keiichi Oshima, professor at Tokyo University, and Jiro Ushio, president of Ushio Inc., presented the plan to MITI vice minister Keiichi Konaga, citing a recent study by the National Institute for Research Advancement showing that Japanese engineering departments are not graduating enough students in semiconductors, biotechnology, and other high-technology fields. Tentatively called the Institute of High Technology, the new university will aim at supplying more trained researchers to private industry. Although the Ministry of Education is encouraging joint research between universities and private industry, Japanese universities are still weak in training competent researchers.

Next-Generation Semiconductor Equipment Project

In July, MITI announced that it will spend $125 million (¥30 billion) over the next eight years to develop new process technologies for semiconductors, precision machine tools, and new compound materials. This project will focus on semiconductor equipment required for the next-generation semiconductor devices being developed by other MITI projects, such as three-dimensional ICs, gallium arsenide (GaAs) digital ICs, and bioelectronic ICs. DATAQUEST observes that MITI is emphasizing new semiconductor process equipment that is not available in the West. The New Semiconductor Functions Element Project, for example, has brought in Canon, Mitsui, and Seiko Instrument to develop semiconductor test equipment for three-dimensional ICs, superlattice devices, and hardened ICs. This new project is part of Japanese industry's overall thrust into semiconductor equipment. DATAQUEST observes that 714 of the 1,911 semiconductor-related patents granted were for process equipment.

PLANT SITING AND EXPANSION

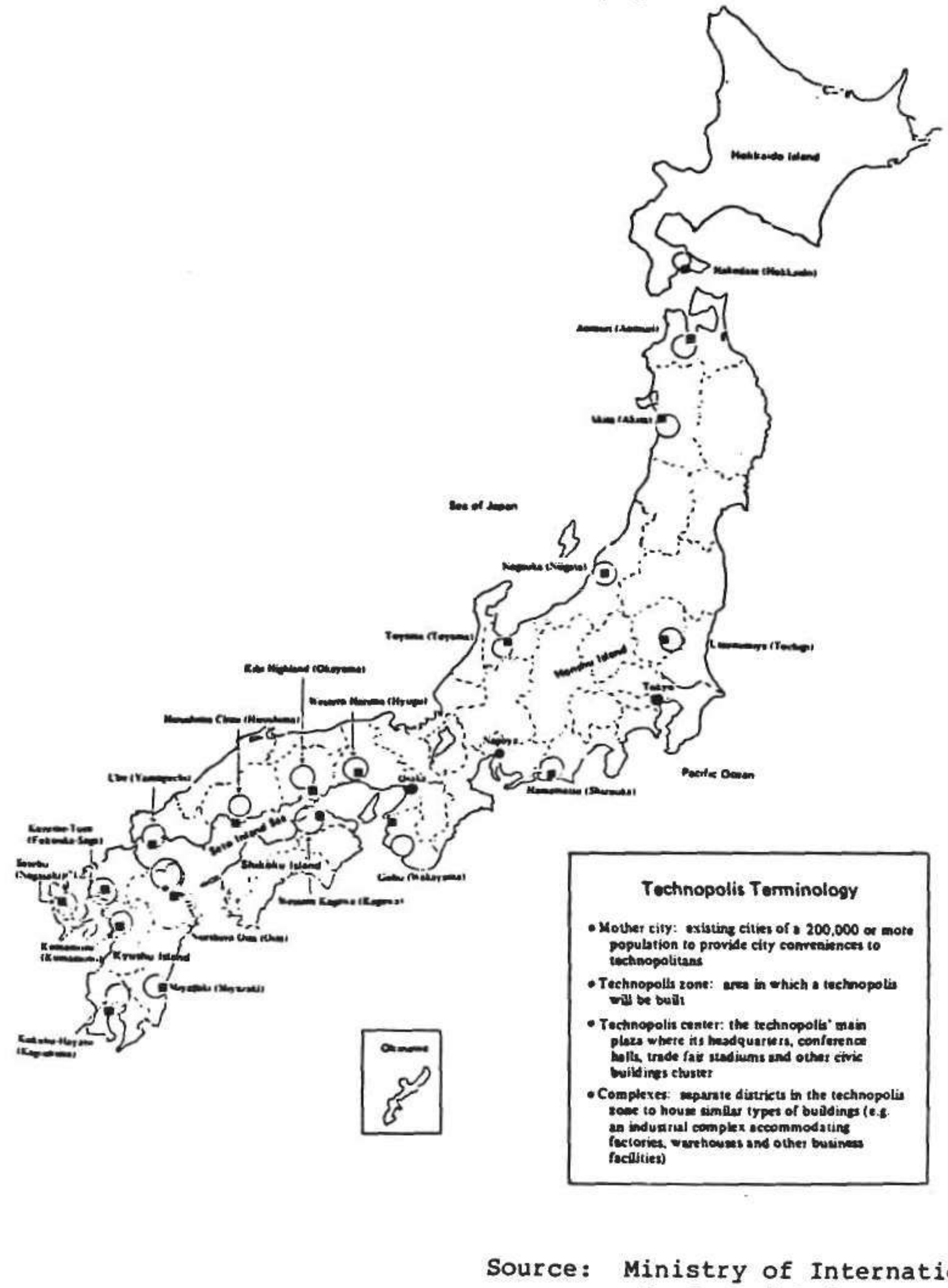
Technopolis Program

MITI's key strategy for the 1980s and 1990s is its Technopolis Concept, an ambitious plan to create 19 high-technology cities patterned after Silicon Valley. The new cities will have populations of 200,000 and will feature research parks combining universities, corporate laboratories, and venture businesses. In February 1984, MITI formally designated nine cities for R&D funding, 7.3 percent Japan Development Bank loans, and tax subsidies. These cities are Nagaoka, Toyama, Hamamatsu, Hiroshima, Kumamoto, Ube, Oita, Kaghoshima, and Miyazaki, as shown in Figure 2. Recently, MITI also designated Okayama, Utsunomiya, and Kurume-Tosu, and plans to establish "Techno-Marts" on an experimental basis in Hamamatsu and Kumamoto to promote trade in technical information and patents. MITI estimates that each of the Technopoli will spend about

$2 billion to $2.5 billion on new infrastructure (roads, housing, research parks, universities), making the Technopolis Concept a $40 billion to $50 billion investment. The cities have already formed joint R&D programs and technology centers to upgrade their research capabilities. DATAQUEST researchers have visited the top 11 Technopoli, which will be described in a book to be published next spring.

Figure 2

JAPAN'S 19 TECHNOPOLIS SITES



Source: Ministry of International Trade and Industry

Matchmaking Service for Foreign Companies

To promote plant siting and investment by foreign companies and to reduce trade friction, MITI established the Foreign Investment Servicing Office in May 1984. Working through the overseas offices of the Japan External Trade Organization (JETRO) and the Japanese Chamber of Commerce, MITI will help foreign companies find Japanese partners or subcontractors and will provide consulting services to firms planning to do business in Japan or with Japanese partners.

In response to American demands for access to MITI's Industrial Structure Council policy-making meetings, MITI began advisory meetings with the American Chamber of Commerce in Japan (ACCJ) in September. The talks will focus on MITI trade policies and U.S. complaints and requests, especially in high-technology areas such as semiconductor trade, VANs, and software protection. The ACCJ is led by Robert Sharp, vice president and deputy manager of the Tokyo branch of Manufacturers Hanover Trust Co; has 22 active committees; and consists of 540 American firms and 1,300 individual members.

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

EIEJ Code: Newsletters

PRESTOWITZ OUTLINES U.S.-JAPAN HIGH-TECHNOLOGY ISSUES

SUMMARY

Clyde Prestowitz, cochairman of the U.S.-Japan High-Technology Trade Commission and assistant secretary of international economic policy in the Department of Commerce, recently discussed key high-technology issues with industry leaders and scholars at Stanford University's U.S.-Japan Asia Forum. A top negotiator for the Reagan administration, Mr. Prestowitz described his efforts to open the Japanese market to non-Japanese investment, research, and manufacturing companies. His discussion focused on these key issues:

- Unequal access to research facilities
- Patent processing
- NTT procurement
- Software protection
- Telecommunications legislation

ACCESS TO RESEARCH FACILITIES

Unlike the United States, Mr. Prestowitz believes that Japan is relatively closed to non-Japanese researchers and scientists. Currently, there are 200 Japanese researchers at the U.S. National Institute of Health, 10 at the Lawrence Livermore Laboratories, and hundreds of graduate students and professors studying and teaching in U.S. universities. Moreover, Japanese researchers make maximum use of the National Technical Information Service (NTIS), providing it with significant revenues. On the other hand, non-Japanese professors are not given tenure in Japanese universities, and there are few non-Japanese researchers in Japanese government research projects. Equal access is still a long way off, but Mr. Prestowitz noted that it is gradually changing. Recently, Nippon Telegraph and Telephone (NTT) and the National Bureau of Standards (NBS) agreed to exchange researchers.

PATENT PROCESSING

Japan's patent processing system puts U.S. companies at a serious competitive disadvantage. Whereas the U.S. Patent Office usually grants patent rights after 2 to 3 years (a period that will be reduced to 18 months due to the Patent Office's automation program), the Japanese Patent Office takes at least 6 to 7 years. In some cases, it has taken up to 12 to 14 years for important patents. The most controversial case is Corning Glass's fiber optic patent application, which was submitted in 1968. Although the United States granted the patent in 1971 and Europe in 1973, Japan has still not granted patent rights. Corning argues that this delay allowed major Japanese manufacturers to infringe on its patent rights, putting it at a disadvantage in NTT's fiber optic procurement program. Vice Minister Wakasugi is trying to automate the Patent Office and reduce piracy, but this effort will take at least several years.

NTT PROCUREMENT

Whereas Japan exported more than $1 billion in telecommunications equipment to the United States in 1983, U.S. companies exported only $140 million to Japan, despite the competitiveness of their equipment. Mr. Prestowitz believes that the major reasons for this imbalance are the openness of the U.S. market since AT&T divestiture, and NTT's previously "closed" procurement practices. Although NTT now has agreed to open its procurement practices and to establish branch offices in the United States, Mr. Prestowitz observed that NTT occasionally lapses into favoring the "NTT family"; he cited NTT's policy not to buy U.S. communication satellites as a case in point. Only after talks with Mr. Prestowitz did NTT President Shinto reverse that policy.

DATAQUEST believes that NTT procurement is one of the most significant high-technology markets in Japan. In fiscal 1984, NTT plans to procure $1.65 billion of fiber optic cable and digital switching systems during the next 20-years for use in its $120 billion Information Network System (INS).

SOFTWARE PROTECTION

The major controversy in U.S.-Japan high-technology relations is software protection. MITI believes that Japan is behind the United States in software and needs to protect this "infant industry." The Ministry of Education traditionally has held the legal authority to administer copyright law, but MITI argues that software is an "economic good" requiring patent protection, not intellectual property that should be accorded the same copyright protection as books and movies. (For more information on this subject, see our EIEJ Research Newsletter, "MITI Bows to U.S. Demand for Software Copyright Protection," April 12 1984.) Late last year, MITI introduced the Software Patent Bill. After strong protest from the U.S. Embassy and Mr. Prestowitz, and much debate with the Cultural Agency of the Ministry of Education, MITI quietly withdrew the bill.

Mr. Prestowitz noted that Japan and the United States are both signatories to the Berne Convention, an international copyright pact, and argued that a copyright protects the expression of an idea, not necessarily the idea itself. The basic concepts between software data bases, for example, are often similar, but copyright law nevertheless protects their unique features.

TELECOMMUNICATIONS BILL

The U.S. Embassy opposed the Telecommunications Bill prepared by the Ministry of Posts and Telecommunications (MPT), which would have restricted non-Japanese ownership to 20 percent in value-added network (VAN) services. Keidanren (Federation of Economic Organizations), a private, nonprofit organization comprising 110 major industry associations and the largest 812 corporations, argued that MPT needs to protect "its little babies," such as NEC, Hitachi, and other telecommunications manufacturers. This bill will be reintroduced later this year, along with the bill to divest NTT.

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

EIEJ Code: Newsletters

WORLDWIDE TECHNICAL MEETINGS

Because of the need to be aware of important business/technical meetings throughout the world, DATAQUEST has compiled a calendar covering major meetings of importance to all JSIS clients.

We have researched and are now making available to you a calendar for the second half of 1984. The calendar lists meeting dates, titles, locations, and addresses for inquiries. We are currently researching the major events for 1985, and will send this calendar out later in the year.

Gene Norrett

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1290 Ridder Park Drive / San Jose, CA 95131 / (408) 971-9000 / Telex 171973

JSIS ELECTRONICS CALENDAR

Date	Activity	Location	Inquiries
MID JULY	1984 National Academic Television Conference	Tokyo	Office of Academic Television Association Kikai Shinko Kaikan 3-5-8 Shibakoen, Minato-ku, Tokyo 105 (03) 432-1677
7/23-27	ACM SIGGRAPH '84 (11th Annual Conference on Computer Graphics and Interactive Techniques)	Minneapolis, MN, USA	Richard Mueller Control Data Corporation P.O. Box 0, Mail Zone HQCD2D Minneapolis, MN 44330, USA
7/25-27	Semicon Osaka '84	Osaka International Exhibition at Minato Center Minato-ku Osaka	Markham International 805 Akasaka-Omotemachi Bldg. 4-8-19 Akasaka, Minatoku, Tokyo 107 (03) 403-8515
7/30-8/2	7th International Conference on Pattern Recognition	Montreal, Quebec, Canada	ICPR Secretariat 3450 University Street Montreal, H3A2A7 Quebec, Canada
8/1-3	3rd International Conference on Molecular Beam Epitaxy	San Francisco Hilton and Tower San Francisco, CA, USA	Hiroyuki Sakaki Tokyo University Manufacturing Technology Lab #3 7-22-1 Roppongi Minatoku, Tokyo (03) 402-6231, ex. 2343
8/6-10	National Conference on Artificial Intelligence (AAAI '84)	University of Texas Austin, TX, USA	American Association for Artificial Intelligence 445 Burgess Drive Menlo Park, CA 94025, USA
8/20-24	13th Congress of International Commission for Optics (ICO 13)	Sapporo, Kyoiku Bunka Kaikan 13 Kitaichijonishi Chuoku, Sapporo	Simul International ICE 13, Sapporo Office Kowa Building, No. 9, 1-8-10 Akasaka, Minatoku, Tokyo 107 (03) 586-8691
8/20-26	22nd Semiconductor Special Seminar	Hotel Jurin, Zao Onsen, Yamagata	Semiconductor Research Association Kawauchi, Sendai City, Miyagi ken 980 (0222) 23-728
8/30-9/1	16th Solid State Material & Element Conference	Kobe International Conference Center 6-9-1 Minato Shimanaka machi Chou-ku, Kobe City	Solid State Devices & Materials Conference Department Nihon Gakkai Jimu Center 2-4-16 Yayoi Bunkyo-ku Tokyo 113 (03) 815-1903

9/10-12	Electronics and Aerospace Systems Conference (EASCON '84)	Shoreham Hotel Washington, D.C., USA	William E. Bearry Manager, Government Marketing Satellite Business Systems 8003 Westpark Drive McLean, VA 22102, USA
9/16-20	COMPCON Fall '84	Arlington, VA, USA	COMPCON Fall '84 P.O. Box 639 Silver Spring, MD 20901, USA
9/17-19	International Micro-electronics Symposium (ISHM '84)	Dallas, TX, USA	Hisao Hirabayashi, ISHM Japan, 5-635 Hanakoganei, Kodaira City, Tokyo, 187 (0424) 67-7602
9/17-21	U.S. Laboratory Automation Exhibit at Tokyo	USA Trade Center World Import Mart 7th Floor 3-1-3 Higashi Ikebukuro Toshima-ku, Tokyo	US Trade Center World Import Mart, 7th Floor 3-1-3 Higashi Ikebukuru Toshima-ku Tokyo 170 (03) 987-2441
9/20-22	Nepcon Osaka '84	Osakajo Hall 37 Osakajo, Higashi-ku Osaka, Japan	CEG Japan Shinjuku Mitsui Building No. 2 3-2-11 Nishi-Shinjuku, 160 (03) 349-8501
9/21-25	10th International Broadcasting Convention (IBC '84)	Brighton Metropole Conference 9 Exhibition Centre Brighton, U.K.	Secretary IBC Technical Programme Committee IBC Secretariat IEE Savoy Place London WC2R OBL U.K.
9/24-25	U.S. Laboratory Automation Exhibit at Osaka	American Merchandise Display Osaka Sankei Kaikan Bldg. 2-4-9 Umeda Kita-ku, Osaka	US Trade Center World Import Mart 7th Floor, 3-1-3 Higashi Ikebukuro, Toshima-ku, Tokyo 170 (03) 987-2441
9/26-28	11th International Symposium on Gallium Arsenide and Related Compounds	Biarritz, France	Takashi Atoda Tokyo University Engineering Department Boarder Domain Research 4-6-1 Komaba, Meguro-Ku Tokyo, 153 (03) 485-3111, ex. 362
9/26-29	Data Show '84	Tokyo International Exhibition Center Harumi, Chuo-ku, Tokyo	Japan Electronics Industry Promotional Association Data Show '84 Office Kikai Shinko Kaikan 3-5-8 Shiba Koen, Minato-ku, Tokyo 105 (03) 434-8211, ex. 352

10/1-5	International Symposium on Subscriber Lines and Service (ISSLS '84)	Nice, France	Masaki Koyama, NTT Yokosuka Telecommunication Lab 1-2356 Take, Yokosuka City Kanagawa-ken, 238, (0468) 59-3180
10/2-4	Software Show '84	Shinjuku NS Building 204 Nishi-shinjuku Shinjuku-ku, Tokyo	Software Distribution Promotion Center Yusei Gojokai Konpira Bldg. 1-14-1 Toranomon, Minato-ku, Tokyo 105 (03) 591-2440
10/4-9	1984 Electronics Show	Tokyo International Exhibition Center Harumi, Chuo-ku, Tokyo	Japan Electronics Show Assoc. Tosho Bldg. 3-2-2 Marunouchi Chiyoda-ku, Tokyo 100 (03) 284-1051
10/16-18	Environmental Electro-magnetic Engineering (EMC) International Symposium	Hotel Pacific, Tokyo 3-13-3 Takanawa, Minato-ku, Tokyo	Ai Takagi Tohoku University Telecommunications Dept. Aoba Aza, Aramaki, Sendai City, Miyagi-ken, 980 (0222) 22-1800, ex. 4266
10/16-18	International Test Conference (Cherry Hill '84)	Franklin Plaza Hotel Philadelphia, PA, USA	Harry Hayman P.O. Box 639 Silver Spring, MD 20901, USA
10/16-19	'84 Japan Electronic Test Exhibition	Kagaku Gijutsu Kan 2-1 Kitanomarukoen Chiyoda-ku, Tokyo	Japan Electronic Test Industry Association 1-9-10 Toranomon Minato-ku, Tokyo 105 (03) 502-0601
10/23-25	International Broadcast Equipment Exhibition	Tokyo Distribution Center 6-1-1 Heiwajima Ota-ku, Tokyo	Japan Electronic Show Assoc. Tosho Building 3-2-2 Marunouchi, Chiyoda-ku Tokyo 100 (03) 284-1051
10/30-11/1	Western Electronic Show and Convention (WESCON '84)	Los Angeles, CA, USA	Dale Litherland Electronic Convention, Inc. 8110 Airport Boulevard Los Angeles, CA 90045, USA
10/30-11/2	7th International Conference on Computer Communication (ICCC '84)	Sydney Opera House and Centre Point Sydney, Australia	Hiroshi Yoshida, NTT Musashino Telecommunication Lab Bucket Switching Research Lab 3-9-11 Midoricho, Musashino City, Tokyo 180 (0422) 59-4220

10/30- 11/2	'84 Optoelectronics Show	Tokyo Distribution Center 6-1-1 Heiwajima Ota-ku, Tokyo	Optical Industry Technology Association Mori Bldg. No. 20, 2-7-4 Nishi-Shinbashi, Minato-ku, Tokyo 105 (03) 508-2091
10/31- 11/2	4th International Conference on Ferrites	Sheraton Palace Hotel San Francisco, CA, USA	Mitsuo Sugimoto Saitama University Electronic Engineering Department 255 Shimookubo, Urawa City Saitama-ken, 338 (0488) 52-2111, ex. 2263
11/5-9	COMPSAC '84	Chicago, IL, USA	COMPSAC '84 P.O. Box 639 Silver Spring, MD 20901 USA
11/5-9	Microwave System Component Exhibit	US Trade Center World Import Mart 7th Floor 3-1-3 Higashi Ikebukuro Toshima-ku, Tokyo	US Trade Center World Import Mart, 7th Floor 3-1-3 Higashi Ikebukuro Toshima-ku, Tokyo 170 (03) 987-2441
11/6-9	International Conference on 5th Generation Computer Systems (FGCS '84)	Keio Plaza Hotel Nishi-shinjuku, Shinjuku-ku, Tokyo	New Generation Computer Technology Development Organization (ICOT) Mita Kokusai Bldg. 1-4-28 Mita Minato-ku, Tokyo 108 (03) 456-2511
11/7-11	Electronica '84	Munich, Federal Republic of Germany	Gerald G. Kallman Kallman Associates 5 Maple Court Ridgewood, NJ 07450, USA
11/11-14	International Telecommunications Energy Conference (INTELEC '84)	New Orleans Hilton New Orleans, LA, USA	James M. Fletcher Western Electric Co. Gateway II Newark, NJ 07102, USA
11/13-16	1st Solar Electric Generation International Conference	Kobe International Conference Center 6-9-1 Minatoshimanaka Chuo-ku, Kobe	Taneo Nishino Osaka University Basic Engineering Department 1-1 Machikaneyamacho, Toyonaka City 560 (06) 844-1151, ex. 4586-8
11/20-23	1st Electronic Equipment Exhibition (PRONIC '84)	Porte de Versailles Exhibition Center Paris, France	France Exhibition Assoc., Japan Office 5-5-1 Roppongi, Minato-ku Tokyo 106 (03) 405-0171
11/25-29	Global Telecommunications Conference (GLOBECOM '84)	Atlanta Hilton Atlanta, GA, USA	Allan H. Cherin Bell Labs 200 N.E. Expressway Norcross, GA 30071, USA
12/3-5	SEMICON Japan '84	Tokyo International Exhibition Center Harumi Chuo-ku, Tokyo	Markham International SEMICON Japan Office 805 Akasaka-omotemachi Bldg. 4-8-19 Akasaka, Minato-ku, Tokyo 107 (03) 403-8515

Nielsen Dataquest RESEARCH BULLETIN

EIEJ Code: Newsletters

ANELVA INTRODUCES GALLIUM ARSENIDE WAFER PROCESSING EQUIPMENT

Anelva Corporation, a major semiconductor equipment maker in Japan, announced on July 5 that it has developed molecular beam epitaxy (MBE) equipment capable of processing 3-inch gallium arsenide (GaAs) wafers. The equipment, which will be priced between ¥130 million and ¥140 million ($565,000 and $609,000), includes two machines:

- A substrate conveyor machine capable of handling six wafers at a time (MBE-831)
- Substrate revolving equipment to improve the uniformity of the thick-film deposition (MBE-832)

The equipment can be used to produce III-V and II-VI compound semiconductors, such as GaAs metal-semiconductor field-effect transistors (MESFETs), high-electron mobility transistors (HEMTs), semiconductor lasers, and high-performance bipolar ICs. At present, the equipment is being used for research and trial production, but will soon be introduced for commercial production.

Anelva specializes in three types of semiconductor equipment: analytical equipment, vacuum instruments (sputtering systems, reactive ion-etching systems, plasma CVD systems, and MBE systems), and thin-film deposition equipment. The company was formed in October 1967 as a joint venture between NEC Corporation and Varian U.S.A., but Varian subsequently sold its shares to NEC Corporation. In recent years, Anelva has introduced advanced in-line sputtering (ILC-1012) and dry-etching (ILD-4002) equipment. Its development of GaAs wafer processing equipment marks the company's move into next-generation semiconductor equipment.

As shown in Table 1, the company recently completed its new Fuji plant in Yamanashi Prefecture to expand production. In addition to its Japanese facilities, Anelva has a sales office in San Jose, California.

Table 1

ANELVA PRODUCTION FACILITIES

Location	Date	Floor Area (Square Meters)	Number of Employees*
Main Plant (Fuchu)	October 1968	9,461	532
Higashi Plant (Fuchu)	April 1980	815	13
Fuji Plant (Yamanashi Prefecture)	April 1983	7,100	116
Total Production		17,376	661

*Excludes 39 administrative personnel

Source: Anelva Corporation

DATAQUEST believes that Anelva's recent announcement reflects the growing commercialization of GaAs devices in Japan. As noted in our 10 February 1984 Research Newsletter entitled "Gallium Arsenide Production Takes Off in Japan," we estimate that total Japanese production of GaAs devices will be ¥30.0 billion ($125 million) in 1984, up 41 percent from 1983. GaAs MESFETs being used in cable TV converters, mobile phones, and broadcast satellite amplifiers will account for 44 percent of total Japanese production, while semiconductor lasers used in digital audio disk (DAD) players, telecommunications, and optical disk files will represent 12 percent of the total. The availability of GaAs wafer processing equipment will be crucial to semiconductor makers for improving wafer yields and quality.

Sheridan Tatsuno

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

MANUFACTURING EQUIPMENT INDUSTRY--
GROWTH OF JAPAN AND REST OF WORLD

Semicon West held its annual trade show May 21 through May 25, 1984. The show included presentations by members of DATAQUEST's Semiconductor Group. Gene Norrett, Vice President and Director, Japanese Semiconductor Industry Service, presented an overview of the Manufacturing Equipment Industry--Growth of Japan and Rest of World.

The presentation covered four major topics:

- Semiconductor and equipment trends in Japan
- Plant siting of Japanese and Western equipment and materials manufacturers
- Joint venture activities between the United States and Japan
- Rest of World semiconductor market estimates with a focus on Korea

Gene Norrett

MANUFACTURING EQUIPMENT INDUSTRY-- GROWTH OF JAPAN AND REST OF WORLD

Gene Norrett
Vice President and Director
Japanese Semiconductor Industry Service

Good morning, ladies and gentlemen.

Welcome again to DATAQUEST. As you have already heard, I am the director of the Japanese Semiconductor Industry Service with an American staff in San Jose and an all-Japanese staff in Tokyo. This service was founded to provide research on Japanese semiconductor technology and equipment trends worldwide, with a focus on the explosive market in Japan. Our growing list of approximately 80 clients worldwide have been receiving approximately 60 pages of research material monthly since our inauguration in June 1983. Our conference next month, June 21, at the Tokyo American Club will have as its theme "East meets West in VLSI." I recommend that if any of you are planning on being in Tokyo at this time, you should attend this highly informative gathering. We will have Dr. Tanaka of Tokyo University and former director of the Japanese VLSI project as a guest speaker.

Today I will cover four main areas:

1. Semiconductor and equipment trends in Japan
2. Plant siting of Japanese and Western equipment and materials manufacturers
3. Joint venture activities between the United States and Japan
4. Rest of World semiconductor market estimates with a focus on Korea

Japanese Semiconductor Industry--Production Trends

The year 1984 is going to have the highest growth rate and be the most broadbased semiconductor industry expansion in the last eight years (see Slide 1). Fueled by the explosive office automation equipment growth, specifically personal computers, the 1984 production of all Japanese semiconductors will grow 38 percent in yen and 44 percent in dollars.

MOS devices will grow 55 percent and will grab a 48 percent share of all semiconductors produced, up 12 percentage points since 1980. It is these products that are driving the manufacturing equipment industry to produce state-of-the-art products.

So as to be able to provide our JSIS clients with a total industry perspective, we track the Japanese equipment and materials market and report periodically on its trends.

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Shown in Slide 2 is our production revenue forecast for Japanese wafer processing, assembly, and testing equipment. The continuing battle between the steppers and projection aligners has furnished the semiconductor industry with a continuous flow of miracle-producing machines. In the wafer processing area, we have seen a compound annual growth of over 35 percent since 1980, with 1984 projected to increase 55 percent. Writing speeds, wafer-handling capabilities, and up-time reliability of the Japanese products are setting the standards for the world industry due to the requirements demanded by the dominent 64K and 256K dynamic RAM manufacturers such as Hitachi, NEC, and Fujitsu.

Because of the complexity of the VLSI devices, testing has become as important as wafer processing in the manufacturing process. Our forecast is for 40 percent growth in production revenues. In the past, the semiconductor manufacturer designed the circuit and then the testing manufacturer designed the equipment and programs needed to test it. The level of complexity of VLSI devices has clearly been reached today where designing for testability and, in fact, adding self-testing to the device design is more the rule than the exception.

The equipment manufacturers shown in Slide 3 represent the top 10 in Japan. I call your attention to the last column on this slide, compound growth rate. The average growth rate over the last four years was 32.6 percent compounded, a growth rate that has exceeded the semiconductor production growth rate over the same period by 27 percent. Nikon, Applied Materials-Japan, and Takeda-Riken have achieved the highest growth rates. Applied Materials' success in Japan is due, to a large extent, to its proximity to the customers and its aggressive marketing and service strategies. Currently, Applied Materials-Japan is planning to increase revenues by 60 percent in FY 1984, just slightly behind Nikon's explosive 63 percent.

Due to the decline in Japan's sunset industries such as steel, heavy electrical equipment, and mining, leading manufacturers in these fields have looked enviously at the sunrise semiconductor equipment industry. As part of our service to our clients, we continuously monitor the new players in this industry and I want to call your attention to some here today.

These manufacturers shown in Slides 4 and 5 have set their production and marketing plans on entering this industry for the first time, or are expanding horizontally. The names on this list should not be taken lightly. They have a heritage of success.

Japanese equipment and materials manufacturers (see Slide 6) as a group have been slower to establish manufacturing plants in the United States as compared to the Japanese semiconductor manufacturers. For example, our Japanese Semiconductor Industry Service factory data base contains a total of seven factories with two more in the planning phase. Our research has yielded only six companies shown here with only two of significance: Kyocera and Shinetsu Handotai. The $30 million SEH plant, near Vancouver, Washington, is the most modern, automated, totally integrated high-purity silicon wafer manufacturing facility in the world. This plant produces single crystal semiconductor-grade silicon ingates, and 4-, 5-, and 6-inch polished wafers.

In order to penetrate the rapidly growing Japanese semiconductor market, some forward thinking U.S. and European manufacturers have set up manufacturing facilities in Japan. These are shown in Slide 7. Materials Research Corporation (MRC), with headquarters in Orangeburg, New York, was the first U.S. manufacturer to set up a manufacturing plant in Japan. MRC opened its first plant in Kyushu in March 1984. The first manufactured products will be the waferline 11 cassette-to-cassette spluttering system. The Kyushu plant represented a $4 million investment for MRC. The project was also significant in that majority financing was provided by the Japanese Development Bank in the first-ever agreement with a primarily foreign-owned company.

In addition to MRC, our research shows six other companies that have opened plants, have plants under construction, or will open plants by the end of 1985. Our clients also have directed our attention to joint venture activities because of their strategic importance to the industry.

Just as in the semiconductor components industry, we have seen a rapid increase in joint ventures in the equipment industry over the last three years. Our joint venture data base shows ten joint ventures since January 1984, six in 1983, and ten in 1982. Here, on Slides 8 and 9, you can see who the bed partners are and for what technology.

The last area I want to cover this morning is the area known by many as Rest of the World (ROW).

As can be seen in Slide 10, the ROW semiconductor industry has increased 20 percent compounded over the past four years. The region is highly dependent on the consumer equipment markets that depressed the semiconductor industry in 1981 and 1982. We are seeing a rapid rise in this market currently, with consumption forecast to rise 34 percent. MOS memories and 8-bit MPUs and MCUs will see growth rates in excess of 60 percent for use in VTRs, telephones, and personal computers. Our service also covers this market in depth, with frequent reports on the growing markets in Korea, Hong Kong, Taiwan, and Singapore.

Speaking of Korea, we have seen a step function increase in the capital investment by leading Korean conglomerates such as Hyundai, Samsung, Gold Star, and Dae Wo.

Slide 11 shows the semiconductor sales and investments by the top six Korean manufacturers. Please note the ratio of investment to sales in 1984--approximately 2:1. Taken together, we believe that these companies will invest $1.5 billion over the 1983 through 1988 period. These investments represent significant sales opportunities for equipment and materials manufacturers that support these Korean manufacturers in their quest for shoulder room in the world's semiconductor industry.

In summary, I want to call your attention to the major points that I have raised this morning (see Slide 12):

- Japanese semiconductor production up 38 percent
- Semiconductor equipment revenues up 48 percent
- Very high levels of joint venture activity
- Some very large new players in the Japanese equipment and materials markets
- ROW semiconductor and capital investments skyrocketing

Thank you for your attention.

Slide 1

JAPANESE SEMICONDUCTOR INDUSTRY ESTIMATED PRODUCTION TRENDS

(Billions of Yen)

	FISCAL YEAR			CAGR
	1980	1983	1984	1980-1984
DISCRETE	¥246.9	¥ 319.6	¥ 383.5	11.6%
OPTO	47.0	93.6	117.0	25.6%
BIPOLAR	260.5	475.7	616.4	24.1%
MOS	309.7	663.6	1,028.6	35.0%
TOTAL	¥864.1	¥1,552.5	¥2,147.5	25.6%

SOURCE: DATAQUEST

Slide 2

JAPANESE SEMICONDUCTOR MANUFACTURING EQUIPMENT ESTIMATED PRODUCTION TRENDS

(Billions of Yen)

	FISCAL YEAR			CAGR
	1980	1983	1984	1980-1984
WAFER PROCESSING	¥49.0	¥110.9	¥171.9	35.7%
ASSEMBLY	16.3	29.7	39.9	25.1%
TEST	11.1	49.8	69.7	58.3%
TOTAL	¥76.4	¥190.4	¥281.5	36.5%

SOURCE: DATAQUEST

Slide 3

MAJOR JAPANESE EQUIPMENT MANUFACTURERS PRODUCTION TRENDS

(Billions of Yen)

	FISCAL YEAR 1980	1983	1984	CAGR 1980-1984
ANDO-ELECTRIC	¥ 7.3	¥ 11.5	¥ 16.2	22.1%
APPLIED MAT.--JAPAN	3.0	15.0	24.0	68.2%
CANON	10.0	15.0	21.0	20.4%
DISCO	6.6	11.4	15.4	23.6%
NIKON	3.0	18.4	30.0	77.8%
SHINKAWA	7.4	14.0	20.2	28.5%
TAKEDA RIKEN	9.4	23.0	32.4	36.3%
TOKYO ELECTRON	19.2	38.0	53.0	28.9%
TOKYO-OHKA	5.7	11.5	15.6	28.6%
ULVAC	8.0	13.0	18.0	22.5%
TOTAL OF ABOVE COMPANIES	¥79.6	¥170.8	¥245.8	32.6%

SOURCE: DATAQUEST

Slide 4

NEW PLAYERS IN JAPAN

SEMICONDUCTOR EQUIPMENT AND MATERIALS

MINEBEA	MINIATURE BALL BEARING MANUFACTURER--TESTING EQUIPMENT
KOKUSAI	SPUTTERS AND CVD EQUIPMENT--MOVING INTO ION BEAM EQUIPMENT
KOMATSU	TOP CONSTRUCTION MACHINERY MANUFACTURER--EPITAXIAL GROWING
NIPPON MINING	CRUDE OIL AND COPPER REFINING--ELECTRONIC MATERIALS
KOBE STEEL CO.	STEEL COMPANY--SEMICONDUCTOR PLATING--THROUGH JOINT VENTURE WITH KITAMURA MEKKI (50-50%)

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Slide 5

NEW PLAYERS IN JAPAN (Continued)

SEMICONDUCTOR EQUIPMENT AND MATERIALS

YOKOGAWA-HOKUSHIN	MAJOR INDUSTRIAL MEASURING EQUIPMENT MANUFACTURER--ENTERED LINEAR IC TEST EQUIPMENT MARKET
SHOWA OIL CO.	OIL REFINING COMPANY--SILICON SINGLE-CRYSTAL SOLAR CELLS AND SOLAR BATTERIES
SUMISHO ELECTRIC SYSTEMS	TRADING COMPANY--MANUFACTURES DRY ETCHING MACHINES DEVELOPED BY GCA USA
TOYO SODA	CHEMICALS--PHOTO MASK MAKING
KISHIMOTO SANGYO	TRADING COMPANY--MANUFACTURES WAFER TRANSPORT SYSTEMS

Slide 6

PLANT SITING IN THE U.S.

JAPANESE COMPANIES

INTERNATIONAL LEADFRAME (MITSUI)
KOHSAKUSHO--LEADFRAMES
KYOCERA--PACKAGES
OSAKA TITANIUM--SILICON WAFERS
SHINETSU HANDOTAI--SILICON WAFERS
SHINKO ELECTRIC--LEADFRAMES

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Slide 7

PLANT SITING IN JAPAN

U.S. AND EUROPEAN COMPANIES

FAIRCHILD TEST
HOECHST (HAS R&D LAB)--NEW FACTORY, 1985
LTX--NEW FACTORY, 1985
MATERIALS RESEARCH CORP. (MRC)
MONSANTO--NEW FACTORY, 1985
SHIPLEY (PHOTO RESIST)--UNDER CONSTRUCTION
TELEDYNE

Slide 8

JOINT VENTURE TRENDS

1984

U.S. COMPANY	JAPANESE COMPANY	PRODUCT
GENUS U.S.A.	C. ITOH	CVD
INTEGRATED AUTOMATION	KISHIMOTO	CVD
MENTOR GRAPHICS	MARUBENI HYTEC CO.	GRAPHICS
VEECO	KOKUSAI	ION BEAM ETCHING EQUIPMENT
GEN RAD	TOKYO ELECTRON	TESTING EQUIPMENT
HEWLETT-PACKARD	YOKOGAMA-HOKUSHIN	LINEAR IC TEST EQUIPMENT

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Slide 9

JOINT VENTURE TRENDS (Continued)

1984

U.S. COMPANY	JAPANESE COMPANY	PRODUCT
DOW CORNING (HEMLOCK S/C)	SHINETSU HANDOTAI	MATERIALS
ANICON	SUMITOMO ELECTRONIC SYSTEMS	CVD EQUIPMENT
ULVAC	L'AIR LIQUIDE	PLASMA ETCHING TECHNOLOGY
KAYEX USA (SUBSIDIARY OF GENERAL ELECTRIC)	KOYO LINDBERG	CRYSTAL GROWING, SLICING, AND POLISHING EQUIPMENT

Slide 10

REST OF WORLD SEMICONDUCTOR INDUSTRY

(Millions of Dollars)

	FISCAL YEAR			CAGR
	1980	1983	1984	1980-1984
DISCRETE	$416	$ 455	$ 531	6.3%
OPTO	120	150	175	10.0%
BIPOLAR	307	464	610	18.7%
MOS	143	450	721	50.0%
TOTAL	$986	$1,519	$2,037	20.0%

SOURCE: DATAQUEST

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Slide 11

KOREAN SEMICONDUCTOR SALES AND INVESTMENTS

(Millions of Dollars)

	SALES		INVESTMENTS	
	1983	1984	1983	1984
KOREAN ELECTRIC COMPANY	$30	$ 45	$15	$ 25
SAMSUNG SEMICONDUCTOR	25	45	20	60
GOLD STAR SEMICONDUCTOR	5	15	15	45
KOREAN INSTITUTE OF ELECTRONIC TECHNOLOGY (KIET)	1	2	6	6
HYUNDAI ELECTRONICS	0	1	25	45
DAEWOO ELECTRONICS	1	2	10	20
TOTAL	$62	$110	$91	$201

Slide 12

SUMMARY

- 1984 JAPANESE SEMICONDUCTOR GROWTH 38.3 PERCENT IN YEN AND 44 PERCENT IN U.S. DOLLARS
- 1984 JAPANESE SEMICONDUCTOR EQUIPMENT GROWTH 48 PERCENT IN YEN AND 55 PERCENT IN U.S. DOLLARS
- TEN JOINT VENTURES BETWEEN JAPAN AND THE WEST AS OF APRIL 1984
- TEN MAJOR NEW PLAYERS IN THIS EXPLOSIVE INDUSTRY
- 1984 ROW SEMICONDUCTOR GROWTH 34 PERCENT
- 1984 KOREAN SEMICONDUCTOR CAPITAL INVESTMENTS TWO TIMES SALES REVENUES

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Nielsen Dataquest RESEARCH NEWSLETTER

Code: EIEJ Newsletters

JAPAN'S SECOND VENTURE CAPITAL BOOM

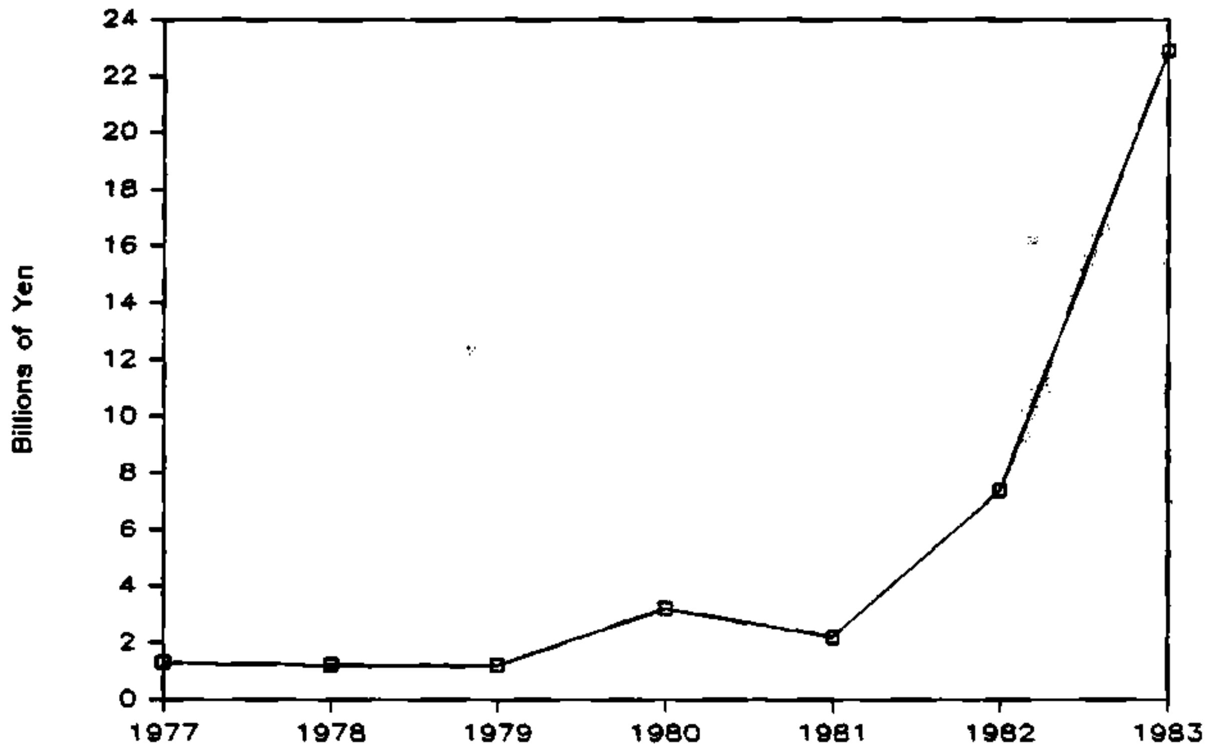
SUMMARY

Since 1982, Japan has experienced a second boom in venture capital activity, popularly known as "benchaa boomu" (venture boom) in the Japanese press. According to the Ministry of International Trade and Industry (MITI), venture capital investments in high-technology venture businesses (start-ups) leaped tenfold, from ¥2.2 billion ($10.0 million) in 1981 to ¥22.9 billion ($97.4 million) in 1983. (See Figure 1.)

This investment growth is being driven by the entry of 16 new venture capital companies and by the influx of American venture capitalists. Although there are still many obstacles to a vibrant venture capital market in Japan, DATAQUEST believes that this recent upsurge in investment activity shows greater potential than the first boom that began in the early 1970s. The creation of an American-style over-the-counter (OTC) stock market in November 1983, the increasing liberalization of the Japanese capital market, and the proliferation of Japanese venture businesses in software and other high-technology fields will create numerous opportunities for foreign investors.

Figure 1

VENTURE CAPITAL INVESTMENTS IN
JAPANESE HIGH-TECHNOLOGY COMPANIES



Source: DATAQUEST

THE FIRST VENTURE BOOM

In the early 1970s, Japan experienced its first "venture boom" as eight venture capital companies were established. As shown in Table 1, these firms were owned primarily by major Japanese banks, securities companies, and life insurance companies. Unlike American venture capital firms, they were staffed exclusively by traditional financial analysts, and lacked in-house technology experts. Moreover, these firms did not offer management or marketing consulting services. Consequently, few of the early Japanese venture capital companies invested in high-risk, leading-edge technologies, but put their yen into more mature retailing, wholesaling, and consumer manufacturing companies that were preparing to go public.

Table 1

THE FIRST BOOM IN JAPANESE VENTURE CAPITAL COMPANIES

Company	Date Established	Major Shareholders
Nippon Enterprise Development Corp. (NED)	Nov. 1972	Long-Term Credit Bank of Japan Daiwa Securities
Kyoto Enterprise Development Corp.	1972 (closed 1979)	Omron Tateishi Electronics Co. Bank of Kyoto
Japan Associated Finance Co. (JAFCO)	April 1973	Nomura Securities Nippon Life Insurance
Universal Finance Co.	Dec. 1973	Yamaichi Securities Dai-Ichi Life Insurance
Central Capital Co.	Jan. 1974	Nikko Securities, Tokai Bank
Techno-Venture Co.	Feb. 1974	Japan Industrial Bank Hitachi Works
Tokyo Venture Capital Co.	April 1974	Dai-Ichi Kangyo Bank Kangyo Kakumaru Securities
Diamond Capital Co.	Aug. 1974	Mitsubishi Bank Tokyo Fire & Marine Insurance

Source: DATAQUEST

This conservative approach was reinforced after a series of wild investment schemes rocked the country in the aftermath of the 1973 oil shock. To protect investors, the Ministry of Finance imposed strict rules for new company listings and trading in 1976. Companies wanting to be listed had to meet minimum capital, earnings, and dividend requirements for a period of several years prior to their request. As a result, daily trading volumes were miniscule, and the OTC market rapidly became known as a graveyard for financially troubled companies that had slipped off the Tokyo and Osaka stock exchanges.

THE SECOND VENTURE BOOM

Since early 1982, Japan has experienced a second venture boom with the emergence of 16 new venture capital companies, as shown in Table 2. Dubbed the "era of small ventures," this renewed activity is being fueled by a variety of factors:

- Rapid growth in high-tech industries, such as semiconductors, computers, software, ceramics, and biotechnology
- Broader, more diversified consumer demand for custom products incorporating new technologies
- Investment shift away from declining heavy industries
- More investors attracted to venture businesses to secure higher returns and new business partners
- Revision of the Foreign Exchange and Trade Control Act (1979) that liberalized foreign capital transactions
- Entry of U.S. venture capital companies and more activity by U.S. banks and securities companies
- Appearance of more adventurous entrepreneurs, especially among mid-career professionals and college graduates who were educated abroad and are employed with foreign companies

These new venture capital companies are markedly different from the first wave of companies. Generally, they are backed by Japanese securities firms, foreign investors, and government banks such as the Long-Term Credit Bank of Japan and the Industrial Bank of Japan. Moreover, these companies are working through the securities and over-the-counter markets, and are willing to provide early-stage equity investments in high-tech ventures, such as software and computer start-ups. Because of their independence from large Japanese banks, these companies are playing a more aggressive role. Probably the most significant change is the entry of foreign investors, especially American venture capitalists, who provide sophisticated technology evaluation and management consulting services.

Table 2

THE SECOND BOOM IN JAPANESE VENTURE CAPITAL COMPANIES

Company	Date Established	Major Shareholders
Jamil Group S.I.	Jan. 1982	Jamil Group (Saudi Arabia)
Japan Investment Finance Co.	Aug. 1982	Daiwa Securities Long-Term Credit Bank of Japan
Sanyo Finance Co.	Aug. 1982	Sanyo Securities Group
Pacific Technology Ventures Inc.	Sept. 1982	Pacific Ventures Technology Management Co. (San Francisco)
Yamaichi Uni-Ven. Co.	Nov. 1982	Yamaichi Securities
New Japan Finance Co.	Dec. 1982	New Japan Securities Industrial Bank of Japan
Wako Finance Co.	Dec. 1982	Wako Securities Industrial Bank of Japan
Marusan Finance Co.	March 1983	Marusan Securities
Okasan Finance Co.	April 1983	Okasan Securities Industrial Bank of Japan
Kansai Venture Capital	May 1983	Osaka-ya Securities Daiwa Bank
Maruman Finance	June 1983	Maruman Securities Tokai Bank
Pariba-Ven Japan	June 1983	Banque de Paris et des Pays-Bas
Fidelity Japan	Aug. 1983	Fidelity Venture Associates (U.S.)
CFB Venture Capital Corp.	Sept. 1983	California First Bank (Bank of Tokyo)
Orient Capital Co.	Oct. 1983	Orient Leasing Co. (Tokyo) Baring Brothers (London) Hambrecht & Quist (San Francisco)
Micro Technology Corp.	Nov. 1983	Pacific Capital Fund (California) Global Commercial (Tokyo) S.G. Inc. (Tokyo)

Source: DATAQUEST

ENTRY OF FOREIGN VENTURE CAPITALISTS

Since early 1982, when the Jamil Group of Saudi Arabia established a Tokyo venture capital group, foreign investors have rapidly entered the market, as shown in Table 3. Companies such as Pacific Venture Technology Management Company, Fidelity Venture Associates, California First Bank, Baring Brothers, Hambrecht and Quist, and Pacific Capital Fund have set up operations in Tokyo to capitalize on the proliferation of Japanese venture businesses. Pacific Technology Venture Fund, for example, hired Kojiro Watanabe, a specialist in early-stage Japanese securities markets, and invested in four Japanese start-ups: Dixy Company (gas plasma displays), Nais Company (flexible manufacturing systems), Robotmation Company (robotics and vision systems), and Systems Architect Company (UNIX-based application software).

Table 3

FOREIGN VENTURE CAPITALISTS IN JAPAN

Parent Company	Major Activities
Banque de Paris et des Pays-Bas (Pariba/Paris)	Pariba-Ven Japan investing $1.2 million in 12 high-tech companies, with eventual goal of 35 to 45 companies
Baring Brothers (London)	20 percent stock in Orient Capital Company, a joint venture capitalized at $1.2 million
Hambrecht & Quist (San Francisco)	20 percent stock in Orient Capital Company (see EIEJ Bulletin, September 16, 1983)
Kleiner, Perkins, Caufield & Byers (KPC&B)	Backing Techno-Venture Co., a Japanese fund headed by Yaiichi Ayukawa, a director to Massachusetts Institute of Technology's governing body
Merrill Lynch	$650 million investment in Japan Associated Finance Co. (JAFCO), venture fund of Nomura Securities, Merrill's Japanese partner
Pacific Ventures Technology Management Co.	Opened Pacific Technology Ventures Co. in Tokyo with $10 million. Plans to raise $20 million to $30 million and invest in about 20 companies
TA Associates	Backing Techno-Venture Co. with Japanese partner
Orient Leasing Company	Capitalized at $1.3 million and will invest in both Japanese and overseas ventures

Source: DATAQUEST

Foreign companies are also entering into joint ventures with Japanese financiers to establish an "insider" presence in Tokyo. Baring Brothers and Hambrecht & Quist, for example, have teamed up with Orient Leasing Company, while Pacific Capital Fund has joined with S.G. Inc. and Global Commercial, both of Tokyo. The revision of the Foreign Exchange and Trade Control Law in 1979 has facilitated these activities by permitting a freer flow of foreign capital and reducing MITI's control over joint ventures.

Japanese Venture Capitalists Waking Up

One spin-off benefit caused by the foreign investors is the reawakening of Japan's lethargic venture capital market. American investors have introduced strong competition and new investment techniques that are changing the nature of the Japanese venture capital market. Existing companies such as the Japan Associated Finance Company (JAFCO), for example, are investing more money in high-technology ventures and offering management consulting services. Recently, JAFCO's president, Teiji Imahara, launched JAFCO II, a venture capital fund that now has more than ¥12.5 billion ($53 million) in the form of partnerships. JAFCO also opened a Hong Kong subsidiary to expand into Southeast Asia. In addition, three Japanese securities houses--Daiwa Securities, Nomura Securities, and Yamaichi Securities--introduced computerized investment services in December 1983 to open the Japanese securities markets to more foreign investors. DATAQUEST believes that these activities are signs that the Japanese venture capital market is finally waking up.

A NEW OVER-THE-COUNTER MARKET

A major development is the creation of an American-style over-the-counter stock market by the Japanese government in November 1983. The change came after much lobbying by MITI and the Japan Securities Dealers Association, and on the recommendation of the Securities Exchange Council. The new rules, which are stricter than NASDAQ's, require a net worth of about $850,000, and pretax profits of more than 4 cents a share for listing. About 12,000 companies would qualify under these liberalized rules, although insiders only expect several hundred to be traded within the next few years. DATAQUEST believes that these new rules will open numerous opportunities for foreign investors, especially in the high-technology fields being pushed by MITI such as biotechnology, fine ceramics, software, electronic machinery (mechatronics), and computers.

MITI'S NEW ROLE

MITI has actively promoted the creation of a venture capital market and venture businesses--the engines for Japan's future economic growth. In 1975, MITI set up a Venture Enterprise Corporation (VEC) to guarantee up to 80 percent of a venture's bank borrowing for product development. But most entrepreneurs shied away, to avoid the burdensome paperwork and the MITI influence. Since its founding, VEC has funded only about $30 million.

During this boom, MITI is downplaying its intervention and emphasizing market incentives, as shown in Figure 2. In February 1984, MITI and the Small Business Agency announced a venture business subsidy program consisting of four financing systems:

- A new credit program at the Small Business Finance Bank that will issue loans up to ¥330 million ($1.5 million) at 8.1 percent for 15 years to high-tech companies

- An R&D subsidy program for new ceramics, mechatronics, and other high-tech product development

- Subsidies to 18 small and medium-size business cooperatives engaged in new ceramic research projects

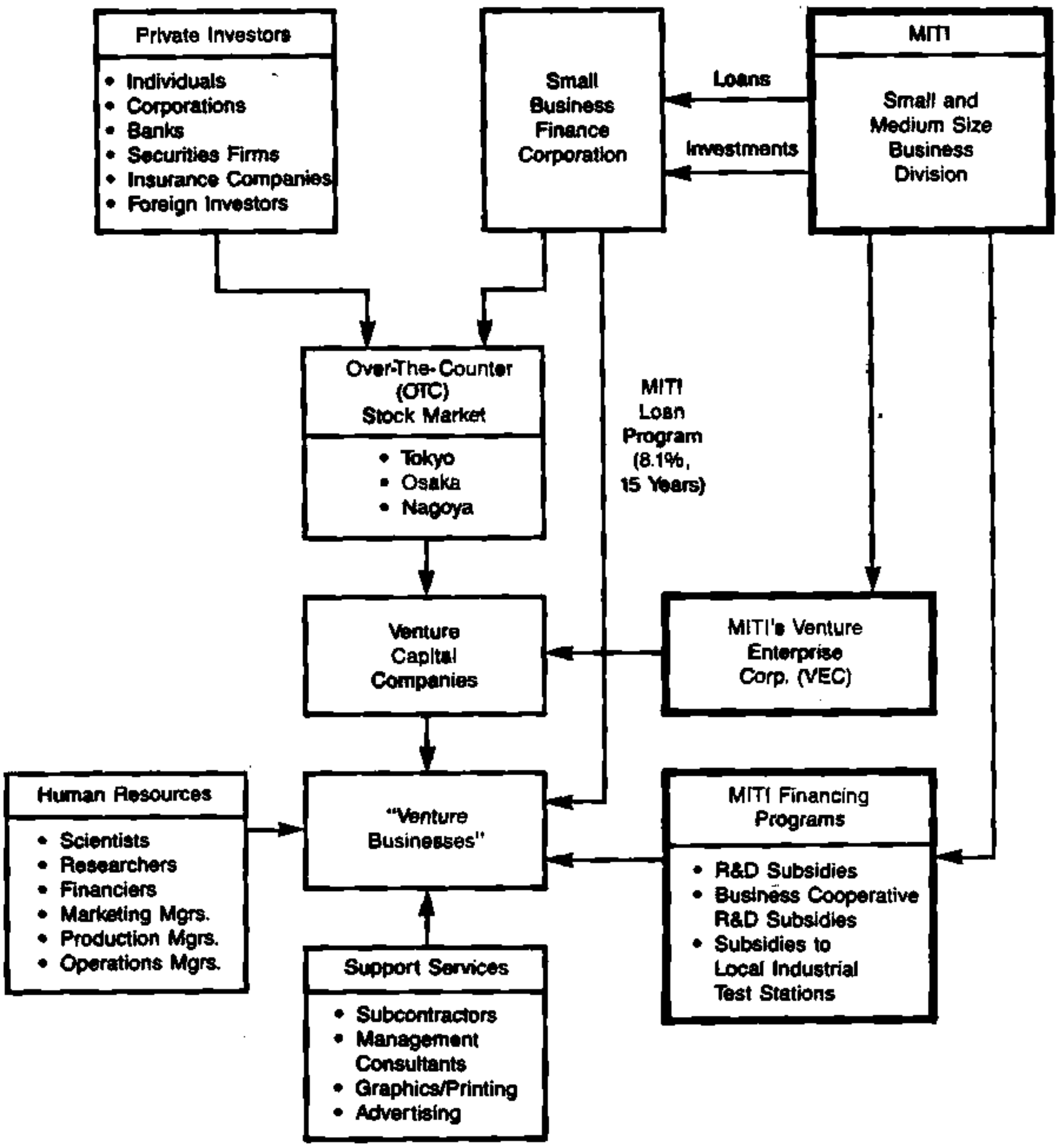
- Subsidies to local industrial testing stations for purchasing mainframe computers and other expensive equipment

MITI is also formulating a "Venture Business Promotion Law" that is scheduled to be introduced in fiscal 1985. This legislation will probably propose new financial measures and technical guidance for high-tech venture businesses, based on the results for the four programs mentioned above.

DATAQUEST believes, however, that there will be heated discussion between MITI and the Ministry of Finance (MOF) over this legislation because of their conflicting interests. MITI wants to gain control over the emerging OTC market to help nurture high-tech venture business. Early-stage program financing would give it major involvement in these sunrise industries. However, MOF is afraid of losing its traditional control over the securities market. In particular, the major Japanese banks, already plagued with too much competition, worry about losing customers to the new venture capital companies. They insist on developing long-term mutual relationships, not just short-term financing arrangements typical of venture capital firms. We expect to see MITI make compromises over its proposed involvement in the OTC market in order to secure passage in the Diet.

Figure 2

MITI'S VENTURE CAPITAL AND VENTURE BUSINESS PROGRAMS



Source: DATAQUEST

MAJOR OBSTACLES

Despite the emergence of new capital companies and an OTC market, there are still many obstacles blocking the establishment of an active venture capital market and venture businesses in Japan. These include:

- Shortage of new venture businesses due to a lack of entrepreneurial spirit (although this is changing)
- Japan's lifetime employment system which discourages spin-offs and job-hopping
- Strong reluctance to give up part of a company to outside investors and venture capitalists (family traditions)
- Federal Trade Commission rules preventing venture capital firms from placing their employees on venture business staffs and prohibiting venture capitalists from acquiring more than 49 percent ownership
- The low-risk, low-return strategy of most Japanese venture capital companies
- Close ties between venture capital companies and large banks (keiretsu)
- Aversion to head-hunting services and raiding to secure qualified managers
- Lack of experience in evaluating new technologies and entrepreneurs and in providing management consulting

Although it will take time before it becomes socially acceptable in Japan to leave one's employer and start one's own company, we see signs of change among young college graduates, working women, mid-career professionals impatient with their slow progress in large corporations, and retirees looking for a second career. According to a recent survey by the Prime Minister's Office, about five million people, or 8.6 percent of the Japanese work force would like to change jobs if given the opportunity. This figure is more than double the 2.5 million people (4.9 percent of the work force) who expressed interest in job-hopping in 1971. Moreover, DATAQUEST believes the influence of Silicon Valley should not be underestimated as Japan shifts to high technology. For millions of Japanese workers faced with the prospect of "lifetime imprisonment" in companies they dislike, the U.S. attitude toward job-hopping, and our more flexible hiring practices seem like heaven.

Sheridan Tatsuno
Nagayoshi Nakano

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

TRADITION BREAK FOR TEXAS INSTRUMENTS

INTRODUCTION

In a sharp break with the past, Texas Instruments announced that it will join the World Trade Statistics Program, originally sponsored by the Semiconductor Industry Association. TI has also decided to participate in the Semiconductor Research Cooperative, which was founded to conduct basic research through a pooling of resources.

DATAQUEST believes that TI's willingness to provide confidential sales figures to Price Waterhouse for incorporation with statistics of other U.S, European, and, recently, Japanese manufacturers is part of a strategy to move aggressively in this currently supply-limited market. We see the Dallas-based manufacturer aggressively expanding its gate array, standard cell, and CMOS business in order to keep pace with both the Japanese and with the current U.S. market leaders, Motorola and National. It is our opinion that the CMOS semiconductor market has the highest growth potential of the industry's emerging new product opportunities.

AN AGGRESSIVE NEW STRATEGY

As shown in Table 1, TI is pursuing an aggressive strategy to capture share of the microcontroller and rapidly growing application-specific IC (ASIC) markets. In 1983, TI signed second-sourcing agreements with Seeq and General Instrument for its successful TMS7000 8-bit MCU. In the gate array field, TI has joined with Fujitsu, Japan's strongest semicustom maker, to second-source Fujitsu's bipolar and CMOS arrays. Harris will second-source TI's CMOS gate arrays, which are being designed according to military specifications under the VHSIC program.

Although TI's sales of CMOS devices have grown at a compound annual growth rate (CAGR) of 35.7 percent since 1980, TI has lost revenues to companies offering CMOS gate arrays, such as LSI Logic. To strengthen its position in the semicustom market, TI has moved aggressively in several directions:

- Developing a 2.0-2.5 um CMOS process in Houston
- Merging its gate array product center and design automation into the Custom Components Division in Dallas and introducing a line of CMOS standard cell logic for integrating 54/74 logic functions
- Adapting its in-house Transportable Integrated Design Automation Language (TIDAL) to run on Apollo 32-bit type workstations
- Licensing its CAD system in exchange for second-sourcing Fujitsu's bipolar and CMOS gate arrays
- Adding 4 design centers in Europe (Bedford, England; Paris, France; Frankfurt, Germany; and Milan, Italy) to its 12 centers in the United States
- Offering two levels of design for its standard cell customers

CONCLUSION

We believe that TI's move to join the World Trade Statistics Program and form partnerships in new technologies to fill voids in its product line will prove helpful in TI's quest to regain its leadership position.

Sheridan Tatsuno
Gene Norrett

Table 1

TI'S RECENT LICENSING AGREEMENTS AND JOINT VENTURES

Date	Partner	Agreement
Feb. 83	Seeq	Application of Seeq's EEPROM technology to TI's TMS7000 8-bit MCU
Feb. 83	Harris	Harris to second-source TI's 1000- and 2000-gate mil-spec CMOS gate arrays (VHSIC program)
March 83	General Instrument	GI to second-source TI's 8-bit TMS7000 MCU
July 83	VLSI Technology, Inc. (VTI)	VTI to second-source TI's TMS4500A 64K DRAM controller and develop new CMOS circuit for TI's 256K DRAM
July 83	Western Digital	Mutual second-sourcing of Western Digital's communications controllers and TI's universal uP peripherals
Nov. 83	General Instrument	GI to second-source TI's TMS320, an NMOS digital signal processor, and develop a CMOS version
Jan. 84	Fujitsu	TI to provide its CAD design for Fujitsu's bipolar and CMOS gate arrays
May 84	National	Second-source 32-bit MPU

Source: DATAQUEST

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A SECOND NTT TAKES SHAPE

Five Japanese companies are making a bold move into the telecommunications business in anticipation of the divestiture of Nippon Telegraph and Telephone (NTT) next year. Kyocera, Sony, Ushio Electric, Secom, and Mitsubishi Corporation have announced that they will establish the "Second NTT Planning Company" on May 31. Headed by Shingo Moriyama, Vice President of Kyocera, the new company will be capitalized at ¥1.6 billion ($7.0 million) and will also involve twenty other companies, including telecommunication manufacturers, banks, securities companies, and trading houses. The five founding companies will hold 50 percent ownership; stock participation outside the initial 25 companies will be available in mid-July. As shown in Table 1, the five companies are well-positioned technically and financially.

The Second NTT Planning Company plans to build a $130 million fiber-optic link along expressways between Tokyo and Osaka, to be operational in 1988. This system will offer phone and data services, and parlay the technical expertise of the five founding companies in large-scale construction projects and home electronics. It will compete directly with NTT's Information Network System (INS) which is scheduled for nationwide operation by 1987 (see our discussion of NTT's INS development plans in the DATAQUEST JSIA notebook, Section 1.2-23). However, Kyocera believes that the new service will be immediately profitable since its rates will be based on the initial link in the heavily used Tokyo-Nagoya-Osaka corridor, not on a nationwide network as with NTT's INS program. An independent survey estimates that fees for the second NTT service would be only 20 percent of NTT's current rates.

Although Yoshinori Iida, an executive with NTT's New York office, said NTT welcomes the competition because it would justify the deregulation process, DATAQUEST believes that approval of the second NTT system by the Ministry of Posts and Telecommunications (MPT) will not be easy. Traditionally, MPT has been very protective of NTT, as shown in the recent value-added network (VAN) controversy with the United States. The construction of a second NTT network would cause substantial losses in revenue to NTT's $120 billion INS System--something that MPT or NTT is unlikely to welcome. Moreover, approval of the new system is likely to be fiercely contested by the major Japanese telecommunications companies who would oppose the second NTT's effort to take the "cream" of the lucrative Tokyo-Nagoya-Osaka market. They would be effectively locked out of the second NTT since the five founding companies hold majority ownership. Added to this is the fierce competition posed by the entry of the Japan National Railways, Japan Highway Corporation, AT&T, IBM, ITT, Corning Glass Works, and other foreign companies into the Japanese fiber-optics market.

Thus, we believe that the second NTT is not yet an established fact but just the beginning of a long-running controversy, as Japan attempts to deregulate its telecommunications industry. However, NTT divestiture and the formation of a second NTT will create many marketing opportunities for foreign semiconductor companies selling optoelectronic ICs, optocouplers, semiconductor lasers, and other optoelectronic devices.

Sheridan Tatsuno

Table 1

FOUNDING COMPANIES OF THE SECOND NTT

Company	Major Products	FY1983 Revenues ($ Millions)
Kyocera	Ceramic IC packaging (70% of world market), OA equipment	$ 723.4
Mitsubishi Corporation	Largest trading company in Japan; strong in heavy electrical power equipment	$31,489.4
Secom (Nihon Keibi Hosho)	Electronic security systems (60% of Japanese market	$ 127.7
Sony	Consumer electronics, semiconductors, floppy disks, word processors	$ 3,277.0
Ushio Electric	Halogen and xenon lamps for semiconductors, OA equipment, automobiles, and optical equipment	$ 33.6

Source: DATAQUEST

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

CAN MCC CATCH UP WITH JAPAN?

Microelectronics and Computer Technology Corporation (MCC), a consortium of 15 major American electronics companies established in 1982 to beat Japan in creating a fifth-generation computer, announced six research directors on April 10, 1984. A research director for the Software Development Program will be announced in mid-May. As shown in Table 1, MCC has selected a team of highly qualified individuals to run its research programs that are formally under way. MCC currently has 110 employees working at its temporary facility, with plans to have the participating companies lend 140 more researchers by 1985. A permanent facility will be built at the University of Texas beginning this year and is scheduled to open in the fall of 1985.

MCC was formed in 1982 by 10 American microelectronics and computer companies. Since then, 5 additional companies have become full participants or shareholders, bringing the total to 15, as shown in Table 2. Each shareholder company must commit funds and staff to support MCC's research program for at least three years. The entry fee is $200,000. Shareholder companies will have exclusive access to research findings for three years after the completion of the project. The research or patents may be licensed and revenues then become the property of MCC. MCC has a funding goal of $324 million, of which $30 million was committed by the founding 10 companies in 1983. In addition, the University of Texas announced on April 10 a $32 million funding package for computer science programs, consisting of $8 million from a private donor, University of Texas oil lands revenues, and private matching funds from 5 Texas foundations. Although not directly benefitting MCC, this funding will provide a local source of trained researchers in the future.

MCC has scheduled four long-range advanced technology programs, as shown in Table 3.

DATAQUEST believes MCC has the potential to achieve major breakthroughs in semiconductor and computer technology. However, the project is several years behind Japan's Fifth Generation Computer Project (1979-1991) and four years behind its Supercomputer (1981-1989) and New Semiconductor Functions Project (1981-1990). We have already observed the beginning of a "patent deluge" from these projects. The New Functions

Project, for example, recently submitted 147 patent applications for 3-dimensional ICs. The real question for MCC is not whether it can produce innovative research; we believe it will. But rather, can it catch up with Japan?

For more information on MCC, contact:

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Director, Government and Public Affairs
Microelectronics and Computer Technology Corporation
9430 Research Blvd.
Echelon Building #1, Suite 200
Austin, Texas 78759-6509
Phone: (512) 343-0860

Sheridan Tatsuno

Table 1

MCC RESEARCH DIRECTORS

Research Program	Director	Previous Positions
Semiconductor Packaging and Interconnects	Dr. Barry Whalen	Consultant to Semiconductor Research Corp. (SRC); Manager of Software and Data Systems Laboratory, and VHSIC Program at TRW Corp.
Software Technology	To be announced in May	
VLSI/CAD	Dr. John Hanne	Osborne Computer and Texas Instruments; at TI, served as VP of Data Systems Group, Manager of DSG Advanced Technology R&D Division and Design Automation
Advanced Computer Architecture comprises 4 projects:		
• Parallel Processing	Dr. Peter C. Patton	Director of University Computer Center and Associate Professor of Graduate Faculties of Aerospace Engineering, Mechanics, and Computer Science at the University of Minnesota
• Data Base Architectures	Dr. Eugene Lowenthal	Director of Strategic Planning at Intel's System Division; Chief Architect of the System 2000 at MRI Systems Corp.

(Continued)

Table 1 (Continued)

MCC RESEARCH DIRECTORS

Research Program	Director	Previous Positions
● Human Factors Technology	Raymond Allard	Vice President at Control Data; oversaw development of Cyber 205; design manager of 3200 and 3300 series computer architectures
● Artificial Intelligence/ Knowledge-Based Systems	Dr. Woodrow Bledsoe	Ashbel Smith Professor of Mathematics and Computer Sciences and Chairman of the Mathematics Department at the University of Texas, Austin (on leave); now President of the American Association of AI

Source: Microelectronics and Computer Technology Corporation

Table 2

MCC CORPORATE OFFICERS AND BOARD OF DIRECTORS

Name	Position	Company
Corporate Officers		
Admiral B.R. Inman	President/CEO/Board Chairman	U.S. Navy*
Palle Smidt	Senior VP/Plans and Programs	Sperry*
Dr. John Pinkston	VP/Chief Scientist	Nat'l. Security Agency*
R.G. Rutishauser	VP/Finance and Administration	Control Data*
George D. Black	VP/Human Resources	RCA*
MCC Shareholders and Board of Directors		
Philip W. Arneson	President	Allied Corporation
George M. Scalise	Sr. VP/Chief Admin. Officer	AMD
Ryal R. Poppa	President/CEO/Chairman	BMC Industries
Robert M. Price	President/CEO	Control Data
F. Grant Saviers	VP/Storage Systems Develop.	Digital Equipment
Michael F. Maguire	Sr. VP/Sector Executive	Harris
James J. Renier	President/Information Systems	Honeywell
Allan M. Norton	VP/Technical Operations	Martin Marietta
Robert E. Caldwell	Sr. VP/Engineering and Tech.	Mostek
William G. Howard, Jr.	VP/Corporate Director	Motorola
Gregory Harrison	VP/Corporate Services	National Semiconductor
Thomas T. Tang	VP/Research and Development	NCR
William C. Hittinger	Executive VP	RCA
Robert L. Cattoi	VP/Corporate Engineering	Rockwell International
Don O. Neddenriep	Group VP Product Division	Sperry

*Previous employer

Source: Microelectronics and Computer Technology Corporation

Table 3

MCC RESEARCH PROGRAMS

Program	Length	Projected Funding	Research Focus
Alpha-Omega	10 Yrs.	$150 M	Artificial intelligence Parallel processing Data base system management Voice and character recognition
CAD/CAM	8 Yrs.	$88 M	VLSI design equipment
Software	7 Yrs.	$56 M	Programs for artificial intelligence and knowledge-based systems
Chip Packaging	6 Yrs.	$30 M	Advanced semiconductor Packaging and interconnect technologies compatible with automatic assembly at circuit and system levels
Total Project	31 Yrs.	$324 M	

Source: DATAQUEST

Nielsen Dataquest RESEARCH BULLETIN

EIEJ Code: Newsletters

MITI BOWS TO U.S. DEMAND FOR SOFTWARE COPYRIGHT PROTECTION

U.S. officials were recently informed by the Ministry of International Trade and Industry (MITI) that the agency would not submit its controversial proposal for a software patent law to the Japanese Diet. This action comes after several months of vigorous protest from U.S. negotiators who argued that the MITI proposal violated the Berne Convention, an international copyright pact, and would effectively push U.S. software makers out of the Japanese market.

Interpreted as a victory by U.S. negotiators, this decision is also noteworthy because it reflects the strong dissension among the Japanese ministries over important high-technology issues. As shown in Table 1, Japanese officials are divided into two camps: those supporting MITI's proposal for a 15-year protection and mandatory licensing law, and those supporting the Ministry of Education's Cultural Agency proposal for a 50-year software copyright law. The major point of contention is over definitions.

MITI, a strong proponent of the computer industry, defines software as an industrial product requiring patent protection, while the Cultural Agency defines it as intellectual property that should be accorded the same copyright protection as books and movies. MITI believes that mandatory disclosure and licensing would enable Japanese industry to develop software more rapidly and would make available to the public vital software in such areas as medical treatment. A 15-year protection period would help Japan, a major software importer, to promote software development, distribution, and use. The Cultural Agency disagrees, arguing that mandatory disclosure and shortening the protection from 50 to 15 years would discourage software development. Table 2 summarizes the major differences between the two ministries.

MITI's decision is clearly an effort to avoid worsening trade friction with the West at a time when sensitive issues such as value-added networks (VAN), satellites, the U.S. unitary tax, and domestic content laws are being discussed in both capitals. Nevertheless, DATAQUEST believes that a compromise version of MITI's proposal will be introduced to the Diet in the near future.

Sheridan M. Tatsuno

Table 1

JAPANESE LINE-UP IN SOFTWARE CONTROVERSY

15-Year Patent Law	50-Year Copyright Law
MITI	Cultural Agency (Ministry of Education)
Japan Electronic Industry Development Association (JEIDA)	Ministry of Posts & Telecommunications
Japan Business Machine Makers Association	
Japan Communication Industries Association	

Table 2

MINISTRY POSITIONS ON SOFTWARE PROTECTION

	MITI	Cultural Agency
Objective	Program protection and licensing; development of national economy	Copyright protection and promotion of cultural development
Right of Use	Control use of illegal software programs	Not regulated
Developer's Personal Rights	Important not to impede software development and diffusion	Protection of developer's copyright
User Protection	Mandatory release of programs vital to public welfare	Not regulated
Registration System	Release and promotion of software programs; price stabilization	Record of third-party transactions

Source: DATAQUEST

Nielsen Dataquest

RESEARCH BULLETIN

EIEJ Code: Newsletters

JAPANESE NONTARIFF BARRIERS—AN UPDATE

SUMMARY

Nontariff barriers are implicit or explicit policies that prevent one or more foreign countries from competing in a particular marketplace. The Japanese marketplace has become a difficult one for foreign competitors to penetrate. This research bulletin addresses the following three currently disputed Japanese nontariff barriers: value-added networks (VANs), software, and satellites.

Value-Added Networks

VANs—value-added networks—are the subject of one trade dispute between the United States and Japan. VANs are data transmission services that allow dissimilar computers to communicate with each other. Services such as electronic mail, credit card checks, airline reservations, and hotel reservations are handled through VANs. In all of these areas, the United States is technically far ahead of any other country, including Japan.

VANs are one of the first in a series of Japanese government-driven programs designed to expand data communications in Japan. Such semiconductors as data conversion circuits, codecs, filters, and other telecommunications chips can expect to see an expanding market due to this push.

On January 31, 1984, the Japanese Ministry of Posts and Telecommunications—which regulates the country's telephone monopolies, Nippon Telegraph and Telephone (NTT) and Kokusai Denshin Denwa (KDD)—decided to allow U.S. companies to compete in the large-scale VAN marketplace in Japan. However, on February 9, a government advisory panel urged the exclusion of all companies with more than 20 percent foreign ownership from Japan's VAN market as a protective measure for Japan.

The dispute is currently still raging, with senior Japanese officials stating that the 20 percent proposal is not a final one. If it were to stand, it would eliminate such U.S. giants in the field as IBM and AT&T.

Software

Another dispute involves software copywriting. MITI-backed legislation would replace current international copyright protection (which lasts until 50 years after the author's death) with a limited 15-year protection for software. Most damaging to foreign firms, however, is the proviso that would require software suppliers to license their software to Japanese firms, allowing the Japanese companies to sell the software without paying royalty fees. This would essentially bar all U.S. and other foreign firms from the large Japanese software market.

Satellites

Another area in which the U.S. has a strong technological edge is satellites. Japan presently does not produce satellites; yet, under Japanese law, Japanese firms must be the prime contractors for satellite development. While on the face of it this requirement should completely eliminate the United States as a supplier of satellites to Japan, Ford and Hughes have both in fact received contracts from major Japanese firms to develop satellites.

Japanese firms are apparently unhappy with current Japanese government policy regarding satellite procurement; therefore, this may prove to be the easiest nontariff barrier to break down.

Patricia S. Cox

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

THE JAPANESE CHALLENGE—ONE MAN'S OPINION

SUMMARY

Dr. Ezra Vogel, Director of the Program on U.S.-Japan Relations and Professor of Sociology at Harvard University, recently spoke to the Japan Society of Northern California on Japan's continuing challenge to the United States. Dr. Vogel, who recently returned from a year-long sabbatical in Japan, believes that Japan will continue to gain strength as an international economic power for the following three reasons:

- Japan is far ahead of any western nation in the "new industrial revolution" of flexible manufacturing systems and robotics.
- As a result of increased office automation, Japan's service sector will become a much greater part of its economy, and will present the major challenge to the western world.
- Japan as a nation demonstrates a real concern for its society as major industrial changes occur.

JAPANESE MANUFACTURING

The Japanese have long been acknowledged as experts and leaders in manufacturing techniques. In addition to the widely publicized use of robotics in factory automation, a new technique, the flexible manufacturing system (FMS), is profoundly affecting today's Japanese manufacturing.

FMS utilizes computerized, numerical control of tooling devices in machining centers. It allows tools to be changed automatically, it links different machines together, and it sets the stage for completely automated assembly lines that require only one operator to monitor the entire operation via a video screen.

Dr. Vogel believes that Japan's software experts have been concentrating their work in the assembly/production field rather than in the packaged software field. Thus the West's perception that the Japanese are not knowledgeable about software or lack the ability to produce it is fallacious.

It is interesting to note that there are approximately three times as many electrical engineers per capita in Japan as there are in the United States. (Another interesting fact is that while Japan has 12,000 practicing attorneys, compared to 600,000 in the United States, Japan's population is only about half that of the United States.) The engineers who work on research and development of a product are the same ones who are involved in production line work on the product, thereby ensuring a very close connection between R&D and actual manufacturing.

SERVICE SECTOR

Office automation activity has increased tremendously in Japan over the last several years. The use of personal computers and other office automation equipment in Japan is a dramatic change because Japanese offices, in contrast to Japanese factories, traditionally have been very inefficient. Until recently no easy-to-use Japanese typewriter existed. With over 2,000 kanji characters, the process of typing in Japanese was very laborious, and in fact, secretaries were often chosen for their legible handwriting.

This situation has changed with advances in microprocessors and large (1Mb) ROMs, which now allow word processors, using a katakana—phonetic—keyboard, to produce kanji characters. (For an explanation of the Japanese language and alphabet, please refer to EIEJ Section 3.6, Japanese Language.) The previous lack of a viable typewriter is the primary reason for the current proliferation of copying machines and facsimile machines in Japan.

As a result of these changes, Japanese office productivity should experience great improvement. MITI now views the service sector as a high growth area, and will begin to target this area for expansion. There will be an increased emphasis on software for personal computers and minicomputers.

The promotion of service industries abroad will eliminate the foreign trade barriers present on commodities such as semiconductors and other equipment. As an example, Japanese banks finance Japanese factories built in the United States; they also have bought out some U.S. banks, especially in California. The same sort of thing can happen in other service areas, such as insurance, real estate, and financial services. This represents a definite penetration of the U.S. economy, but not one that is as easily quantifiable as manufactured goods.

CONCERN FOR SOCIETY

Japanese companies are known for loyalty to their employees. This extends beyond lifetime employment to the areas of continuing education and retraining of personnel, concepts that are foreign to most western companies. Large Japanese companies such as NEC maintain complete educational programs for their employees, so that engineers, for example, will be kept up-to-date on the latest technologies and information, and their skills will not become obsolete. Many companies retrain personnel who are in obsolete jobs, so that they can remain with the company in another position. To the best of our knowledge, Japanese companies' educational and training programs are more comprehensive and receive greater emphasis than any similar U.S. programs. Overall, Japanese companies have a great sense of responsibility toward their employees.

Because of continuing education and retraining, Japanese employees will probably not face the problems faced by many U.S. employees who are losing jobs in declining industries such as steel, and find themselves unprepared for any other kind of work.

CONCLUSIONS

Dr. Vogel concluded his remarks by presenting his ideas about what the United States can do to respond to the Japanese challenge:

- Think about competitive problems by developing nongovernmental analytical groups in Washington that would provide Congress with analyses on which to base legislation.

- Train more people in Japanese language, history, and culture, and put their skills to use in business. In this manner, American business will have employees versed in Japanese language and culture, the only attributes that really allow American businesses to successfully penetrate the Japanese market. There are great forces of conservatism in place in Japan, and the only way to break through these is through true knowledge of Japan and the Japanese.

- Get the American point of view into the Japanese press. As an example of the need to represent the American view, Dr. Vogel reported that, regarding the IBM-Hitachi case, IBM was presented in the Japanese press as a "bad buy" who tricked Hitachi.

- Form more cross-culture organizations, such as joint ventures, especially in scientific and technical areas.

Patricia S. Cox

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

JAPAN DEVELOPMENT BANK LOANS AVAILABLE TO FOREIGN COMPANIES

SUMMARY

For foreign companies interested in exporting high-technology equipment to Japan or opening research centers and plants there, the Japan Development Bank (JDB) is a potential source of low-cost funds. Since 1968, JDB has issued ¥117 billion in loans to foreign capital-affiliated enterprises (those whose foreign capitalization is 50 percent or more). In fiscal 1983 (April to March 31), 13 companies received a total of ¥17 billion, or about ¥1.3 billion ($5.4 million) each, as shown in Table 1.

Table 1

JAPAN DEVELOPMENT BANK LOANS TO FOREIGN COMPANIES

Fiscal Year	Total Funds (¥ Billion)	Exchange Rate (Yen/$)	Dollar Value ($Million)	Number of Companies	Per Company ($Million)
1979	4.9	220	22.3	9	2.5
1980	10.4	225	46.2	6	7.7
1981	12.8	220	58.2	8	7.3
1982	11.0	250	44.0	5	8.8
1983	17.0	240	70.8	13	5.4

Source: Japan Development Bank

NEW LOW-INTEREST LOAN PROGRAM FOR MANUFACTURING PLANTS

In order to lessen trade friction with other countries, JDB has expanded its loan program to promote foreign imports and investments in Japan. Beginning in fiscal 1984, about ¥13 billion ($55 million) in special loans with a 7.8 percent interest rate will be issued to foreign companies for up to 40 percent of their investments under the "International Cooperation Loan System." This compares with the 8.4 percent loans under the existing JDB program. As of October 1983, 20 companies had applied for these low-interest loans, of which 12 projects have been selected to be financed in fiscal 1984. The four IC-related projects selected are shown in Table 2.

Table 2

FOREIGN IC PLANTS TO BE FINANCED IN FISCAL 1984

Foreign Company	Cost (¥B)	Loan (¥B)	Amount* ($M)	Construction Period	Project
Japan Burr Brown	1.0	0.4	1.7	Jan.-Aug. 1984	Hybrid IC plant in Tsukuba Science City
Nippon Motorola	2.0	0.8	3.4	Dec. 1983-Sept. 1984	Hybrid IC plant in Aizu Wakamatsu
Intel	40.0	16.0	68.1	Fiscal 1984	IC plant
Fairchild	6.5	2.6	11.1	Fall 1983-Fall 1984	Bipolar logic plant in Isahaya industrial park, Nagasaki Prefecture

*Maximum available; not actual amount
Note: Interest rate 7.8 percent, 40 percent ratio, 10 years

Source: Japan Development Bank

WHO IS ELIGIBLE

Foreign companies that invest in regional development, new technologies, pollution prevention, energy and resource projects, and urban development are eligible for funding, as shown in Table 3. The Ministry of International Trade and Industry (MITI) and the prefectures place special emphasis on new technologies, such as semiconductors, computers, biotechnology, and new materials, because of their potential for creating new jobs. In June 1983, Materials Research Corporation of New York was the first company to receive a preferential loan for ¥350 million ($1.46 million) to finance its $3.2 million sputtering machine factory in Kyushu's Oita Prefecture. The loan has an 8.4 percent interest rate for a period of 10 years. Since then, JDB has lowered the interest rate to 7.8 percent under the new International Cooperation Loan System.

Table 3

TYPES OF PROJECTS ELIGIBLE FOR JDB LOANS

Loan Area	Types of Projects
Regional Development	Plant construction in less-developed regions; warehouses, distribution centers, and hotels in local cities
Technology Development	New technologies such as semiconductors, biotechnology, new materials, and computers
Pollution Prevention and Safety	Antipollution facilities, safety testing labs for pharmaceuticals, agrochemicals, and building construction
Resource and Energy Projects	Facilities for resource and energy conservation, oil-to-coal switching technology, and oil and LPG storage
Urban Development	Construction of large-scale distribution centers, warehouses, and urban redevelopment
Other	Ocean shipping, ocean development facilities, large hotels in urban areas

Source: Japan Development Bank

JDB LOAN TERMS

Under the JDB loan program, the terms of the loans vary according to the type of project proposed, as shown in Table 4. Loans to high-technology companies are covered by the Law for Temporary Measures for Special Machinery and Information Industries, which aims to raise the level of productivity and technological research throughout Japan.

Table 4

LOAN TERMS UNDER JDB'S REGULAR LOAN PROGRAM

Area	Interest Rate	Amount Covered	Loan Period
Regional Development	8.4%	30%-50%	7 to 10 years
Technology Development	8.4% (special rates 7.3%-8.3%)*	40%	5 to 10 years
Pollution Prevention and Safety	7.5% 8.0%	50% 50%	First three years thereafter
Resource and Energy Projects	8.4% (special rates 7.3%-8.3%)	40%-50%	5 to 15 years
Urban Development	8.4% (special rates 7.3%-8.3%)	40%-50%	5 to 15 years

*7.8 percent under new International Cooperation Loan System

Source: Japan Development Bank

NATIONAL AND LOCAL TAX INCENTIVES

Foreign companies are eligible for special depreciation on production equipment under the Special Taxation Act. In addition, tax incentives under the Industrial Relocation Promotion Law for investments in undeveloped industrial areas and local tax incentives from the prefectures are available to foreign companies. For example, Kumamoto Prefecture in Kyushu (the southern island known as "Silicon Island") offers complete business tax exemptions for three years on plants over ¥15 million ($64,000) in existing industrial areas and reduced real estate taxes (by 1.26/100) for three years on plants over ¥100 million ($425,000) in new industrial areas. Currently, MITI is coordinating foreign plant siting as part of its strategy to create "technopoli," or high-tech industrial areas, throughout Japan. MITI's Industrial Location Guidance Division provides information on industrial parks and tax incentives and offers siting assistance. The prefectures compete with each other to attract foreign plants by offering a variety of incentives and services that are usually negotiable on a case-by-case basis.

NEW LOW-INTEREST LOAN PROGRAM FOR IMPORTERS

In fiscal 1984 (April 1, 1984 to March 31, 1985), JDB will also offer low-interest loans to Japanese leasing companies that import high-technology equipment from advanced industrial nations. A ¥2.0 billion ($8.5 million) fund has been established to provide 7.8 percent loans to leasing firms importing computers, peripherals, communications equipment, medical equipment, and machine tools. This program is part of MITI's import promotion policy that was recently adopted to reduce trade friction with Japan's trading partners. Although minimal in size, DATAQUEST believes these JDB loans are important because they are a signal to Japanese banks that the import activities are being promoted by MITI.

FOR MORE INFORMATION

For more information about Japan Development Bank loans, contact the following offices.

Head Office

- 9-1, Otemachi 1-chome
  Chiyoda-ku, Tokyo 100, Japan
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  (03) 245-0439 (nonbusiness hours)
  Cable: DEVEBANK TOKYO
  Telex: J24343 DEVEBANK

Overseas Offices

- Washington, D.C.
  Representative Office
  1019 19th Street, N.W., Suite 600
  Washington, DC 20036 U.S.A.
  Phone: (202) 331-8696
  Cable: DEVEBANK WASHINGTONDC
  Telex: 440084 JDBK UI

- New York Representative Office
  71 Broadway, Room 306
  New York, NY 10006 U.S.A.
  Phone: (212) 269-0527
  Cable: DEVBANKMIN NEWYORK
  Telex: 421054 KAIGIN

- London Representative Office
  P. & O. Building
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  Phone: (01) 623-0172, 0173
  Cable: JADEBANK LONDON-EC3
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Sheridan M. Tatsuno

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

JAPANESE MARKET OVERVIEW—1982-1983

DATAQUEST's Semiconductor Industry Service held its annual conference in Palm Springs, California, on October 17 through 19, 1983. The conference included presentations by members of DATAQUEST's Semiconductor Group. Gene Norrett, Director of the Japanese Semiconductor Industry Service, presented an overview of the Japanese market.

The presentation covered three major topics:

- The Japanese economy
- The Japanese electronics industry
- DATAQUEST's outlook for the Japanese semiconductor industry

A copy of Mr. Norrett's presentation is attached for your information.

Patricia S. Cox

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JAPANESE MARKET OVERVIEW--1982-1983

Gene Norrett
Director
Japanese Semiconductor Industry Service
Dataquest Incorporated

Mr. Norrett is Director of DATAQUEST's Japanese Semiconductor Industry Service. Prior to joining DATAQUEST, Mr. Norrett spent 14 years with the Motorola Semiconductor Group, serving in various marketing and management positions. He was most recently Manager of Market Research, where he was responsible for research analysis of worldwide semiconductor industry trends. While at Motorola, he also served as Chairman of the Semiconductor Industry Association's Trade Statistics Committee. His educational background includes a B.A. degree in Mathematics from Temple University and an M.S. degree in Applied Statistics from Villanova University.

Dataquest Incorporated
SEMICONDUCTOR INDUSTRY CONFERENCE
October 17-19, 1983
Palm Springs, California

JAPANESE MARKET OVERVIEW 1982-1983

Gene Norrett
Director - Japanese Semiconductor Industry Service
DATAQUEST Incorporated

Good Morning Ladies and Gentlemen.

I would like to talk to you this morning on three topics: the Japanese economy, its electronics industry and, finally, an overview of our current outlook for its semiconductor industry.

Because of Japan's heavy reliance on its trading partners, the country also suffered from the recession which gripped the rest of the world in 1981 and 1982. In fact, Japanese commentators frequently note that: "When the U.S catches a cold, Japan gets pneumonia." The recession hit Japan during the final quarter of calendar year 1981, when the economy recorded its first quarterly decline since the 1975 recession.

In the first quarter of 1983 we saw signs of recovery, which lagged behind the U.S. recovery. In that quarter Japan experienced a real growth rate of 2.8 percent versus a U.S. growth of 2.4 percent. The second quarter has just been announced, at 3.6 percent, good by some standards but substantially less than the U.S.'s explosive 9.2 percent.

Going back to 1982 for a moment, we believe that the decline in Japan's GNP was largely due to a sharp decline in the export sector since domestic demand had already been weak since early 1980 and it has remained that way through 1981 and 1982. Net external demand (that is, exports minus imports) was the mainstay of Japanese economic growth during much of 1980 and 1981. During these years exports rose 30.7 and 13.9 percent, respectively, on a yen basis. Then in 1982 the growth of exports dropped to only 2.7 percent causing serious production and marketing dislocations throughout the economy. These dislocations plus the serious growing deficit problem has government officials thoroughly perplexed.

National bankruptcy is not a term outsiders would use to describe the Japanese state; however this term is becoming common among Japanese bureaucrats and businessmen to describe the huge budget deficits. The need for tax structure reforms is evident and these have been a major goal of Prime Minister Nakasone and his two predecessors. Despite the weakness of the economy in 1982, government expenditures have continued to grow. The result has been a pervading sense of crisis over the public debt and an increasing sense of frustration over how to deal with it.

The nation's deficit in fiscal 1982 was $45.02 billion and was 3.8 percent of the GNP. Although down slightly from 1981, it is still too high. Amazingly it is a higher percentage than the U.S. deficit, which was 3.2 percent of GNP or $42.9 billion.

To finance this deficit the government has resorted to bond issues, which were first made in 1975. Before then the government only issued construction bonds which were primarily used to finance infrastructure projects such as roads, bridges and harbors. Deficit bond issues have accelerated to the point that they have exceeded construction bond issues.

The current slowdown in the Japanese economy has called into question the feasibility of former Prime Minister Suzuki's original pledge of eliminating deficit financing bonds in fiscal 1984. We believe that the Nakasone government will have to increase taxes and continue issuing deficit bonds beyond fiscal 1984.

Moreover, growing U.S. pressure for increased Japanese defense spending is further frustrating the government and creating debates among the predominantly pacifist population. The principal reason for this U.S. insistence is the fact that, although Japan is the second leading western industrial power behind the U.S., it is fourth in defense spending behind the U.S., West Germany, U.K. and France. We believe that Japan will increase defense spending but fall short of levels suggested by the other western powers. A major constraint though is Article 9 of the Japanese constitution which limits defense spending to 1 percent of the GNP.

On the balance of trade scene, Japan's trade friction with its major trading partners seems to have eased considerably, due to the government's recent agreements to curb exports of cars and video tape recorders to the U.S. and Western Europe. However, the U.S. trade representatives still maintain that Japan has given its industry an advantage over other countries by supporting basic R&D and promoting exports.

When we look at Japan's historic trade balance with its three major partners - the United States, Western Europe and South East Asia - we see some very striking trends. First, Japan's total trade with the United States - imports plus exports - grew from $40 billion to $60 billion between 1978 and 1982. However, there was a decline in 1982 - the first such decline since 1975. Second, Japan's balance of trade with the United States climbed from a $1 billion deficit in 1975 to a $12 billion surplus in 1982. This rapid rise has triggered the Reagan administration policy makers to develop three "hard-line" approaches:-

- First, criticism of Japan's industrial policy, including allegations of product dumping and targeting by key high growth industries

- Second, pressure to open public corporations such as Nippon Telegraph and Telephone, and strategic industries, such as semiconductors

- Third, to encourage the Japanese government to liberalize capital markets in order to promote appreciation of the yen

Regarding the last two approaches we have observed that Japanese tariffs on industrial goods are now on the average comparable or below those of the United States and the EEC. Secondly, there appears to be a political commitment to increase the liberalization process, as evidenced in these steps:

- April 1983 - MITI sent 30 represented to the United States, New York, Chicago, Los Angeles, San Francisco, to encourage industrial siting.

- August 1983 - They have established a low interest rate financing system with $55 million for 12 projects in Fiscal 1984. Of these 12 projects, the following companies have been involved:

  - Nippon Motorola
  - Intel Japan
  - Fairchild Japan
  - Burr Brown Japan

- September 1983 - They have created a reliability center in Japan to inspect products and issue quality guarantee certificates.

- September 1983 - They will exchange aggregated sales data of the top 12 integrated circuit manufacturers with the department of commerce, and finally

- April 1984 - They have agreed to the elimination of tariffs on semiconductors.

While not all of these approaches will bear fruit in the first year, we believe that they will help reduce trade frictions between the two countries.

Next, looking at Japanese trade with Western Europe, we observe the following trends:

- Between 1975 and 1982 total trade rose from $12 billion to a little over $33 billion.

- Japan's trade surplus with Western Europe was $13 billion - versus $12 billion with the United States.

- The European deficit has been growing at a compound annual rate of 26.6 percent.

- European imports into Japan have been essentially flat since 1979.

These alarming statistics have been fodder for protectionist sentiment in Europe. In February 1983, European countries imposed quotas on Japanese VTRs in an attempt to help their own producers, which are trailing far behind. However, quotas alone will not suffice. Increased Japanese investment in Europe will be required in order to reduce trade frictions. Through March 1982, Japanese investments in Europe totaled $5.3 billion, of which $1.0 billion was invested in manufacturing.

Finally we have observed that the level of trade between Japan and Southeast Asia neighbors is significantly higher than with either the U.S. or Western Europe. At the end of 1982, total trade was $67 billion, up from $23 billion in 1975. Also you will note that Japan's very low trade deficit even declined slightly in 1982.

Now, for a moment, let's turn our attention to the electronics industry which has been the main engine for Japan's economic growth.

Until the late 1970s, Japan sought to catch up with the technological superiority of the West. The much touted VLSI Project (1976-79) is a dramatic example of MITI's determined effort to achieve superiority in dynamic RAMs.

By the early 1980's however, Japan had achieved parity with the West in many technical fields such as robotics, ceramics, advanced computers and new semiconductor elements. Instead of copying and improving technology from the West, Japan has been forced to innovate. In 1980, MITI issued its famous "Visions for the 1980s" which sets out its goal of creating an information-based society. Fourteen high-technology industries have been selected for development.

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In order to develop these industries, MITI and NTT have structured a three-pronged strategy consisting of the following:

- Joint R&D projects involving government, industry and universities
- Infrastructure development
- Venture capital infusion

By coordinating these programs, MITI hopes to catalyze technological innovation in various regions of Japan which are now suffering from the decline in the mature heavy equipment industries.

Joint R&D Programs

MITI's plan for the 1980s consists of a set of joint government/industry R&D programs running on parallel tracks.

Undoubtedly you have already heard of the 5th generation computer project, which is the centerpiece of Japan's high-technology strategy. However, that is only part of the story. As you can see, MITI has initiated several other projects organized in a manner similar to the VLSI project. Total government funding for these projects will be around $1.4 billion. This does not include corporate funding, which may equal or exceed this amount.

In addition, NTT is developing a nationwide telecommunications network, called the Information Network System (INS). Total estimated procurement costs for this system will be $120 billion during the next 20 years (or $6 billion dollars per year)for system investments.

One of the least publicized aspects of the Japanese R&D programs is the fierce competition between MITI and NTT. For example, NTT surpassed MITI in the development of a Japanese-to-English and English-to-Japanese computerized language translator. Incidentally, this was one of MITI's major goals of the fifth generation project, which will be discussed shortly.

Briefly, I would like to summarize the goals and research themes of each of these MITI and NTT projects.

- 5th Generation Computer - The main purpose is to develop an artificial intelligence computer using parallel processing with a large knowledge based system. To a novice a knowledge based system combines current technology systems with new inference systems. According to Tohru Motooka, Tokyo University Professor of Electrical Engineering and Chairman of this project (ICOT), the hardware design of the sequential machine will be completed by the end of 1983. Total funding will be about $450 million.

- Supercomputer - The purpose is to design a high-speed computer for scientific and technological uses which will be able to perform 10 billion floating point operations per second, i.e. 10 gigaflops. The key semiconductor research areas include gallium arsenide (GaAs), Josephson Junctions, and high electron mobility transistors (HEMT). The current state of the art production machine is Hitachi's HITAC S-81, which operates at 630 megaflops. Total funding for the Supercomputer project will be about $105 million.

- Next Generation Industries - In October 1981, the Long-Term Industrial Technology Planning Committee, a study group of academics and experts commissioned by MITI, issued a report recommending basic research essential for establishing new industries that are expected to flourish in the 1990s. These industries include biotechnology, aerospace, information processing, alternative energies, and ocean development. Three general fields were chosen by MITI for development: new materials (such as high polymers, ceramics, and composite materials), biotechnology, and new semiconductor function elements. The total funding is projected to be $473 million.

- New Semiconductor Function Elements - A portion of the Next Generation Industries Project is the New Semiconductor Function Element Project, Japan's next step in developing basic semiconductor technology. The overall goal of the project is to extend the geometric design and durability of integrated circuits. Ten companies have organized themselves into the Research and Development Association for Future Electronics Devices, which is being commissioned to conduct basic research. Project expenses will be covered by MITI consignment payments and patents will be made available through the Industrial Technology Promotion Agency. The total cost of the project is expected to run about $114 million.

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- Integrated Network System - The last and potentially the largest development program to be discussed in this sequence is the Nippon Telegraph and Telephone Integrated Network System (INS). NTTs INS program aims to develop a nationwide digital system for telephone network, data and FAX services using fiber optics and satellite broadcasting.

Infrastructure Development

The key to Japan's strategy for dominance in high-technology fields is the Technopolis Concept, which is a plan aimed at establishing new tech cities throughout the country. Tsukuba, which is 60 miles northeast of Tokyo, is the first of these cities and will be quite a show piece when it is completed.

Moreover, these new cities are programmed to have populations of more than 200,000 and would consist of research institutes, schools, housing, and recreational facilities clustered around new high-technology industries. It is further planned that they would be within one-day travel from Tokyo, Osaka, or Nagoya, by plane or bullet train.

The Industrial Location and Environment Protection Board of MITI is currently screening 19 candidate sites for the new Technopolis cities. The overall project is being directed by the Technopolis '90 Construction Concept Committee, an advisory board to MITI. Cities designated as Technopolis centers will receive central government financing, public works projects, tax benefits, and MITI and JETRO guidance.

Venture Capital

The third pillar of Japan's new industrial strategy is to provide venture capital to start-up firms. This strategy has long been utilized by the West to stimulate new ventures. Generally, DATAQUEST has observed the following trends in Japanese venture capital activities:

- Source of venture capital are large banks, securities companies, and trading houses.

- Six of the largest venture capital firms are not private, but are owned by huge conglomerates such as Mitsubishi Bank, Nomura Securities, and the Dai-Ichi Kangyo Bank.

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- Venture capital firms are proliferating in Japan - BUT not for the purposes consistent with MITI goals of high-technology development. Few of these companies want to insure risk capital involved in leading edge technology, but are investing in more secure industries such as retailing, wholesaling, and consumer manufacturing.

- Japanese venture capital firms spread their portfolio about 70 percent in loans and 30 percent in equity stocks.

- Most loans go to relatively mature companies preparing to go public.

- Japanese entrepreneurs are reluctant to forfeit part of the ownership of their companies to outside firms - this is why most venture capital is in the form of loans rather than equity.

- Typical start ups are especially reluctant to allow foreign investment in their companies, either directly or through venture capitalist.

- Legal guidelines in Japan state that venture capital firms may not place a director on the board of a company they invest in (unlike the U.S.) and they may own no more than 49 percent of a company.

Semiconductor

Finally I want to turn your attention to the semiconductor industry in Japan. When I first came to DATAQUEST to start the Japanese Semiconductor Industry Service last October and started to look into this industry, I became aware very quickly that on the surface there was considerable distrust and misunderstanding. However, as I looked closer, what I saw was entirely different.

First, from the factory siting we noted the following activities.

U.S. Companies in Japan

Company	Activities
Texas Instruments	3 factories.
Motorola	1 factory, 1 planned
Intel	Design Center and factory planned
Fairchild	factory planned
Burr Brown	factory planned
IBM	1 factory
Analog Devices	1 factory
Intel Rectifier	1 factory

Other U.S. and European companies have marketing with some final testing.

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Japanese Companies in the West

NEC	4 factories, California and Scotland
Hitachi	2 factories, Texas and West Germany
Toshiba	1 factory in California
Fujitsu	1 factory in California
Mitsubishi	1 factory planned in N. Carolina

Other Japanese companies have Marketing with some final testing.

Next from a joint venture and licensing perspective we have observed a very rapid rise in this activity since 1980. By our calculation there were 4 in 1980, 6 in 1981, and 10 in 1982. Through June of this year it has grown to 13. At this rate we could see over 20 joint ventures and licensing agreements between U.S. and Japanese companies for 1983.

We believe there are two reasons for this growth.

1. In December 1980, Japan revised the Foreign Exchange and Trade Control law, which loosened MITI's control over joint ventures.

2. The proliferation of microprocessor and peripheral applications has forced many Japanese manufacturers to form partnerships with the U.S. leaders in order to develop their own expertise. The following figure shows just the licensing agreements that currently exist today:

Impact of VLSI Project on Equipment Manufacturers

One of the least discussed outcomes of the VLSI Project is its impact on U.S. semiconductor equipment manufacturers. Besides the 64K DRAM, the project sought to develop process technologies for eventual use in 1M, 4M and ultimately 16M bit DRAMs. Key VSLI manufacturing innovations include:

- High-speed E-beam drawing unit for 1M bit devices. It draws a 1 square centimeter device in 9 to 15 minutes.
- High performance dry etching machine
- E-beam software system
- Laser scanning LSI analyzing system
- Infrared scanning IC thermo distribution measuring system
- Ultra-high-speed pattern generator with 300 mHz speed

After the VLSI project ended, these patents were sold to Japanese manufacturers who are currently developing automated equipment.

U.S. manufacturers are responding in several ways:

- Signing joint ventures with Japanese manufacturers to gain entry or increase presence in the Japanese market. Since 1981, there have been 20 joint ventures in semiconductor fab equipment

- Opening manufacturing plants in Japan (e.g. MRC)

Next I want to discuss the semiconductor market. First, right up front, I want to say that 1983 will be a good year for the industry. The year started out with the market being driven principally by office automation and factory automation products. But as consumer end equipment inventories wore down due to an inproving export market demand, production of products such as VTRs, video disks and color TVs began to increase and we now have a market condition that is similar to what you have heard about the U.S. from Fred Zieber.

As of June 1983, new order rates for semiconductors were up an average of 28 percent ahead of the fourth quarter, with office automation leading the pack. The office automation market is currently seeing demand up 58 percent over the fourth quarter levels. Currently there is a shortage of 64K DRAMs, EPROMs, 8-bit microcontrollers D to A and A to D converters, laser diodes and TTL. The shortage of TTL is so acute that Nissho-Iwai Co. Limited, a major trading company, imported $300,000 worth of TTL from the U.S.S.R. in July. This chart shows our quarterly forecast for consumption through the fourth quarter of 1984.

Our analysis and forecast shows a resurgence of the industry in the second and third quarters of 1983, with a continual building quarter-to-quarter through 1984. We believe that the backlogs that are currently being built will be translated into solid shipments and end consumption for at least the next six quarters.

Our forecast calls for discretes to grow about 12 percent this year and 13 percent in 1984. For integrated circuits we see 29 percent in 1983 and 32 percent growth next year.

The principal reasons for assuming that 1984 will be a good year for semiconductor consumption in Japan are as follows:

- The 1984 Olympics will precipitate sales of all types of consumer electronics.

- U.S. presidential elections will take place in 1984 and we can expect the U.S. economy to be "dressed" for the ritual.

- Japanese 256K DRAM production will be ramped from 800 thousand units in 1983, to 10 million units in 1984, and 64K DRAM production will grow from 208 million units in 1983 to 420 million in 1984.

- The Japanese government will act to stimulate capital investment in 1983, which will pay dividends in 1984 in terms of industrial electronics, such as telecommuncations, and all forms of office and factory automation products.

Summary

In summary, first I have talked about an economy that is debt ridden but one that shows every sign of being able to cope and in fact achieve more than a 3 percent real growth rate this year.

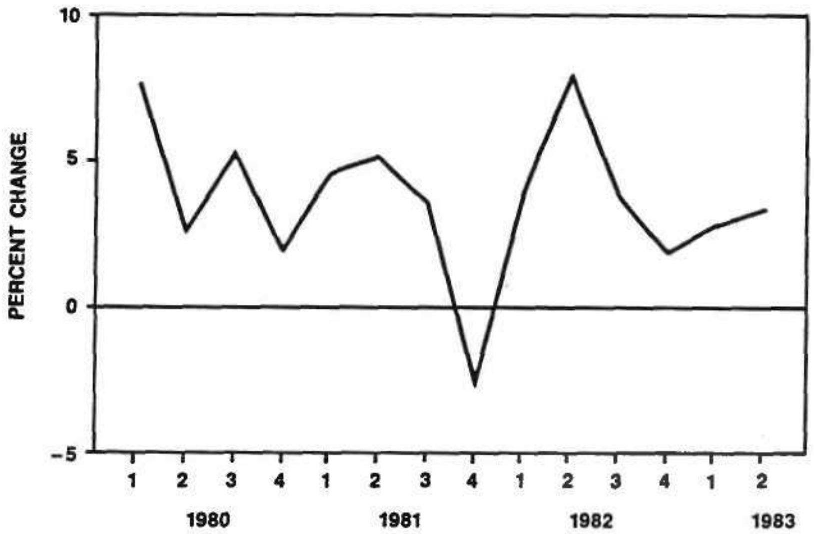
Second, we have observed an electronics industry that is embarking on a "take lead" path, one that is certainly very costly and will no doubt be successful in some but not all of its endeavors.

Third, we see a very healthy semiconductor industry, one that has every sign of achieving and in fact bettering our projection of 24 percent growth in yen for 1983.

Finally, we have seen a multitude of trade barrier breaking moves on both sides of the Pacific which will only breed a strengthening of the world semiconductor and electronics industry.

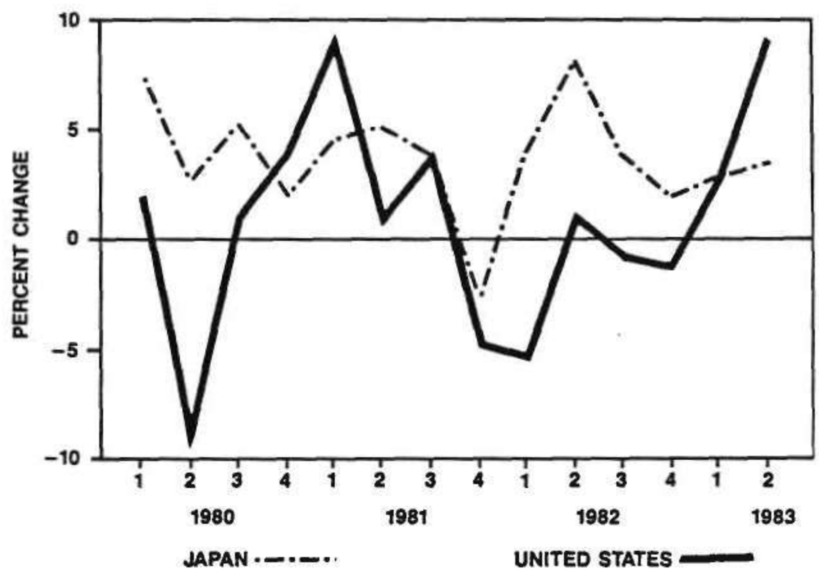
Thank you.

JAPAN REAL GNP GROWTH RATE SEASONALLY ADJUSTED AT ANNUAL RATE

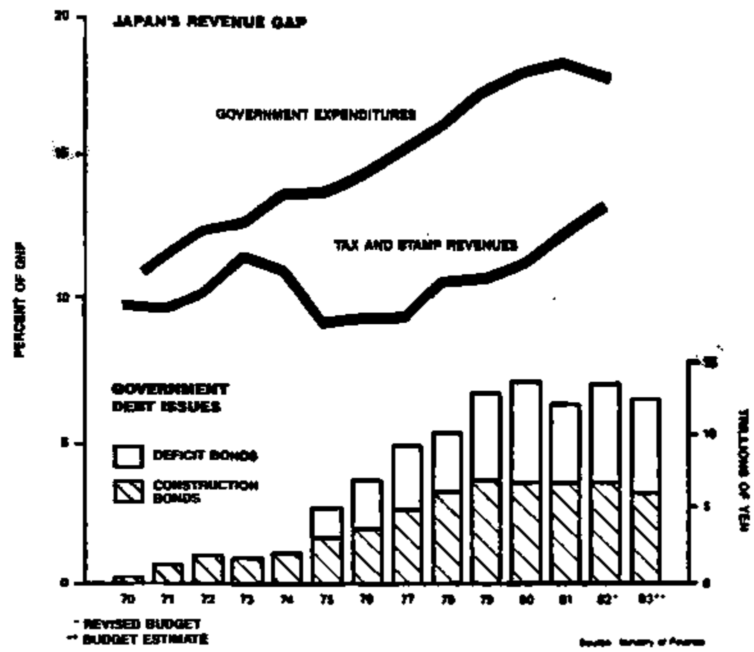


Source: International Monetary Fund
DATAQUEST

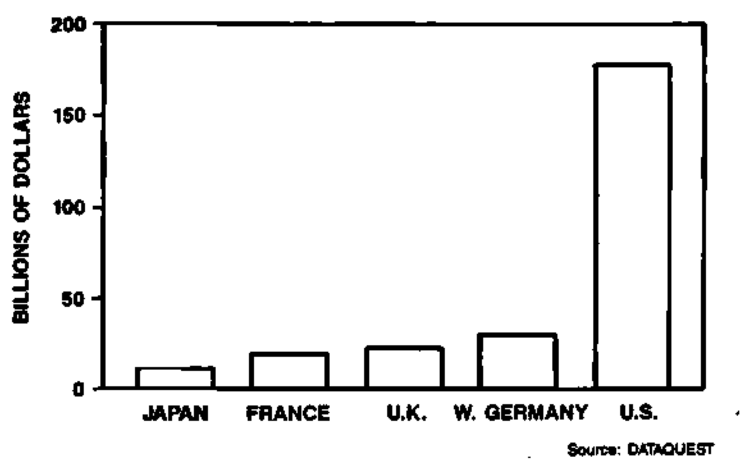
REAL GNP GROWTH RATE SEASONALLY ADJUSTED AT ANNUAL RATE — U.S. AND JAPAN



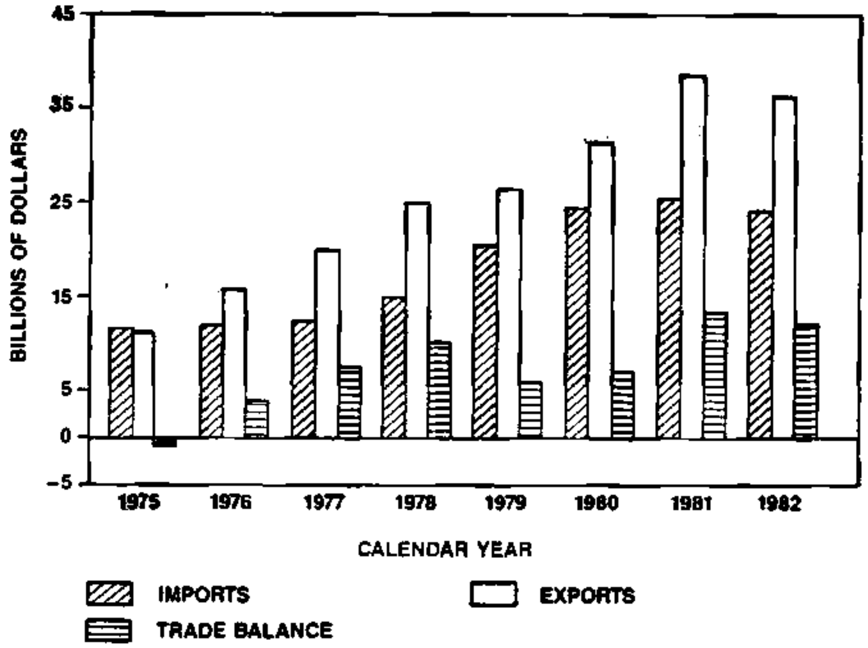
Source: International Monetary Fund
DATAQUEST



1982 DEFENSE SPENDING
(Billions of Dollars)



JAPAN — U.S. TRADE BALANCE



LIBERALIZATION OF TRADE

- APRIL 1983 - SENT 30 REPRESENTATIVES TO NEW YORK, CHICAGO, LOS ANGELES, SAN FRANCISCO TO ENCOURAGE INDUSTRIAL SITING
- AUGUST 1983 - ESTABLISHED A LOW INTEREST RATE FINANCING SYSTEM WITH $55 MILLION FOR 12 PROJECTS IN FISCAL 1984. OF THESE 12 PROJECTS, THE FOLLOWING COMPANIES HAVE BEEN INVOLVED:
  - NIPPON MOTOROLA
  - INTEL JAPAN
  - FAIRCHILD JAPAN
  - BURR BROWN JAPAN
- SEPTEMBER 1983 - ESTABLISHMENT OF A RELIABILITY CENTER IN JAPAN TO INSPECT PRODUCTS AND ISSUE QUALITY GUARANTEE CERTIFICATES
- SEPTEMBER 1983 - EXCHANGE AGGREGATED SALES DATA OF THE TOP 12 INTEGRATED CIRCUIT MANUFACTURERS WITH THE DEPARTMENT OF COMMERCE
- APRIL 1984 - ELIMINATION OF TARIFFS ON SEMICONDUCTORS

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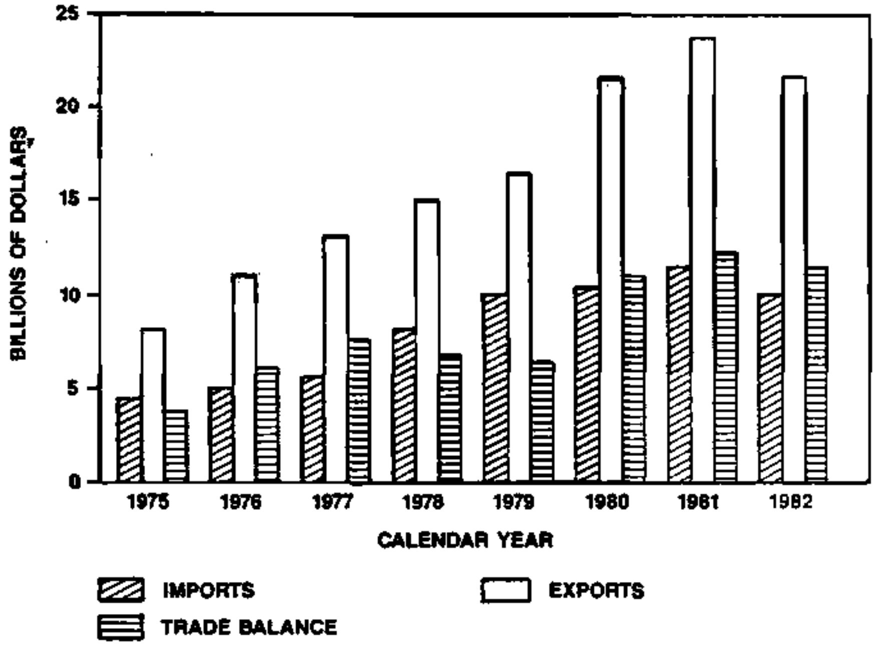
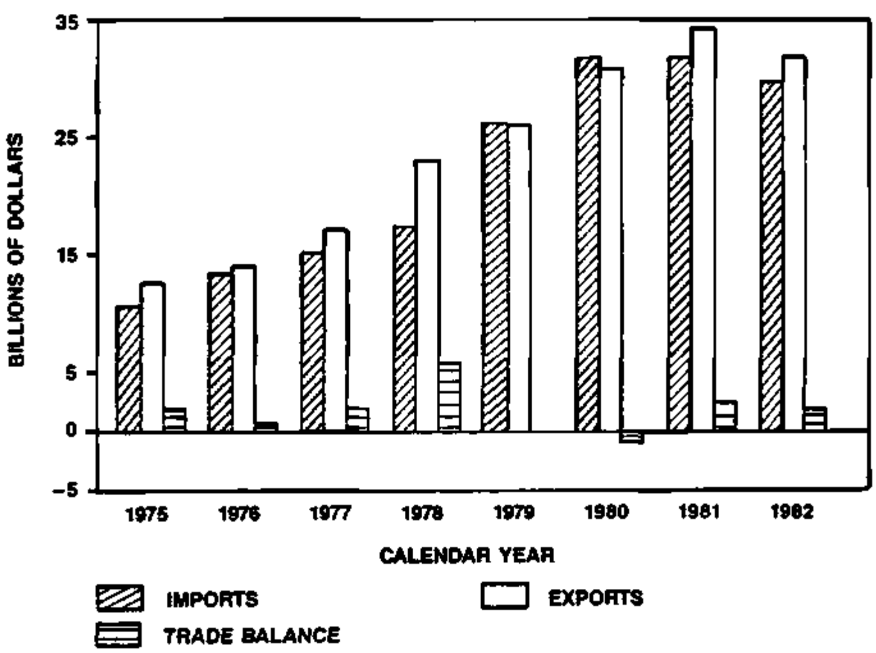
JAPAN — WESTERN EUROPE TRADE BALANCE



JAPAN — SOUTHEAST ASIA TRADE BALANCE

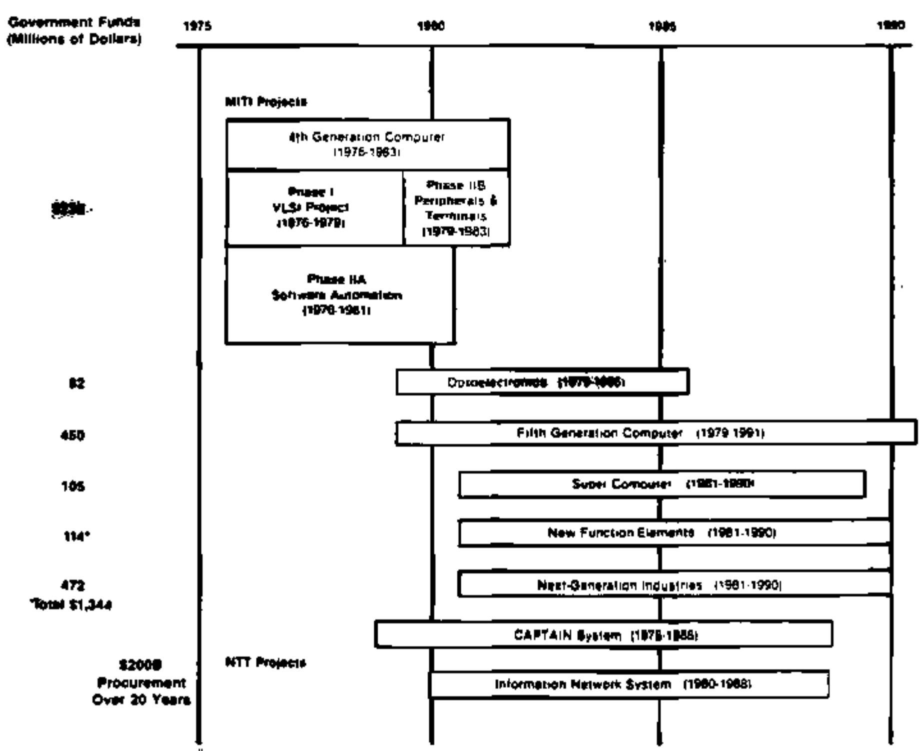


JAPANESE STRATEGIC INDUSTRIES FOR THE EIGHTIES

- AIRCRAFT
- SPACE
- OPTICS
- BIOTECHNOLOGY
- MEDICAL ELECTRONICS
- INDUSTRIAL ROBOTS
- INTEGRATED CIRCUITS
- COMPUTERS
- WORD PROCESSORS
- METAL-BASED NEW MATERIALS
- FINE CERAMICS
- MEDICINE AND MEDICAL SUPPLIES
- INDUSTRIAL MATERIAL
- SOFTWARE

STRATEGY NO. 1

GOVERNMENT R&D PROJECTS IN THE 1980s



* Included in Next Generation Industries Total

Source: U.S. Embassy, Tokyo, May 1982

THE FIFTH GENERATION COMPUTER PROJECT (1979–1991) $450M FUNDING

THE SUPERCOMPUTER PROJECT (1981–1989) $105M FUNDING

NEXT GENERATION INDUSTRIES (1981–1990) $472M FUNDING

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THE NEW SEMICONDUCTOR FUNCTION ELEMENTS PROJECT (1980–1990)

$114M FUNDING

INFORMATION NETWORK SYSTEM (INS)

1983	– DIGITAL LOCAL SWITCHING; DATA AND FACSIMILE SERVICE
1984	– INSTALLATION AT HOMES AND BUSINESSES
1985–86	– TESTING AT MUSASHINO SUBURB AND DOWNTOWN MARUNOUCHI
1985	– 10,000 SUBSCRIBERS
	– EXPO 85 TSUKUBA
1986	– NATIONWIDE INS
1987	– EXTEND TO PREFECTURAL CAPITALS
1988	– INTRODUCE DIGITAL SWITCHING AND FIBER OPTICS
1995	– COMPLETE INS

STRATEGY NO. 2
TECHNOPOLIS CONCEPT

STRATEGY NO. 3
VENTURE CAPITAL

U.S. COMPANIES IN JAPAN

TEXAS INSTRUMENTS	MARKETING HEADQUARTERS, 3 FACTORIES
MOTOROLA	MARKETING HEADQUARTERS, 1 FACTORY, 1 PLANNED
INTEL	MARKETING HEADQUARTERS, DESIGN CENTER AND FACTORY PLANNED
FAIRCHILD	MARKETING HEADQUARTERS, 1 FACTORY PLANNED
BURR BROWN	MARKETING HEADQUARTERS, 1 FACTORY PLANNED
IBM	MARKETING HEADQUARTERS, 1 FACTORY
ANALOG DEVICES	MARKETING HEADQUARTERS, 1 FACTORY
INTERNATIONAL RECTIFIER	MARKETING HEADQUARTERS, 1 FACTORY

OTHER U.S. AND EUROPEAN COMPANIES HAVE MARKETING WITH SOME FINAL TESTING

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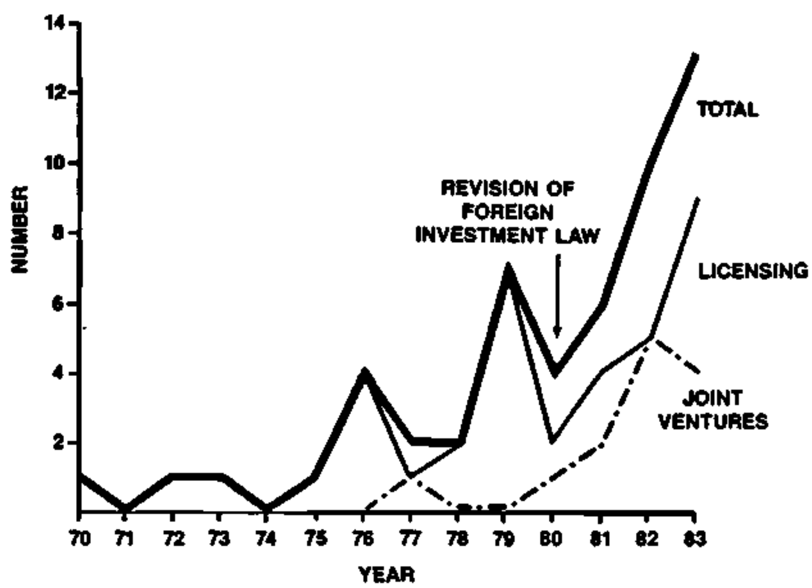
JAPANESE COMPANIES IN THE WEST

NEC	MARKETING HEADQUARTERS, 4 FACTORIES—CALIFORNIA AND SCOTLAND
HITACHI	MARKETING HEADQUARTERS, 2 FACTORIES—TEXAS AND WEST GERMANY
TOSHIBA	MARKETING HEADQUARTERS, 1 FACTORY IN CALIFORNIA
FUJITSU	MARKETING HEADQUARTERS, 1 FACTORY IN CALIFORNIA
MITSUBISHI	MARKETING HEADQUARTERS, 1 FACTORY PLANNED IN N. CAROLINA

OTHER JAPANESE COMPANIES HAVE MARKETING WITH SOME FINAL TESTING

U.S. — JAPANESE SEMICONDUCTOR JOINT VENTURES AND LICENSING AGREEMENTS



Source: DATAQUEST

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U.S.—JAPANESE LICENSING AGREEMENTS

AREA	U.S. COMPANY	JAPANESE COMPANY
MPUs MCUs	INTEL	FUJITSU
	INTEL	NEC
	INTEL	MITSUBISHI
	TEKTRONIX	NEC
	ZILOG	TOSHIBA
	ZILOG	SHARP
	AMI	NEC
	MOTOROLA	HITACHI
DRAMs	H-P	HITACHI
	MOTOROLA	HITACHI
	NATIONAL SEMICONDUCTOR	OKI
CMOS TECHNOLOGY	SMC	HITACHI
	SMC	FUJITSU
	SMC	NEC

Source: DATAQUEST

U.S.—JAPANESE JOINT VENTURES AMONG SEMICONDUCTOR EQUIPMENT MANUFACTURERS 1981

JAPANESE COMPANY	U.S. COMPANY	PRODUCTS
TOKYO ELECTRON LTD. (TEL)	TRE SEMICONDUCTOR	WAFER STEPPERS AND OTHER LITHOGRAPHIC SYSTEMS
TOKYO ELECTRON LTD. (TEL)	THERMCO PRODUCTS CORP.	OXIDATION CVD AND DIFFUSION REACTORS
TOYO INC. MANUFACTURING CO. (50%)	MORTON CHEMICAL CO. (50%)	EPOXY MOLDING COMPOUND
ULVAC CORP (50%)	CTI-CRYOGENICS CO. (50%)	CRYOGENIC PUMPS AND SPUTTERERS
TOKYO ELECTRON LTD. (TEL)	GEN RAD	IC TEST SYSTEMS

U.S.—JAPANESE JOINT VENTURES AMONG SEMICONDUCTOR EQUIPMENT MANUFACTURERS 1982

JAPANESE COMPANY	U.S. COMPANY	PRODUCTS
OMRON TATEISHI ELECTRONICS (50%)	GENERAL SIGNAL (50%)	ULTRATECH AUTOMATIC WAFER STEPPER, ELECTROGAS AUTOMATIC WAFER PROBE, MICRO AUTOMATION DICING SAW, DIE SEPARATION SYSTEM
MIDORIYA ELECTRIC (20%)	MATERIALS RESEARCH CORP. (80%)	CASSETTE-TO-CASSETTE SPUTTERING EQUIPMENT FOR 256K DRAMs
TOKYO ELECTRON LTD. (TEL) (50%)	VARIAN (50%)	VARIAN'S MODEL CF-300 ION IMPLANTER
SUMITOMO SHOJI TRADING COMPANY (50%)	GCA CORP. (50%)	DSW STEPPER (REDUCTION PROJECTION ALIGNER) AND WAFERTRAC SYSTEM
VARIOUS FIRMS (50%)	AEHR TEST SYSTEMS (50%)	BURN-IN SYSTEMS FOR ICs
TABAI SEISAKUSHO	CONTRACT SYSTEM INC.	IC AUTOMATIC INSERTION MACHINES
TOKYO OHKA KYGYO CO.	AIRCO TEMESCAL	PLASMA ETCHING EQUIPMENT
ANALYTICA (62%)	VARIAN (38%)	ANALYTICAL INSTRUMENTS
KANEMATSU SEMICONDUCTOR	PERKIN-ELMER	PERKIN-ELMER ELECTRON BEAM LITHOGRAPHY EQUIPMENT, MASK ALIGNERS AND METAL SPUTTERERS
JAPAN SILICON CO. LTD. (SUBSIDIARY OF MITSUBISHI MOTOROLA)	SMIEL (DIVISION OF DYNAMIT NOBEL)	SILICON WAFERS
KOKUSAI ELECTRIC CO.	VEECO INSTRUMENTS	VEECO—ION IMPLANTATION, WAFER PROCESSING EQUIPMENT KOKUSAI—SILICON EPITAXIAL REACTORS, CVD DIFFUSION EQUIPMENT

U.S.—JAPANESE JOINT VENTURES AMONG SEMICONDUCTOR EQUIPMENT MANUFACTURERS 1983

JAPANESE COMPANY	U.S. COMPANY	PRODUCTS
SUMITOMO HEAVY MACHINERY	EATON	VLSI ION IMPLANTATION EQUIPMENT
TOKYO ELECTRON LTD. (50%)	LAM RESEARCH CORP. (50%)	PLASMA ETCHING EQUIPMENT (AUTO ETCH 480)
SANKYO SEIKI MFG. CO.	APPLIED MATERIALS JAPAN	SEMICONDUCTOR MATERIAL HANDLING ROBOTS

JAPAN SEMICONDUCTOR CONSUMPTION (Billions of Yen)

1983	Q1	Q2	Q3	Q4	TOTAL YEAR
DISCRETE	¥ 73.4	¥ 80.0	¥ 89.0	¥ 94.0	¥ 336.4
IC	186.5	210.0	249.0	265.0	910.5
TOTAL	¥259.9	¥290.0	¥338.0	¥359.0	¥1,246.9

1984	Q1	Q2	Q3	Q4	TOTAL YEAR
DISCRETE	¥ 90.0	¥ 92.0	¥ 96.0	¥102.0	¥ 380.0
IC	270.0	296.0	314.0	324.0	1,204.0
TOTAL	¥360.0	¥388.0	¥410.0	¥426.0	¥1,584.0

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JAPAN SEMICONDUCTOR CONSUMPTION
(Billions of Yen)

	1982	PERCENT CHANGE 1982-1983	1983	PERCENT CHANGE 1983-1984	1984
DISCRETES	300.5	11.9%	336.4	12.9%	380.0
INTEGRATED CIRCUITS	707.6	28.7%	910.5	32.3%	1,204.0
TOTAL	1,008.1	23.7%	1,246.9	27.0%	1,584.0

Nielsen Dataquest RESEARCH NEWSLETTER

EIEJ Code: Newsletters

HIRING UP 15 PERCENT AT JAPANESE ELECTRONICS COMPANIES

According to a recent survey by Dempa, Japan's daily electronics newspaper, major Japanese electronics companies will hire 15 percent more high school and college graduates in 1984 than in 1983. This increase is a result of strengthening sales of office automation (OA) equipment, consumer audio players, digital equipment, microcomputers, and software.

As shown in Table 1, companies will be hiring more graduates with science and engineering backgrounds, and less with liberal arts backgrounds. This is especially true of manufacturers of industrial electronics (63.9 percent science and engineering backgrounds) and electronic components (60.2 percent). In 1984 job offers to male engineers will increase 20.5 percent versus 3.9 percent for male liberal arts graduates. Offers to female engineers will increase 14.9 percent. Japanese companies generally hire in March, at the end of the academic year.

Several important new hiring trends are developing as follows:

- Greater emphasis is being placed on the job applicant's individuality and character, not just grades. Encouraging creativity and innovation has become a major concern among industry leaders and educators.
- Companies are hiring more young women with strong technical backgrounds and assigning them to software development. This traditionally low-paying field is rapidly becoming important for office automation manufacturers.
- Electronic component markets are hiring more graduates with training in chemistry, mechanical engineering, and metals due to the trend toward total, complex systems.

Sheridan M. Tatsuno

Table 1

FY1984 HIRING PLANS FOR 69 JAPANESE ELECTRONICS COMPANIES

CONSUMER ELECTRONICS

Manufacturer	Actual 1983 Science Engineer	Actual 1983 Total Hired	Planned 1984 Science Engineer	Planned 1984 Total Hired	Total Increase
Mitsubishi	600	1,130	650	1,150	20
Toshiba	720	920	720	920	-
Hitachi Works	670	880	670	880	-
Mitsubish Electric	700	1,680	700	1,680	-
Sanyo Electric	100	1,360	60	1,410	50
Sharp	458	1,091	490	1,065	(26)
Sony	500	650	500	650	-
Nippon Denso	175	360	175	360	-
General	29	43	25	45	2
Nippon Victor	170	310	200	360	50
Nippon Columbia	11	35	11	35	-
Pioneer	70	100	180	330	230
Toriyo	0	0	40	50	50
Sansui Electric	5	19	10	20	1
Clarion	N/A	100	N/A	100	0
Akai Electric	19	19	48	48	29
Teac	11	15	35	40	25
Aiwa	28	58	50	90	32
Nippon Marantz	19	28	25	40	12
Subtotal	4,285	8,798	4,589	9,273	475
Increase	48.7%		49.5%		5.4%

N/A = Not Announced

(Continued)

[redacted]

Table 1 (Continued)

FY1984 HIRING PLANS FOR 69 JAPANESE ELECTRONICS COMPANIES

INDUSTRIAL ELECTRONICS

Manufacturer	Actual 1983 Science Engineer	Actual 1983 Total Hired	Planned 1984 Science Engineer	Planned 1984 Total Hired	Total Increase
Fujitsu	750	950	N/A	N/A	N/A
NEC	730	1,300	N/A	N/A	N/A
Canon	233	325	267	337	12
Ricoh	250	405	250	405	-
Casio	139	252	150	220+	N/A
Fuji/Xerox	77	149	230	460	311
Nippon IBM	373	637	N/A	N/A	N/A
Minolta Camera	82	139	N/A	N/A	N/A
Oki Electric	200	250	240	300	50
Iwasaki Communications	41	77	30-35	64-69	(8-11)
Yohohawa Hokushin	96	120	75	100	(20)
Anritsu Electric	32	62	40	75	13
Ando Electric	64	128	65	120	(8)
Takeda Riken	65	85	65	85	-
Seno Works	10	23	19	32	9
Dai-Ni Seikosha	123	144	115	139	(6)
Mutoh Industries	41	44	N/A	50	6
Nippon Data General	N/A	40	N/A	50	10
Shibasohu	8	13	15	17-18	4-5
Ono Sokki	14	39	25	50	11
Leader Electric	15	15	22	22	7
Subtotal	3,343	5,197	1608-1613	2,526-2,532	389-391
Increase	64.3%		63.9%	(announced to date)	(announced to date)

N/A = Not Announced

(Continued)

Table 1 (Continued)

FY1984 HIRING PLANS FOR 69 JAPANESE ELECTRONICS COMPANIES

ELECTRONIC COMPONENTS

Manufacturer	Actual 1983 Science Engineer	Actual 1983 Total Hired	Planned 1984 Science Engineer	Planned 1984 Total Hired	Total Increase
Alps Electric	110	242	125	280	38
TDK	80	106	60+	130	24
Showa Musen	16	40	40	70	30
Nippon Chemicon	20	27	N/A	35	8
Elna	4	6	10	15	9
Sankyo Seiki Works	34	44	50	65	21
JAL Electronics	15	61	N/A	61	-
Hokuriku Electric	16	18	20	22	4
Kowa Electric	8	13	13	15	2
Hirose Electric	13	16	13	16	-
Teikoku Communications	2	9	N/A	20	11
Taiyo Yuden	19	22	25	30	8
Tamura Works	21	26	35	45	19
Hitachi Metals	40	60	45	65	5
Fujisohu	2	2	20	20	18
Nippon Kaiheiki	2	2	3	3	1
Mabuchi Motors	7	15	15	31	16
Sumitomo 3M	44	73	N/A	N/A	N/A
Sanken Electric	2	8	24	48	40
Stanley Electric	51	71	70	80	9
Tohoku Metals	14	21	N/A	N/A	N/A
Fuji Electric Chemicals	24	40	27	42	2
Toko	21	26	N/A	N/A	N/A
Murata Works	81	147	120	195	(21)
Kyocera	107	161	110+	150	(56)
Tateishi Electric	131	211	105	155	24
Nippon Condenser	14	26	40+	50	21
Hoshi Electric	11	12	25	33	21
ROLM	40	58	50	60	2
Subtotal	949	1,563	1,045	1,736	256
% Science and Eng. Background	60.7%		60.2%	(announced to date)	(announced to date)
Total Hiring	8,577 (55.1%)	15,558	7,242-7,247 (53.5%)	13,535-13,541 (announced to date)	1,120-1,122 (announced to date)

N/A = Not Announced

Source: Dempa Shimbun
DATAQUEST

Nielsen Dataquest **RESEARCH BULLETIN**

EIEJ Code: Newsletters

JAPANESE, U.S., AND BRITISH FIRMS FORM INTERNATIONAL VENTURE CAPITAL COMPANY

In a break from tradition, Orient Leasing Company has become the first Japanese company to internationalize its venture capital activities. A new firm, tentatively named Orient Capital, will begin operations in October, managing venture capital originating in Japan, the United States, and Europe. In addition, cooperative funds will be established for investments in new entrepreneurial businesses.

Capital will be raised in the United States and Europe by Hambrecht and Quist, a U.S. venture capital firm, and Baring Brothers, a British merchant bank.

It has been reported that Orient Capital will be capitalized at ¥300 million (US$1.2 million); however, DATAQUEST believes that the capitalization will be substantially higher. Partners and percent of capital are as follows:

Partner	Percent of Capital Supplied
Orient Leasing Company	40%
Baring Brothers	20%
Hambrecht and Quist	20%
Daiwa Securities	5%
Daiwa Securities Research Institute Co.	5%
Dai-Ichi Mutual Life Insurance	5%
Sanwa Bank	5%

The new firm will be 60 percent Japanese owned. The Japanese partners fit the traditional Japanese venture capital mold of being part of large banks, securities companies, and trading houses.

The types of firms that Orient Capital will invest in are not yet known. Traditionally, Japanese venture capital has gone to relatively mature companies that are engaged in relatively established fields such as retailing, wholesaling, and consumer goods. In contrast to the United States, Japanese venture capital usually has not favored high-technology industries; however, DATAQUEST believes that Orient Capital, with its U.S. and British partners, intends to break with this tradition and invest in high-technology start-ups.

Patricia S. Cox

JSIS Code: Newsletters 1985-1986, JSIA
1986-52

JAPANESE INDUSTRIAL ELECTRONICS PRODUCTION FORECAST AT ¥12.5 TRILLION IN FY 1990

SUMMARY

Japanese industrial electronics production will reach ¥12.5 trillion ($74.8 billion)in fiscal 1990, achieving an 11.9 percent compound annual growth rate (CAGR) from fiscal 1985 to fiscal 1990, according to a forecast compiled recently by the Electronic Industries Association of Japan (EIAJ).

INDUSTRIAL ELECTRONICS

Based on the assumption that industrial electronics production in fiscal 1986 will be ¥7,761.3 billion ($46.5 billion), EIAJ forecasts that it will reach ¥12,489.6 billion ($74.8 billion) in fiscal 1990. The CAGR is expected to maintain a level of 11.9 percent for the next five years, a slowdown from the 17.5 percent CAGR of the past five years.

Computers and related electronic data processing equipment are expected to lead the way in substantially raising industrial electronics production. These areas are forecast to grow at a 16.9 percent CAGR. EIAJ expects a surge in demand for large-scale mainframes and networked workstations.

Also worthy of note is the forecast for production of computers and other related electronic data processing equipment, which are expected to reach ¥7.7 trillion ($46.1 billion) in fiscal 1990 and rise to 61.7 percent of total industrial electronics production.

Table 1 shows the EIAJ forecast in detail.

DATAQUEST COMMENTS

Dataquest finds this forecast too optimistic in several areas, although we share the assumption, by and large, that computers and related products will play a key role in Japanese industrial electronics production for the next five years.

In particular, Dataquest believes that the forecast growth rate of 15.9 percent in the computer-related field is too high. This estimate seems to include an expectation of an upturn in the data processing industry. We are concerned that this emphasis is dangerous to the semiconductor industry because if the industry believes this forecast, another cycle of overcapacity and overinventory could begin.

Nagayoshi Nakano

Table 1

MAJOR INDUSTRIAL ELECTRONICS PRODUCTION FORECAST IN JAPAN
1985-1990
(Billions of Yen)

	FY 1985	FY 1986	FY 1997	FY 1990	CAGR (85-90)
Industrial electronics	¥7,127.8	¥7,761.3	¥8,813.1	¥12,489.6	11.9%
Telecommunication systems	¥1,979.0	¥2,034.1	¥2,116.0	¥ 2,543.5	5.1%
Electronic application equipment	¥4,174.5	¥4,794.7	¥5,674.2	¥ 8,621.3	15.6%
Computers and related equipment	¥3,525.7	¥4,150.0	¥4,950.0	¥ 7,700.0	16.9%
Electronic measuring instrumentation	¥ 557.5	¥ 511.0	¥ 563.0	¥ 724.5	5.4%
Electronic business machines	¥ 416.8	¥ 421.5	¥ 459.9	¥ 600.3	7.6%
Calculators	¥ 162.4	¥ 104.0	¥ 108.7	¥ 124.0	(5.3%)
Word processors	¥ 144.3	¥ 214.5	¥ 240.0	¥ 336.3	18.4%
Cash registers	¥ 108.6	¥ 102.3	¥ 110.5	¥ 139.1	5.1%
Accounting machines	¥ 1.5	¥ 0.7	¥ 0.7	¥ 0.9	(9.7%)

Source: EIAJ

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-53

1986 JAPANESE CAPITAL SPENDING REVISED DOWNWARD: THE GLOOM DEEPENS

SUMMARY

Continued market sluggishness is forcing Japanese semiconductor makers to reduce their capital spending. After peaking at ¥847 billion ($3.6 billion) in 1984, Japanese semiconductor makers' capital spending declined by 6.6 percent to ¥791 billion ($3.3 billion) in 1985. As shown in Table 1, Dataquest estimates that Japanese capital spending in 1986 will decrease by 50.9 percent in yen to ¥390 billion ($2.3 billion). We believe that there are several reasons for this decrease in spending:

- Sluggish exports due to the U.S.-Japan Semiconductor Agreement, which has established high foreign market values (FMVs) for commodity products
- Sharply reduced profits in 1986 and potential layoffs in 1987
- Excess capacity and declining domestic prices due to growing competition from new entrants
- The yen shock, which has raised production costs by more than 50 percent within the last year

Due to these severe conditions, Dataquest expects Japanese manufacturers to remain cautious in their capital spending for the foreseeable future. However, we observe three areas of increased activity in this otherwise dismal scenario. First, the U.S.-Japan Semiconductor Agreement is accelerating Japanese plans to build wafer fabs in the United States. Second, several companies such as Japan Semiconductor (LSI Logic KK), New Japan Radio, and Sony, have increased their capital spending since 1984. Third, overall R&D spending is increasing in absolute and relative terms.

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TOP MAKERS LOWER 1986 REVENUE FORECASTS

Lowered revenue forecasts are a major reason for the downward revision in Japanese capital spending. As shown in Table 2, the top six Japanese makers have lowered their 1986 revenue forecasts by an overall 8 percent. Hitachi (-12.8 percent), and Oki Electric (-18.2 percent) show the largest percentage declines.

CAPITAL SPENDING AMONG MAJOR VENDORS

Capital spending by the top nine Japanese semiconductor makers has dropped sharply since 1984. As shown in Table 3, their combined spending decreased by 9.4 percent (in yen) in 1985. Earlier this year, these nine companies had planned to lower their 1986 spending by 24.6 percent (in yen). Due to the market softness, they will lower their 1986 spending plans by 53.6 percent in yen (or 33.9 percent in dollars). Table 4 provides their capital spending in dollar values.

The declines in 1986 capital spending vary by company. Fujitsu (-58.3 percent), Hitachi (-65.2 percent), Matsushita (-69.0 percent), and NEC (-55.3 percent) show the greatest declines, while Mitsubishi (-48.4 percent), Toshiba (-47.2 percent), Sanyo (-34.0 percent), Sharp (-36.1 percent), and Oki Electric (-42.3 percent) plan slightly smaller decreases.

In absolute terms, Toshiba has the highest spending plan (¥65 billion/$389 million), followed closely by NEC (¥55 billion $329 million). Toshiba is focusing its investments on its Oita, Himeji, and Kita-Kyushu plants. Recently, Toshiba announced a 50/50 manufacturing joint venture with Motorola in Japan. In Roseville, California, NEC is boosting DRAM production to avoid high FMVs.

NEW MANUFACTURING PLANT ACTIVITIES

Despite the downturn, Japanese semiconductor makers are still adding new production capacity for 256K/1Mb DRAMs, ASICs, and MPUs. Their 1986 spending plans are large enough to finance at least one new plant each. Table 5 lists plant expansions, product changes, shutdowns, and delays recently announced by Japanese makers.

Given the U.S.-Japan Semiconductor Agreement, we believe that there is a strong possibility that Japanese companies will add new plant capacity overseas either through direct investment or mutual fab agreements with U.S. and European companies. The Fujitsu/Fairchild and Toshiba/Motorola joint ventures are harbingers of this trend toward fab capacity consolidation. Table 6 summarizes the current plant expansion activities of major Japanese semiconductor makers in the United States and Europe.

DATAQUEST CONCLUSIONS

The continuing market slump and the U.S.-Japan Semiconductor Agreement are forcing Japanese makers to lower their 1986 spending plans. However, major makers are still adding significant new capacity for 256K and 1Mb DRAMs, ASICs, and MPUs in Japan. With the growing U.S. request for Japanese market access, Dataquest believes that major Japanese makers will enter fab agreements with U.S. and European makers to utilize their excess fab capacity. The NMB Semiconductor/National, Seiko Epson/Lattice, Ricoh/Silicon Compilers, and Toshiba/Motorola agreements are recent examples of this trend toward Japanese foundry services. Morever, we expect that reduced Japanese spending plans will be focused on retrofitting existing plants and adding new fab capacity overseas, especially in Europe and the United States. Assembly and testing agreements with other Asian companies will also proliferate as Japanese makers seek to reduce their production costs.

Kaz Hayashi
Sheridan Tatsuno

Table 1

ESTIMATED JAPANESE CAPITAL SPENDING

Company	CY 1984 ¥B	CY 1984 $M	CY 1985 ¥B	CY 1985 $M	CY 1986 ¥B	CY 1986 $M
Fuji Electric	¥ 12	$ 51	¥ 12	51	¥ 9	$ 42
Fujitsu	115	489	72	304	30	180
Hitachi	120	511	92	388	32	192
Japan Semiconductor	0	0	0	0	10	60
Matsushita	88	374	87	367	27	162
Mitsubishi	65	277	62	262	32	192
NEC	129	549	123	519	55	329
New Japan Radio	4	17	5	21	6	36
NMB Semiconductor	14	60	14	59	3	18
Oki Electric	26	111	26	110	15	90
Rohm	6	26	9	38	6	36
Sanken	6	26	6	25	4	24
Sanyo	32	136	47	198	31	186
Sharp	26	111	36	152	23	138
Shindengen	2	9	1	4	2	12
Seiko Epson	18	77	8	34	5	29
Sony	14	60	36	152	20	120
Toshiba	136	579	123	519	65	389
Others	34	145	32	135	15	90
Total	¥847	$3,608	¥ 791	$3,338	¥390	$2,325
% Change	113%	126%	(6.6%)	(7.4%)	(50.9%)	(30.4%)

Source: Dataquest
December 1986

Table 2

ESTIMATED 1986 JAPANESE SEMICONDUCTOR REVENUES
(Billions of Yen)

Company	FY 1985 First Half Result	FY 1985 Plan	FY 1986 Revised	Percent Revision
Fujitsu	¥10.5	¥ 25.0	¥ 22.0	(12.0%)
Hitachi	18.5	43.0	37.5	(12.8%)
Mitsubishi	9.0	20.0	20.0	(0.07%)
NEC	23.0	52.0	47.0	(9.6%)
Oki	3.2	11.0	9.0	(18.2%)
Toshiba	20.5	43.5	43.5	0%
Total	¥84.7	¥194.5	¥179.0	(8.0%)
$ Millions	$507	$1,165	$1,072	(8.0%)

Table 3

CAPITAL SPENDING PLANS OF TOP 9 JAPANESE SEMICONDUCTOR MAKERS
(Billions of Yen)

Company	CY 1984	CY 1985	CY 1986 Plan	CY 1986 Revised
Fujitsu	¥115	¥ 72	¥ 58	¥ 30
Hitachi	120	92	65	32
Matsushita	88	87	58	27
Mitsubishi	65	62	40	32
NEC	129	123	102	55
Oki	26	26	22	15
Sanyo	32	47	42	31
Sharp	26	36	32	23
Toshiba	136	123	85	65
Subtotal	¥737	¥668	¥504	¥310
Others	109	125	101	78
Total	¥846	¥793	¥605	¥388

Source: Dataquest
December 1986

Table 4

CAPITAL SPENDING PLANS OF TOP 9 JAPANESE SEMICONDUCTOR MAKERS
(Millions of Dollars)

Company	CY 1984	CY 1985	CY 1986 Plan	CY 1986 Revised
Fujitsu	$ 489	$ 304	$ 347	$ 180
Hitachi	511	388	389	192
Matsushita	374	367	347	162
Mitsubishi	277	262	240	192
NEC	549	519	611	329
Oki	111	110	132	90
Sanyo	136	198	251	186
Sharp	111	152	192	138
Toshiba	579	519	509	389
Total	$3,137	$2,819	$3,018	$1,858
Exchange Rate	235	238	167	

Table 5

RECENT JAPANESE PLANT ACTIVITIES

Date	Company	Plant	Cost	Products
Q2/88	Hitachi	Irving, Texas	$100M*	256K DRAMs, ASICs
1987	Oki	Sendai, Miyagi	N/A	VLSI (1-micron)
2/87	Toshiba	Oita	¥50B ($316M)	LSIs
Q2/87	Toshiba	Kita-Kyushu	¥700M ($4.43M)	LSIs
Q3/87	Fujitsu	Gresham, Oregon	¥3-4B ($19-25M)	ASICs
11/86	Sharp	Fukuyama	¥38B ($245M)	256K DRAMs, CCDs
11/86	Toshiba/Moto	Sendai	¥35B ($219M)	DRAMs, SRAMs, MPUs
10/86	Fairchild Jpn	Nagasaki	¥25B ($161M)	MPUs, ASICs, SRAMs
10/86	Mitsubishi	Kochi	¥25B ($161M)	CMOS MCUs
10/86	NEC	Yamaguchi	N/A	Moving to 4-/8-bit MPU
9/86	Matsushita	Uozu, Fukui	¥25B ($161M)	1Mb DRAMs
7/86	Matsushita	China**	N/A	Linear IC

*Includes fab, assembly, and test
**Contract to export linear IC plant to Shangdong Province in China
N/A = Not Available

Source: Dataquest
December 1986

Table 6

JAPANESE OVERSEAS FAB ACTIVITIES

Company	United States	Europe
Fujitsu	Retrofit Fairchild plant for memories? Gresham, Oregon, ASICs plant on hold	
Hitachi	Irving, Texas, plant for 256K/1Mb/ASICs (Q1/88)	
Matsushita		
Mitsubishi	Considering wafer fab in Research Triangle, North Carolina, for ASICS	
NEC	Expanding Roseville DRAM/ASICs production	Scotland 256K DRAM fab (Q1/87) linked to Ireland plant
Oki	May seek joint venture	
Rohm/Exar	Recently acquired Exel fab	
Sanyo	Possible future joint fab with Vitelic or NMB Semiconductor?	
Sharp	RCA/Sharp venture ended; may open ASICs fab; possibly seeking U.S. partner	
Sony	Possible joint fab with AMD or Vitelic?	
Toshiba	1Mb DRAMs at Sunnyvale, California; fab (Q1/87). Currently seeking a U.S. fab site, probably not in Silicon Valley.	1Mb DRAM fab in West Germany (Q4/86)

Source: Dataquest
December 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-54

JAPAN'S EXPANDING SPACE PROGRAMS DEMAND HI-REL ICs

SUMMARY

Dataquest expects Japan to increase emphasis on high-reliability (hi-rel) GaAs and Si ICs in support of its expanding space programs. While Japan claims to have a zero military budget, it has massed tremendous capabilities in aerospace hardware in recent years, and has aggressive plans for the next decade. This bulletin details some of Japan's capabilities and plans in this area.

Japan's space activities include the following programs, which require mil range and, in many cases, radiation-hardened (rad-hard) ICs and discrete semiconductors:

- Three new expandable boosters: H-I, M-38-2, and H-II
- More than ten advanced satellites
- Space platforms
- A space shuttle
- Participation in a U.S. shuttle mission
- Participation in the U.S./international space station
- Moon and Venus probes

Japan's space activities represent an increasing threat to Western leadership in satellites, platforms, and shuttles. Dataquest believes that there will be increased international interest in Japan's satellite launch capability as a result of 1986's shuttle, Ariane, and other launch failures.

DISCUSSION AND ANALYSIS

Japan has two space agencies: NASDA (National Space Development Agency) and ISAS (Institute of Space and Astronautical Science). These agencies have been responsible for launching about one satellite per year since 1970. MITI (Ministry of International Trade and Industry) serves to create competitive pressures by funding specific payloads.

Japan's space agencies are developing more than 10 satellites and space probes, many designed for geosynchronous orbit (approximately 22,000 miles altitude). These satellites require state-of-the-art GaAs and Si ICs to accomplish the intended functions within launch payload constraints. In addition, rad-hard requirements are expected to impact the IC designs.

Thirteen Japanese companies are studying the MITI/ISAS platform concept for launch by the U.S. shuttle and Japan's H-II booster (developed by Mitsubishi). The H-II booster will support manned launches by 1995. A summary of Japan's spacecraft including launch dates, type of payload and other pertinent data is given in Table 1. These include four communications satellites and two meteorological satellites designed for geosynchronous orbit.

DATAQUEST CONCLUSIONS

Japan is developing a demand for low volumes of domestically produced hi-rel, rad-hard ICs. To achieve better economies of scale, the next logical step is to take these ICs to the international marketplace. Western suppliers of mil-range ICs may experience increased market pressure as a result of Japan's space efforts.

Japan's investment in its space efforts is resulting in far greater capacities in hi-rel semiconductors, satellite systems, and launch hardware than required to support the programs listed in Table 1. In view of recent Western launch failures, we believe that Japan will likely experience increasing difficulty in attempting to keep a low profile regarding its space programs.

Gene Miles

Table 1

JAPANESE SPACECRAFT

Launch Date	Type	Name	Company	Payload (Lbs.)	Orbit Height	Comments
8/1/86	EGP	Experimental Geodetic Payload	Kawasaki	1,500	900 miles	Laser target, first H-I payload
Mid-1987	ETS-5	Engineering Test Satellite #5	Mitsubishi	N/A	Geosync.	Mobile Satcom with ships, planes
1/87	MOS-1	Marine Observation Satellite	NEC	1,650	545 miles	Carrying CCDs and other multispectral detectors
Early 1988	CS-3A	Communications Satellite #3A	Mitsubishi	N/A	Geosync.	Third-generation, 6,000 voice channels plus K- and C-band transponders
Mid-1988	CS-3B	Communications Satellite #3B	Mitsubishi	N/A	Geosync.	Sister to CS-3A
Mid-1989	GMS-4	Geosync. Meteorological Sat.	NEC	N/A	Geosync.	Weather spacecraft; H-I launch vehicle
Mid-1989	GMS-5	Geosync. Meteorological Sat.	NEC	N/A	Geosync.	$185 million development cost; 3-axis stabilized; H-I launch vehicle
Mid-1990	BS-3A	Broadcast Satellite	NEC	N/A	Geosync.	Color TV--3 channels
Mid-1991	BS-3B	Broadcast Satellite	NEC	N/A	Geosync.	Sister to BS-3A
N/A	ERS-1	Earth Resources Satellite #1	NEC/Mitsubishi	3,000	N/A	Will carry synthetic aperture radar, visible and IR sensors
1/92	ETS-6	Engineering Test Satellite #6	Mitsubishi	N/A	N/A	First H-II payload
1994	N/A	Moon Probe	N/A	N/A	Inapplic.	H-II payload; seismic detection
Mid-1990s		Venus Probe	N/A	N/A	Inapplic.	H-II payload; magnetosphere probe

Geosync. = Geosynchronous orbit (approximately 22,700 miles above Earth's surface)
N/A = Not available at press time
Inapplic. = Inapplicable

Source: AZTEK Associates

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-49

JAPANESE SEMICONDUCTOR APPLICATION TRENDS SECOND QUARTER 1986

SUMMARY

Second-quarter 1986 electronic/electric equipment production in Japan was ¥3,963 billion ($23,312 million), down 4.1 percent from the same period in 1985, but up 0.6 percent from the first quarter of 1986.

Second-quarter 1986 semiconductor consumption was ¥511.9 billion ($3,011 million), an increase of 1.4 percent compared with the first quarter of 1986.

We have modified our forecast for Japanese electronic equipment production downward. We believe that production value in 1986 will decline from the 1985 result of ¥16.5 trillion to stand at ¥16.0 trillion in 1986.

We do not expect a large increase in equipment production in the second half of 1986 because of the high appreciation of the yen against the dollar (a 70 percent increase in the yen's value from 1985 to 1986).

THE MARKET

To forecast the 1986 market, we have followed the general export trends that affect equipment production in Japan. According to MITI data, the total export ratio (export/production) was down from 51.8 percent in the second half of 1985 to 43.3 percent in the first half of 1986. We have observed an apparent depression in which the export ratio of consumer electronics products has come down from an average of 75 percent in the second half of 1985 to an average of 60 percent in the first half of 1986, peaking at 86 percent in August 1986, just before the high yen appreciation trigger month. The export ratio trends are shown in Figure 1.

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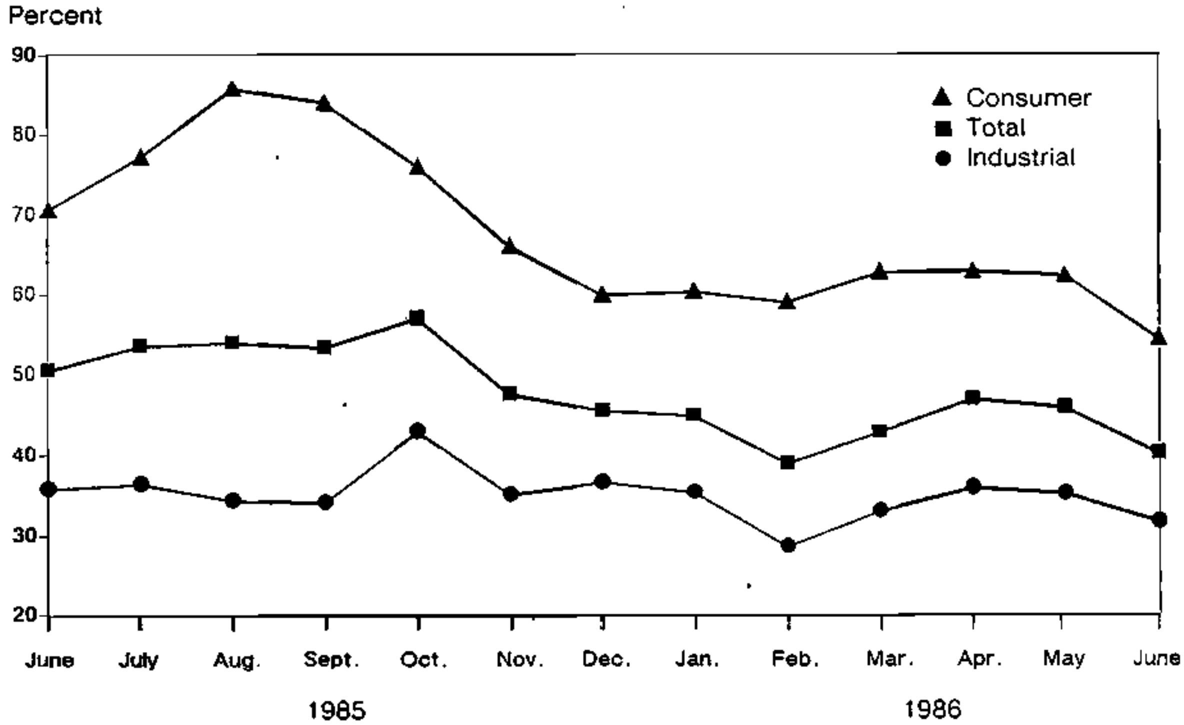
Figure 1

EXPORT RATIO TRENDS
JUNE 1985 TO JUNE 1986



Source: MITI
Dataquest
September 1986

Table 1 shows that second-quarter 1986 consumer electronics production was ¥1,961.7 billion ($11,539 million) and industrial electronics production was ¥2,001.4 billion ($11,773 million). Compared with the same period last year, consumer electronics production decreased 6.5 percent and industrial electronics production decreased 1.6 percent.

To facilitate comparison with the U.S. and European markets, the same data converted to dollars are shown in Table 2. Total Japanese electronics production is expected to be $96.6 billion in 1986, a 38.9 percent increase. We have shown the market value in dollars as a convenience, but all of this growth is due to appreciation of the yen.

Table 1

ESTIMATED QUARTERLY JAPANESE ELECTRONICS PRODUCTION
1985-1986
(Billions of Yen)

	1985				
	Q1	Q2	Q3	Q4	Year
Consumer	¥1,855.4	¥2,098.8	¥1,942.5	¥2,036.5	¥ 7,933.2
Industrial	2,076.6	2,033.3	2,213.7	2,240.1	8,563.7
Total	¥3,932.0	¥4,132.1	¥4,156.2	¥4,276.6	¥16,496.9

	1986				
	Q1	Q2	Q3	Q4	Year
Consumer	¥1,776.8	¥1,961.7	¥1,813.6	¥1,902.5	¥ 7,454.6
Industrial	2,161.3	2,001.4	2,178.7	2,212.5	8,553.9
Total	¥3,938.1	¥3,963.1	¥3,992.3	¥4,115.0	¥16,008.5

Table 2

ESTIMATED QUARTERLY JAPANESE ELECTRONICS PRODUCTION
1985-1986
(Millions of Dollars)

	1985				
	Q1	Q2	Q3	Q4	Year
Consumer	$ 7,219.5	$ 8,361.8	$ 7,993.8	$ 9,838.2	$33,413.2
Industrial	8,080.2	8,100.8	9,109.9	10,821.7	36,112.6
Total	$15,299.6	$16,462.5	$17,103.7	$20,659.9	$69,525.8
Exhange Rate	¥257.0	¥251.0	¥243.0	¥207.0	¥237.3

	1986				
	Q1	Q2	Q3	Q4	Year
Consumer	$ 9,451,1	$11,539.4	$11,700.6	$12,274.2	$44,965.3
Industrial	11,496.3	11,772.9	14,056.1	14,274.2	51,599.5
Total	$20,947.3	$23,312.4	$25,756.8	$26,548.4	$96,564.9
Exchange Rate	¥188.0	¥170.0	¥155.0	¥155.0	¥166.0

Source: Dataquest
October 1986

SEMICONDUCTOR CONSUMPTION

Table 3 shows estimated Japanese semiconductor consumption in the second quarter by application category. Total semiconductor consumption was ¥511.9 billion ($3,011 million). Semiconductor consumption in consumer products was ¥152.0 billion ($894 million), and industrial semiconductor consumption was ¥359.9 billion ($2,117 million).

Table 3

ESTIMATED SECOND-QUARTER 1986 SEMICONDUCTOR CONSUMPTION IN JAPAN BY APPLICATION CATEGORY (Billions of Yen)

	Q2/86	Share	Percent Change versus Q1/86
Total Semiconductor	¥511.9	100.0%	1.4%
Total Consumer	¥152.0	29.7%	7.5%
Video	¥ 77.9	15.2%	12.2%
Audio	¥ 42.2	8.2%	4.7%
Home Appliance/Other	¥ 31.9	6.2%	0.9%
Total Industrial	¥359.9	70.3%	(1.0%)
Computer	¥104.9	20.5%	(1.6%)
EDP	¥133.7	26.1%	6.5%
Communication	¥ 58.5	11.4%	(11.6%)
Industrial/Other	¥ 62.8	12.3%	(4.3%)

Note: Columns may not add to totals shown due to rounding.

Source: Dataquest
October 1986

Consumer Electronics

Among the consumer electronics products, large increases were found in VTRs and headphone stereos. Estimated semiconductor consumption in the second quarter was ¥50.8 billion ($299 million) for VTRs, up 15.1 percent, and ¥3.4 billion ($20 million) for headphone stereos, up 40.8 percent.

On the other hand, large decreases were observed in video cameras and digital audio disk players. We estimate that semiconductor consumption in video cameras and digital audio disk players was ¥11.4 billion ($67 million) and ¥9.6 billion ($56 million), respectively, decreases of 8.6 percent and 6.7 percent compared with the first quarter of 1986.

The main reason that video cameras recorded a slowdown was a very poor showing in May. The production value of video cameras was down to ¥27.7 billion ($163 million) that month, from ¥33.3 billion in January, ¥36.7 billion in February, ¥36.8 billion in March, and ¥36.9 billion in April.

Industrial Electronics

Semiconductor consumption in industrial electronics fell in the second quarter. A large decrease was found in copying machines with semiconductor consumption at ¥24.4 billion ($144 million), down 10.3 percent from the first quarter.

On the other hand, semiconductor consumption in word processors recorded high growth. This upswing is particularly worth noticing because both production values and units continued to rise gradually without any dip in the first half of 1986. Semiconductor consumption for word processors was ¥17.8 billion ($105 million), a big quarterly increase of 45.8 percent.

Nagayoshi Nakano

Dataquest
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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-50

KOREAN SEMICONDUCTOR COOPERATIVE RESEARCH PROJECT

INTRODUCTION

This report is the third in a series to supplement the Korean Semiconductor Industry Analysis, which was published in March 1986.

South Korea's emergence as an internationally competitive semiconductor component supplier introduces both a challenge and threatening situation.

As Korean companies complete the first phase of building their manufacturing lines, they are concerned about how to fill the huge capacity they have established. Current capacity is estimated at approximately 2.5 million wafer starts of 5-inch equivalent per year. Current utilization is estimated at 50 percent, with some companies reporting higher than average usage.

Initially, Korea has followed Japan's strategy, concentrating on the commodity memory products, such as 64K and 256K DRAMs. However, advanced product design know-how and the design engineering resources of the individual companies is limited. Therefore, we believe that production of products beyond 1Mb DRAM will be quite difficult. The Korean government recognized this problem and initiated a dialogue among Korean semiconductor companies as early as the summer of 1985 to form a cooperative effort to produce advanced memory products. This effort began to materialize in the spring of 1986 in the form of a formal cooperative project known as the Korean Semiconductor Cooperative Research Project (also known as the Korean VLSI Project).

THE KOREAN SEMICONDUCTOR COOPERATIVE RESEARCH PROJECT

The Project was formally launched on April 10, 1986, and its organization was announced immediately, as shown in Figure 1.

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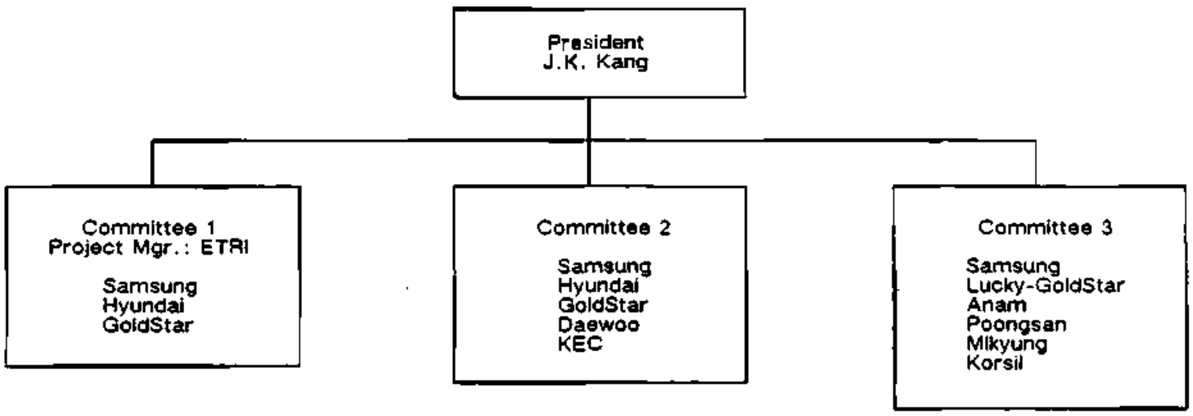
Figure 1

KOREAN VLSI PROJECT ORGANIZATION CHART



Source: Dataquest
October 1986

The presidency of the organization was assumed by Jin-Ku Kang, president of Samsung Semiconductor and Telecommunications Industries, Ltd.

Project Committees

As shown in Figure 1, the Project comprises three committees, each of which has specific assigned projects.

Committee 1

- Project Manager: Semiconductor Group, Electronics and Telecommunications Research Institute

- Participants: Samsung Semiconductor and Telecommunications, Hyundai Electronics Industries, GoldStar Semiconductor

- Objectives: Develop 4Mb DRAM by 1989 and begin manufacturing in 1990. To implement this project, the following tasks should be accomplished:

  - Product design capability

  - Process development of 0.8-micron critical dimension utilizing a totally dry etch process

  - Product test capability

Committee 2

- Project Manager: Not assigned

- Participants: Samsung Semiconductor and Telecommunications, Hyundai Electronics Industries, GoldStar Semiconductor, Daewoo Telecommunications (Semiconductor), Korea Electronics Co. (KEC)

- Objective: Nonmemory-related IC projects:

  - Advance consumer IC products by 1989

  - Establish IC design automation technology, such as simulator, layout software, standard cell library, by 1991

  - Establish 1-micron ASIC technology by 1991

  - Develop 32-bit and 64-bit microprocessors by 1991

  - Develop industrial ICs, such as smart power devices, by 1989

  - Develop ISDN ICs by 1991

Committee 3

- Project Manager: Not assigned

- Participants: Samsung Group, Lucky-GoldStar Group, Anam, Poongsan, Mikyung, Korsil

- Objective: Develop support industries

  - Establish ability to produce very high-purity silicon wafers by 1990

  - Produce compound semiconductors, GaAs, InP, and others by 1991

  - Produce chemicals, specialty gases by 1991

  - Qualify lead-frame material PMC 102 by 1988

  - Develop and manufacture bonding wire by 1989

  - Produce certain packaging equipment by 1989

PROJECT FUNDING

The Korean VLSI Project funding is to be shared equally by government and industry. However, the industry portion will be heavily subsidized by government-guaranteed, low interest loans. Table 1 shows the project funding allocated through 1988.

Table 1

KOREAN VLSI PROJECT FUNDING

	Year		Billions of Won	Millions of Dollars*
Committee 1	1986		W 16.3	$ 18.5
	1987		26.6	30.2
	1988		26.9	30.6
		Total	W 69.8	$ 79.3
Committee 2	1986		W 5.4	$ 6.1
	1987		5.6	6.4
	1988		6.3	7.2
		Total	W 17.3	$ 19.7
Committee 3	1986		W 3.4	$ 3.9
	1987		6.3	7.1
	1988		8.0	9.1
		Total	W 17.7	$ 20.1
		Total Project Fund	W104.8	$119.1

*Exchange rate W800/$

Source: Dataquest
October 1986

DATAQUEST CONCLUSIONS

The Korean government and the Korean semiconductor industry have embarked on a very ambitious project to bring the industry up to the level of competing industrialized countries. In our opinion, certain areas are overly ambitious while others are certainly achievable. We believe that the reported fundings for Committees 2 and 3 are not adequate, but since they are only revenue allocations through 1988, perhaps they may be increased further in the future. However, success will really depend on how closely all participating companies work together and how well the Project will be managed. The significant point is that the Project has started, and it has the strong support of the Korean government.

Gene Norrett
Dr. Mike Bae

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JAPANESE
RESEARCH
NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-51

SYMPOSIUM HIGHLIGHTS LATEST GaAs IC DEVELOPMENTS

SUMMARY

The 1986 IEEE-sponsored GaAs IC Symposium and associated activities served the emerging GaAs IC industry as an excellent forum for the interchange of R&D and manufacturing concepts and practices. A design workshop preceded the three days of meetings; a manufacturing conference (open only to citizens and permanent residents of the United States of America) followed the symposium. Fifty-five papers (selected from 126 submissions) and four panel sessions covered a broad range of topics: digICs, MMICs, materials, design, testing, manufacturing, and others. The United States was well represented, giving 41 papers (75 percent). Japan was represented by 9 papers (16 percent), followed by France (3 papers), the United Kingdom (2 papers), and Canada (1 paper). Speakers from West Germany and several other countries were notably absent, although GaAs R&D is progressing in those countries as well. Conference attendance exceeded 830 persons.

Some significant advances in GaAs ICs in 1986 were:

- Development of 4-inch NDF (near-defect-free) GaAs wafers
- Demonstration of 600ps 1Kx1 SRAMs
- ECL-compatible one gigasample/sec. 8-bit DAC with untrimmed nichrome resistors on-chip
- Operation of GaAs MMIC amplifier with 135mW output power at 41 GHz
- Successful multiple-sourcing of GaAs 12x12 multiplier chips
- Development of 88-pin LCC for 8-GHz operation in 50-Ohm system

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MATERIALS

The current status of IC-grade GaAs ingots (from which wafers are produced) was reviewed by R.N. Thomas of Westinghouse. Mitsubishi-Monsanto and others presented results on 3-inch and 4-inch NDF crystals grown using vertical-magnetic-field (VMF), indium-doped, LEC methodology. Crystal Specialties is promoting NDF HB (horizontal Bridgman) crystal growth and presented data in support of this approach.

Based on an informal survey of some of the attendees, Dataquest believes that approximately 70 Cambridge Instruments CI-352 pullers are now in use for growing GaAs crystals (approximately 10 in Europe and 30 each in the United States and Japan). The Seidensha LEC-801 is gaining popularity; both the CI-352 and the LEC-801 are useful for growing In-doped GaAs boules. Presently, carbon contamination appears to be the limiting factor in In-doped wafer quality. LEC-grown GaAs wafer production is now approximately 65 percent 3-inch and 30 percent 2-inch, with 4-inch wafer production expected to grow rapidly in the next two to three years as defect and contamination issues are resolved.

RAMS

Rockwell has developed a 1Kb SRAM, using HEMT structures (see Table 1). The device has 0.6ns access time at 25°C and 450mW power dissipation, opening new applications in memory hierarchies. Mitsubishi described the development of a 4Kb SRAM with 2.5ns t_{aa} and 200mW P_d using a power supply voltage of 0.7V; while the performance and power are impressive, the part is not ECL compatible. Honeywell and GigaBit presented data on their 1K SRAM efforts.

Although Ford, Fujitsu, Texas Instruments, and Vitesse did not present RAM papers, each of these companies has developed GaAs SRAMs; examples of their product efforts are included in Table 1 for comparison purposes. HEMT structures clearly allow superior performance and speed-power efficiency, two of the major factors that usually drive the commercial user to apply GaAs technology to systems.

Table 1

GaAs SRAMs

Company	Org.	T_{aa} max. (ns)	P_d max. (mW)	First Reported (Mo./Yr.)	Package	Comments
Rockwell	1Kx1	0.6	450	10/86	N/A	E/D HEMT
Rockwell	256x4	3	150	10/86	N/A	E/D MESFET, 110x110 sq. mil. die
GigaBit 12G014	256x4	2.3	2,500	4/85	40-pin LCC	D MESFET, I/O latches, ECL compatible
Mitsubishi	1Kx4	2.5	200	10/86	N/A	0.7V power supply
Ford 40G01	256x4	3	1,400*	1985	28-pin LCC	E/D, latched I/Os
Fujitsu	1Kx1	0.87	360	2/86	42-pin FP	1.6V supply, E/D HEMT, DCFL
Texas Instruments	1K	6	500	9/86	N/A	GaAs on Si substrate
Vitesse 12G474	1Kx4	3.5	TBD	9/86	LCC, FP	E/D, I/O latches

N/A = Not Available
TBD = To Be Determined
*Typical value

Source: AZTEK Associates

OTHER DIGICS

A one-day course on digIC device physics, process technology, and circuit design was held on Monday, October 27, 1986. Three conference sessions focused on digICs; these included 20 technical papers (36 percent of the total). Presenters of digIC papers included persons from these companies and organizations:

- AT&T
- Ford
- Gigabit Logic
- Honeywell (2)

- IBM
- ITT
- Matsushita
- Mayo Foundation
- McDonnell Douglas
- Mitsubishi
- NTT (3)
- Oki
- Plessey
- Rockwell (4)
- TriQuint
- TRW

Multiplexer/demultiplexer chips from Matsushita, NTT, Oki, and Rockwell/TriQuint, geared toward fiber-optic applications in the 1- to 3-GHz range, attracted much interest. A Honeywell/Mayo Foundation team has developed and multisourced a 6,000-gate array based on SDFL structures and has tested it to 160°C operating temperature. This chip contrasts with the largest ECL gate array to date, which has 8,000 gates and maximum operating temperature of 125°C. The 6,000-gate GaAs array has 176 I/O leads plus 40 power/ground leads, and it has been used to implement a single-chip 12x12 multiplier.

HBT (heterojunction bipolar transistor) structures offer very high performance potential in digital systems because of the very high cutoff frequency of HBTs (f_t to 456 GHz). Rockwell reported the first uncompensated-CML MSI circuits in HBT, including a 3-GHz 8-bit shift register. TRW (Internal R&D) and Plessey (ESPRIT Program project) also reported HBT results. Although progress has been made, the integration level of HBT is not yet sufficient to offer a speed advantage compared to silicon ECL LSI. Also, temperature compensation is needed to enhance usefulness of HBT ICs.

MMICs

Texas Instruments reported MMIC power amplifiers with output power of 200mW at 34 GHz and 135mW at 41 GHz. Hughes described a 1.3W output 7-15.5 GHz MMIC amplifier. ITT, Pacific Monolithics, LEP (Philips), and Raytheon authors described their work in other special-purpose MMICs. These chips allow users to further miniaturize communications and other equipment.

Fabrication

Ford Microelectronics detailed a self-aligned, low temperature E/D process that is employed in Ford's 561-cell 4-input NOR array, 1K SRAM, and other LSI chips. Ford's exhibit included a demonstration of a multiplier implemented with the 561-cell array chip. Matsushita described an all-implant MMIC process. Hughes has developed an E/D process using pure tungsten gates. Hewlett-Packard presented a method for improved control of threshold voltage, heretofore a significant limiting factor in GaAs IC development. Together, the papers represent a maturing of GaAs IC fabrication technology.

Packaging

Dataquest believes that the most significant breakthrough discussed in this area is the work reported by the Mayo Foundation in packages ranging in lead count from 24 to 240. Mayo efforts have resulted in 88 I/O lead chip carriers using copper/polymide structures with 50-Ohm properties at frequencies to 8 GHz (see Table 2). Jeff Frisco of Harris summarized GaAs packaging problems and challenges.

Table 2

GaAs IC CHIP CARRIERS--88 I/O LEADS

Vendor	Material	BW (GHz)	Line W/S (mils)	Thermal Imped. (°C/W)	Signal Environment	Proto-Type Price ($)
Interamics	Cofired alumina	3.0	4/6	0.3	Coated microstrip	$ 90.00
Brush/Wellman	Cofired beryllia	4.5	4/8	0.25	Stripline	$650.00
Augat/Microtec	Copper/polymide	8.0	4/5	0.3	Stripline	$ 65.00
Gen. Microwave	Thin film beryllia	N/A	3/3	0.25	Coated microstrip	$100.00

N/A = Not Available

Source: Mayo Foundation

Applications

Eugene Gregory of Hughes described the large-volume MMIC demand developing in the United States defense market, driven by radar, EW, and smart weapons. Corresponding demands are now placed on GaAS MMIC chip costs, which are presently 10 to 30 times greater than required for expendable hardware.

IBM reported the monolithic integration of a 3-GHz photodetector and preamp, using a process that is fully compatible with high-performance MESFETs. This approach is expected to pave the way to highly integrated photoreceivers, leading to lower-cost optical storage retrieval electronics, fiber-optic LANs receivers, and other developments. Other applications addressed by various speakers included image rejection frequency converters, mixers and dividers for communications, and DSP functions including the Honeywell/Mayo multiplier.

During informal discussions, the subject of systems implications of sub-ns GaAs devices was examined. Dataquest believes that SRAMs (such as the Rockwell 600ps device) will have a greater impact on system architecture than will other logic devices. Because of the ratio of speeds achievable in GaAs SRAMs and CMOS/NMOS DRAMs, it appears necessary for systems designers to consider multilevel caches--in many cases, for the first time. In a multilevel cache approach, the first-level GaAs cache RAM will probably be most efficient if placed on the processor package. The second-level cache technology is open to question; 5 to 10ns ECL or 15ns CMOS SRAM may be more appropriate than GaAs due to the number of chips and corresponding interconnect impedances involved. Location of second-level cache is critically dependent on relative timing of loaded devices as well as other factors.

GaAs INDUSTRY TRENDS

Many attendees are involved in bringing GaAs technology to bear on some of the electronics industry's most challenging problems. There is a growing concern that U.S. and European users of ICs are allowing their Japanese competitors to beat them to market with products that take advantage of this critical technology. Increasingly, the problem is no longer one of availability but one of acceptance; currently, products exist and capacity goes unused. The military arena, despite strong budget pressures, is pressing forward to take advantage of the unique properties of GaAs. However, if a broad range of customers' price demands are to be met, a strong commercial applications base must develop to provide adequate economies of scale, not unlike the "chicken and egg" scenario in the silicon world in 1969.

DATAQUEST CONCLUSIONS

GaAs ICs are here to stay. Suppliers are making great strides toward production of functions suitable for tommorrow's high-performance systems. Dataquest believes that the growing number of systems houses presently making judicious use of this technology will help create their own economic recovery despite overall market conditions. It's November 1986; do you know what your competitors are doing with GaAs technology?

Gene Miles

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-48

U.S.-JAPAN SEMICONDUCTOR TRADE UPDATE: SECOND QUARTER 1986

TRADE STATISTICS

Bilateral U.S.-Japan semiconductor trade continued an upward trend in the second quarter of 1986, with imports of U.S. semiconductors into Japan up 17.4 percent and exports of Japanese semiconductors to the United States up 2.5 percent, according to Japanese Ministry of Finance (MOF) figures.

Although there is no doubt that the rising yen was partially responsible for the increase in U.S. imports into Japan, import growth actually exceeded the growth in yen value by 6.8 percent. The yen grew 10.6 percent from the first quarter to the second quarter of 1986 (from $0.005319 per ¥1 to $0.005882 per ¥1), while U.S. imports into Japan grew 17.4 percent.

Japanese exports to the United States grew only 2.5 percent, considerably slower than the U.S. semiconductor market, which was up 14.4 percent. However, several Japanese firms announced plans early in the second quarter to shift distribution and production plans, in order to evade the dumping penalties on DRAMs and EPROMs that were imposed in late March 1986. A shift in assembly sites to Europe or other "third countries" for chips aimed at the U.S. market, combined with financial pressures of the high yen and dumping penalties, could account for the small second-quarter increase in exports.

MOS memory exports from Japan to the United States remained low as a percentage of total exports, accounting for 41 percent, down from 43 percent in first quarter 1986.

Bipolar digital IC imports from the United States to Japan, as a percentage of total imports, appeared to be up in both the first and second quarters of 1986. This category accounted for 33 percent of total imports in the second quarter, while it averaged only 18 percent of total imports during 1985.

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Table 1 shows quarterly exports of Japanese semiconductors to the United States. Imports of U.S. semiconductors into Japan are shown in Table 2. In both tables, total integrated circuit and discrete plus optoelectronic figures are from MOF; the integrated circuit split by product line is estimated from U.S. Department of Commerce (DOC) figures.

The United States continued to maintain a positive trade balance in bipolar digital logic and linear ICs, as shown in Table 3; however, the overall trade balance was negative $103 million in the second quarter of 1986. It must be pointed out that this represents a decrease from the first quarter in the U.S. semiconductor trade deficit with Japan. The total U.S.-Japan semiconductor trade picture is illustrated in Figure 1.

Tables 4 and 5 show quarter-to-quarter and year-to-year growth in semiconductor trade between the United States and Japan from the first quarter of 1984 through the second quarter of 1986.

DATAQUEST ANALYSIS

We are beginning to see major changes in the way Japanese companies conduct business in the United States. We believe that these changes are due to:

- The semiconductor "trade war" between Japan and the United States
- The preliminary dumping penalties levied beginning in the second quarter of 1986
- The upward spiral of the yen, which finally appears to be at rest
- The final signing of the U.S.-Japan Semiconductor Trade Arrangement, which requires Japanese companies to buy more U.S. chips, and also imposes "foreign market values" (FMVs), assigned on a company-by-company basis by the U.S. DOC, on Japanese-manufactured chips sold in foreign markets

Japanese companies are shifting production of end equipment to Asia to cut costs. Many Japanese companies are studying U.S. companies to determine which ones may be ripe for takeovers, as a way of establishing production bases in the United States, as well as acquiring U.S. technology. The purchase of 80 percent of Fairchild by Fujitsu is a case in point. If Fujitsu can shift production of EPROMs and 256K and above DRAMs to Fairchild, it can avoid FMVs and also save itself the expense of building a factory at its Gresham, Oregon, site.

We are now collecting data for our preliminary 1986 market share estimates. Early next year we will publish the annual results of actual sales in Japan by U.S. companies and in the United States by Japanese companies.

Patricia S. Cox

Table 1

QUARTERLY EXPORTS OF JAPANESE SEMICONDUCTORS TO THE UNITED STATES
(Millions of Dollars)

	1/84	2/84	3/84	4/84	Total 1984
Total Semiconductor	$315	$389	$428	$457	$1,589
Total Integrated Circuit	$284	$355	$393	$424	$1,456
Bipolar Digital	$ 29	$ 33	$ 32	$ 34	$ 128
Bipolar Digital Memory	$ 12	$ 15	$ 17	$ 17	$ 61
Bipolar Digital Logic	$ 17	$ 18	$ 15	$ 17	$ 67
MOS	$242	$306	$345	$369	$1,262
MOS Memory	$199	$244	$251	$273	$ 967
MOS Micro Devices	$ 16	$ 24	$ 27	$ 28	$ 95
MOS Logic	$ 27	$ 38	$ 67	$ 68	$ 200
Linear	$ 13	$ 16	$ 16	$ 21	$ 66
Total Discrete + Opto	$ 31	$ 34	$ 35	$ 33	$ 133
Exchange Rate (Yen per US$)	230.5	231.9	246.6	248.1	240.2

	1/85	2/85	3/85	4/85	Total 1985
Total Semiconductor	$311	$250	$199	$212	$ 972
Total Integrated Circuit	$286	$223	$170	$180	$ 859
Bipolar Digital	$ 25	$ 23	$ 21	$ 28	$ 97
Bipolar Digital Memory	$ 14	$ 13	$ 11	$ 16	$ 54
Bipolar Digital Logic	$ 11	$ 10	$ 10	$ 12	$ 43
MOS	$244	$185	$137	$136	$ 702
MOS Memory	$180	$103	$ 69	$ 84	$ 436
MOS Micro Devices	$ 22	$ 19	$ 12	$ 12	$ 65
MOS Logic	$ 42	$ 63	$ 56	$ 40	$ 201
Linear	$ 17	$ 15	$ 12	$ 16	$ 60
Total Discrete + Opto	$ 25	$ 27	$ 29	$ 32	$ 113
Exchange Rate (Yen per US$)	257.3	250.8	237.9	206.9	238.8

	1/86	2/86	YR/Date
Total Semiconductor	$239	$245	484
Total Integrated Circuit	$210	$214	
Bipolar Digital	$ 33	$ 38	
Bipolar Digital Memory	$ 20	$ 20	
Bipolar Digital Logic	$ 13	$ 18	
MOS	$163	$161	
MOS Memory	$103	$100	
MOS Micro Devices	$ 18	$ 19	
MOS Logic	$ 42	$ 42	
Linear	$ 14	$ 15	
Total Discrete + Opto	$ 29	$ 31	
Exchange Rate (Yen per US$)	188.1	169.4	

Source: Japanese MOF
U.S. DOC
Dataquest
November 1986

Table 2

QUARTERLY IMPORTS OF U.S. SEMICONDUCTORS INTO JAPAN
(Millions of Dollars)

	1/84	2/84	3/84	4/84	Total 1984
Total Semiconductor	$155	$173	$162	$154	$644
Total Integrated Circuit	$147	$163	$154	$145	$609
Bipolar Digital	$ 27	$ 32	$ 34	$ 34	$127
Bipolar Digital Memory	$ 9	$ 12	$ 13	$ 13	$ 47
Bipolar Digital Logic	$ 18	$ 20	$ 21	$ 21	$ 80
MOS	$ 56	$ 76	$ 63	$ 72	$267
MOS Memory	$ 20	$ 29	$ 28	$ 39	$116
MOS Micro Devices	$ 8	$ 12	$ 15	$ 18	$ 53
MOS Logic	$ 28	$ 35	$ 20	$ 15	$ 98
Linear	$ 64	$ 55	$ 57	$ 39	$215
Total Discrete + Opto	$ 8	$ 10	$ 8	$ 9	$ 35
Exchange Rate (Yen per US$)	230.5	231.9	246.6	248.1	240.2

	1/85	2/85	3/85	4/85	Total 1985
Total Semiconductor	$109	$119	$114	$117	$459
Total Integrated Circuit	$102	$111	$108	$109	$430
Bipolar Digital	$ 23	$ 19	$ 23	$ 19	$ 84
Bipolar Digital Memory	$ 9	$ 8	$ 12	$ 8	$ 37
Bipolar Digital Logic	$ 14	$ 11	$ 11	$ 11	$ 47
MOS	$ 52	$ 58	$ 51	$ 52	$213
MOS Memory	$ 21	$ 23	$ 22	$ 24	$ 90
MOS Micro Devices	$ 16	$ 19	$ 14	$ 15	$ 64
MOS Logic	$ 15	$ 16	$ 15	$ 13	$ 59
Linear	$ 27	$ 34	$ 34	$ 38	$133
Total Discrete + Opto	$ 7	$ 8	$ 6	$ 8	$ 29
Exchange Rate (Yen per US$)	257.3	250.8	237.9	206.9	238.8

	1/86	2/86
Total Semiconductor	$121	$142
Total Integrated Circuit	$114	$134
Bipolar Digital	$ 34	$ 47
Bipolar Digital Memory	$ 10	$ 14
Bipolar Digital Logic	$ 24	$ 33
MOS	$ 48	$ 48
MOS Memory	$ 18	$ 19
MOS Micro Devices	$ 14	$ 14
MOS Logic	$ 16	$ 15
Linear	$ 32	$ 39
Total Discrete + Opto	$ 7	$ 8
Exchange Rate (Yen per US$)	188.1	169.4

Source: Japanese MOF
U.S. DOC
Dataquest
November 1986

Table 3

QUARTERLY U.S. TRADE BALANCE WITH JAPAN
(Millions of Dollars)

	1/84	2/84	3/84	4/84	Total 1984
Total Semiconductor	($160)	($216)	($266)	($303)	($945)
Total Integrated Circuit	($137)	($192)	($239)	($279)	($847)
Bipolar Digital	($ 2)	($ 1)	$ 2	$ 0	($ 1)
Bipolar Digital Memory	($ 3)	($ 3)	($ 4)	($ 4)	($ 14)
Bipolar Digital Logic	$ 1	$ 2	$ 6	$ 4	$ 13
MOS	($186)	($230)	($282)	($297)	($995)
MOS Memory	($179)	($215)	($223)	($234)	($851)
MOS Micro Devices	($ 8)	($ 12)	($ 12)	($ 10)	($ 42)
MOS Logic	$ 1	($ 3)	($ 47)	($ 53)	($102)
Linear	$ 51	$ 39	$ 41	$ 18	$149
Total Discrete + Opto	($ 23)	($ 24)	($ 27)	($ 24)	($ 98)
Exchange Rate (Yen per US$)	230.5	231.9	246.6	248.1	240.2

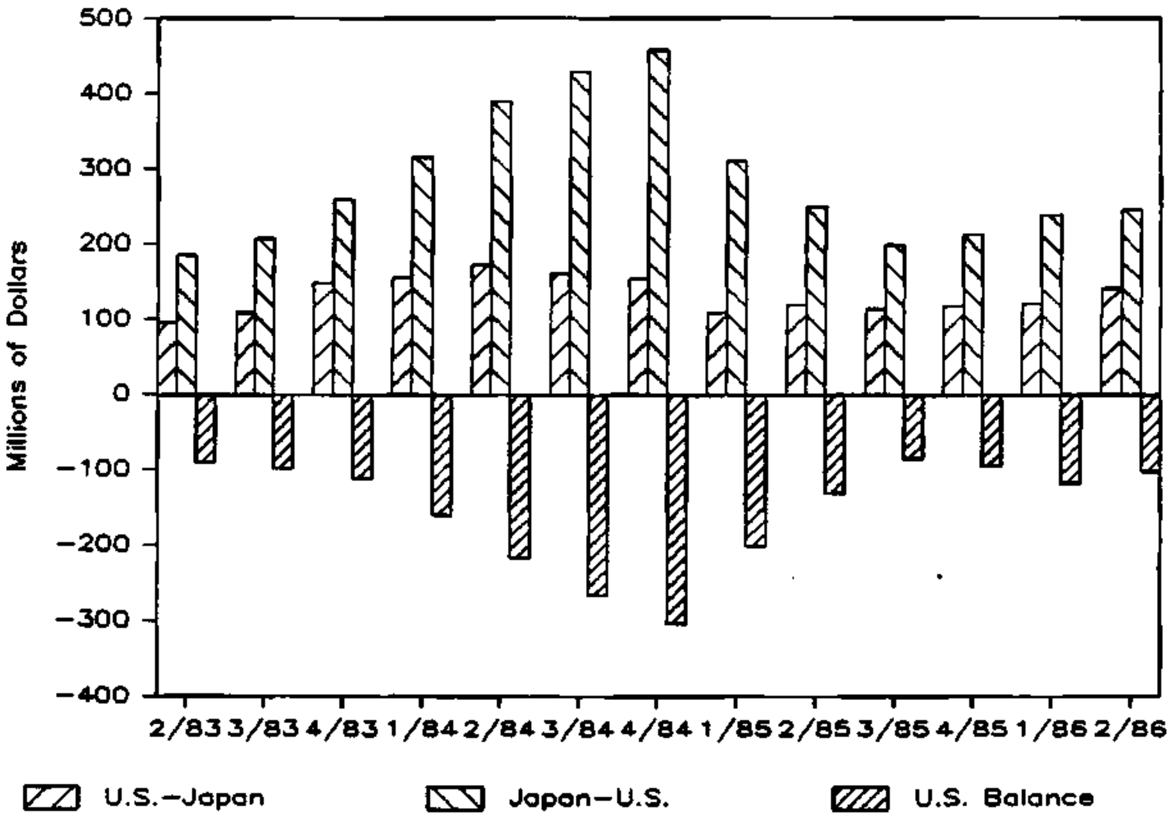
	1/85	2/85	3/85	4/85	Total 1985
Total Semiconductor	($202)	($131)	($ 85)	($ 95)	($513)
Total Integrated Circuit	($184)	($112)	($ 62)	($ 71)	($429)
Bipolar Digital	($ 2)	($ 4)	$ 2	($ 9)	($ 13)
Bipolar Digital Memory	($ 5)	($ 5)	$ 1	($ 8)	($ 17)
Bipolar Digital Logic	$ 3	$ 1	$ 1	($ 1)	$ 4
MOS	($192)	($127)	($ 86)	($ 84)	($489)
MOS Memory	($159)	($ 80)	($ 47)	($ 60)	($346)
MOS Micro Devices	($ 6)	$ 0	$ 2	$ 3	($ 1)
MOS Logic	($ 27)	($ 47)	($ 41)	($ 27)	($142)
Linear	$ 10	$ 19	$ 22	$ 22	$ 73
Total Discrete + Opto	($ 18)	($ 19)	($ 23)	($ 24)	($ 84)
Exchange Rate (Yen per US$)	257.3	250.8	237.9	206.9	238.8

	1/86	2/86	
Total Semiconductor	($118)	($103)	(121)
Total Integrated Circuit	($ 96)	($ 80)	
Bipolar Digital	$ 1	$ 9	
Bipolar Digital Memory	($ 10)	($ 6)	
Bipolar Digital Logic	$ 11	$ 15	
MOS	($115)	($113)	
MOS Memory	($ 85)	($ 81)	
MOS Micro Devices	($ 4)	($ 5)	
MOS Logic	($ 26)	($ 27)	
Linear	$ 18	$ 24	
Total Discrete + Opto	($ 22)	($ 23)	
Exchange Rate (Yen per US$)	188.1	169.4	

Source: Japanese MOF
U.S. DOC
Dataquest
November 1986

Figure 1

QUARTERLY U.S. SEMICONDUCTOR TRADE BALANCE WITH JAPAN



Source: Japanese MOF
Dataquest
November 1986

Table 4

PERCENT CHANGE QUARTER-TO-QUARTER
AND YEAR-TO-YEAR
QUARTERLY EXPORTS OF JAPANESE SEMICONDUCTORS TO THE UNITED STATES
(Millions of Dollars)

	1/84	2/84	3/84	4/84	Total 1984
Total Semiconductor	21.6%	23.5%	10.0%	6.8%	94.8%
Total Integrated Circuit	22.9%	25.0%	10.7%	7.9%	100.1%
Bipolar Digital	26.1%	13.8%	-3.0%	6.3%	60.0%
Bipolar Digital Memory	20.0%	25.0%	13.3%	0.0%	103.3%
Bipolar Digital Logic	30.8%	5.9%	-16.7%	13.3%	34.0%
MOS	22.2%	26.4%	12.7%	7.0%	104.9%
MOS Memory	25.9%	22.6%	2.9%	8.8%	90.7%
MOS Micro Devices	0.0%	50.0%	12.5%	3.7%	196.9%
MOS Logic	12.5%	40.7%	76.3%	1.5%	159.7%
Linear	29.3%	23.1%	0.0%	31.3%	109.4%
Total Discrete + Opto	10.7%	9.7%	2.9%	-5.7%	51.1%

	1/85	2/85	3/85	4/85	Total 1985
Total Semiconductor	-31.9%	-19.6%	-20.4%	6.5%	-38.8%
Total Integrated Circuit	-32.5%	-22.0%	-23.8%	5.9%	-41.0%
Bipolar Digital	-26.5%	-8.0%	-8.7%	33.3%	-24.2%
Bipolar Digital Memory	-17.6%	-7.1%	-15.4%	45.5%	-11.5%
Bipolar Digital Logic	-35.3%	-9.1%	0.0%	20.0%	-35.8%
MOS	-33.9%	-24.2%	-25.9%	-0.7%	-44.4%
MOS Memory	-34.1%	-42.8%	-33.0%	21.7%	-54.9%
MOS Micro Devices	-21.4%	-13.6%	-36.8%	0.0%	-31.6%
MOS Logic	-38.2%	50.0%	-11.1%	-28.6%	0.5%
Linear	-19.0%	-11.8%	-20.0%	33.3%	-9.1%
Total Discrete + Opto	-24.2%	8.0%	7.4%	10.3%	-15.0%

	1/86	2/86
Total Semiconductor	12.7%	2.5%
Total Integrated Circuit	16.7%	1.9%
Bipolar Digital	17.9%	15.2%
Bipolar Digital Memory	25.0%	0.0%
Bipolar Digital Logic	8.3%	38.5%
MOS	19.9%	-1.2%
MOS Memory	22.6%	-2.9%
MOS Micro Devices	50.0%	5.6%
MOS Logic	5.0%	0.0%
Linear	-12.5%	7.1%
Total Discrete + Opto	-9.4%	6.9%

Source: Japanese MOF
U.S. DOC
Dataquest
November 1986

Table 5

PERCENT CHANGE QUARTER-TO-QUARTER
AND YEAR-TO-YEAR
QUARTERLY IMPORTS OF U.S. SEMICONDUCTORS INTO JAPAN

	1/84	2/84	3/84	4/84	Total 1984
Total Semiconductor	4.7%	11.6%	-6.4%	-4.9%	46.7%
Total Integrated Circuit	5.0%	10.9%	-5.5%	-5.8%	48.2%
Bipolar Digital	-18.2%	18.5%	6.3%	0.0%	54.9%
Bipolar Digital Memory	50.0%	33.3%	8.3%	0.0%	80.8%
Bipolar Digital Logic	-33.3%	11.1%	5.0%	0.0%	42.9%
MOS	1.8%	35.7%	-17.1%	14.3%	25.4%
MOS Memory	-4.8%	45.0%	-3.4%	39.3%	43.2%
MOS Micro Devices	-27.3%	50.0%	25.0%	20.0%	20.5%
MOS Logic	21.7%	25.0%	-42.9%	-25.0%	11.4%
Linear	23.1%	-14.1%	3.6%	-31.6%	85.3%
Total Discrete + Opto	0.0%	25.0%	-20.0%	12.5%	25.0%

	1/85	2/85	3/85	4/85	Total 1985
Total Semiconductor	-29.2%	9.2%	-4.2%	2.6%	-28.7%
Total Integrated Circuit	-29.7%	8.8%	-2.7%	0.9%	-29.4%
Bipolar Digital	-32.4%	-17.4%	21.1%	-17.4%	-33.9%
Bipolar Digital Memory	-30.8%	-11.1%	50.0%	-33.3%	-21.3%
Bipolar Digital Logic	-33.3%	-21.4%	0.0%	0.0%	-41.3%
MOS	-27.8%	11.5%	-12.1%	2.0%	-20.2%
MOS Memory	-46.2%	9.5%	-4.3%	9.1%	-22.4%
MOS Micro Devices	-11.1%	18.8%	-26.3%	7.1%	20.8%
MOS Logic	0.0%	6.7%	-6.3%	-13.3%	-39.8%
Linear	-30.8%	25.9%	0.0%	11.8%	-38.1%
Total Discrete + Opto	-22.2%	14.3%	-25.0%	33.3%	-17.1%

	1/86	2/86
Total Semiconductor	3.4%	17.4%
Total Integrated Circuit	4.6%	17.5%
Bipolar Digital	78.9%	38.2%
Bipolar Digital Memory	25.0%	40.0%
Bipolar Digital Logic	118.2%	37.5%
MOS	-7.7%	0.0%
MOS Memory	-25.0%	5.6%
MOS Micro Devices	-6.7%	0.0%
MOS Logic	23.1%	-6.3%
Linear	-15.8%	21.9%
Total Discrete + Opto	-12.5%	14.3%

Source: Japanese MOF
U.S. DOC
Dataquest
November 1986

Dataquest
a company of The Dun & Bradstreet Corporation

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-47

SIGNIFICANT PRODUCT ANNOUNCEMENTS--GaAs ICs

Product development activity is accelerating in the GaAs industry. Important announcements have been made by several GaAs houses in recent months; this newsletter examines the most significant recent product introductions.

BIT SLICES--THE RACE IS ON

Vitesse introduced the first commercially available LSI GaAs digital IC set, an ECL 100K compatible 4-bit slice family, on September 10, 1986, at Midcon. The product family consists of the VE29G01 4-Bit Microprocessor Slice, the VE29G02 Look-Ahead Carry Generator, and the VE29G10 Microcontroller. Engineering samples of the VE29G02 are available now, and engineering samples of the VE29G01 and VE29G10 are expected by February 1987. Earlier, McDonnell-Douglas released details on a 2901-type GaAs bit slice; however, McDonnell-Douglas is not a merchant market supplier of the device. Vitesse's product family is supported by a 3.5ns cycle 1024x4 registered static RAM, the VE12G474.

The VE29GXX family is expected to permit customers to achieve a factor of 3x speed improvement over a CPU implementation using the AMD2901C, a bipolar device. Interestingly, Vitesse has employed LCC packaging to preserve the device speed advantage at the system level as much as practical. Very aggressive forward pricing is available from Vitesse, allowing the user to project systems costs through 1990. So far, more than 1,000 customers have expressed interest in this product set. Dataquest expects a wide range of applications to make use of this technology, including minisupercomputers, "smart" high-speed instrumentation, DSPs and other military functions, arithmetic/logic accelerators, and high-speed graphics equipment.

STATIC RAMs

For several months, 1K SRAMs have been offered for beta site evaluation by GigaBit, Ford Microelectronics, and others. GigaBit just received a $500 thousand, two-year U.S.A.F. contract to perform Class 8 screening, reliability evaluation, and radiation hardness evaluation on its 1K SRAM.

Vitesse's VE12G474 is the first commercially available 4K GaAs SRAM. Other announcements are expected this month, including devices from Honeywell, Rockwell, and GAIN. Several Japanese companies have been working on SRAMs for at least three years; these products appear targeted first for internal needs before being taken to merchant market. GaAs SRAMs feature cycle times in the 0.6 to 3.5ns range at 1K and 4K densities, compared to the 5 to 7ns range for the fastest commercially available silicon ECL RAMs (see Table 1).

CUSTOM DESIGN

GAIN Electronics Corporation has announced a custom design service based initially on E/D MESFET technology and followed by SDHT (selectively doped heterostructure transistor), otherwise known as HEMT (high electron mobility transistor), technology. SDHT, invented by Dr. Raymond Dingle (GAIN's president), offers the highest-performance commercially available GaAs circuitry. Typical transistor cutoff frequency is 80 GHz, versus 50 and 15 GHz, respectively, for GaAs FETs and Si bipolar transistors. GAIN will also offer a full line of device and design capabilities, and an epitaxial GaAs/ALGaAs wafer.

GigaBit Logic (GBL) has announced a standard cell library of D-MESFET logic blocks featuring 1μ geometries and 100 to 200ps gate delays at 1 to 2mW per gate. The initial family includes 13 macrocells, with 17 additional macros including a 4-bit adder planned for 1987. GigaBit charges $10,000 for its cell library diskette and user manual, refundable against the cost of the first development program.

MMICs

Dataquest believes that the most significant announcement in GaAs MMIC (microwave monolithic IC) technology in recent months is the introduction of a GaAs linear/analog macrocell library by Pacific Monolithics. The library consists of more than 25 macrocells fabricated and tested prior to July 1986, with another 20 macros in development. The cells cover the 0.5 to 18 GHz frequency range and include amplifiers, switches, combiners, splitters, attenuators, and VCOs (see Table 2).

Pacific Monolithics' macrocell library offers its users two major advantages. First, the design lead time, which ranges from 1 to 2-1/2 years for a custom MMIC, can be reduced by a factor of 2 to 5 using standard cells. Second, development cost is dramatically reduced, by a factor of 3 to 8 for a typical MMIC design. Dataquest believes that Pacific Monolithic's library availability at this device performance level may radically alter the approach to electronic warfare systems design. Furthermore, the approach may have a major impact on the entire present microwave industry structure, which includes hybrid houses, silicon device suppliers, third-party designers and other relatively expensive, time-consuming factors.

GATE ARRAYS

Honeywell, TriQuint, Texas Instruments, and others are developing gate arrays using GaAs technology. Honeywell recently withdrew its 2K gate array and is reportedly developing a standard cell alternative. Suppliers are polarizing into two camps regarding GaAs ASICs. One group is pursuing gate arrays of 400 to more than 5,000 gate density. The second group is proceeding on the basis that a standard cell solution will offer the best performance/cost trade-off to the user. Dataquest believes that sufficient applications exist to support both approaches, and expects additional announcements in this area in the coming months.

DATAQUEST CONCLUSIONS

The pace of GaAs product activity is quickening, spurred by major capital investments in 1984 and 1985 and by a soft electronics market in 1985 and 1986. Users have a growing variety of GaAs design options available, supported by an expanding infrastructure of suppliers. Dataquest believes that performance-oriented applications will gravitate at an accelerating rate toward the use of GaAs in critical hardware paths. Significant commercial systems house announcements based on the use of GaAs components are expected, starting in 1987.

Gene Miles

Table 1

GaAs RAM PRODUCTS

Part Number (Company)	Organization	Taa Maximum (ns)	Pd Maximum (mW)	100-Piece Price	Intro. Date	Package	Comments
40G01 (Ford)	256 x 4	3.0	1,400*	TBA	TBA	28-pin LCC	E/D MESFET, I/O latches
12G014 (GBL)	256 x 4	3.0	2,000	N/A	1Q87	40-pin LCC	D MESFET, I/O latches
12G474 (Vitesse)	1K x 4	3.5	N/A	$595	9/86	LCC, FP	E/D MESFET, I/O latches
Rockwell	1K	0.6	N/A	N/A	TBA	N/A	E/D HEMT
Honeywell	256 x 4	3.0	150	N/A	TBA	N/A	E/D MESFET, 110 x 110 sq. mil die
Texas Instruments	1K	6.0	500	N/A	N/A	N/A	GaAs on silicon substrate

*Typical Value
TBA = To Be Announced
N/A = Not Available

Source: AZTEK Associates

Table 2

PACIFIC MONOLITHICS CELL LIBRARY

Existing

Function	Frequency (GHz)
Amplifier Gain Blocks:	
10dB	2 to 6
15dB	0.1 to 2
15dB	1 to 3
AGC amp, 10dB	2 to 6
Oscillators (VCOs, DROs):	
Neg. resistance	1 to 3
Neg. resistance	3 to 6
Double-Balanced Mixers:	
Diode Mixer	1 to 3
Diode Mixer	3 to 6
Diode Mixer	6 to 8
Attenuator	DC-12
FET SPDT switch	DC-12
Low-Noise Amplifiers	
FET LNA, 16dB	3.7 to 4.2
FET LNA, 13bB	4.4 to 5.0
FET LNA, 16dB	1.2 to 1.6
Power Amplifier, 12dB	3 to 7
Biphase Modulator	5 to 10
QPSK Modulator	5 to 10
Power Splitter/Combiner	5 to 10
90^{o} Hybrid	3.5 to 4.5
Active Isolator	0.1 to 10
Balun	1 to 3
Balun	2 to 6
Balun	5 to 8

In Development

Function	Frequency (GHz)
Amplifiers:	
SS amp, 10dB	6 to 18
SS amp, 10dB	6 to 12
LNA, 12dB	11 to 14
Power amp, 10dB	6 to 18
Power amp, 10dB	6 to 12
AGC amp, 10dB	6 to 18
Mixers:	
Balanced-Diode	6 to 10
Balanced-Diode	10 to 18
Dual-Gate	2 to 6
High-Dynamic Range	6 to 10
Oscillators:	
Neg. resistance	6 to 12
Neg. resistance	12-18
Subsystems:	
Freq. Downconv.	10 to 14
Freq. Downconv.	6 to 17
Freq. Synthesizers	DC-5
Digital ICs:	
Dividers	6
Flip-Flops/Latches	1.5
Other Building Blocks:	
Balun	6 to 12
Balun	6 to 18
Attenuator	6 to 18
Limiting Amplifiers	2 to 6
Vector modulator	5 to 10
Subsystems:	
Freq. Downconv.	1 to 3
Freq. Downconv.	3 to 6
Freq. Downconv.	5 to 8
Image-Rej. Dnconv.	3.7 to 4.2

Source: Pacific Monolithics

Dataquest

Conference Schedule

1986

Semiconductor	October 20-22	Hotel Inter-Continental San Diego, California
Technical Computer	November 3-5	Silverado Country Club Napa, California
Asian Peripherals	November 5-7	Hotel Okura Tokyo, Japan
Semiconductor Users/ Semiconductor Application Markets	November 10	Sheraton Harbor Island San Diego, California
Electronic Publishing	November 17-18	Westin Copley Place Boston, Massachusetts
CAD/CAM EDA	December 4-5	Santa Clara Marriott Santa Clara, California

1987

Semiconductor Users/ Semiconductor Application Markets	February 4-6	Saddlebrook Resort Tampa, Florida
Copying and Duplicating	February 23-25	San Diego Hilton Resort San Diego, California
Electronic Printer	March 23-25	Silverado Country Club Napa, California
Japanese Semiconductor	April 13-14	The Miyako Kyoto, Japan
Telecommunications	April 13-15	Silverado Country Club Napa, California
CAD/CAM	May 14-15	Hyatt Regency Monterey Monterey, California
Display Terminals	May 20-22	San Diego Hilton Resort San Diego, California
European Semiconductor	June 4-5	Palace Hotel Madrid, Spain
European Copying and Duplicating	June 25-26	The Ritz Hotel Lisbon, Portugal
Financial Services	August 17-18	Silverado Country Club Napa, California
Western European Printer	September 9-11	Palace Hotel Madrid, Spain
European Telecommunications	October 1-2	Monte Carlo, Monaco
Semiconductor	October 19-21	The Pointe Resort Phoenix, Arizona
Office Equipment Dealers	November 5-6	Hyatt Regency Monterey, California
Electronic Publishing	November 16-17	Stouffer Hotel Bedford, Massachusetts
CAD/CAM EDA	December 10-11	Santa Clara Marriott Santa Clara, California

Dataquest

Product Offerings

Industry Services

Business Computer Systems
CAD/CAM
Computer Storage—Rigid Disks
Computer Storage—Flexible Disks
Computer Storage—Tape Drives
Copying and Duplicating
Display Terminal
Electronic Printer
Electronic Publishing
Electronic Typewriter
Electronic Whiteboard
European Semiconductor*
European Telecommunications
Gallium Arsenide
Graphics
Imaging Supplies
Japanese Semiconductor*
Office Systems
Personal Computer
Personal Computer—Worldwide Shipments and Forecasts
Robotics
Semiconductor*
Semiconductor Application Markets*
Semiconductor Equipment and Materials*
Semiconductor User Information*
Software—Artificial Intelligence
Software—Personal Computer
Software—UNIX
Technical Computer Systems
Technical Computer Systems—Minisupercomputers
Telecommunications
Western European Printer

Executive and Financial Programs

Corporate Alliance Program
Coporate Technology Program
Financial Services Program
Strategic Executive Service

Newsletters

European PC Monitor
First Copy
Home Row
I.C. ASIA
I.C. USA

Focus Reports

The European PC Market 1985-1992
European PC Retail Pricing
PC Distribution in Europe
PC Software Markets in Europe
PC Local Area Networking Markets in Europe
The Education Market for PCs in Europe
Japanese Corporations in the European PC Markets
Home Markets for PCs in Europe
Integrated Office Systems—The Market and Its Requirements
European Market for Text Processing
Image Processing in the Office
Work Group Computing
Translation Systems
Vendor Support
The IBM 3270 Market: 1986 and Beyond
Korean Semiconductor Industry Analysis
Diskettes—The Market and Its Requirements

Directory Products

I.C. Start-Ups—1987
SpecCheck—Competitive Copier Guide
SpecCheck—Competitive Electronic Typewriter Guide
SpecCheck—Competitive Whiteboard Guide
Who's Who in CAD/CAM 1986

Future Products

- Industry Services
  Manufacturing Automation
  Computer Storage—Optical
  Computer Storage—Subsystems
- Focus Reports
  Japanese Printer Strategy
  Japanese Telecommunications Strategy
  Canon CX Laser—User Survey
  Digital Signal Processing
  PC-based Publishing
  Taiwan Semiconductor Industry Analysis
  China Semiconductor Industry Analysis
  PC Distribution Channels
- Directory Products
  SpecCheck—Competitive Facsimile Guide
  SpecCheck—Competitive Electronic Printer Guide

*On-line delivery option available

For further information about these products, please contact your Dataquest sales representative or the Direct Marketing Group at (408) 971-9661.

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RESEARCH BULLETIN

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Rev. 11/19/86

THE SUPERALLIANCE: FUJITSU BUYS 80 PERCENT OF FAIRCHILD

SUMMARY

In a dramatic gesture, Fairchild/Schlumberger announced on October 23 that Fujitsu Limited will make a major equity investment in Fairchild. Under the agreement, Fujitsu will own approximately 80 percent and Schlumberger 20 percent of the new international company. Donald W. Brooks will remain president and CEO of the expanded Fairchild. We believe that the board of directors will consist of Fujitsu Semiconductor's Sadao Inoue, Donald Brooks, and several other Fujitsu and Schlumberger representatives. Consummation of the agreement awaits government approval.

A GLOBAL STRATEGY FOR THE 1990s

We believe that Fujitsu's investment in Fairchild is a strategic move to create a global company that will be a dominant player in the 1990s. By joining forces, Fujitsu (number 7 in 1985) and Fairchild (number 13) jump to fifth place in 1985 worldwide semiconductor ranking, as shown in Table 1. Moreover, the new Fairchild/Fujitsu company will be the largest supplier of emitter-coupled logic (ECL) devices, with $208 million in combined ECL sales in 1985 or 30.6 percent of worldwide market share. This ECL tie-up will strengthen Fujitsu, which currently sells its supercomputers through Amdahl, in the emerging supercomputer race with Cray, Control Data, Digital Equipment, Hitachi, IBM, and NEC.

CREATING SYNERGY BETWEEN COMPLEMENTARY TEAMS

The new company will benefit by combining the complementary product lines of both companies, as shown in Table 2. Fairchild is strong in bipolar devices (especially TTL and ECL), linear, military electronics, MPUs (32-bit Clipper) and smart power. Fujitsu offers TTL, ECL, linear, NMOS and CMOS memories, MPUs, ASICs (world leader in standard cells), standard logic, and Advantest (Takeda Riken) testers.

The arrangement will enable Fujitsu to sell its products worldwide under the Fairchild label and will allow Fairchild to enter the Japanese market through Fujitsu. Fairchild has a large customer base and an extensive distribution network in the United States, which will bolster U.S. sales of Fujitsu devices. Fairchild's main attraction is its U.S. plants, which will enable Fujitsu to circumvent the U.S.-Japan semiconductor agreement by producing memories in the United States at Fairchild's plants. The recent U.S.-Japan semiconductor agreement seriously hurt Fujitsu's MOS memory sales by forcing it to sell DRAMs and EPROMs at high fair market values (FMVs).

THE STRATEGIC IMPLICATIONS

Although many observers fear that Fairchild is giving away its technology to Fujitsu, we believe that this agreement not only enables Fairchild to stay in the game, but will enable both companies to become major global players in the 1990s by pooling their resources. Moreover, the U.S. Department of Defense will have access to Fujitsu's semiconductor and supercomputer technology through its procurement of Fairchild parts. The Japanese government recently agreed in principle to participate in the Strategic Defense Initiative (SDI). These agreements are the first in a series of closer U.S.-Japan commercial and military ties.

Sheridan Tatsuno

Table 1

1985 WORLDWIDE RANKING OF SEMICONDUCTOR MAKERS
(Millions of Dollars)

Rank	Company	1985 Revenue
1	NEC	$1,984
2	Motorola	$1,830
3	Texas Instruments	$1,767
4	Hitachi	$1,671
(5)	Fujitsu/Fairchild	$1,512
5	Toshiba	$1,468
6	Philips/Signetics	$1,068
7/8	Fujitsu	$1,020
7/8	Intel	$1,020
9	National	$ 943
10	Matsushita	$ 906

Source: Dataquest
October 1986

Table 2

FAIRCHILD AND FUJITSU SEMICONDUCTOR REVENUE IN 1985
(Millions of Dollars)

Category	Fairchild	Fujitsu	Both	WW Share
Semiconductors	$492	$1,020	$1,512	6.2%
Integrated Circuits	451	940	1,391	7.5%
Bipolar Digital	329	267	596	15.9%
TTL	257	111	368	11.9%
ECL	68	140	208	30.6%
Other	4	16	20	12.7%
MOS	22	631	653	6.5%
Memory	4	412	416	10.8%
Micro Devices	10	106	116	4.3%
Logic	8	113	121	3.4%
Linear	100	42	142	3.0%
Discrete	39	37	76	1.6%
Optoelectronics	2	43	45	3.7%

Source: Dataquest
October 1986

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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-45

**FALLOUT FROM THE U.S.-JAPAN CHIP AGREEMENT:
JAPAN'S SHIFT TO INNOVATIVE PRODUCTS**

The recently signed U.S.-Japan Semiconductor Agreement has seriously impacted Japanese semiconductor makers and the worldwide memory market. Coming in the midst of a serious industry downturn and a 50 percent appreciation in the value of the yen, this agreement is forcing Japanese memory makers to rethink their corporate strategies. With the entry of South Korean and other Asian companies, Dataquest observes that Japanese chip makers are faced with a series of difficult challenges:

- Reducing their operating costs
- Eliminating excess fab capacity to lower the fair market values (FMVs) of their DRAMs and EPROMs
- Diversifying product portfolios
- Building closer vendor-user ties
- Buying more semiconductors from U.S. and European vendors
- Developing innovative products and pursuing more creative research

We expect the "yen shock" to cause a massive restructuring of the Japanese economy during the next three to four years. Already, Japanese companies are shifting much of their commodity-oriented manufacturing to Southeast Asia and moving up the technology ladder to higher value-added products. Many Japanese companies have developed 5-year recovery plans.

The chip agreement will accelerate this shift to more innovative products. Initially, several Japanese vendors will be forced to abandon commodity memory markets and compete with U.S., European, and start-up companies in specialized memory markets and other non-commodity areas. Japanese companies are already diversifying into application-specific ICs (ASICs) and specialized microprocessors. Dataquest expects numerous changes in the structure of the Japanese semiconductor industry over time, as shown in Table 1.

Dataquest observes that the industry's center of gravity is quickly shifting to the Pacific Rim, which will account for 51 percent of worldwide semiconductor consumption in 1987. As this global shift occurs, it will be crucial for semiconductor companies to establish a strong marketing and R&D presence in Asia in order to maintain their global competitiveness.

Sheridan Tatsuno

Table 1

EXPECTED JAPANESE RESPONSES TO THE U.S.-JAPAN SEMICONDUCTOR AGREEMENT

	Short-Term (1-2 years)	Long-Term (5 years)
Pricing	Sharp FMV rise in Q3/1986, declining in Q4/1986	FMV pricing inversely related to capacity utilization
	Lower prices in Japanese domestic market	Possible worldwide multitier pricing structure
OEM Activity	Vendor/OEM deals with rebates to lower FMVs	Boardstuffing in Japan and more Asian production to remain price competitive
	Opening of procurement offices in Tokyo and Seoul	More U.S. captive fabs and alliances with start-ups
Assembly & Testing	Rapid Japanese shift to Asia to cut costs	Massive shift of Japanese assembly and testing to Asia in all industries
Fab Capacity	Japanese vendors offer foundry capacity to increase plant utilization and reduce FMVs Older lines phased out and sold to emerging Asian countries	More U.S. and European fabs More fab agreements and joint ventures Modular fabs ($20-$50 million) with flexible manufacturing systems
New Products	Japanese diversification into ASICs, MPUs, optoelectronics, etc. Emphasis on innovative new products (e.g., video memories)	Broadly diversified portfolio of high-value-added products More ASIC design centers overseas
Basic R&D	More R&D spending and basic R&D labs Accelerate national R&D projects and initiate new projects (e.g., synchrotron orbital radiation)	Push into highly focused creative research (AI parallel processors, biochips, specialized compilers, specialized MPUs, etc.) Hire more foreign researchers and open overseas R&D labs Develop ties to foreign university R&D centers

Source: Dataquest
October 1986

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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-44

NATIONAL CAPTIVATES ITS REPS

In a dramatic move on Monday, October 13, 1986, National Semiconductor made an offer to purchase its entire force of 150 to 200 U.S. sales representatives. Dataquest believes that this is an excellent move on the part of National and that it is also significant to the industry at large.

Currently, National's U.S. sales are almost exclusively through reps, while its European and Asian sales are handled by company employees. National is well along in its transition from a "jellybean" house to a firm with a broad line of proprietary products. Currently, more than 75 percent of National's new products are proprietary, and 18 of the top-selling 20 products are proprietary. National's component R&D expenditures have grown at a compound rate of 29 percent for the last three fiscal years and now stand at an estimated 19 percent of component revenue.

The acquisition of its North American sales force will permit National to better control its customer relations. This move represents a major push at National, where the corporate mission is to "provide service second to none--resulting in long-term National Semiconductor/ customer partnerships." Under National, this sales force should be able to better support the increasing complexity of the company's proprietary products and more effectively work with customers during long design-in cycles. Additionally, this offer is well timed because many reps are currently somewhat disheartened with their businesses. National should be able to acquire a direct sales force for much less than it could recruit and train one.

This action by National is worthy of note by other semiconductor firms since reps that sell National products no longer will sell other firms' products. Dataquest believes that the semiconductor industry is becoming more "globalized," with U.S. firms striving to enter the Japanese market and Japanese and European firms striving to enter the North American market. Given this increasingly competitive situation, access to a captive sales force could be a major advantage.

Patricia S. Cox
Howard Z. Bogert

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JAPANESE
RESEARCH
NEWSLETTER

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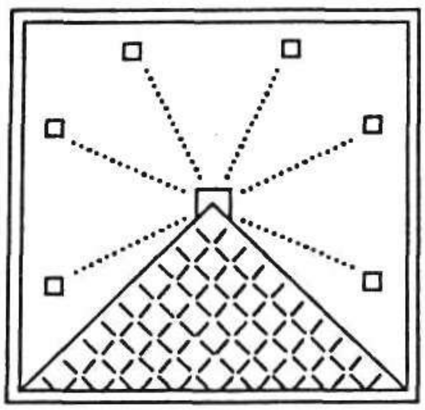
1986-43



IC CARDS: *THE NEXT PC BOOM?*

SHERIDAN M. TATSUNO
Senior Industry Analyst
Japanese Semiconductor Industry Service

Dataquest Incorporated

At Dataquest's recent Semiconductor Application Markets Focus Conference in Santa Clara, JSIS Senior Industry Analyst, Sheridan Tatsuno, gave a presentation on IC card market applications and technology trends. A copy of his speech is presented on the pages that follow.

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OVERVIEW

- Applications
- Technologies
- Pricing trends
- ISO standards
- Europe
- United States
- Japan

During this industry downturn, semiconductor vendors have been seeking and developing new applications. Telecommunications, automotive electronics, compact disks, digital television, and minisupercomputers are attracting interest because of their immediate use and rapid growth potential. Less visible are IC cards, or "smart cards," which offer numerous applications and large market potential. However, because they require more long-term investments and a commitment to educating users, IC cards have been largely ignored by U.S. semiconductor makers.

Dataquest believes that IC cards will become a major end use in the 1990s, but it will be at least five years before we see large production runs. Until then, we will see numerous IC card tests worldwide and much trial and error. These conditions favor larger corporations with "patient money" or fast-moving start-ups that are willing to develop market niches. As a result, unless companies begin development now, they will be excluded from this future market.

IC CARD APPLICATIONS ("3M")

Market Sector	Applications
Military	"Dog tags" Procurement inventory
Medical	Health maintenance organizations (HMOs) Kidney dialysis Biofeedback records
Manufacturing	Inventory and process control Product testing records

Key points to note:

- Financial applications were the initial focus of IC card makers, but too many limitations, especially high costs and disagreements over standards, soured the market.
- The "3M" applications, which are not limited by standards and packaging requirements, will be the major thrust for IC cards during the next few years. They will be the catalyst for getting the financial side reinterested. There are serious problems here seeking IC solutions.
- Military: the U.S. Army is conducting a Soldier Data Tag Program at Fort Benjamin Harrison in Indiana. Another test is being conducted at Fort Lewis, Washington, from June 1986 to June 1987. The U.S. Army's goal is to eliminate paper records.
- Medical: IC cards can help solve major problems facing the medical industry: high administrative costs, malpractice insurance, redundant data handling, continuous care, and preventive care, especially among the elderly and non-English speaking groups.
- Manufacturing: This is a highly fragmented market that requires unique solutions. Generally, users are not knowledgeable about IC technology and require product families. Major applications are process and inventory control cards.

IC CARD APPLICATIONS (Continued)

Market Sector	Applications
Banking	Credit and cash cards* Access ID cards (vault)
Telecommunications	Phone cards*
Office	Personnel records Health insurance programs* Data access keycards* Sophisticated software Laser printers Intelligent photocopiers

*Currently being tested.

Key points to note:

- Banking, telecommunications, and office automation will require IC cards to increase security and reduce administrative costs. Starred (*) applications are currently being tested.
  - Banking: Visa and MasterCard are testing credit and cash cards (see pages 20 to 21). ID cards could be used to control access into vaults and other high-security areas.
  - Telecommunications: Phone cards are being tested in France but could be universally used for long-distance and international calls from public phone booths.
  - Office automation: IC cards could be used to keep records and reduce paperwork, especially for personnel, social security, health insurance, and training records. Future OA equipment may offer IC cards as portable, high-security memory storage devices using personalized identification numbers (PIN). Mitsubishi is developing a PC on a card.

IC CARD APPLICATIONS (Continued)

Market Sector	Applications
Hotels	Room ID key cards Check-in/out time records Reservations
Home	Video games* Educational games (CAI) Utilities records
Automotive	Driver's licenses Door ID key cards Car maintenance records*

*Currently being tested.

Key points to note:

- Hotels, homes, and automobiles offer potential IC card applications. Tests are already being conducted on video game software and car maintenance records.

  - Hotels: IC cards could be used to simplify reservations and monitor check-in/check-out times. IC key cards could be issued as "gold cards" by hotel chains for faster check-in/check-out.

  - Home: Video game software is already being put onto IC cards in Japan. In the future, IC cards could be issued by schools for educational purposes. Utility companies could issue IC cards as a simple way for homeowners to monitor their gas, water, heating, and air-conditioning bills on a daily basis.

  - Automotive: IC cards could be issued as driver's licenses with records of driving offenses, medical disabilities, and outstanding tickets. Door ID key cards could prevent car theft. Installed IC cards could be used to keep records of gas mileage, oil changes, tune-ups, odometer readings, and repairs.

IC CARD APPLICATIONS (Continued)

Market Sector	Applications
Government	Social Security records Food stamps* Tax records Commuter passes Voter registration
Schools	Library cards Student transcripts*
Sports	Personal training records Professional and collegiate team statistics and scorecards

*Currently being tested.

Key points to note:

- Government, schools and universities, and sports fans could become major users of IC cards.
  - Government: The U.S. Department of Agriculture is testing IC cards to reduce food stamp fraud and waste. IC cards could also be used for tax payments, social security, and voter registration. Local governments could issue IC cards as library cards, commuter passes, and property tax records.
  - A major issue with government uses will be individual privacy due to the potential for surveillance.
  - Schools: The University of Paris VII is testing IC cards for student transcripts. IC cards could also be used as library cards, medical records, and student dormitory key cards.
  - Sports: Professional and amateur athletes could keep training and meet records in portable IC cards. "Football cards," "baseball cards," or "Olympics cards" with team and player statistics could be sold at retail stores during the season.

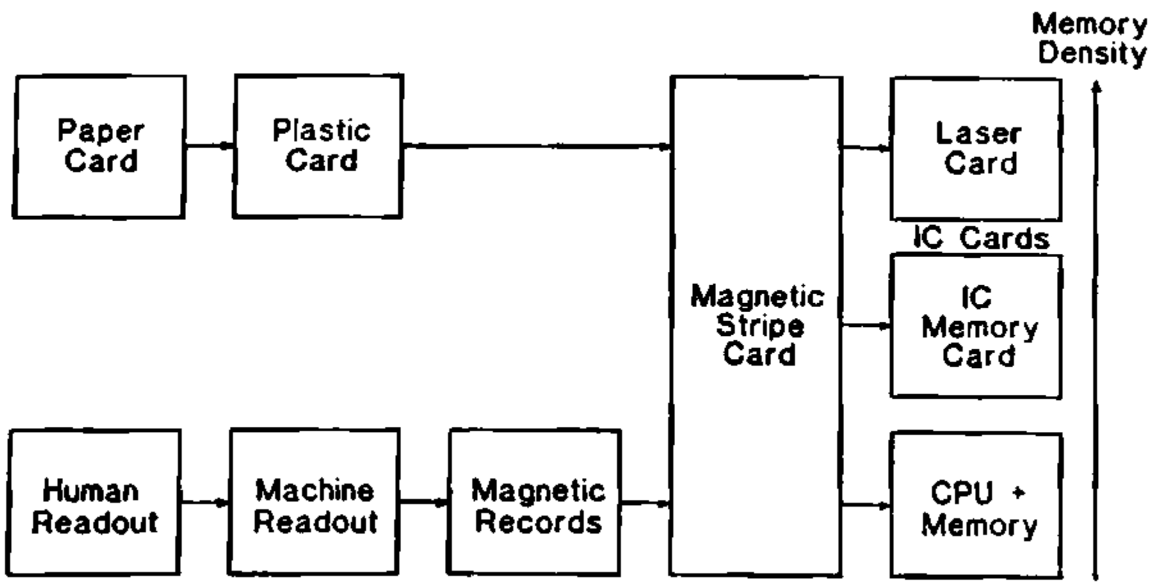
DRIVING FORCES

- Search for the next PC
- Demand-pull, not technology push
  - Convenience and portability
  - Data security
- France-Japan-U.S. rivalry
- Many applications not restricted by ISO packaging standards
- Piggyback onto credit use

Key points to note:

- There are many market forces driving the development of IC cards. Probably the major factor is market demand for improved convenience, portability, and data security in the military, medical, and manufacturing areas.
- The strong rivalry between France, Japan, and the United States to commercialize inexpensive IC cards will accelerate their development.
- Unlike the financial area, the "3M" applications do not require ISO packaging standards before implementing IC cards. They can develop tailored, application-specific uses.
- Eventually, IC cards will supplement but not necessarily replace plastic credit cards. They may be "gold cards" that offer faster, better service, such as "speed lines" at crowded stores and more security.

CARD TECHNOLOGICAL EVOLUTION



Source: Dataquest
October 1986

Key points to note:

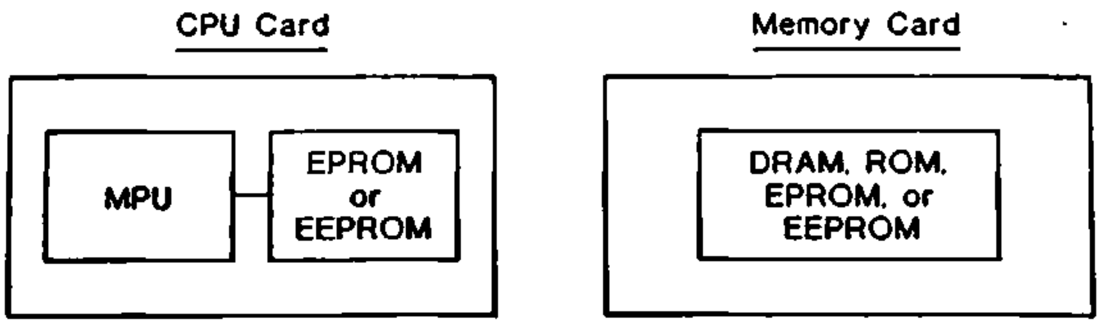
- IC cards represent a major technological evolution over existing plastic, magnetic stripe, and laser cards.

- Magnetic stripe cards, which have 1,200-bit capacity of binary data, offer easy read/write, but they have limited memory capacity and security protection.

- Laser cards will be used for large memory storage. Drexler, for example, has 20 licensees for its Drexon Card. But laser cards are hard to align and require very clean environments for writing, which eliminates many commercial and manufacturing applications.

- IC cards are divided into two types: memory cards and CPU cards. Memory cards will offer portability and micrographics capabilities, while CPU cards will offer processing functions.

IC CARD TECHNOLOGIES



CPU Card

- Shift to one-chip solution
- 8-bit MPU to 16-bit MPU
- 8K to 128K EPROMs
- 16K to 256K EEPROMs

Memory Card

- 256K to 4Mb DRAMs
- 128K to 1Mb ROMs
- 128K to 1Mb EPROMs
- 16K to 256K EEPROMs

Source: Dataquest
October 1986

Key points to note:

- CPU cards will be used primarily for financial, medical, and other high-function uses.

- CPU cards using EPROM technology are being tested for credit cards, but they require complex final testing, longer test time, and external power (20V to 25V).

- CPU cards with built-in EEPROMs are more difficult to manufacture, but they offer many advantages over EPROMs: simple final test, electrical erasability, on-chip voltage; built-in programming, and shorter testing time (one-third of EPROMs.)

- Memory cards are being used primarily for game software storage and factory automation. In the future, PC software may be issued on an IC card.

CPU CARD APPLICATIONS

Type	Applications
ISO	Cash and credit cards Home banking Phone cards Medical cards Electronic messaging
Non-ISO	Factory process control cards Company ID key cards Equipment maintenance cards

Key points to note:

- General applications, such as credit cards and phone cards, have broader market potential, but require ISO standards, which will limit their immediate commercialization.
- On the other hand, manufacturing only requires non-ISO cards for specific applications. Thus, Dataquest believes that non-ISO applications offer easier entry and earlier commercialization potential.
- If ISO standards are not quickly decided, many financial institutions may establish their own standards with other institutions.

MEMORY CARD APPLICATIONS

Type	Applications
RAM + Battery	Personal computer data files Printer and typewriter disk files Television still photo files Digital sound storage cards
ROM (EPROM or EEPROM)	Game software Phone cards Dictionaries Factory records OA character files (Kanji)

Key points to note:

- Memory cards may eventually replace floppy disks for personal computer data files. Several Japanese companies are working on megabyte memory card prototypes, but they are still unproven.

- The weakness of memory cards is that they require a battery, but this obstacle could be overcome by lithium cell batteries being developed for on-chip and on-package use.

- ROM cards offer a wide variety of applications. Key features are its portability and convenience.

ANALOG CARD APPLICATIONS

Type	Applications
MPU + Analog	Noncontact ID cards (cars, factories, offices) Factory process and shipment control
Analog	Noncontact ID cards

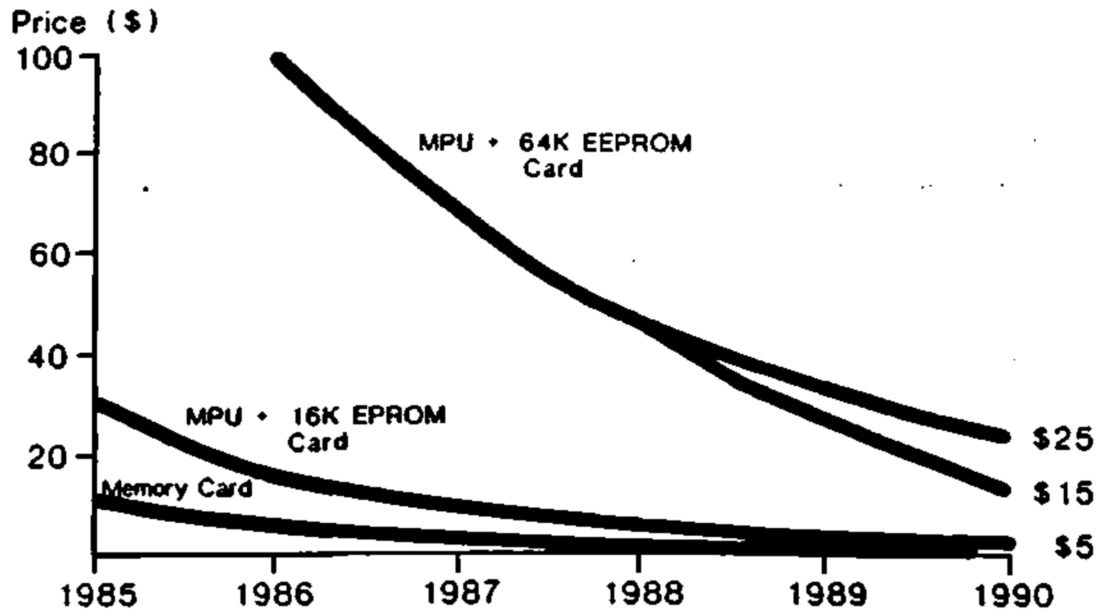
Key points to note:

- Noncontact analog cards offer solutions for access control (buildings, data banks, and computer rooms), supervision (laboratories, factories, and hospitals), and distribution (air freight and shipment of valuables).

- Analog cards, which are expected to replace magnetic cards, offer an automatic communication function, a sensor panel, control unit, and a register. The card automatically emits a signal that is received by the security control unit in entrances.

- In Japan, Arimura Institute of Technology is developing nontouch card systems that are being jointly marketed with Toshiba.

IC CARD PRICING FORECAST



Source: Dataquest
October 1986

Key points to note:

- For volume production to pick up, IC cards must become much cheaper. More efficient CAD design and manufacturing techniques will be required to move down the learning curve.
- CPU cards with a 16K EPROM will decline from their current price of $30 to less than $5 by 1990.
- Medical cards with an MPU and 64K EEPROM are expected to decline from more than $100 today to between $15 and $25 by 1990.
- Dataquest believes that Japanese vendors, especially printing companies, will be the price leaders.

ISO STANDARDS

- ISO and American National Standards Institute (ANSI)
- Physical characteristics
  - Size and thickness
  - Flexibility
  - Durability
- Dimension and location of contacts (CP8 French standard; top of card)
- Electronic signals and exchange protocols (from 1987)

Key points to note:

- ISO standards are the major stumbling block to widespread use of IC cards. To date, the location of contacts has been decided; the French standard of having the IC in the top of the card will be followed.
- Another problem is that of achieving the goal of 30 mils thickness. CPU cards with EEPROMs still cannot fit into these dimensions, so financial applications will be limited. However, CPU + EPROM cards are being developed and poised for growth.

INDUSTRY SCORECARD

	Western Europe	Asia/ Japan	North America
Tests Completed	8	0	3
Tests Under Way	19	19	3
Test Cards	10Ks	1Ks	1 to 10Ks
Card Types	5	44	7
Vendors	4	81	6

Source: Dataquest
October 1986

Key points to note:

- To date, 11 IC card tests have been completed worldwide, mostly in France.

- However, 81 Japanese vendors are conducting some 19 experiments or more to develop the market. The Ministry of International Trade and Industry (MITI) has set up an ISO standards committee to promote industry agreement over standards. The Ministry of Posts and Telecommunications (MPT) and the Ministry of Finance (MOF) are working with banks to introduce cash, credit, and phone cards.

- Unlike Europe and Japan, the major IC card tests in the United States are sponsored by large corporations, such as Visa and MasterCard.

MAJOR PLAYERS IN EUROPE

Company	Country	Ties or Subsidiaries
Bull Group	France	MicroCard (U.S.); Olivetti
Crouzet	France	Toshiba
Flonic-Schlumberger	France	Paymatek (France)
MasterCard	United States	Credit Agricole and Credit Mutuel (France)
Multimil	Switzerland	Paytel TV (U.K.)
Perroux	France	Datacard (U.S.)
Philips	Netherlands	TRT Telecommunications
Siemens	West Germany	Dai Nippon Printing (Japan)
Steria/Thomson	France	Carte Bancaire (France)

Source: Dataquest
October 1986

Key points to note:

- The French are the inventors and innovators of IC cards. By the end of 1986, France will have the following infrastructure in place: 4 million POS and phone cards (16 million by 1988), 52,000 POS terminals, 50,000 certifiers ordered, 30,000 phone booths, 56,000 card readers, and 8,200 card dispensers.

- The French effort is driven by several factors: the government emphasis on computerization, telematique (videotex and IC cards), and more efficient check processing.

- Major players are the Bull Group, Crouzet, and Flonic-Schlumberger.

EUROPEAN IC CARD EXPERIMENTS

Start	Location	Sponsor	Use	Number of Cards
1982	Caen, Blois, Lyon	French PPT	POS systems	65,000
1983	Paris	University of Paris VII	Student transcripts	8,000
1983	Lyon, Blois	French PPT	Public phones	1,000,000
1983	Paris	French PPT	Telepayment	2,000,000 (1985)
1985	Bormio (Italy)	Credito Valtellinese	Savings	5,000

Source: Dataquest
October 1986

Key points to note:

- The French Public Posts and Telecommunications (PPT) is the furthest along in IC card testing. In the fall of 1982, the French PPT installed check clearing and communication lines at three cities to reduce check processing costs, which were four times those in the United States. The Bull Group, Paymatec, and Philips provided IC cards. The test had disappointing results: cards were used an average of 2.6 times in 18 months and only 65,000 of the 120,000 cards were requested. On the other hand, only 0.1 percent of the cards failed.

- In 1983, the French PPT introduced 200 public IC card phones to reduce the rampant cashbox vandalism problem. Paymatec and Flonic-Schlumberger provided the cards. In 1985, more than 10,000 public phones and 2 million cards were involved.

- In Paris, the French PPT also experimented with three types of telepayment: prepaid, phone credit, and bank cards.

- There is a major dispute between Gie Carte Bancaire and French retailers over the IC card fee structure ($20 monthly lease plus 1 percent fee for each transaction). Retailers are requesting lower fees to encourage more customers to use IC cards.

U.S. IC CARD VENDORS

- Manufacturers
  - AT&T
  - Data Card Corporation
  - Datakey
  - General Instrument
  - IHMS
  - Intellicard International
  - Smart Card International
  - Smart Card Systems

Key points to note:

- Due to the long-term investment required, there has been little U.S. semiconductor vendor support for IC cards, except for Motorola.
- Major companies are quickly opening sales offices in the United States to take advantage of this market opening. Key players include: the Bull Group, Casio, Crouzet, Logicom, Mitsubishi Electric, Schlumberger, and Toshiba.
- Motorola recently announced a single-chip Hi-CMOS CPU card with 4-Kbyte EEPROM.
- Datakey has introduced IC datakeys with 8-bit MCU and 16K and 64K EEPROM.

POTENTIAL U.S. IC CARD VENDORS

- AT&T
- American Express
- Bank of America
- Chase Manhattan Bank
- Citicorp
- Eastman Kodak
- J.C. Penney
- MCI
- New York Stock Exchange
- Polaroid
- Sears
- U.S. Department of Defense
- U.S. Department of Agriculture

Key points to note:

- Dataquest observes that there are many large companies that could be major IC card users. The key obstacle is educating these users and developing a working alliance to jointly develop application-specific IC cards.

- Potential users of IC cards include banks, securities companies, department store chains, gas station chains, government agencies, and telephone companies.

- We believe that the window for developing strategic alliances with these major users will be short (1987 to 1989). There is a strong possibility that French and Japanese IC vendors will be major players in the U.S. market because of their headstart.

- Unlike the calculator market, the IC card market will be largely determined by institutional arrangements.

MAJOR U.S. IC CARD EXPERIMENTS

Company	Location	Type
MasterCard International	Columbia, Maryland	POS systems
Visa International	Palm Beach, Florida	SuperSmart Card
U.S. Navy	Ft. Lee, Virginia	Medical records
U.S. Dept. of Agriculture	Reading, Pennsylvania	Food stamp card
J.C. Penney	North Dakota	Home banking
Bank of Virginia	Virginia	MasterCard trial
U.S. Dept. of HEW	Washington, D.C.	Plans for national health insurance subscriber IC cards

Source: Dataquest
October 1986

Key points to note:

- Until recently, the IC card market in the United States has been developed by entrepreneurial companies. Due to the Visa and MasterCard experiments, major companies such as Toshiba and the Bull Group are entering the market.

- MasterCard International is developing IC cards to reduce credit card fraud and overcharging, which reached $900 million in 1985 and may grow to $2.1 billion by 1990. About three-quarters of all losses, or $690 million in 1985, was due to overcharging over authorized limits by legitimate card holders.

- The MasterCard experiment in Maryland involves 10 banks, 33,000 cards, and 200 merchants.

- The Visa experiment in Florida involves six banks, 14,000 cards, and 100 terminals.

- In addition, the U.S. Department of Health, Education, and Welfare (HEW) has plans for a National Health Insurance Subscriber IC Card program to reduce fraud and waste.

VISA VS. MASTERCARD COMPARISON

Visa	MasterCard
Self authorization	Dual authorization
EEPROM	EPROM
Prototype concept announced	Currently testing
Smart Card International (General Instrument and Toshiba)	Microcard Technologies (Motorola) Casio Microcard (NEC)

Source: Dataquest
October 1986

Key points to note:

- MasterCard International is currently testing an MCU card with an EPROM for transaction records and add/subtract credit balancing.
- The biggest savings in financial IC cards will come from reduced user abuse (overcharging) and authorization costs, not fraud reduction.
- Visa is behind MasterCard, so it has joined with Toshiba to develop the SuperSmart Card by the fall of 1987. This card will feature a keyboard, display, battery, stripe terminal, and chip/magnetic communications. The first prototype was announced in May 1986.
- Visa issued an IC card report in October 1985 that arrived at the following conclusions:
  - IC card use is justified
  - New services offer the greatest potential
  - Card membership should be optional

MAJOR U.S. IC CARD MARKETS

	Millions
• Credit cards (total cardholders)	600
– Visa--70 million	
– MasterCard--55 million	
– American Express--15 million	
• Food Stamp recipient households (1984)	7.7
• School and college enrollment (1989)	25.0
• U.S. military personnel (1984)	2.1
• Car sales (1983)	6.3

Source: Dataquest
October 1986

Key points to note:

- The American Bankers Association reports that there are about 140 Visa, MasterCard, and American Express card holders, representing a potential market of $700 million, assuming $5 per IC credit card.

- The potential U.S. market for IC credit cards is about $3 billion, or 600 cardholders, in 1990.

- Other major markets include a potential $40 million market for food stamp recipients, $125 million educational market, and $40 million military market (at $20 per card for medical dog tags), and $30 million car market.

JAPANESE IC CARD EXPERIMENTS

Start	Group Leader	Application	IC Device
December 1984	Mitsui Bank and Toshiba Credit	Banking and shopping	64K EPROM with 8-bit MPU
March 1985	Seibu Bank	Medical	16K EEPROM with CPU
May 1985	Sumitomo Bank	Shopping	64K EEPROM with CPU
December 1984	Toyo Trust Bank	Financial management	64K EPROM with CPU
August 1985	Dai-Ichi Kangyo	Banking	64K EPROM with CPU
October 1985	Sanwa Bank	Shopping	64K EEPROM with CPU
October 1985	Fuji Bank	Corporate banking	16K EEPROM with CPU
October 1985	Daiwa Bank	Shopping	16K EEPROM with CPU
October 1985	Toshiba	Point-of-Sale	64K EEPROM with CPU

Source: Dataquest
October 1986

Key points to note:

- Japan has become the major center for IC card experiments. There are 40 major tests and 50 to 75 small tests being conducted now by 81 vendors.
- The Ministry of International Trade and Industry (MITI) and the Ministry of Posts and Telecommunications (MPT) are coordinating the effort through an ISO standards committee.
- Seibu Bank and Sante Systems introduced 12,000 medical cards with 16K EEPROMs to 300 hospitals in 1985. The cards were developed by Dai-Nippon Printing.
- In May 1985, the New Media Service Project, consisting of 1,600 bank monitors, was formed by Matsushita, NEC, Dai-Nippon Printing, Toppan Printing, and others. The goal was to test 6,000 experiment cards.
- Fuji Bank and Tobu Stores introduced the Fuji Banknet IC Key Card Test System using cards developed by Oki Electric and Dai-Nippon Printing in 1985.
- The Center for Financial Industry Information Systems conducted a study between July 1985 and May 1986 to analyze the feasibility of IC cards.

TOP JAPANESE CARD VENDORS

Background	Company	Strength
Printers	Dai-Nippon Printing	60% of magnetic cards
	Toppan Printing	30% of magnetic cards
	Kyodo Printing	15% of magnetic cards
ICs	Toshiba	Visa International tie
	Mitsubishi Electric	Mitsubishi Bank, FA
Materials	Mitsubishi Plastics	Video games and CAI (Japan and Spain)
Watch and Calculators	Casio	Calculator leader
	Citizen/Arimura	Watch manufacturing (72% sales)

Source: Dataquest
October 1986

Key points to note:

- Printers, IC makers, materials manufacturers, and watch and calculator makers are the top IC card vendors in Japan. Currently, there are 81 vendors offering 44 types of cards.
- Dai-Nippon, Toppan, and Kyodo are already major magnetic card makers, an advantage that they will leverage in the IC card market.
- Mitsubishi Electric has made a major commitment to IC cards for its factory automation systems and its producing 2 million MelCards monthly.

OTHER JAPANESE PLAYERS

ICs	Precisions
Fujitsu	Nippon Coinco
Hitachi	NCR Japan
Hitachi Maxell	Tokyo Electron
Matsushita	Omron Tateishi
NEC	
Oki	

Key points to note:

- There is fierce competition in the Japanese IC card market. Dataquest expects a shakeout in the merchant market, with major players moving into the United States by late 1987 and minor players being limited to captive uses or niche markets in Japan.

- Currently, Japanese makers are focusing on one-chip solutions that involve developing EPROMs and EEPROMs, then inserting them into their standard cell libraries. The IC card market will be strongly driven by ASICs and CAD technology development.

JAPANESE CREDIT CARDS IN USE (1985)

Type	Millions
Banks	18.2
Credit	17.3
Department stores	13.4
Hire purchase	9.7
Wholesale	4.6
Electrical makers and dealers	4.3
Door-to-door sales	3.6
Small businesses	1.9
Telecommunications	0.2
Car makers and dealers	0.1
Total	73.3

Source: MITI 1985 Consumer Credit Survey

Key points to note:

- In 1985, MITI conducted a consumer credit survey to identify potential IC card markets. Of the 73.3 million credit cards in circulation, about 58.6 million (or 80 percent) are issued by banks, credit companies, department stores, and purchasing offices. These are the major markets.
- Wholesalers, door-to-door sales, and other small businesses offer smaller niche markets for minor IC card players.

MARKET OBSTACLES

- Cost of IC cards
- Cost of card readers
- Consumer reluctance ("float period" lost)
- Rivalry to become industry standard

Key points to note:

- The above slide shows market obstacles for financial applications. The "3M" non-ISO applications are only limited by the imagination and efforts of vendors and users.
- The cost of IC cards is rapidly falling to the $5 range due to the entry of numerous players.
- The price of card readers is now less than $500. MicroTech offers a $100 handheld reader.
- Financial institutions will receive no clear benefits from the disappearance of "float period" for IC credit cards, since it may discourage cardholders from using them. Instead, "artificial float" and other forms of marketing savvy may be required to overcome consumer reluctance.
- IC users are competing to become the industry standard. If no ISO standards are developed soon, the industry may end up with multiple standards.

SUMMARY

- IC card market in testing phase
- Gradual commercialization from 1987
- Volume sales from 1990
- Institutional ties required now
- Many applications possible
- Need to be creative in developing market

Key points to note:

- There are many potential IC card applications. However, unlike the PC market, semiconductor makers must be creative in developing new markets and applications.
- If the MasterCard tests prove positive, Dataquest expects low production volumes (100,000s) in 1987, medium volumes (low millions) in 1988, and high volumes in 1990.
- Until 1990, the manufacturing, medical, and military ("3M") markets offer the easiest market entry since ISO standards are not required.

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-42

**JAPANESE SEMICONDUCTOR MARKET QUARTERLY UPDATE:
HIGH YEN MASKS A DEPRESSED MARKET**

SUMMARY

Nearly everything we said in our August market update newsletter (JSIS Number 1986-33, "Japanese Semiconductor Market Quarterly Update: High Yen Wreaking Havoc on Japanese Consumption") is still true. However, we are sufficiently pessimistic about what those things mean that we have revised our third and fourth quarter 1986 and most of 1987 projections downward from the last forecast.

We believe that the Japanese semiconductor market will grow 40.6 percent in dollars, this year, followed by a 19.4 percent increase in 1987. In terms of yen, however, the Japanese market--which grew only 1.1 percent in first quarter 1986 and 1.4 percent in second quarter 1986--will experience negative growth in both third and fourth quarter 1986, resulting in a decline of 2.0 percent for the year.

We have used actual exchange rates for the first three quarters of 1986: ¥188, ¥170, and ¥155 per dollar, respectively. The ¥155 exchange rate is carried forward through fourth quarter 1986 and through the four quarters of 1987.

Figure 1 shows quarter-to-quarter percent growth in yen for the Japanese semiconductor market from the first quarter of 1985 through the fourth quarter of 1987. Figure 2 presents the same data in dollars. A comparison of these two graphs shows that the dramatic ascent of the yen makes a depressed industry appear to be undergoing strong growth when expressed in dollars.

FORECAST

Our quarterly forecast, in both yen and dollars, is shown in Tables 1 through 4.

We expect to see a healthier market in 1987, as the painful adjustment period accompanying the yen's rise ends and the market begins to stabilize. We believe that the total Japanese semiconductor market will grow 11.4 percent in yen in 1987, or 19.4 percent in dollars.

Our revised forecast is based on the following:

- The strength of the yen against the dollar is causing end-equipment production to sag in third and fourth quarter 1986. We believe that this situation will continue in the first two quarters of 1987. Japanese industry is beginning to adjust to the age of the high yen, but we believe that the complete adjustment process will take at least one year. The movement of end-equipment production offshore from Japan has caused us to lower the 1987 growth forecast to only 11.4 percent in yen.

- Increasing competition among semiconductor suppliers in Japan is causing continued pricing pressure. We believe that price decreases will continue through second quarter 1987. Unit growth may be high, but in value it will be very tough for the Japanese semiconductor industry to have a high growth rate. There is still a good deal of overcapacity in the industry; therefore, the impetus is still to sell as much as possible at low prices in order to keep factories running.

- The effects of the price monitoring and demand forecasting provisions of the U.S.-Japan Semiconductor Trade Arrangement have not yet been felt. MITI is now in the process of establishing new pricing systems for Japanese companies in Japan and third countries. We believe that the effects of these efforts will contribute to a healthier market beginning early in 1987.

DATAQUEST CONCLUSIONS

The Japanese market will surpass the U.S. market as the world's largest semiconductor market in 1986, with total consumption of $12.1 billion. Because of the U.S.-Japan Semiconductor Trade Arrangement and pricing pressure caused by the ascent of the yen versus the dollar, we expect this always intensely competitive market to become even more fiercely competitive.

The structure of the Japanese semiconductor industry is going through its biggest upheaval in history. For the first time since the 1975 industry recession--when the Japanese market was only slightly larger than the European semiconductor market--the Japanese industry is taking drastic cost-cutting measures. Executive salaries and bonuses are being slashed and temporary workers are being let go in droves. The export-driven Japanese economy is being threatened by pressure from Japan's international trading partners to increase domestic consumption. The mood in Tokyo is grim, but we believe that stability will be recaptured in the second half of 1987 and that the Japanese semiconductor market will remain a major opportunity for suppliers.

Patricia S. Cox
Osamu Ohtake

Figure 1

JAPANESE SEMICONDUCTOR MARKET
QUARTER-TO-QUARTER PERCENT GROWTH IN YEN

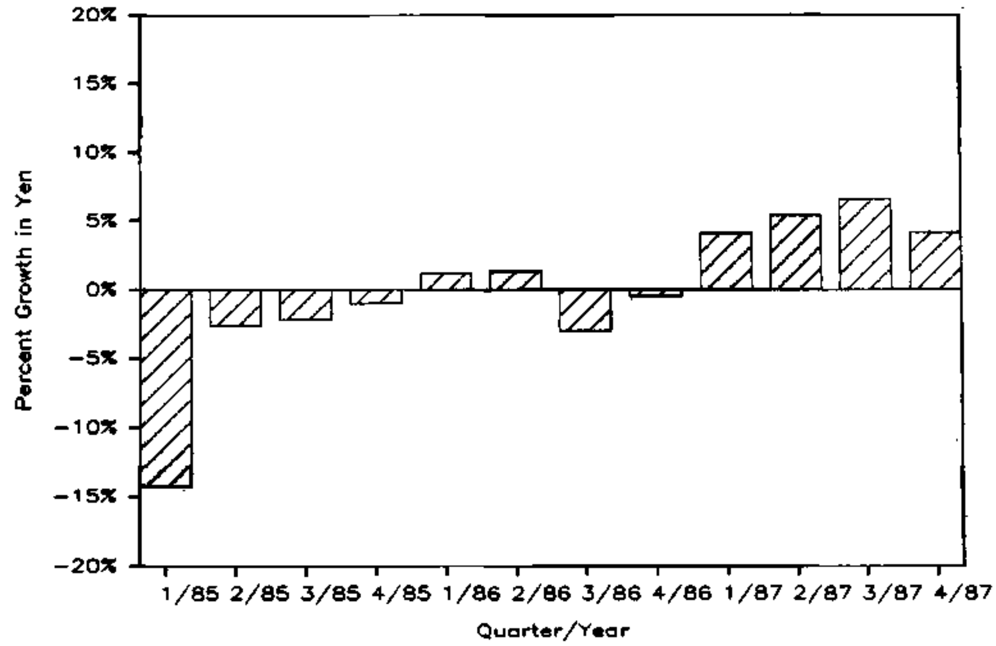
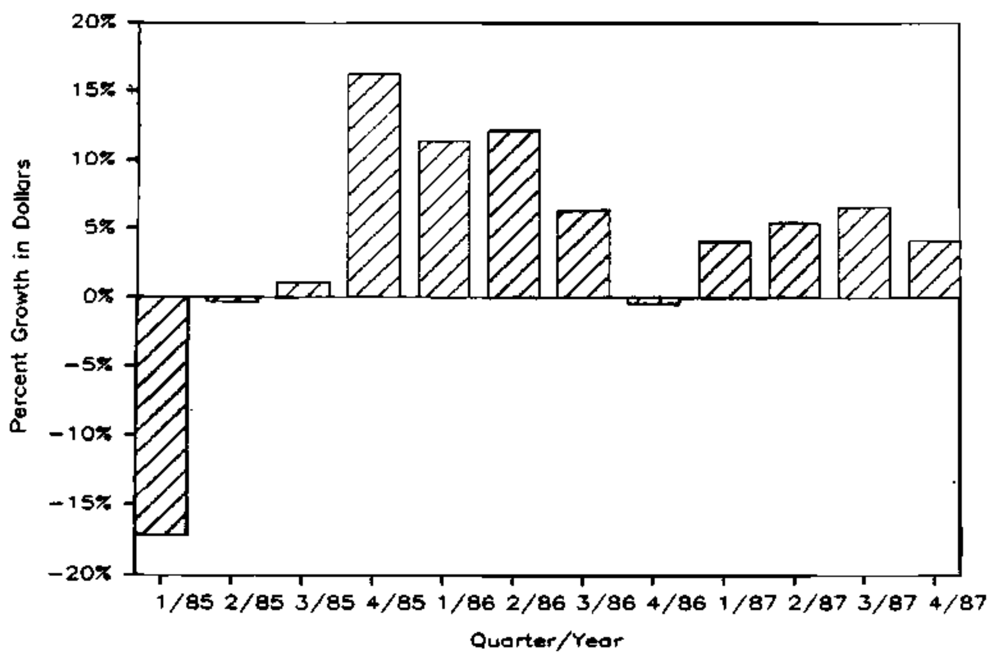


Figure 2

JAPANESE SEMICONDUCTOR MARKET
QUARTER-TO-QUARTER PERCENT GROWTH IN DOLLARS



Source: Dataquest
October 1986

Table 1

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
PERCENT GROWTH
1985-1987
(Percent of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor		-2.6%	-2.2%	-1.0%	-2.3%
Total IC		-2.7%	-3.0%	-2.0%	-1.5%
Bipolar Digital		-10.5%	-8.3%	-0.6%	-3.8%
Memory		-10.3%	-10.3%	-8.6%	-4.5%
Logic		-10.6%	-8.0%	0.7%	-3.7%
MOS		-3.7%	-4.4%	-5.2%	-3.2%
Memory		-12.8%	-17.7%	-5.5%	-19.5%
Micro Device		10.9%	10.9%	4.6%	2.2%
Logic		-1.1%	-0.1%	-12.2%	17.2%
Linear		3.9%	2.4%	3.1%	2.9%
Discrete		-3.8%	-2.2%	1.5%	-5.8%
Optoelectronic		2.8%	10.0%	4.5%	-1.3%
	Q1/86	**Q2/86**	**Q3/86**	**Q4/86**	**1986**
Total Semiconductor	1.1%	1.4%	-3.0%	-0.4%	-2.0%
Total IC	2.3%	1.9%	-2.8%	1.4%	-1.2%
Bipolar Digital	-1.0%	6.3%	2.2%	4.6%	-1.9%
Memory	0.0%	3.1%	3.0%	2.9%	-10.4%
Logic	-1.1%	6.8%	2.0%	4.8%	-0.7%
MOS	5.2%	0.7%	-2.9%	5.4%	-1.9%
Memory	1.9%	2.3%	-4.3%	0.0%	-15.7%
Micro Device	6.7%	-5.9%	-8.8%	5.0%	9.8%
Logic	7.1%	5.0%	2.8%	10.1%	4.3%
Linear	-1.0%	1.9%	-4.8%	-7.0%	0.5%
Discrete	-4.1%	-0.1%	-5.0%	-8.1%	-9.3%
Optoelectronic	2.7%	-0.6%	0.3%	-2.0%	10.9%
	Q1/87	**Q2/87**	**Q3/87**	**Q4/87**	**1987**
Total Semiconductor	4.1%	5.4%	6.6%	4.2%	11.4%
Total IC	4.7%	6.3%	7.8%	4.8%	15.5%
Bipolar Digital	4.7%	4.5%	3.2%	1.3%	17.1%
Memory	1.4%	4.2%	5.4%	3.8%	13.4%
Logic	5.2%	4.6%	3.0%	1.0%	17.6%
MOS	6.5%	9.1%	9.3%	6.9%	24.5%
Memory	6.1%	9.9%	11.1%	7.6%	20.9%
Micro Device	7.8%	9.7%	12.0%	7.2%	21.9%
Logic	6.0%	8.0%	6.0%	6.2%	29.6%
Linear	1.3%	1.7%	7.1%	2.1%	-1.0%
Discrete	1.4%	2.3%	2.1%	2.0%	-4.3%
Optoelectronic	2.3%	1.3%	1.3%	0.9%	2.7%

Source: Dataquest
October 1986

Table 2

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
1985-1987
(Billions of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor	529.1	515.3	504.2	499.3	2,047.9
Total IC	407.1	396.3	384.6	377.0	1,565.0
Bipolar Digital	64.5	57.7	52.9	52.6	227.7
Memory	8.7	7.8	7.0	6.4	29.9
Logic	55.8	49.9	45.9	46.2	197.8
MOS	228.5	220.1	210.4	199.4	858.4
Memory	99.5	86.8	71.4	67.5	325.2
Micro Device	47.8	53.0	58.8	61.5	221.1
Logic	81.2	80.3	80.2	70.4	312.1
Linear	114.1	118.5	121.3	125.0	478.9
Discrete	96.6	92.9	90.9	92.3	372.7
Optoelectronic	25.4	26.1	28.7	30.0	110.2
Exchange Rate	257.0	251.0	243.0	207.0	237.0
	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	504.9	511.8	496.4	494.2	2,007.3
Total IC	385.6	392.8	381.7	386.9	1,547.0
Bipolar Digital	52.1	55.4	56.6	59.2	223.3
Memory	6.4	6.6	6.8	7.0	26.8
Logic	45.7	48.8	49.8	52.2	196.5
MOS	209.8	211.3	205.1	216.1	842.3
Memory	68.8	70.4	67.4	67.4	274.0
Micro Device	65.6	61.7	56.3	59.1	242.7
Logic	75.4	79.2	81.4	89.6	325.6
Linear	123.7	126.1	120.0	111.6	481.4
Discrete	88.5	88.4	84.0	77.2	338.1
Optoelectronic	30.8	30.6	30.7	30.1	122.2
Exchange Rate	188.0	170.0	155.0	155.0	166.0
	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	514.3	542.1	577.8	602.1	2,236.3
Total IC	405.2	430.8	464.4	486.8	1,787.2
Bipolar Digital	62.0	64.8	66.9	67.8	261.5
Memory	7.1	7.4	7.8	8.1	30.4
Logic	54.9	57.4	59.1	59.7	231.1
MOS	230.2	251.1	274.4	293.3	1,049.0
Memory	71.5	78.6	87.3	93.9	331.3
Micro Device	63.7	69.9	78.3	83.9	295.8
Logic	95.0	102.6	108.8	115.5	421.9
Linear	113.0	114.9	123.1	125.7	476.7
Discrete	78.3	80.1	81.8	83.4	323.6
Optoelectronic	30.8	31.2	31.6	31.9	125.5
Exchange Rate	155.0	155.0	155.0	155.0	155.0

Source: Dataquest
October 1986

Table 3

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
PERCENT GROWTH
1985-1987
(Percent of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor		-0.3%	1.1%	16.2%	-2.8%
Total IC		-0.3%	0.3%	15.0%	-2.1%
Bipolar Digital		-8.4%	-5.2%	16.5%	-4.6%
Memory		-8.8%	-6.5%	6.9%	-5.3%
Logic		-8.3%	-5.0%	18.0%	-4.5%
MOS		-1.3%	-1.3%	11.2%	-3.9%
Memory		-10.6%	-15.0%	10.9%	-20.6%
Micro Device		13.4%	14.7%	22.7%	2.5%
Logic		1.3%	3.1%	3.0%	16.2%
Linear		6.3%	5.7%	21.0%	2.8%
Discrete		-1.6%	1.1%	19.3%	-6.2%
Optoelectronic		5.1%	13.5%	22.9%	-1.1%

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	11.4%	12.1%	6.3%	-0.4%	40.6%
Total IC	12.7%	12.7%	6.5%	1.4%	41.9%
Bipolar Digital	9.1%	17.7%	12.0%	4.7%	41.7%
Memory	9.7%	14.7%	12.8%	2.3%	29.6%
Logic	9.0%	18.1%	11.8%	5.0%	43.5%
MOS	15.9%	11.4%	6.4%	5.4%	41.2%
Memory	12.3%	13.1%	5.1%	0.0%	22.0%
Micro Device	17.5%	4.0%	0.0%	5.0%	55.6%
Logic	17.9%	16.2%	12.7%	10.1%	50.8%
Linear	9.0%	12.8%	4.3%	-7.0%	43.4%
Discrete	5.6%	10.4%	4.2%	-8.1%	29.7%
Optoelectronic	13.1%	9.8%	10.0%	-2.0%	57.9%

	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	4.1%	5.4%	6.6%	4.2%	19.4%
Total IC	4.7%	6.3%	7.8%	4.8%	23.7%
Bipolar Digital	4.7%	4.5%	3.1%	1.4%	24.9%
Memory	2.2%	4.3%	4.2%	4.0%	21.0%
Logic	5.0%	4.5%	3.0%	1.0%	25.4%
MOS	6.5%	9.1%	9.3%	6.9%	33.3%
Memory	6.0%	10.0%	11.0%	7.6%	29.5%
Micro Device	7.9%	9.7%	12.0%	7.1%	31.0%
Logic	6.1%	8.0%	6.0%	6.1%	38.2%
Linear	1.3%	1.6%	7.2%	2.1%	6.3%
Discrete	1.4%	2.4%	2.1%	1.9%	2.8%
Optoelectronic	2.6%	1.0%	1.5%	1.0%	10.1%

Source: Dataquest
October 1986

Table 4

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
1985-1987
(Millions of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor	2,059	2,053	2,075	2,412	8,599
Total IC	1,584	1,579	1,583	1,821	6,567
Bipolar Digital	251	230	218	254	953
Memory	34	31	29	31	125
Logic	217	199	189	223	828
MOS	889	877	866	963	3,595
Memory	387	346	294	326	1,353
Micro Device	186	211	242	297	936
Logic	316	320	330	340	1,306
Linear	444	472	499	604	2,019
Discrete	376	370	374	446	1,566
Optoelectronic	99	104	118	145	466
Exchange Rate	257	251	243	207	237

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	2,686	3,011	3,202	3,188	12,087
Total IC	2,051	2,311	2,462	2,496	9,320
Bipolar Digital	277	326	365	382	1,350
Memory	34	39	44	45	162
Logic	243	287	321	337	1,188
MOS	1,116	1,243	1,323	1,394	5,076
Memory	366	414	435	435	1,650
Micro Device	349	363	363	381	1,456
Logic	401	466	525	578	1,970
Linear	658	742	774	720	2,894
Discrete	471	520	542	498	2,031
Optoelectronic	164	180	198	194	736
Exchange Rate	188	170	155	155	166

	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	3,318	3,497	3,727	3,884	14,426
Total IC	2,614	2,779	2,995	3,140	11,528
Bipolar Digital	400	418	431	437	1,686
Memory	46	48	50	52	196
Logic	354	370	381	385	1,490
MOS	1,485	1,620	1,770	1,892	6,767
Memory	461	507	563	606	2,137
Micro Device	411	451	505	541	1,908
Logic	613	662	702	745	2,722
Linear	729	741	794	811	3,075
Discrete	505	517	528	538	2,088
Optoelectronic	199	201	204	206	810
Exchange Rate	155	155	155	155	155

Source: Dataquest
October 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-38

GALLIUM ARSENIDE ICs--FACT OR FANCY?

It has been said that the quantity of paper published on gallium arsenide (GaAs) technology outweighs the shipments of chips, and this certainly holds true for GaAs ICs. Dataquest recently analyzed the industry to determine the extent of activity in this field and to gain insight into the reality of the emerging markets for GaAs semiconductors.

A CRITICAL MASS OF PLAYERS AND INVESTMENTS

Dataquest estimates the number of participants in the GaAs industry to be:

- 28 merchant market suppliers of GaAs ICs
- 26 additional companies supplying discretes
- 21 captive-only producers of GaAs chips
- More than 20 merchant suppliers of GaAs wafers, plus 10 or more suppliers of other III-V compound wafers such as InP
- 10 merchant foundries
- 11 IC start-ups not included above, with planned shipments starting in 1986 or 1987
- 30 Japanese companies in MITI-supported projects funded at $348 million

Additionally, more than 60 universities in the free world are involved in III-V compound semiconductor R&D, many with fabrication facilities. The number of professionals with degrees in this field is rapidly approaching 10,000. Analog GaAs ICs for TVRO applications are now available at ASPs

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of less than \$20. Vitesse Electronics Corporation has announced a 2900-type bit slice family of digital ICs that includes a 1Kx4 SRAM and are based on a 1.2μ E/D MESFET process. Dataquest estimates that capital infusion into the GaAs IC field exceeded \$330 million in 1985.

WHAT IS THE FUTURE OF THE GaAs IC INDUSTRY?

A recent Dataquest analysis of available high-speed ICs shows that silicon technology is evolving rapidly on several fronts. CMOS processes are now pushing critical dimensions (CDs) to less than 1.5μ and, in some cases, below 1.0μ, resulting in subnanosecond gate delays. ECL gate arrays based on sub-u CDs are now in limited volume production and feature gate delays of less than 300 picoseconds. This progress, coupled with product schedule slippages at several major GaAs digital houses, has raised some doubt as to the viability of using GaAs digital ICs in new systems now being developed, especially at bottom-line-sensitive U.S. computer houses. This situation has also inspired many U.S.-based silicon IC suppliers to maintain the status quo of evolutionary progress in silicon as opposed to extending themselves by risking investment in GaAs.

Dataquest observed during this analysis that all of the Japanese GaAs IC suppliers are vertically integrated, supplying communications and EDP equipment; many also produce their own wafers. This contrasts sharply with the typical U.S. GaAs IC start-up, which is a "chips-only" company.

Despite the number of players in the GaAs arena, wafer defect densities are still excessive with respect to LSI chip fab requirements. This problem and the problem of gate threshold control have, to date, prevented the introduction of cost-effective GaAs chips into commercial systems. However, these problems are resolvable with the appropriate application of presently understood technology. The GaAs IC situation today is not unlike the Si NMOS situation in 1971, when the industry struggled to produce the standard 1K DRAM, the 1103. At that time, Burroughs, NCR, and others took leadership positions by designing the 1103 into systems and pressuring the U.S. industry to rise to the occasion, which it did. Today, to Dataquest's knowledge, only one U.S. systems house is applying similar pressure to potential GaAs RAM suppliers. If history is any indicator, the GaAs IC industry needs several more courageous champions within systems houses demanding tens of millions of GaAs LSI chips and backing their demands with purchase orders and multiyear schedules. It now appears that if such a situation evolves, it will do so in Japan, leading to a further demise of U.S. EDP houses in the world marketplace.

DATAQUEST CONCLUSIONS

While the U.S. Department of Defense appears to be pushing the U.S. industry very hard for viable merchant GaAs IC sourcing, many potential suppliers are limited by the lack of adequate additional demand from the commercial sector. This shortfall in demand is preventing a sufficiently rapid buildup of volume, making it difficult, if not impossible, to achieve the minimum efficiency of scale required for the success of the GaAs IC industry. The MITI-backed effort at vertically integrated Japanese firms does not face the same limitation; the net effect may be the eventual domination of the emerging worldwide GaAs IC market by Japanese firms. However, the race has just started, with only two Japanese suppliers of merchant GaAs ICs at present; a few courageous "drivers" in U.S. systems houses could have a major impact on the outcome.

Gene Miles

Dataquest
a company of The Dun & Bradstreet Corporation

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-39

THE SMART IC CARD--MARKET OVERVIEW

INTRODUCTION

By 1990 the total number of magnetic credit cards in circulation worldwide will top 1 billion. The credit card has become an accepted part of everyday life. Popular though it is, this card is not without its limitations. Small memory capacity, a limited lifetime, and a susceptibility to fraud are factors limiting the true market potential for growth and acting as a driving force in bringing about the next generation of credit cards--the IC card.

IC CARD

The IC card, "smart card," or intelligent data carrier, as it is sometimes called, is a credit card with an integrated circuit imbedded in it. Metal contacts on the surface of the card allow the integrated circuit to be accessed by interfaced circuitry and the information held on the card to be updated. The International Standards Organization (ISO) has begun the process of creating standards for the IC card that will be used in financial transactions. Discussed below are the areas in which critical parameters are being specified.

Mechanical Stability

The IC card must be able to withstand the harsh environmental stresses to which a standard credit card is subjected. Some of the most rigorous torsional requirements experienced by the card take place during wintertime when the cards are pressed into service for clearing frosty windshields. The North American user subjects the credit cards to much greater wear and tear than his European or Asian counterpart. European and Asian males tend to carry their credit cards in their jacket pockets or in purses whereas North American males regularly sit upon theirs. All these factors have been taken into account in arriving at the current specification.

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Security

The device has to be secure, meaning that its contents should not be able to be read or modified by unauthorized persons. As part of the evaluation of the prospective vendors for their CP8 card, the French company CII Honeywell Bull used the services of the National Security Organization to determine how the cards could be accessed or tampered with. Tests included a scanning electron-microscope evaluation and microprobing of the die surface. Only one IC card out of the four under review passed all the security tests.

Electronic Protocols

Important for the acceptance of the card within the global financial community is the standardization of the electronic signals and exchange protocols used in reading and writing information to the card. At the time of writing, this specification is still being worked on by the major card manufacturers and financial institutions represented on the ISO.

Contact Location

ISO has agreed to adopt the CP8 French standard as the international smart card standard. This decision was reached in two stages. In May 1985, the United States withdrew its objections to the existence of two standards for the position of the chip on the card. The French chip is placed at the top of the card while other manufacturers have a chip at the bottom. ISO then accepted the French standard for the exchange of information. The technology, invented by the French inventor Roland Moreno, was adopted by Bull and thus has given Bull a substantial lead over other smart card manufacturers. Mr. Moreno has been in contact with a number of Japanese electronics groups, which could lead to the licensing of the French smart card technology in Japan.

THE MAGNETIC MARKET

North America is the premier credit card marketplace. Within this geographic area, Visa and MasterCard together have achieved 40 percent penetration of the marketplace while the upscale American Express Card has 15 percent. Further market development is limited by the increasing number of expensive on-line authorizations and the growth of fraud. Visa and MasterCard reported a combined fraud, abuse, and authorization cost of $902 million as of 1984, and estimate an additional cost of $21.5 billion by 1990. These factors, combined with the high potential for innovative intelligent new products afforded by a smart IC card, are generating the hotbed of activity surrounding IC card trials. The magnetic card is fighting back in the guise of the latest magnetic striped card under trial with Visa. This card uses magnetic stripes to increase memory capacity and the complexity of user validation, thereby increasing both the lifetime and the security quotient of the card.

TYPES OF IC CARDS

The IC card can be divided into two distinct types: a simple version containing only memory and a more complex form consisting of the processor core with an interface to memory.

Memory Card

EPROM, EEPROM, and fusible link-based technologies are under development, where 16K bits of memory correspond to 2,000 letters. The current cash card has a capacity of 0.6K bits of memory, or 75 letters. The increased availability of larger EPROMs and EEPROMs is an important factor in the growth of this sector, with 128K-bit and 256K-bit memories currently under development. Applications include usage as a robust storage medium for data that would normally be held on a magnetic tape or in a floppy disk format. In an industrial production environment it will be ideal as a batch tracking medium, processing information being modified and updated as production lots move from station to station.

Processor Card

Built-in processing power in the form of a CPU core interfacing with memory on a chip or as part of a two-chip set increases the flexibility and hence the number of applications available to the user. For example,

- The handling of multiple bank accounts
- The ability to deal with transactions in a variety of currencies
- Its use as a personal directory/memorandum
- The use of a single card for many transactions (e.g., financial, educational, and social)

In addition, the more intelligent the card the higher the levels of security that can be implemented. Worldwide credit card fraud is presently estimated at more than $500 million per year.

Outlined below is a résumé of the market situation by country. A list of IC card activity by region is detailed in Table 1.

France

In March 1985, France announced its intention to establish a sophisticated nationwide cashless retailing method involving an initial investment of FFr220 million. This scheme is based on the IC card and incorporates a two-stage introduction schedule. The first stage is the introduction of 3 million cards in four regions of France, namely

Brittany, Calais, Lyons, and the Riviera. The second stage of investment is scheduled to spread into 12 million smart cards around the whole country by the end of 1988. The total cost for both stages will be around FFr1 billion. Concerted action has been planned by the Post Office and Savings Banks in France for IC cards. DGT, the French telecommunications authority, is to place an order for 1 million cards for coinless pay phones with 15,000 such booths in use by early 1987.

Though Bull of France and Olivetti of Italy have agreed to form a joint venture for the development and production of automatic teller machines (ATMs) the agreement would result in an ATM operation large enough to be competitive worldwide. TRT Telecommunications and Informatique, the French electronics company owned by Philips, have been awarded a FFr130 million contract to provide IC cards for the French banking payments network. The order was signed with the Carte Bancaire organization which will supply 4.2 million cards over the next three years. The Carte Bancaire organization also has a contract with Bull for 12.4 million cards to be shipped by 1988.

Italy

A trial system in Bormio, North Italy, has been using 5,000 IC cards and 35 terminals. This is being operated as a joint venture between Credito Valtellinese and Intelmatique, a subsidiary of the French PTT.

Japan

Although not as fast as their European counterparts at introducing IC card trials, Japanese manufacturers have nevertheless been moving quickly to strengthen their position in the domestic market. The test results are being used to lobby U.S. companies with a view to making inroads into the important North American marketplace. There have been a number of trials running during 1985 and 1986. One of the most notable is between the Sumitomo Bank and Kyowa Bank in Haikarigaoka Park Town, Mitaka City. This was a financial system, with the card being utilized for banking, home shopping, and cable television (CATV) charge accounts. In Tokyo, The Women's University of Medicine has developed a health control card system called Sante. It uses an electronic module that accepts input data on the patient's health history.

The manufacturing and assembly process for IC cards has to be controlled within very fine limits. IC card manufacture lends itself well to the assembly, production and electronic techniques developed by the watch and calculator manufacturers. Dataquest believes that, given the opportunity, Japan has the technological infrastructure to capitalize quickly on the global market opportunity presented by the IC card.

United Kingdom

Thorn EMI has plans to supply smart cards for an identification system developed to help solve soccer hooliganism. Sperry would supply the computer terminals. British Telecom is looking to increase the use of prepaid phone cards for its pay phones, and an IC card is one system under consideration. Another use for smart cards is demonstrated by Paytel, a cable TV company, which makes pay-per-view television equipment operated by debit cards.

United States

MasterCard started two IC card tests, one in Washington, D.C., using Bull cards and one in Florida using Casio cards. For each of these two tests MasterCard has made 50,000 cards available. MasterCard's version uses an intelligent terminal to debit the balance held in the card. This requires dual ownership, i.e., acceptance by the terminal and knowledge by the person holding the card of the authorization code, before the transaction will be completed. Bull, anticipating a favorable outcome of its trials against Casio, is pressing ahead to begin production of smart cards in the fall at a new facility in Dallas, Texas.

MasterCard's major rival, Visa, has recently unveiled plans for a super IC card incorporating a touch-sensitive keyboard and display which it expects to test in about 18 months. This card will eliminate the need for special terminals. The card carries account balances that are created as the card is loaded with deposits by punching in a code provided by the bank. After each purchase, the balance on the Visa card is debited by the amount used. If the cardholder tries to make a purchase for more than the amount the card contains, he or she will not receive an authorization code.

West Germany

A banking committee has been formed, headed by the Deutsche Sparekassen and the Giroverband, to implement an IC card scheme. The banks believe this will complement the Eurocheque guarantee cards currently held by 50 percent of their banking customers.

Sheridan Tatsuno
Jennifer Berg

Table 1

IC CARD ACTIVITY BY GEOGRAPHIC REGION

Location	Company	Activity
Australia		
Canberra	Commonwealth Bank	Bank trial with Steria (France)
Canberra	The National Bank	Bank trial with Steria (France)
Perth	ANZ	Bank trial with Steria (France)
Sydney	NSW State Bank	Bank trial with Steria (France)
Canada		
Toronto	Royal Bank of Canada	Use of Bull IC card as an access security device to financial network
France		
Aix-en-Provence	Thomson	IC manufacture for Bull
Grenoble	Crouzet	IC card electronic cash registers
Paris	Carte Bancaire	Installing IC card payment network
Paris	Credit Agricole	MasterCard trial
Paris	Credit Mutuel	MasterCard trial
Paris	DGT (French PTT)	15,000 telephone paybooths by the end of 1986
Paris	Schlumberger	IC card manufacturer
Paris	Steria	Card designer
Trappes	Bull	IC card manufacturer

(Continued)

Table 1 (Continued)

IC CARD ACTIVITY BY GEOGRAPHIC REGION

Location	Company	Activity
Holland		
Eindhoven	Philips	IC supplier to Bull
Italy		
Bormio	Credito Valtellinese	Trial system, 5K cards
Milan	Olivetti	Automatic teller machine producer
Japan		
Akijimi City	Mitsui Bank	Firm banking system
Kamei	Seibu Credit	Health record and management service
Minatoku, Tokyo	NEC	IC supplier to Casio
Mitaka City	Sumitomo Bank	Home shopping services
Tokyo	Casio	IC card producer
Tokyo	Dai Nippon Printing	Leading printing company in IC trials
Tokyo	Kyodo Printing	Developing IC card
Tokyo	Mitsubishi Plastics	IC memory card producer for education market
Tokyo	Postal Savings Bureau	International Giro Card
Tokyo	Seibu Credit	Gold card trial, 30K people
Tokyo	Toyo Trust Bank	Private financial management and forecast service

(Continued)

Table 1 (Continued)

IC CARD ACTIVITY BY GEOGRAPHIC REGION

Location	Company	Activity
Switzerland		
Zurich	GRETAG	Security card manufacturer
United Kingdom		
Glasgow	Motorola	IC supplier to Bull
London	Thorn EMI	Soccer supporter ID
London	Paytel	Per-per-view TV
United States		
Boston	Tandem Computers	System security product development with Voest-Alpine
Colorado Springs (Colorado)	Intelligent Card International	IC card manufacturer
Dallas	Micro Card Technology	Distributor of Bull cards for MasterCard trial (Bull subsidiary)
Florida	Citicorp	MasterCard trial, user
Florida	Microcard	Distributor of Casio card for MasterCard trial
Maryland	Maryland Bank	MasterCard trial, user
New York	MasterCard	Card trial organizer
New York	Paymatek	U.S. IC card division of Schlumberger
Palo Alto (California)	Indentix	Security card manufacturer (fingerprints)

(Continued)

Table 1 (Continued)

IC CARD ACTIVITY BY GEOGRAPHIC REGION

Location	Company	Activity
United States (Continued)		
San Mateo (California)	Visa	Super smart card proposal
Texas	Multimil, Richardson	IC card test kit with RS-232 interface
Virginia	Bank of Virgina	MasterCard trial, user
Washington, D.C.	Dept. of HEW	Plan to issue National Health Insurance subscriber IC cards
West Germany		
Frankfurt	Giroveband	Eurocheque trial
Munich	Deutsche Sparekassen	Eurocheque trial

Source: Dataquest
August 1986

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JAPANESE RESEARCH NEWSLETTER

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AMD'S ANNUAL SHAREHOLDERS' MEETING

INTRODUCTION

Advanced Micro Devices' (AMD) annual shareholders' meeting, originally scheduled to take place on September 10 at the Pierre Hotel in New York, was relocated to AMD's office building in the Lawrence Business Park on Lawrence Expressway in Sunnyvale, California. As AMD President and CEO Jerry Sanders set the scene for the semiconductor industry in the United States, it became apparent why the change had occurred--economic pressures. U.S. semiconductor manufacturers' combined losses were approximately $500 million in 1985 and AMD's fiscal year 1986 was the worst in its history. On sales of $576 million in fiscal year 1986, AMD lost $37 million or 65 cents a share. This compares to 1985 earnings of $135 million on sales of $931 million. Revenue for the first two quarters of 1986 was essentially flat at $153 million and $154 million, respectively, with losses of $11 million and $28 million, respectively.

To the question, "Is it too late to save the U.S. semiconductor industry?" Mr. Sanders responds with a firm "No!" How can U.S. semiconductor manufacturers compete in a global market? Innovation, he believes, is the key. In 1986, AMD invested $184 million or 32 percent of sales in R&D and it has spent about 25 percent of total sales on capital investment over the last five years. However, now that excess capacity has reduced the need for capital spending, AMD is now spending at only half of last year's level.

AMD's stated goals are to maintain its R&D expenditure and its commitment to the employees. Although the semiconductor industry is cyclical in nature, which accounts somewhat for the depressed state of the industry, the realities of the marketplace have changed. Fierce international competition and predatory pricing, the overall weak economy and underutilized capacity, and AMD's oversized (in the circumstances) infrastructure and no lay-off policy, have resulted in the worst financial year yet in AMD's history.

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AMD'S STRATEGY

To combat this turn of events, Mr. Sanders outlined AMD's three-part strategy:

- To maintain competitive process technology
- To narrow the cost differential by more efficient manufacturing--a difficult task in today's economy
- To bring innovative new products to market

Process Technology

EPROMs are AMD's technology driver for its process technology. In the fourth quarter of fiscal year 1985, EPROMs accounted for 23 percent of AMD's sales but declined to a low point in third quarter fiscal year 1986 to represent 65 percent of the company's operating losses. Largely due to predatory pricing by foreign suppliers that gained market share in the United States at the expense of domestic suppliers, ASPs for EPROMs declined sharply. Thus, because of the significance of EPROM technology to AMD's long-term well-being, AMD joined with other semiconductor manufacturers in the dumping suit brought against the Japanese in late 1985. Mr. Sanders sees the July 30, 1986, trade agreement as a big step forward to restoring equity to the marketplace, and is heartened by the U.S. government's recognition of the strategic importance of semiconductor technology to the economic health and defense of this country. The trade agreement, Mr. Sanders feels, could herald a new era of "constructive competition" and, if faithfully implemented, could offer a tremendous opportunity to U.S. semiconductor suppliers.

Economy

The current economic environment outlook is poor--the GNP is stagnant, factory utilization is down, ever more U.S. manufacturing is migrating off-shore, and the trade deficit is up, none of which augurs well for the near future. Faced with these conditions, AMD's response has been to drop marginal products, such as DRAMs--which represented less than 1 percent of sales in fiscal 1986, but caused considerable losses--and to increase factory utilization and lower manufacturing costs at its 6-inch wafer fab installation in Austin, Texas. In 1986, 72 percent of AMD's wafer starts were 5-inch and above, as compared to 1984 when 87 percent of wafers used were 4-inch and below. Along with the elimination of marginal products, the Company decided to revoke its "no lay-off policy" in August of this year, a decision which caused Mr. Sanders considerable pain and personal regret but which he recognized as necessary to provide the greatest good for the greatest number. Project reviews are now in progress to discuss which marginal projects should be eliminated, which may result in layoffs in October.

Innovation

R&D spending has been extremely high as a percent of sales and AMD's goal is to reduce it to around $40 million per quarter and to better focus it to leverage spending. The Liberty Chip program (one major new product a week starting in October 1985 through September 1986) has been successful, with 62 new product introductions to date, of which 22 are in CMOS. The most recent introduction was the 8895 hard disk controller. The newest member of the Liberty drive is the Am 29337 Bounds Checker, which deals with placement of data in memory. This product was introduced September 15.

DATAQUEST COMMENTS

The following issues were addressed during the question and answer portion of the meeting:

- AMD is the fourth largest foreign supplier to the Japanese market.
- AMD employment in Japan, now at 50 employees, will double in the near future.
- It was recently announced that the company will open a quality and reliability center, and next year a new sales office in Japan.
- Last quarter, Liberty sales accounted for 6 percent of sales and is growing.
- AMD is targeting early 1987 for renewed profitability, but this depends on many things, including getting costs in line and the actual product mix.
- Mr. Sanders is optimistic about the economy, but considers any further prognostication as too speculative.
- The company's largest customers are ordering more but distributor sales are down.
- AMD has just had its first successful run of a CMOS SRAM using 6-inch wafers.
- The 1Mb EPROM is in CMOS and many more products will be in CMOS.
- By and large, customer-specific ICs will not figure heavily in AMD's product portfolio, although where an opportunity exists to increase revenue in a unique way such an opportunity will be examined--for example, the decision to produce ECL gate arrays.
- Mr. Sanders considers AMD's proprietary chips to be "ASIC" (as opposed to CSIC, customer-specific ICs, such as gate arrays) and the company will continue to participate in the programmable products market with microprocessors, PROMs, and FPLDs.

- AMD's long-term product strategy is reflected in its linkup with Sony, undertaken with a view to defining new products for the consumer market segment where AMD has little experience.

- Investment is being made in ISDN products now, although the market may not be important until the 1988 through 1989 time frame.

- Mr. Sanders is not optimistic about acquiring second-source rights to Intel's 80386, at least in the near term, primarily because Intel is capable of supplying the market demands itself.

- AMD's strength lies partially in the diversity and breadth of its product offerings--no single product represents more than 10 percent of sales.

The new tax law tends to be more punitive to capital-intensive business and the expectation is that it will increase AMD's tax liability over the next several years, although Mr. Sanders wryly commented that he was "looking forward to paying taxes." AMD's cash flow has been positive during the first half of 1986, and the company has no plans to go for bond or equity financing. The outlook for 1987 calls for a modest economic recovery and increased access to the Japanese market, but continuing concern over the worldwide glut. Conditions today are very different from the "good old days of" 1984, and only the "gold medalists" will survive.

Patricia S. Cox
Patricia Galligan
Janet Oncel

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RESEARCH BULLETIN

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1986-41

ENTERING THE JAPANESE MARKET:
NMB SEMICONDUCTOR AND NATIONAL SIGN FOUNDRY AGREEMENT

SUMMARY

NMB Semiconductor and National Semiconductor recently signed a long-term agreement to design, produce, and sell CMOS SRAMs in Japan. The initial agreement covers only 2Kx8 CMOS SRAMs but will be expanded to include three other configurations.

NMB Semiconductor currently produces CMOS DRAMs for Vitelic and Inmos and CMOS SRAMs for two undisclosed U.S. companies at its highly automated fab in Tateyama City, Chiba Prefecture. Completed in April 1985, the fab has two modules with 100 x 36-meter clean rooms, of which about 25 percent is Class 1 area. Module 1, which has a capacity of 20,000 to 24,000 wafers per month, handles 5-inch wafers. Module 2 handles 6-inch wafers. All wafer handling in the modules is fully automated.

DATAQUEST ANALYSIS

We believe that this agreement is significant for several reasons. Not only does it enable National to become a player in the Japanese SRAM market, but it helps NMB utilize its existing fab capacity. Moreover, it signals the growing use of Japanese foundries by major U.S. semiconductor makers. As shown in Table 1, many U.S. start-ups are already using Japanese foundries. Now major U.S. vendors are using Japanese foundries as a way to enter the Japanese market without having to make heavy capital investments up front. We see several emerging trends that will dramatically impact the semiconductor industry:

- More alliances between U.S. vendors and second-tier Japanese foundries to compete against the top 10 Japanese vendors
- The potential for major Japanese vendors to provide foundry to U.S. vendors to increase their capacity utilization, thereby lowering their fair market value for DRAMs and EPROMs (e.g., the recent Toshiba/Motorola DRAM agreement)

- The inclusion of second-tier Japanese foundries into the U.S.-Japan Semiconductor Arrangement

Strategic alliances are the key to survival. Companies may choose not to pursue an aggressive strategy, but they cannot afford to ignore the options available to them. In the long run, marketing strategy by omission is just as important as strategy by commission.

Sheridan Tatsuno

Table 1

U.S.-JAPANESE FOUNDRY AGREEMENTS

Foundry	Company	Date	Products
Fuji Electric	Lattice	10/85	64K CMOS SRAMs
Kawasaki Steel	LSI Logic	09/85	ASIC joint venture fab
NMB	Inmos	06/84	256K CMOS DRAMs
	Vitelic	11/85	1Mb CMOS DRAMs
	U.S. Maker	1985	Fast 64K SRAMs
	National	09/86	CMOS SRAMs (four types)
	Unannounced yet	1986	CMOS SRAMs and DRAMs
Oki Electric	Silicon Systems	09/86	Single-chip modem LSIs (1,200 bps)
Ricoh	VTI	09/83	64K/128K/256K ROMs
	Silicon Compilers	09/86	Custom ICs (Ricoh CMOS n-channel)
Seiko Epson	Xilinx	12/85	Logic cell arrays
	Lattice	02/86	Fast 64K SRAMs (16Kx4)
	Lattice	09/86	Programmable logic (GAL)
Sharp	Wafer Scale	12/84, 10/85	64K/256K CMOS EPROMs
	Mosel	05/86	Fast 256K SRAMs
Sony	Vitelic	07/85	256K/1Mb/4Mb CMOS DRAMs
Suwa Seikosha	SMOS Systems	12/84	CMOS gate arrays
	AMCC	05/85	CMOS chips
Toshiba	Motorola	09/86	ASICs; later 64K/256K DRAMs

Source: Dataquest
September 1986

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RESEARCH BULLETIN

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EXAR HOLDS FIRST ANNUAL SHAREHOLDERS' MEETING

INTRODUCTION

Exar Corporation, the first Japanese subsidiary in Silicon Valley, held its first annual shareholders' meeting September 15, 1986, in San Jose, California. The meeting marked the beginning of Exar's life as a public company.

Exar, a Rohm Co., Ltd., subsidiary, was formed in 1971 as a joint venture between Rohm and three former Signetics engineers. Exar was the first Japanese-owned company to begin semiconductor fabrication in the United States, at its Sunnyvale, California, fab. In August 1985, Exar completed its initial public offering of stock, selling 1.4 million shares at $11 a share. In February 1986, Exar acquired Exel Microelectronics Inc., a San Jose, California, manufacturer of EEPROMs. (Currently, Exar's stock is selling for $8.25 per share.)

MEETING HIGHLIGHTS

Exar's target application markets--telecommunications, data communications, computer peripherals, and industrial control and instrumentation--continue to provide strong growth opportunities for the company.

Exar's sales growth exceeded 100 percent from 1983 through 1986, although it dipped slightly in 1986, from $56.9 million to $52.5 million. The company has remained profitable, with net income of $4.4 million in fiscal 1986. Its parent company, Rohm Co., Ltd., accounted for 37.6 percent of Exar's total sales in fiscal 1986. Other international sales accounted for 17.0 percent of sales, and U.S. sales were 45.4 percent of sales.

Along product lines, sales of linear/digital and digital ICs--the newer products--increased, while sales of the company's more mature linear ICs fell. In fiscal 1985, custom and standard product sales were almost equal; in fiscal 1986, custom product sales were much higher.

Exar's R&D expenditures increased to 10 percent of sales in fiscal 1986 ($5.3 million). Included in this figure was a VAX 8600 host computer for the engineering department.

The purchase of Exel Microelectronics has given Exar an inexpensive fab with Class 10 clean room and access to Exel's 2-micron CMOS and EEPROM technology. In addition, Exel's $40 million in operating losses and $3 million in tax credits give Exar tax benefits. Exar has restarted the Exel fab, and is continuing product development at Exel.

Exar's future plans include the offering of wafer foundry services, the development of analog/digital compilers jointly with Silicon Compilers, Inc., and a comprehensive USIC (User-Specific Integrated Circuit) program. In an effort to expand its international presence, Exar recently opened a design center in London.

NEW PRODUCTS

Two major new products have been developed by Exar and Exel, respectively. They are as follows:

- Exar's FLEXAR™: A flexible linear array that allows a designer to make any transistor in the array either NPN or PNP. In addition, unused bonding pads may be converted to resistors, capacitors, or diodes, as required.

- Exel's ERASIC™: An electrically erasable programmable logic device (EEPLD) that allows multilevel logic.

Exel will soon introduce a 1-transistor cell EEPROM that the company believes will finally make EEPROMs competitive with EPROMs.

DATAQUEST COMMENTS

Exar has established a fine record as a profitable manufacturer of custom and standard linear, linear/digital, and digital ICs. The company has positioned itself well in a growing market. With majority ownership still in the hands of Rohm Co., Ltd., Exar has the ability and opportunity to continue to be both profitable and innovative.

Patricia S. Cox

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-36

DATAQUEST ANNOUNCES FINAL 1985 JAPANESE SEMICONDUCTOR MARKET SHARE FIGURES

SUMMARY

This newsletter summarizes the data contained in the Market Share chapter of JSIS Volume I, Markets. The tables in this newsletter rank companies by product for 1984 and 1985. You may wish to file this newsletter behind the Market Share tab of JSIS Volume I.

WORLDWIDE SEMICONDUCTOR MARKET

In a worldwide semiconductor market that fell 16 percent in 1985, Japanese companies' revenues declined only 12 percent, due to their dominant position in their home market, which declined far less than the worldwide market.

NEC, with total worldwide semiconductor revenue of almost $2 billion, became the number one semiconductor supplier worldwide in 1985, the first year a Japanese company has held that position. Five of the top ten manufacturers in the world were Japanese companies in 1985, and Japanese companies gained worldwide market share, growing from 39.5 percent of the market in 1984 to 41.2 percent in 1985. The top five Japanese companies alone accounted for 28.7 percent of the total worldwide semiconductor market in 1985. The Japanese presence is most strongly felt in MOS memory and optoelectronics, areas in which they hold worldwide market shares of 56.9 percent and 50.0 percent, respectively.

Tables 1 through 12 give Japanese companies' 1984 and 1985 worldwide rankings in the major semiconductor product families.

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Table 1

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL SEMICONDUCTOR MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	2,251	1,984	-12%
2	2	Hitachi	2,051	1,671	-19%
3	3	Toshiba	1,561	1,459	-7%
4	4	Fujitsu	1,190	1,020	-14%
6	5	Matsushita	928	906	-2%
5	6	Mitsubishi	964	706	-27%
7	7	Sanyo	455	457	0%
9	8	Sharp	354	329	-7%
8	9	Oki	362	307	-15%
10	10	Rohm	252	250	-1%
12	11	Fuji Electric	176	173	-2%
11	12	Sony	177	168	-5%
13	13	Sanken	162	149	-8%
14	14	Seiko Epson	115	93	-19%
		Other Japanese Companies	484	438	-10%
		Japanese Companies	11,482	10,110	-12%
		Total Market	29,051	24,543	-16%

Source: Dataquest
September 1986

Table 2

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL INTEGRATED CIRCUIT MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	1,838	1,603	-13%
2	2	Hitachi	1,569	1,236	-21%
4	3	Toshiba	1,035	995	-4%
3	4	Fujitsu	1,098	940	-14%
6	5	Matsushita	592	595	1%
5	6	Mitsubishi	766	510	-33%
8	7	Sanyo	305	314	3%
7	8	Oki	343	289	-16%
9	9	Sharp	238	201	-16%
10	10	Sony	132	130	-2%
12	11	Rohm	111	105	-5%
11	12	Seiko Epson	115	93	-19%
13	13	Sanken	47	46	-2%
14	14	Fuji Electric	32	31	-3%
		Other Japanese Companies	307	299	-3%
		Japanese Companies	8,528	7,387	-13%
		Total Market	22,788	18,706	-18%

Source: Dataquest
September 1986

Table 3

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL BIPOLAR DIGITAL MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Fujitsu	305	267	-12%
2	2	Hitachi	223	194	-13%
3	3	NEC	134	129	-4%
4	4	Mitsubishi	123	79	-36%
5	5	Toshiba	37	33	-11%
6	6	Oki	25	22	-12%
7	7	Matsushita	22	21	-5%
8	8	Sanyo	18	18	0%
9	9	Rohm	15	15	0%
10	10	Sony	8	5	-38%
11	11	Fuji Electric	2	1	-50%
		Other Japanese Companies	32	21	-34%
		Japanese Companies	944	805	-15%
		Total Market	4,778	3,763	-21%

Source: Dataquest
September 1986

Table 4

WORLDWIDE SEMICONDUCTOR MARKET
BIPOLAR DIGITAL MEMORY MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Fujitsu	136	125	-8%
2	2	Hitachi	59	54	-8%
3	3	NEC	23	25	9%
		Other Japanese Companies	0	0	N/A
		Japanese Companies	218	204	-6%
		Total Market	807	666	-17%

N/A = Not Applicable

Source: Dataquest
September 1986

Table 5

WORLDWIDE SEMICONDUCTOR MARKET
BIPOLAR DIGITAL LOGIC MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	Fujitsu	169	142	-16%
2	2	Hitachi	164	140	-15%
4	3	NEC	111	104	-6%
3	4	Mitsubishi	123	79	-36%
5	5	Toshiba	37	33	-11%
6	6	Oki	25	22	-12%
7	7	Matsushita	22	21	-5%
8	8	Sanyo	18	18	0%
9	9	Rohm	15	15	0%
10	10	Sony	8	5	-38%
11	11	Fuji Electric	2	1	-50%
		Other Japanese Companies	32	21	-34%
		Japanese Companies	726	601	-17%
		Total Market	3,972	3,097	-22%

Source: Dataquest
September 1986

Table 6

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL MOS MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	1,414	1,174	-17%
2	2	Hitachi	1,167	853	-27%
3	3	Toshiba	770	727	-6%
4	4	Fujitsu	753	631	-16%
5	5	Mitsubishi	541	320	-41%
7	6	Matsushita	283	269	-5%
6	7	Oki	315	264	-16%
8	8	Sharp	214	173	-19%
9	9	Seiko Epson	115	93	-19%
10	10	Sanyo	67	68	1%
11	11	Sony	51	49	-4%
12	12	Fuji Electric	6	6	0%
13	13	Rohm	5	5	0%
		Other Japanese Companies	51	43	-16%
		Japanese Companies	5,752	4,675	-19%
		Total Market	13,088	10,176	-22%

Source: Dataquest
September 1986

Table 7

WORLDWIDE SEMICONDUCTOR MARKET
MOS MEMORY MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Hitachi	971	662	-32%
2	2	NEC	713	470	-34%
3	3	Fujitsu	527	412	-22%
4	4	Toshiba	396	288	-27%
5	5	Mitsubishi	370	169	-54%
6	6	Oki	149	90	-40%
7	7	Matsushita	80	58	-28%
8	8	Sharp	40	28	-30%
9	9	Seiko Epson	29	20	-31%
10	10	Sony	8	8	0%
11	11	Sanyo	1	1	0%
		Other Japanese Companies	6	3	-50%
		Japanese Companies	3,290	2,209	-33%
		Total Market	6,340	3,883	-39%

Source: Dataquest
September 1986

Table 8

WORLDWIDE SEMICONDUCTOR MARKET
MOS MICRODEVICE MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	411	375	-9%
5	2	Matsushita	119	111	-7%
4	3	Hitachi	120	110	-8%
3	4	Fujitsu	121	106	-12%
2	5	Mitsubishi	156	97	-38%
7	6	Toshiba	70	69	-1%
6	7	Sharp	71	46	-35%
8	8	Oki	46	43	-7%
9	9	Sanyo	35	36	3%
10	10	Sony	26	26	0%
11	11	Seiko Epson	18	15	-17%
12	12	Rohm	2	2	0%
		Other Japanese Companies	11	9	-18%
		Japanese Companies	1,206	1,045	-13%
		Total Market	3,257	2,739	-16%

Source: Dataquest
September 1986

Table 9

WORLDWIDE SEMICONDUCTOR MARKET
MOS LOGIC MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Toshiba	304	370	22%
2	2	NEC	290	329	13%
3	3	Oki	120	131	9%
4	4	Fujitsu	105	113	8%
6	5	Matsushita	84	100	19%
5	6	Sharp	103	99	-4%
7	7	Hitachi	76	81	7%
8	8	Seiko Epson	68	58	-15%
11	9	Mitsubishi	15	54	260%
9	10	Sanyo	31	31	0%
10	11	Sony	17	15	-12%
12	12	Fuji Electric	6	6	0%
13	13	Rohm	3	3	0%
		Other Japanese Companies	34	31	-9%
		Japanese Companies	1,256	1,421	13%
		Total Market	3,492	3,554	2%

Source: Dataquest
September 1986

Table 10

WORLDWIDE SEMICONDUCTOR MARKET
LINEAR MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
2	1	Matsushita	287	305	6%
1	2	NEC	290	300	3%
3	3	Toshiba	228	235	3%
4	4	Sanyo	220	228	4%
5	5	Hitachi	179	189	6%
6	6	Mitsubishi	102	111	9%
7	7	Rohm	91	85	-7%
8	8	Sony	73	76	4%
9	9	Sanken	47	46	-2%
10	10	Fujitsu	40	42	5%
12	11	Sharp	24	28	17%
11	12	Fuji Electric	24	24	0%
13	13	Oki	3	3	0%
		Other Japanese Companies	224	235	5%
		Japanese Companies	1,832	1,907	4%
		Total Market	4,927	4,767	-3%

Source: Dataquest
September 1986

Table 11

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL DISCRETE MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Hitachi	430	392	-9%
2	2	Toshiba	418	368	-12%
3	3	NEC	379	351	-7%
4	4	Matsushita	247	227	-8%
5	5	Mitsubishi	185	178	-4%
6	6	Fuji Electric	132	130	-2%
7	7	Rohm	112	111	-1%
9	8	Sanyo	105	103	-2%
8	9	Sanken	109	97	-11%
10	10	Fujitsu	40	37	-8%
11	11	Sony	34	28	-18%
12	12	Oki	4	4	0%
		Other Japanese Companies	135	102	-24%
		Japanese Companies	2,330	2,128	-9%
		Total Market	4,984	4,648	-7%

Source: Dataquest
September 1986

Table 12

WORLDWIDE SEMICONDUCTOR MARKET
TOTAL OPTOELECTRONIC MARKET SHARE ESTIMATES
SALES BY JAPANESE MANUFACTURERS
(Millions of Dollars)

Ranking Worldwide 1984	Ranking Worldwide 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Sharp	116	128	10%
2	2	Toshiba	108	96	-11%
3	3	Matsushita	89	84	-6%
4	4	Fujitsu	52	43	-17%
5	5	Hitachi	52	43	-17%
6	6	Sanyo	45	40	-11%
8	7	Rohm	29	34	17%
7	8	NEC	34	30	-12%
10	9	Mitsubishi	13	18	38%
9	10	Oki	15	14	-7%
11	11	Fuji Electric	12	12	0%
12	12	Sony	11	10	-9%
13	13	Sanken	6	6	0%
		Other Japanese Companies	42	37	-12%
		Japanese Companies	624	595	-5%
		Total Market	1,280	1,189	-7%

Source: Dataquest
September 1986

JAPANESE SEMICONDUCTOR MARKET

Japanese manufacturers dominated their home market, with 89.8 percent market share in 1985. (For Japanese market share splits by manufacturers' home base, see Market Share in Japan--Executive Summary, behind the Market Share tab of JSIS Volume I, Markets.) In the Japanese market, only one foreign-based manufacturer--Texas Instruments--is ranked among the top ten suppliers.

NEC, Toshiba, Hitachi, Matsushita, and Fujitsu were the top five suppliers to the Japanese market in 1985. These companies' sales accounted for 61.7 percent of the Japanese semiconductor market in 1985. Of these, Fujitsu suffered the most severe revenue decline, dropping 9 percent.

Two of the top ten suppliers--Sony and Sharp--actually increased their sales in Japan in 1985. All but $2 million of Sony's semiconductor sales were to the Japanese market, and the company surged ahead in almost all of its product families, including MOS memory, MOS logic, diodes, and optoelectronic devices. Sony has been a captive supplier for some time, and only entered the merchant market in 1983, so its small existing merchant sales base has provided plenty of room for growth. In addition, high levels of compact disk player production have given Sony an excellent captive market for laser diodes. Sharp was also able to capitalize on a strong 1985 consumer market, in which it is a major player. The top ten suppliers to the market accounted for 82.3 percent of the total Japanese semiconductor market.

Top ranked foreign companies in the Japanese market in 1985 were Texas Instruments (number 8), Intel (number 14), Motorola (number 16), National Semiconductor (number 18), Philips-Signetics (number 19), AMD (number 20), Fairchild (number 21), and Analog Devices (number 22). However, foreign suppliers all told accounted for only 10.2 of the entire Japanese semiconductor market in 1985. Also, only one European company is listed in the top 25--Philips-Signetics. It must be noted here that the July 31 U.S.-Japan semiconductor trade agreement calls for increased penetration of the Japanese semiconductor market by foreign-based semiconductor firms, not solely by U.S. semiconductor firms; therefore, European firms have some hope for increased Japanese market access in the future.

Tables 13 through 24 rank the top worldwide manufacturers' semiconductor sales in Japan in 1984 and 1985.

NOTE

A complete set of market share tables by product for Japanese companies worldwide and for all companies into Japan was published in August 1986. This set of tables is entitled Market Share Estimates, and is filed behind the Market Share tab of JSIS Volume I, Markets. Please contact your JSIS binderholder for more information.

Patricia S. Cox

Table 13

JAPANESE SEMICONDUCTOR MARKET
TOTAL SEMICONDUCTOR MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	1,556	1,518	-2%
2	2	Toshiba	1,104	1,096	-1%
3	3	Hitachi	1,093	1,029	-6%
4	4	Matsushita	798	798	0%
5	5	Fujitsu	772	706	-9%
6	6	Mitsubishi	757	595	-21%
7	7	Sanyo	358	361	1%
8	8	Texas Instruments	342	268	-22%
11	9	Sony	169	250	48%
10	10	Sharp	198	241	22%
9	11	Oki	209	207	-1%
12	12	Rohm	155	161	4%
13	13	Fuji Electric	150	134	-11%
14	14	Intel	107	91	-15%
16	15	Sanken	85	86	1%
15	16	Motorola	97	71	-27%
18	17	Seiko Epson	52	42	-19%
20	18	National Semiconductor	45	40	-11%
21	19	Philips-Signetics	30	33	10%
17	20	Advanced Micro Devices	54	29	-46%
19	21	Fairchild	45	28	-38%
22	22	Analog Devices	26	27	4%
29	23	Burr-Brown	10	17	70%
23	24	General Instrument	24	16	-33%
24	25	Harris	18	15	-17%
		All Other Companies	535	482	-10%
		Total Market	8,789	8,341	-5%

Source: Dataquest
September 1986

Table 14

JAPANESE SEMICONDUCTOR MARKET
TOTAL INTEGRATED CIRCUIT MARKET SHARE ESTIMATES
BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	1,223	1,206	-1%
2	2	Toshiba	732	773	6%
3	3	Hitachi	720	684	-5%
4	4	Fujitsu	710	645	-9%
6	5	Matsushita	515	535	4%
5	6	Mitsubishi	584	410	-30%
7	7	Texas Instruments	340	267	-21%
8	8	Sanyo	234	243	4%
9	9	Oki	194	193	-1%
10	10	Sony	122	153	25%
12	11	Sharp	98	128	31%
11	12	Intel	107	91	-15%
13	13	Rohm	94	89	-5%
14	14	Motorola	92	68	-26%
17	15	Sanken	47	46	-2%
16	16	Seiko Epson	52	42	-19%
19	17	National Semiconductor	38	34	-11%
21	18	Philips-Signetics	30	33	10%
15	19	Advanced Micro Devices	54	29	-46%
18	20	Fairchild	41	28	-32%
22	21	Analog Devices	26	27	4%
20	22	Fuji Electric	31	19	-39%
25	23	Burr-Brown	10	17	70%
23	24	Harris	18	15	-17%
24	25	ITT	16	12	-25%
		All Other Companies	426	388	-9%
		Total Japanese Market	6,554	6,175	-6%

Source: Dataquest
September 1986

Table 15

JAPANESE SEMICONDUCTOR MARKET
TOTAL BIPOLAR DIGITAL MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	Fujitsu	210	188	-10%
2	2	Texas Instruments	180	144	-20%
3	3	Hitachi	119	119	0%
5	4	NEC	114	115	1%
4	5	Mitsubishi	116	72	-38%
6	6	Toshiba	37	33	-11%
7	7	Fairchild	27	22	-19%
9	8	Matsushita	22	21	-5%
13	9	Philips-Signetics	15	21	40%
11	10	Motorola	19	20	5%
10	11	Oki	21	19	-10%
12	12	Sanyo	16	16	0%
8	13	Advanced Micro Devices	25	15	-40%
14	14	Monolithic Memories	12	8	-33%
15	15	National Semiconductor	8	8	0%
16	16	Harris	4	3	-25%
17	17	Intel	4	2	-50%
18	18	Ferranti	2	1	-50%
19	19	Fuji Electric	2	1	-50%
20	20	Plessey	1	1	0%
		All Other Companies	29	21	-28%
		Total Market	983	850	-14%

Source: Dataquest
September 1986

Table 16

JAPANESE SEMICONDUCTOR MARKET
BIPOLAR DIGITAL MEMORY MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	Fujitsu	80	77	-4%
2	2	Hitachi	32	36	13%
3	3	NEC	17	20	18%
4	4	Texas Instruments	12	10	-17%
5	5	Philips-Signetics	5	8	60%
6	6	Advanced Micro Devices	4	3	-25%
9	7	Harris	3	2	-33%
8	8	Fairchild	3	1	-67%
7	9	Monolithic Memories	4	1	-75%
11	10	Motorola	1	1	0%
10	11	National Semiconductor	2	0	-100%
		All Other Companies	6	5	-17%
		Total Market	169	164	-3%

Source: Dataquest
September 1986

Table 17

JAPANESE SEMICONDUCTOR MARKET
BIPOLAR DIGITAL LOGIC MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Texas Instruments	168	133	-21%
2	2	Fujitsu	130	112	-14%
4	3	NEC	97	95	-2%
5	4	Hitachi	85	80	-6%
3	5	Mitsubishi	116	72	-38%
6	6	Toshiba	37	33	-11%
7	7	Fairchild	24	21	-13%
8	8	Matsushita	22	21	-5%
10	9	Motorola	18	19	6%
9	10	Oki	21	19	-10%
11	11	Sanyo	16	16	0%
13	12	Philips-Signetics	10	13	30%
14	13	Monolithic Memories	8	10	25%
15	14	National Semiconductor	8	9	13%
12	15	Advanced Micro Devices	15	7	-53%
16	16	Intel	4	2	-50%
17	17	Ferranti	2	1	-50%
18	18	Harris	1	1	0%
19	19	Plessey	1	1	0%
		All Other Companies	23	16	-30%
		Total Market	806	681	-16%

Source: Dataquest
September 1986

Table 18

JAPANESE SEMICONDUCTOR MARKET
TOTAL MOS MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	828	799	-4%
2	2	Toshiba	480	516	8%
3	3	Fujitsu	460	417	-9%
4	4	Hitachi	449	400	-11%
6	5	Matsushita	240	241	0%
5	6	Mitsubishi	371	232	-37%
7	7	Oki	170	171	1%
10	8	Sharp	77	103	34%
8	9	Intel	103	89	-14%
9	10	Texas Instruments	100	72	-28%
14	11	Sony	38	59	55%
12	12	Sanyo	51	52	2%
11	13	Seiko Epson	52	42	-19%
13	14	Motorola	49	31	-37%
15	15	Advanced Micro Devices	25	12	-52%
20	16	VLSI Technology	7	9	29%
17	17	ITT	9	7	-22%
19	18	Harris	7	6	-14%
21	19	Fuji Electric	5	5	0%
18	20	National Semiconductor	8	5	-38%
26	21	American Microsystems	3	3	0%
33	22	Integrated Device Tech	2	3	50%
16	23	Mostek	11	3	-73%
25	24	RCA	4	3	-25%
29	25	Rohm	3	3	0%
		All Other Companies	58	41	-29%
		Total Market	3,610	3,324	-8%

Source: Dataquest
September 1986

Table 19

JAPANESE SEMICONDUCTOR MARKET
MOS MEMORY MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Hitachi	354	295	-17%
2	2	NEC	315	250	-21%
3	3	Fujitsu	271	226	-17%
5	4	Toshiba	148	125	-16%
4	5	Mitsubishi	235	97	-59%
6	6	Matsushita	68	52	-24%
7	7	Oki	46	32	-30%
9	8	Intel	29	25	-14%
8	9	Texas Instruments	32	18	-44%
12	10	Sharp	10	15	50%
11	11	Seiko Epson	10	14	40%
16	12	Sony	4	12	200%
10	13	Advanced Micro Devices	11	5	-55%
18	14	Xicor	3	3	0%
20	15	Harris	2	2	0%
21	16	Integrated Device Tech	2	2	0%
15	17	Micron Technology	5	2	-60%
17	18	Seeq	3	2	-33%
23	19	VLSI Technology	2	2	0%
		All Other Companies	30	9	-70%
		Total Market	1,580	1,188	-25%

Source: Dataquest
September 1986

Table 20

JAPANESE SEMICONDUCTOR MARKET
MOS MICRODEVICE MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	284	267	-6%
3	2	Fujitsu	114	101	-11%
4	3	Matsushita	101	99	-2%
2	4	Mitsubishi	126	85	-33%
5	5	Intel	64	60	-6%
6	6	Toshiba	63	60	-5%
7	7	Hitachi	55	55	0%
8	8	Oki	39	36	-8%
11	9	Sharp	22	31	41%
9	10	Texas Instruments	35	28	-20%
10	11	Sanyo	25	26	4%
13	12	Motorola	13	10	-23%
12	13	Advanced Micro Devices	13	7	-46%
14	14	Harris	3	3	0%
15	15	National Semiconductor	2	2	0%
17	16	Zilog	2	2	0%
		All Other Companies	18	13	-28%
		Total Market	979	885	-10%

Source: Dataquest
September 1986

Table 21

JAPANESE SEMICONDUCTOR MARKET
MOS LOGIC MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Toshiba	269	331	23%
2	2	NEC	229	282	23%
3	3	Oki	85	103	21%
4	4	Fujitsu	75	90	20%
5	5	Matsushita	71	90	27%
6	6	Sharp	45	57	27%
8	7	Hitachi	40	50	25%
14	8	Mitsubishi	10	50	400%
9	9	Sony	34	47	38%
7	10	Seiko Epson	41	27	-34%
10	11	Texas Instruments	33	26	-21%
12	12	Sanyo	25	25	0%
11	13	Motorola	29	20	-31%
15	14	ITT	8	7	-13%
17	15	VLSI Technology	5	7	40%
16	16	Fuji Electric	5	5	0%
13	17	Intel	10	4	-60%
20	18	American Microsystems	2	3	50%
18	19	National Semiconductor	4	3	-25%
		All Other Companies	31	24	-23%
		Total Market	1,051	1,251	19%

Source: Dataquest
September 1986

Table 22

JAPANESE SEMICONDUCTOR MARKET
LINEAR MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	NEC	281	292	4%
2	2	Matsushita	253	273	8%
3	3	Toshiba	215	224	4%
4	4	Sanyo	167	175	5%
5	5	Hitachi	152	165	9%
6	6	Mitsubishi	97	106	9%
8	7	Sony	84	94	12%
7	8	Rohm	91	85	-7%
9	9	Texas Instruments	60	51	-15%
10	10	Sanken	47	46	-2%
11	11	Fujitsu	40	40	0%
12	12	Analog Devices	26	27	4%
16	13	Sharp	21	25	19%
15	14	National Semiconductor	22	21	-5%
19	15	Burr-Brown	10	17	70%
14	16	Motorola	24	17	-29%
13	17	Fuji Electric	24	13	-46%
17	18	Philips-Signetics	15	12	-20%
31	19	Silicon Systems	3	7	133%
18	20	Fairchild	14	6	-57%
22	21	Harris	7	6	-14%
21	22	Intersil	8	6	-25%
24	23	Sprague	6	6	0%
23	24	ITT	7	5	-29%
25	25	Precision Monolithics	5	5	0%
		All Other Companies	282	277	-2%
		Total Market	1,961	2,001	2%

Source: Dataquest
September 1986

Table 23

JAPANESE SEMICONDUCTOR MARKET
TOTAL DISCRETE MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Hitachi	351	325	-7%
3	2	NEC	308	289	-6%
2	3	Toshiba	309	270	-13%
4	4	Matsushita	195	181	-7%
5	5	Mitsubishi	165	169	2%
6	6	Fuji Electric	107	105	-2%
7	7	Sanyo	86	84	-2%
8	8	Sony	34	42	24%
9	9	Rohm	33	39	18%
10	10	Sanken	32	34	6%
11	11	Fujitsu	30	30	0%
12	12	General Instrument	17	13	-24%
13	13	National Semiconductor	7	6	-14%
18	14	International Rectifier	3	4	33%
16	15	Oki	4	4	0%
20	16	Semikron	3	4	33%
19	17	KEC	3	3	0%
14	18	Motorola	5	3	-40%
21	19	Siliconix	3	3	0%
		All Other Companies	69	51	-26%
		Total Market	1,764	1,659	-6%

Source: Dataquest
September 1986

Table 24

JAPANESE SEMICONDUCTOR MARKET
TOTAL OPTOELECTRONIC MARKET SHARE ESTIMATES
SALES BY MAJOR MANUFACTURERS
(Millions of Dollars)

Ranking in Japan 1984	Ranking in Japan 1985	Company	1984	1985	Percent Change 1984-1985
1	1	Sharp	100	113	13%
2	2	Matsushita	88	82	-7%
9	3	Sony	13	55	323%
3	4	Toshiba	63	53	-16%
4	5	Sanyo	38	34	-11%
6	6	Rohm	28	33	18%
5	7	Fujitsu	32	31	-3%
7	8	NEC	25	23	-8%
8	9	Hitachi	22	20	-9%
13	10	Mitsubishi	8	16	100%
10	11	Fuji Electric	12	10	-17%
11	12	Oki	11	10	-9%
12	13	Hewlett-Packard	8	6	-25%
14	14	Sanken	6	6	0%
16	15	Siemens	2	4	100%
		All Other Companies	15	11	-27%
		Total Market	471	507	8%

Source: Dataquest
September 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-35

IMPROVING INTERNATIONAL COMPETITIVENESS: A DATAQUEST VIEW

SUMMARY

Dataquest held a half-day seminar on July 31 to discuss international competitiveness in the semiconductor industry. Five Dataquest analysts and four outside speakers presented data and analysis on the topics of preserving strategic industries, the implications of trade cases for future competition, the status and future of the Japanese semiconductor industry, the future implications of shifting market shares in the semiconductor industry, intellectual property and trade restrictions, Korean manufacturers' competitiveness, and onshore versus offshore assembly.

The seminar coincided with an announcement from the White House that a final semiconductor trade agreement between the United States and Japan had been reached in the early hours of the morning. There was much speculation on the immediate and ultimate results of the agreement on market access and price monitoring. Most seminar attendees believed that price monitoring will be difficult to enforce. Skepticism was expressed on how much U.S. companies will actually be able to penetrate the Japanese semiconductor market, given the high percentage of consumer semiconductors used in Japan.

COMPETITIVENESS, MARKET SHARE, AND PRESERVATION OF THE INDUSTRY

Gene Norrett, associate director of Dataquest's Semiconductor Industry Group, noted the persistent decline of manufacturing as a percentage of the U.S. GNP, and the corresponding manufacturing trade imbalance. He pointed out the dominance of Japanese suppliers in the MOS memory business and noted that any company not involved in MOS memory--the largest single sector of the semiconductor industry--will lose market share as a result of the expected slower compound annual growth rate (CAGR) of the semiconductor industry excluding MOS memory.

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MOS memory manufacturers will gain market share. Japanese companies are also fast gaining ground in the semiconductor equipment business. The three top lead frame manufacturers, for example, are Japanese.

Patricia Cox, research analyst for the Japanese Semiconductor Industry Service, presented Dataquest's estimates of the phenomenal growth in Japanese semiconductor revenue (at a rate almost twice as fast as U.S. companies), the high growth in Japan's domestic semiconductor market, and the explosive growth in Japanese companies' semiconductor exports. These statistics, coupled with Japanese companies' extremely high R&D and capital spending, indicate continued trends toward Pacific Basin dominance of the semiconductor industry. Dataquest believes that Japanese-company worldwide semiconductor market share will exceed U.S.-company worldwide market share in 1986.

Although Japanese companies are gaining market share and the Japanese market has grown very fast, there are still a number of problems facing the Japanese semiconductor industry, according to Osamu Ohtake, associate director of the Japanese Semiconductor Industry Service. He pointed to the profit squeeze caused by the fast appreciation of the yen, the tremendous industry overcapacity, and the competitive threat of older industrial companies that are now branching out into semiconductors in an attempt to diversify. He concluded that win-win relationships should be formed between U.S. and Japanese companies in the form of synergistic alliances in manufacturing, sales, distribution, and development.

Dr. Mike Bae, president of Macro Group and consultant to Dataquest on the Korean semiconductor industry, discussed the current status of the Korean manufacturers. The hard times in Japan are creating the perfect opportunity for Korean companies to begin to penetrate the worldwide semiconductor market. He noted that Samsung has become the first Korean company to produce a working 1Mb DRAM. He cautioned that the Koreans must be careful to avoid dumping charges by pricing near the market level.

Anthony Perrotta, president of Amkor Electronics Inc., presented Amkor/Anam's view of onshore versus offshore assembly. Taking into account shifting geographic demand for semiconductors, the growing ASIC market, and shifting packaging types, he examined the relative merits of onshore versus offshore assembly. He concluded that although some new assembly will be installed in the United States between now and 1990, the bulk of new assembly will be in the Far East.

TRADE, TRADE, AND TRADE

Two seminar speakers focused on the semiconductor trade agreement signed early July 31 between the U.S. and Japanese governments.

Dr. William Finan, of Quick, Finan, and Associates, believes that the Japanese think that the ball game is over--and that they won. He pointed out, however, that the case that is potentially the most significant in its long-term effects has not yet been decided--that is, Texas Instruments' lawsuit against Japanese companies for patent infringement in

256K DRAMs. The case will most likely not be decided until next year, but it could potentially result in an embargo on the importation to the United States of all DRAMs made by the infringing companies, both in chip form and embedded in end equipment.

Dr. John Barton, professor of law at Stanford University, discussed the international status of intellectual property law but more particularly focused on the trade agreements. He believes that the market access issue is a qualitative problem that needs a qualitative solution. Regarding the price-monitoring system scheduled to begin this month, he does not believe that most companies will adhere to the minimum prices they are required to charge, because that would severely hamper their ability to sell their products. But Dr. Barton does believe that the legality of the agreement will be upheld in U.S. courts. The only possible counterargument would be that true production costs are extremely difficult to calculate, thereby shedding doubt on the accuracy of the cost and pricing data used in enforcement of the agreement.

CONCLUSIONS

Sheridan Tatsuno, senior industry analyst for the Japanese Semiconductor Industry Service, concluded the seminar with a summary of the main points:

- Semiconductor industry dominance is shifting from the United States to Japan and Asia.

- Because Japan is currently facing economic problems associated with the high value of the yen and political pressure from the major economic powers, the country is pushing to achieve the next major technological breakthrough by focusing heavily on innovation and creativity.

- In light of the recent semiconductor agreement, U.S., European, and Asian vendors should seek alliances with Japanese OEMs to increase their market shares in Japan.

Bound seminar proceedings and a videotape of the seminar will soon be available. To purchase copies of either, please call JSIS at (408) 971-9000, extension 481.

Patricia S. Cox
Sheridan Tatsuno

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JAPANESE RESEARCH NEWSLETTER

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1986-34
Rev. 9/12/86

JAPANESE SEMICONDUCTOR APPLICATION TRENDS FIRST QUARTER 1986

SUMMARY

First quarter 1986 electronics/electric equipment production in Japan was ¥4.0 trillion ($19 billion), up 1.0 percent from the same period in 1985 but down 7.1 percent from the fourth quarter of 1985.

First quarter 1986 semiconductor consumption decreased by 4.7 percent compared with the first quarter of 1985, although it increased 1.0 percent over the ¥499.4 billion ($2.4 billion) reported in the fourth quarter of 1985.

We believe that equipment production value in 1986 will grow only slightly to ¥16.5 trillion ($100 billion at ¥165 per US$1), up from ¥16.4 billion ($68.9 billion) over 1985 due to the appreciation of the yen.

The high appreciation of the yen has also caused the first quarter GNP to drop by 0.5 percent in real terms from the previous quarter. The most significant impact of the yen appreciation has been a sharp drop in exports; they have decreased by 4.9 percent relative to fourth quarter 1985.

THE MARKET

Dataquest's Japanese Semiconductor Industry Service recently constructed a data base composed of 50 different types of major electronics/electrical equipment. We have analyzed these equipment types for their semiconductor usage, and have built up a semiconductor consumption data base as a check against the analysis of industry and government data.

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Table 1 shows the first quarter 1986 electronics production value as ¥1.8 trillion ($7.2 billion) for consumer electronics and ¥2.1 trillion ($8.2 billion) for industrial electronics. Compared with the same period last year, consumer electronics production decreased 2.7 percent, while industrial electronics production increased 4.3 percent. Industrial electronics production, however, declined 2.1 percent compared with the fourth quarter of 1985.

To facilitate the comparison with the U.S. and European markets, the same data converted to dollars are shown in Table 2. Total Japanese electronics production is expected to be $95.2 billion in 1986, achieving 36.9 percent growth. We have shown the market in dollars, but this really is of little use, since all of this growth is due to yen appreciation.

Table 3 shows the year-to-year quarterly comparisons of electronics equipment production in Japan based on the first quarter result. We forecast an overall 5.6 percent decrease for consumer electronics and a 5.0 percent increase for industrial electronics in 1986. If this happens then we expect zero growth for total electronics production in 1986.

SEMICONDUCTOR CONSUMPTION

Table 4 shows Japanese semiconductor consumption in the first quarter by application category. In the first quarter of 1986, semiconductor consumption was ¥504.4 billion ($2.68 billion). Consumer semiconductor consumption was ¥141.3 billion ($0.75 billion) and industrial semiconductor consumption was ¥363.1 billion ($1.9 billion).

Figure 1 shows the composition of the semiconductor consumption for first quarter 1986. Because of the drive to produce industrial electronics, industrial semiconductor consumption increased to 72 percent of the total in first quarter 1986 from 69.2 percent in first quarter 1985.

Consumer Electronics

Semiconductor consumption for consumer electronics in the first quarter of 1986 was ¥141.3 billion ($751.6 million). Among the consumer electronics products, digital audio disk players and video cameras grew rapidly. The estimated semiconductor consumption in the first quarter was ¥12.5 billion ($66.5 million) for video cameras, up 50.5 percent, and ¥10.3 billion ($54.8 million) for digital audio disk players, up 258.1 percent.

On the other hand, large decreases were observed in headphone stereos and tape recorders (including radiocassettes). Dataquest estimates that semiconductor consumption in headphone stereos and tape recorders was ¥2.4 billion ($12.8 million) and ¥8.7 billion ($46.3 million), respectively, and both decreased 36.1 percent compared with fourth quarter 1985.

Industrial Electronics

Generally speaking, semiconductor consumption in industrial electronics was not as bad as for consumer electronics. Comparing first quarter in 1986 versus fourth quarter 1985, we did not see large declines.

Although industrial semiconductor consumption declined 0.6 percent from the first quarter of 1985, it grew 2.3 percent compared with the fourth quarter.

In particular, we observed large increases in semiconductor consumption for input/output units, peripheral units, and telephone-related devices. Their growth ratios from the fourth quarter of 1985 were 86.2 percent, 71.4 percent, and 67.4 percent, respectively.

In the computer category, the semiconductor demands for personal computers and office computers were brisk, with consumption values of ¥33.4 billion ($177.7 million), up 28 percent, and ¥9 billion ($47.8 million, up 31 percent, respectively.

Nagayoshi Nakano

Table 1

FORECAST QUARTERLY JAPANESE ELECTRONICS PRODUCTION
1985-1986
(Billions of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Consumer	¥1,855.4	¥2,098.8	¥1,942.5	¥2,036.5	¥ 7,933.3
Industrial	2,076.6	2,033.3	2,213.7	2,240.1	8,563.7
Total	¥3,932.1	¥4,132.1	¥4,156.2	¥4,276.6	¥16,497.0

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Consumer	¥1,805.5	¥1,932.9	¥1,858.0	¥1,895.4	¥ 7,491.7
Industrial	2,166.9	2,104.0	2,337.7	2,382.7	8,991.3
Total	¥3,972.4	¥4,036.8	¥4,195.7	¥4,278.1	¥16,483.0

Note: Totals may not add due to rounding.

Table 2

FORECAST QUARTERLY JAPANESE ELECTRONICS PRODUCTION
1985-1986
(Millions of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Consumer	$ 7,219.5	$ 8,361.8	$ 7,993.8	$ 9,838.2	$33,413.3
Industrial	8,080.2	8,100.8	9,109.9	10,821.7	36,112.6
Total	$15,299.7	$16,462.6	$17,103.7	$20,659.9	$69,525.9
Exchange Rate (Yen per US$)	257	251	243	207	237

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Consumer	$ 9,603.7	$11,437.3	$10,994.1	$11,215.4	$43,250.5
Industrial	11,526.1	12,449.7	13,832.5	14,098.8	51,907.1
Total	$21,129.8	$23,887.0	$24,826.6	$25,314.2	$95,157.6
Exchange Rate (Yen per US$)	188	169	169	169	174

Source: Dataquest
August 1986

Table 3

YEAR-TO-YEAR QUARTERLY COMPARISONS OF JAPANESE ELECTRONICS PRODUCTION
PERCENT GROWTH--1985-1986
(Percent of Yen)

	Q1/85- Q1/86	Q2/85- Q2/86	Q3/85- Q3/86	Q4/85- Q4/86	1985- 1986
Total	1.0%	(2.3%)	0.9%	0	(0.1%)
Consumer	(2.7%)	(7.9%)	(4.4%)	(6.9%)	(5.6%)
Industrial	4.3%	3.5%	5.6%	6.4%	5.0%

Table 4

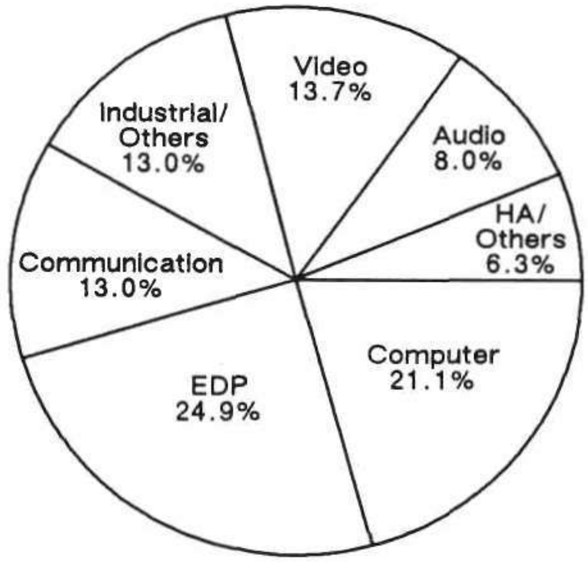
ESTIMATED FIRST QUARTER 1986 SEMICONDUCTOR CONSUMPTION IN JAPAN
BY APPLICATION CATEGORY
(Billions of Yen)

		Percent Change Versus	
	Q1/86	Q1/85	Q4/85
Total Semiconductor	¥504.4	(3.5%)	(6.8%)
Total Consumer	¥141.3	(10.2%)	6.3%
Video	¥ 69.4	(10.2%)	(12.0%)
Audio	¥ 40.3	0.5%	(4.4%)
HA/Others	¥ 31.6	3.3%	(6.0%)
Total Industrial	¥363.1	(0.6%)	2.3%
Computer	¥106.6	27.1%	(16.8%)
BDP	¥125.5	0	0
Communication	¥ 65.4	1.3%	42.0%
Industrial/Others	¥ 65.6	(40.7%)	(1.2%)

Source: Dataquest
August 1986

Figure 1

ESTIMATED SEMICONDUCTOR CONSUMPTION IN JAPAN BY APPLICATION
FIRST QUARTER 1986
(Percent of Yen)



Source: Dataquest
August 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-33

JAPANESE SEMICONDUCTOR MARKET QUARTERLY UPDATE: HIGH YEN WREAKING HAVOC ON JAPANESE CONSUMPTION

SUMMARY

Dataquest has tempered its forecast for the 1986 Japanese semiconductor market as the devastating effects of the high yen make themselves felt. We have lowered our forecast for yen growth in Japanese consumption to a meager 1.2 percent in 1986, followed by a healthy 22.2 percent in 1987. At the same time, due to a still-rising yen, we expect dollar consumption in Japan to grow a hefty 39.1 percent in 1986, followed by slower growth of 25.3 percent in 1987. However, because we have assumed a flat exchange rate of ¥169 per US$1 from the second quarter of 1986 through the fourth quarter of 1987, real growth (i.e., yen growth) is expected to be considerably higher in 1987 than in 1986.

Figure 1 shows quarter-to-quarter percent growth in yen for the Japanese semiconductor market from the first quarter of 1985 through the fourth quarter of 1987. Figure 2 presents the same data in dollars.

EFFECTS OF CURRENCY FLUCTUATIONS

The effects of the extreme drop in the dollar and concomitant rise in the yen must not be underestimated. The high yen is making Japanese-manufactured electronic equipment--both consumer and industrial electronics--uncompetitive in dollar terms. To counter this effect and maintain profitability, Japanese firms are beginning to manufacture this end equipment in Korea, Taiwan, and other Asian countries where they can save on cheap labor rates. As a result, many semiconductors (and other components) that normally would be consumed in equipment made in Japan are now being consumed in equipment made and marketed by Japanese companies in other Asian countries. This shift in consumption has the effect of dramatically increasing the Asian semiconductor market in 1986.

Our forecast uses actual quarterly exchange rates through the second quarter of 1986; from the third quarter of 1986 through the fourth quarter of 1987 we have used the Q2/86 exchange rate of ¥169 per US$1.

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Most Japanese semiconductor companies are assuming a 1986 average exchange rate of approximately ¥170 per US$1; however, the dollar continues to hit new lows against the yen, reaching a new record of ¥155.5 on July 21.

ASSUMPTIONS

The following observations and assumptions underlie our current forecast for the Japanese semiconductor market:

- A consumption shift is taking place in which Japanese market consumption is moving to Asia.
- This shift is most prevalent in linear ICs and discrete semiconductors for the consumer electronics market, both of which are expected to show negative growth in 1986.
- We expect optoelectronic growth to be stronger than any other category of semiconductor in 1986, due to the strong consumption of semiconductor lasers and ultrabright LEDs in consumer and automotive products.
- Consumption is forecast to rebound in 1987 (although not as much as our previous forecast indicated) aided by a stable yen, increased purchasing of U.S.-made semiconductors, and a generally healthier worldwide marketplace for electronic equipment.

Our quarterly forecast, in both yen and dollars, is shown in Tables 1 through 4.

DATAQUEST CONCLUSIONS

Dataquest believes that, because of rapid yen appreciation, the Japanese semiconductor market will grow to be the world's largest in 1986, at almost $12 billion. Although this figure inflates actual growth due to the dramatic ascent of the yen, it does have significant effects. Among these are:

- Because of this high growth, we expect Japanese semiconductor manufacturers to score large gains in worldwide market share in 1986. Our current estimates are that the Japanese companies will grow at least 30 percent (in dollars) in 1986 semiconductor revenue.
- We anticipate competition in the always highly competitive Japanese market to become even fiercer than usual, causing pricing pressure on all semiconductor products.

Patricia S. Cox
Osamu Ohtake

Figure 1

JAPANESE SEMICONDUCTOR MARKET
QUARTER-TO-QUARTER PERCENT GROWTH IN YEN

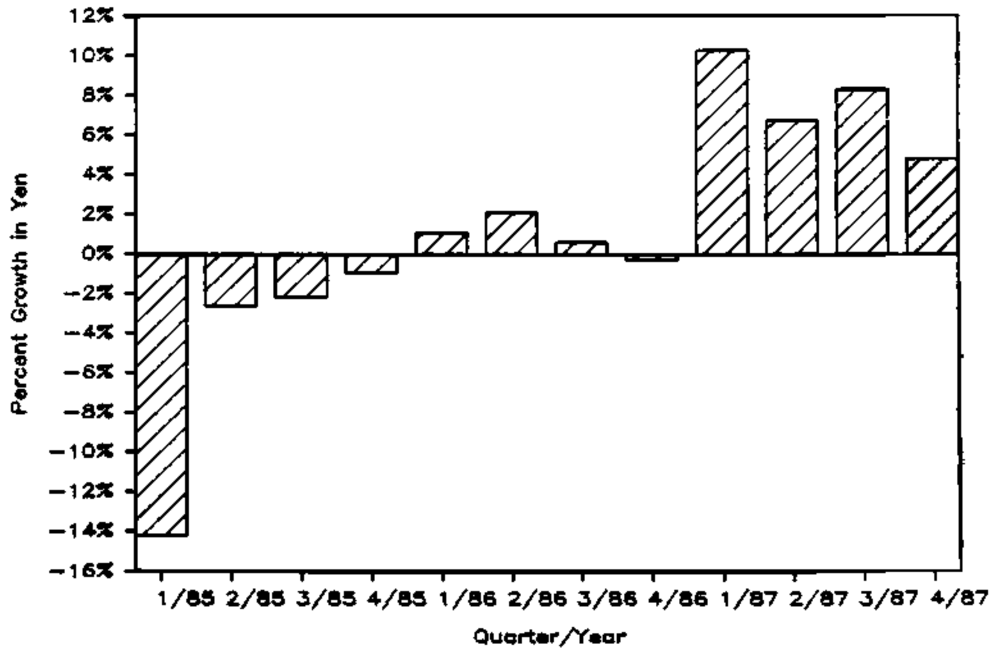
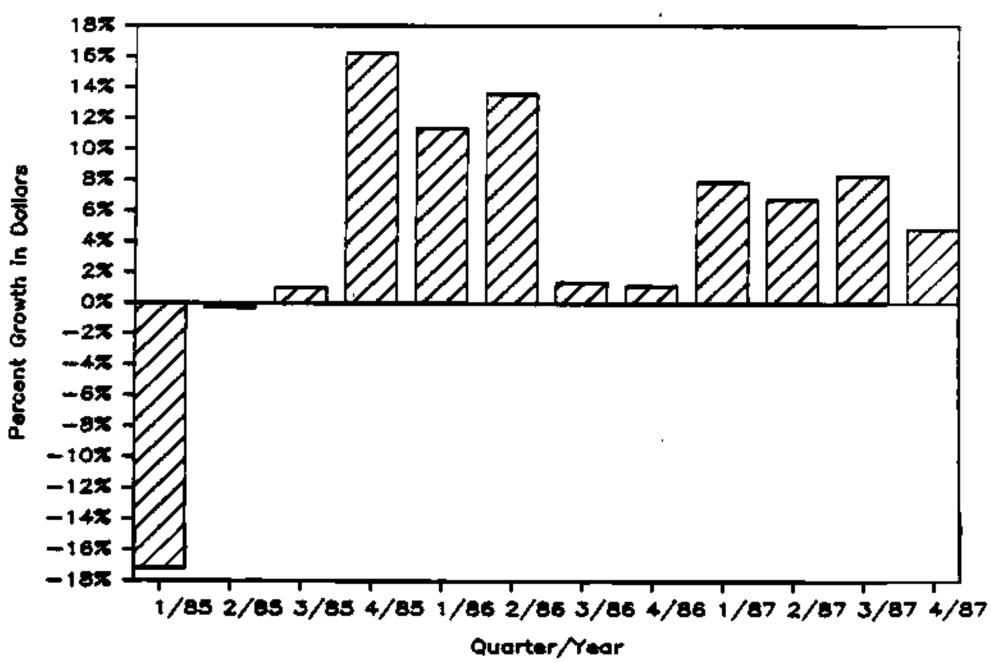


Figure 2

JAPANESE SEMICONDUCTOR MARKET
QUARTER-TO-QUARTER PERCENT GROWTH IN DOLLARS



Source: Dataquest
August 1986

Table 1

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
PERCENT GROWTH
1985-1987
(Percent of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor		-2.6%	-2.2%	-0.9%	-2.3%
Total IC		-2.7%	-3.0%	-2.0%	-1.5%
Bipolar Digital		-10.5%	-8.3%	-0.6%	-3.8%
Memory		-10.3%	-10.3%	-8.6%	-4.5%
Logic		-10.6%	-8.0%	0.7%	-3.7%
MOS		-3.7%	-4.4%	-5.2%	-3.2%
Memory		-12.8%	-17.7%	-5.5%	-19.5%
Micro Device		10.9%	10.9%	4.6%	2.2%
Logic		-1.1%	-0.1%	-12.2%	17.2%
Linear		3.9%	2.2%	3.1%	2.9%
Discrete		-3.9%	-2.2%	1.7%	-5.7%
Optoelectronic		2.8%	10.0%	4.5%	-1.3%
	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	1.1%	2.1%	0.6%	-0.3%	1.2%
Total IC	2.3%	3.0%	1.5%	0.8%	2.7%
Bipolar Digital	-1.0%	4.0%	7.6%	8.2%	.0%
Memory	0.0%	7.8%	5.8%	2.7%	-6.0%
Logic	-1.1%	3.5%	7.8%	9.0%	0.9%
MOS	5.2%	5.0%	3.0%	2.5%	5.4%
Memory	1.9%	21.7%	4.5%	5.6%	2.2%
Micro Device	0.8%	-6.5%	2.1%	5.1%	9.2%
Logic	12.2%	-0.5%	7.1%	5.9%	6.1%
Linear	-1.0%	-1.0%	-4.0%	-6.0%	-1.0%
Discrete	-4.2%	-2.0%	-4.0%	-6.0%	-9.7%
Optoelectronic	2.7%	3.6%	2.8%	0.9%	16.7%
	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	10.3%	6.8%	8.3%	4.8%	22.2%
Total IC	12.0%	9.1%	11.7%	5.9%	30.3%
Bipolar Digital	6.5%	4.8%	4.3%	1.1%	25.3%
Memory	2.7%	2.6%	5.1%	2.4%	15.3%
Logic	7.0%	5.0%	4.2%	0.9%	26.7%
MOS	16.4%	9.3%	13.2%	6.9%	39.3%
Memory	9.4%	9.3%	14.6%	7.7%	42.8%
Micro Device	15.0%	9.9%	15.9%	7.0%	40.3%
Logic	10.1%	9.0%	9.9%	6.0%	35.2%
Linear	6.0%	11.0%	12.1%	5.9%	15.3%
Discrete	2.0%	-4.0%	-9.9%	-2.0%	-13.0%
Optoelectronic	8.2%	1.4%	1.1%	0.8%	13.4%

Source: Dataquest
August 1986

Table 2

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
1985-1987
(Billions of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor	¥529.3	¥515.4	¥504.1	¥499.4	¥2,048.2
Total IC	¥407.2	¥396.4	¥384.5	¥377.0	¥1,565.1
Bipolar Digital	¥ 64.5	¥ 57.7	¥ 52.9	¥ 52.6	¥ 227.7
Memory	¥ 8.7	¥ 7.8	¥ 7.0	¥ 6.4	¥ 29.9
Logic	¥ 55.8	¥ 49.9	¥ 45.9	¥ 46.2	¥ 197.8
MOS	¥228.5	¥220.1	¥210.4	¥199.4	¥ 858.4
Memory	¥ 99.5	¥ 86.8	¥ 71.4	¥ 67.5	¥ 325.2
Micro Device	¥ 47.8	¥ 53.0	¥ 58.8	¥ 61.5	¥ 221.1
Logic	¥ 81.2	¥ 80.3	¥ 80.2	¥ 70.4	¥ 312.1
Linear	¥114.2	¥118.6	¥121.2	¥125.0	¥ 479.0
Discrete	¥ 96.7	¥ 92.9	¥ 90.9	¥ 92.4	¥ 372.9
Optoelectronic	¥ 25.4	¥ 26.1	¥ 28.7	¥ 30.0	¥ 110.2
Exchange Rate	257.0	251.0	243.0	207.0	237.0
	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	¥504.9	¥515.6	¥518.8	¥517.5	¥2,072.0
Total IC	¥385.6	¥397.0	¥402.8	¥406.2	¥1,606.8
Bipolar Digital	¥ 52.1	¥ 54.2	¥ 58.3	¥ 63.1	¥ 227.7
Memory	¥ 6.4	¥ 6.9	¥ 7.3	¥ 7.5	¥ 28.1
Logic	¥ 45.7	¥ 47.3	¥ 51.0	¥ 55.6	¥ 199.6
MOS	¥209.8	¥220.3	¥226.9	¥232.6	¥ 904.8
Memory	¥ 68.8	¥ 83.7	¥ 87.5	¥ 92.4	¥ 332.4
Micro Device	¥ 62.0	¥ 58.0	¥ 59.2	¥ 62.2	¥ 241.4
Logic	¥ 79.0	¥ 78.6	¥ 84.2	¥ 89.2	¥ 331.0
Linear	¥123.7	¥122.5	¥117.6	¥110.5	¥ 474.3
Discrete	¥ 88.5	¥ 86.7	¥ 83.2	¥ 78.2	¥ 336.6
Optoelectronic	¥ 30.8	¥ 31.9	¥ 32.8	¥ 33.1	¥ 128.6
Exchange Rate	188.0	169.0	169.0	169.0	173.8
	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	¥570.7	¥609.4	¥660.1	¥691.7	¥2,531.9
Total IC	¥455.1	¥496.5	¥554.4	¥587.1	¥2,093.1
Bipolar Digital	¥ 67.2	¥ 70.4	¥ 73.4	¥ 74.2	¥ 285.2
Memory	¥ 7.7	¥ 7.9	¥ 8.3	¥ 8.5	¥ 32.4
Logic	¥ 59.5	¥ 62.5	¥ 65.1	¥ 65.7	¥ 252.8
MOS	¥270.8	¥296.1	¥335.3	¥358.6	¥1,260.8
Memory	¥101.1	¥110.5	¥126.6	¥136.4	¥ 474.6
Micro Device	¥ 71.5	¥ 78.6	¥ 91.1	¥ 97.5	¥ 338.7
Logic	¥ 98.2	¥107.0	¥117.6	¥124.7	¥ 447.5
Linear	¥117.1	¥130.0	¥145.7	¥154.3	¥ 547.1
Discrete	¥ 79.8	¥ 76.6	¥ 69.0	¥ 67.6	¥ 293.0
Optoelectronic	¥ 35.8	¥ 36.3	¥ 36.7	¥ 37.0	¥ 145.8
Exchange Rate	169.0	169.0	169.0	169.0	169.0

Source: Dataquest
August 1986

Table 3

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
PERCENT GROWTH
1985-1987
(Percent of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor		-0.3%	1.0%	16.2%	-2.8%
Total IC		-0.3%	0.2%	15.0%	-2.1%
Bipolar Digital		-8.4%	-5.2%	16.5%	-4.6%
Memory		-8.8%	-6.5%	6.9%	-5.3%
Logic		-8.3%	-5.0%	18.0%	-4.5%
MOS		-1.3%	-1.3%	11.2%	-3.9%
Memory		-10.6%	-15.0%	10.9%	-20.6%
Micro Device		13.4%	14.7%	22.7%	2.5%
Logic		1.3%	3.1%	3.0%	16.2%
Linear		6.4%	5.6%	21.1%	2.8%
Discrete		-1.7%	1.1%	19.3%	-6.1%
Optoelectronic		5.1%	13.5%	22.9%	-1.1%

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	11.4%	13.6%	1.4%	1.2%	39.1%
Total IC	12.7%	14.5%	2.5%	2.6%	41.3%
Bipolar Digital	9.1%	15.9%	7.5%	8.1%	38.1%
Memory	9.7%	20.6%	4.9%	2.3%	29.6%
Logic	9.0%	15.2%	7.9%	8.9%	39.4%
MOS	15.9%	16.8%	4.8%	5.6%	45.4%
Memory	12.3%	35.2%	4.6%	5.6%	42.4%
Micro Device	11.1%	3.9%	2.0%	5.1%	48.6%
Logic	23.5%	10.7%	7.1%	6.0%	46.3%
Linear	9.0%	10.2%	-4.0%	-6.0%	35.4%
Discrete	5.5%	8.9%	-4.1%	-5.9%	23.7%
Optoelectronic	13.1%	15.2%	2.6%	1.0%	59.4%

	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	7.9%	6.8%	8.3%	4.8%	25.3%
Total IC	9.0%	9.1%	11.6%	5.9%	33.5%
Bipolar Digital	6.7%	4.8%	4.1%	1.2%	28.3%
Memory	4.5%	2.2%	4.3%	2.0%	18.5%
Logic	7.0%	5.1%	4.1%	1.0%	29.6%
MOS	11.0%	9.4%	13.2%	7.0%	42.7%
Memory	9.3%	9.4%	14.5%	7.7%	45.8%
Micro Device	14.9%	9.9%	15.9%	7.1%	44.1%
Logic	10.0%	9.0%	10.0%	6.0%	38.6%
Linear	6.0%	11.0%	12.1%	5.9%	18.4%
Discrete	1.9%	-4.0%	-9.9%	-2.0%	-10.6%
Optoelectronic	8.2%	1.4%	0.9%	0.9%	16.2%

Source: Dataquest
August 1986

Table 4

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
1985-1987
(Millions of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985
Total Semiconductor	$2,060	$2,054	$2,075	$2,412	$8,600
Total IC	$1,584	$1,579	$1,583	$1,821	$6,567
Bipolar Digital	$ 251	$ 230	$ 218	$ 254	$ 953
Memory	$ 34	$ 31	$ 29	$ 31	$ 125
Logic	$ 217	$ 199	$ 189	$ 223	$ 828
MOS	$ 889	$ 877	$ 866	$ 963	$3,595
Memory	$ 387	$ 346	$ 294	$ 326	$1,353
Micro Device	$ 186	$ 211	$ 242	$ 297	$ 936
Logic	$ 316	$ 320	$ 330	$ 340	$1,306
Linear	$ 444	$ 472	$ 499	$ 604	$2,019
Discrete	$ 376	$ 370	$ 374	$ 446	$1,567
Optoelectronic	$ 99	$ 104	$ 118	$ 145	$ 466
Exchange Rate	257	251	243	207	237

	Q1/86	Q2/86	Q3/86	Q4/86	1986
Total Semiconductor	$2,686	$3,051	$3,093	$3,129	$11,959
Total IC	$2,051	$2,349	$2,407	$2,470	$ 9,277
Bipolar Digital	$ 277	$ 321	$ 345	$ 373	$ 1,316
Memory	$ 34	$ 41	$ 43	$ 44	$ 162
Logic	$ 243	$ 280	$ 302	$ 329	$ 1,154
MOS	$1,116	$1,303	$1,366	$1,443	$ 5,228
Memory	$ 366	$ 495	$ 518	$ 547	$ 1,926
Micro Device	$ 330	$ 343	$ 350	$ 368	$ 1,391
Logic	$ 420	$ 465	$ 498	$ 528	$ 1,911
Linear	$ 658	$ 725	$ 696	$ 654	$ 2,733
Discrete	$ 471	$ 513	$ 492	$ 463	$ 1,939
Optoelectronic	$ 164	$ 189	$ 194	$ 196	$ 743
Exchange Rate	188	169	169	169	174

	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	$3,377	$3,606	$3,905	$4,093	$14,981
Total IC	$2,693	$2,938	$3,280	$3,474	$12,385
Bipolar Digital	$ 398	$ 417	$ 434	$ 439	$ 1,688
Memory	$ 46	$ 47	$ 49	$ 50	$ 192
Logic	$ 352	$ 370	$ 385	$ 389	$ 1,496
MOS	$1,602	$1,752	$1,984	$2,122	$ 7,460
Memory	$ 598	$ 654	$ 749	$ 807	$ 2,808
Micro Device	$ 423	$ 465	$ 539	$ 577	$ 2,004
Logic	$ 581	$ 633	$ 696	$ 738	$ 2,648
Linear	$ 693	$ 769	$ 862	$ 913	$ 3,237
Discrete	$ 472	$ 453	$ 408	$ 400	$ 1,733
Optoelectronic	$ 212	$ 215	$ 217	$ 219	$ 863
Exchange Rate	169	169	169	169	169

Source: Dataquest
August 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-32

DOING HIGH-TECHNOLOGY BUSINESS IN KOREA

SUMMARY

This newsletter is the second to supplement the Korean Semiconductor Industry Analysis (KSIA) that was published in March 1986. (For more information on the 150-page, in-depth analysis, please contact Maureen Davies at (408) 971-9000, extension 481.)

As described briefly in Chapter 7 of KSIA, the Korean government selected nine strategic industries and placed special emphasis on developing approximately 600 technologies essential to them. The semiconductor industry is one of these; the other industries are computer materials, biochemicals, bioengineering, precision machinery, plant engineering, textiles, and energy resources. For these strategic industries, the government offers financial and technological support to individuals, companies, and venture groups seeking to establish new technology-intensive businesses using up-to-date technology.

Dataquest has prepared the following summary of "what-to-do" and "how-to-do-it" if one desires to enter or participate in the fast-growing high-technology industries in Korea.

INITIAL PHASE

It is very important to assess the basic business strategy of your company before entering the market in Korea. The following steps will guide you in planning the initial phase.

Type of Business

Trading: Import/Export

Without Your Own Product: Pure Trading - Check the list of products banned from Korea. (This list is available from the Korean Ministry of Electronics.) In general, if a high-technology product is

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available from a Korean manufacturer it is banned from import. This is the government's attempt to protect high-technology start-up industries from foreign competition.

<u>With Your Own Product</u> - If a product is not made in Korea, then import authorization will usually be given. Even if a product is on the banned list, it may be manufactured and marketed in Korea if it is not on the Negative List. (See the following sections for a description of products on this list.)

<u>Where to Get More Information</u>

- Korean diplomatic missions in major cities:
  - Addresses and telephone numbers are listed in the white pages of telephone directories.
  - The mission will provide a broad range of information on government policies, investment guidelines, etc. If you want more specific information, they will guide you to the proper organization.
- Korean Traders' Association (KTA)
  - A nonprofit, nongovernmental economic organization, KTA has more than 5,000 member companies comprising all licensed exporters and importers in Korea. KTA provides foreign businessmen with up-to-date and comprehensive information about the Korean economy and export products. KTA also recommends suitable domestic exporters, importers, or manufacturers.
  -

Main office:	17th Fl., World Trade Center, Seoul, Korea
Mailing Address:	CPO Box 1117, Seoul, Korea Telephone: 771-41 Telex: K24265 KOTRASO
Tokyo Office:	Tel: (03) 438-2761 Telex: 27464 KOTRASO J
New York Office:	Tel: (212) 421-8804 Telex: 425572 KTANY
Washington Office:	Tel: (202) 682-1550 Telex: 757427 KTAWSH
Hong Kong Office:	Tel: 5-432234 Telex: 74386 KOCEK HX
Dusseldorf Office:	Tel: (0211) 498930 Telex: 8584754 KTAD

- Foreign Investment Information Center, Ministry of Finance
  - Address: 108-4 Susong-dong, Chongro-ku, Seoul, Korea
Tel: 720-2757, 723-1681
  - This office is a one-stop information center for investing in Korea.

Manufacturing

As described briefly above, it is possible to manufacture and market a product in Korea. Extra incentives will be given to products that are exported in order to stimulate the growth of foreign exchange. (Refer to the following sections.)

Products or Services

Once you have decided upon the product or service to be introduced to Korea, it is necessary to see if the product is on the Negative List. The List may be obtained from the Korean diplomatic missions or Ministry of Finance. In general, almost all high-technology-related products and services are not included in this List. But even if a product or service is on the Negative List, it will still be permitted as long as the manufactured product or service provided is 100 percent exported.

BUSINESS FORMATION: DEFINITIONS AND GUIDELINES

Branch Office of a Foreign Company

A foreign company may open a branch office in Korea by reporting to the Bank of Korea and registering the business. Registered branches conduct business for profit and must pay taxes. Branches are granted export-import licenses; however, branch offices cannot manufacture products and cannot own shares in Korean companies.

Trading Agents

Official trading agents must be registered with the Korea Traders' Association (KTA). Only these agents are allowed to issue quotations or trading orders that are recognized by the government or by banks authorized to deal in foreign exchange. (See the KTA described in the previous section.)

Corporate Entity

The Commercial Code recognizes four types of corporations: the partnership, the limited partnership, the limited company, and the stock company. The foreign investor may choose any of these four types; however, the stock corporation is the most common among foreign investors. To establish a stock corporation, articles of incorporation must be drawn up and notarized. Seven or more individuals or promoters are required for incorporation, none of whom needs to be a Korean national. Under the Civil Code, their status as "promoters" lasts only until the corporation is registered, when the board of directors assumes control of the company.

A stock corporation can be set up under either the Foreign Exchange Control Act or the Foreign Capital Inducement Act (FCIA). In practice, most foreign investors choose to establish a corporation under the FCIA, which offers tax benefits, guaranteed repatriation of profits, and other incentives (see below). The FCIA was described in a previous newsletter, entitled "Korean Taxation."

INVESTMENT

Basic Policy and Governing Laws

In recent years, the government has pursued an open-door policy for foreign investment. The basic position is clearly stated in the FCIA as follows: "The purpose of this law shall be to effectively induce and protect foreign capital conducive to the sound development of the national economy . . . ."

The FCIA is the primary governing law that regulates foreign equity investment, foreign loans, and technology inducement. It further stipulates conditions and procedures for licensing, tax incentives, and repatriation of capital as well as remittance of dividends. Other laws relating to foreign investment are the Foreign Exchange Control Act, the Alien Land Acquisition Act, the Customs Law, the Commercial Code, and various tax laws.

FCIA provides that foreign investors and enterprises are treated the same as Korean nationals in the course of performing business in Korea.

Eligible and Noneligible Projects

Industrial areas in which foreign investment is prohibited or restricted are described on the Negative List. A foreign investment in a product or service not appearing on the Negative List may be allowed with the approval of the Minister of Finance.

- Noneligible Projects (on the Negative List)
  - Public projects conducted by the government or public organizations
  - Projects that cause harm to the health and sanitation of Korean nationals and the maintenance of the environment
  - Projects that are clearly contrary to good morals and traditions
  - Other projects prescribed by the Enforcement Decree of FCIA

- Restricted Projects

  These are projects that will be permitted after certain developments in the national economy.

  - Projects that are being supported by the government on a special basis
  - Projects that consume energy excessively or use imported raw materials at an overly high rate
  - Highly pollution-prone projects
  - Projects that cause luxurious consumption or extravagance
  - Projects that endanger the livelihoods of farmers and fishermen
  - Projects belonging to infant industries that need temporary protection

<u>Minimum Foreign Investment Ratio</u>

The minimum allowable amount or value of foreign equity investment is US$100,000, and this investment must be less than 50 percent of the total investment.

The form of equity investment may be as follows:

- Cash
- Capital goods
- Profits accruing from stocks or shares acquired in accordance with the FCIA
- Industrial property rights, or any other technology equivalent thereto or any right to use it

This foreign investment ratio is set forth in an official agreement between the foreign investor and his Korean partner, as outlined in the articles of incorporation. Foreign investment with a ratio less than 50 percent may be approved immediately if the following conditions are met:

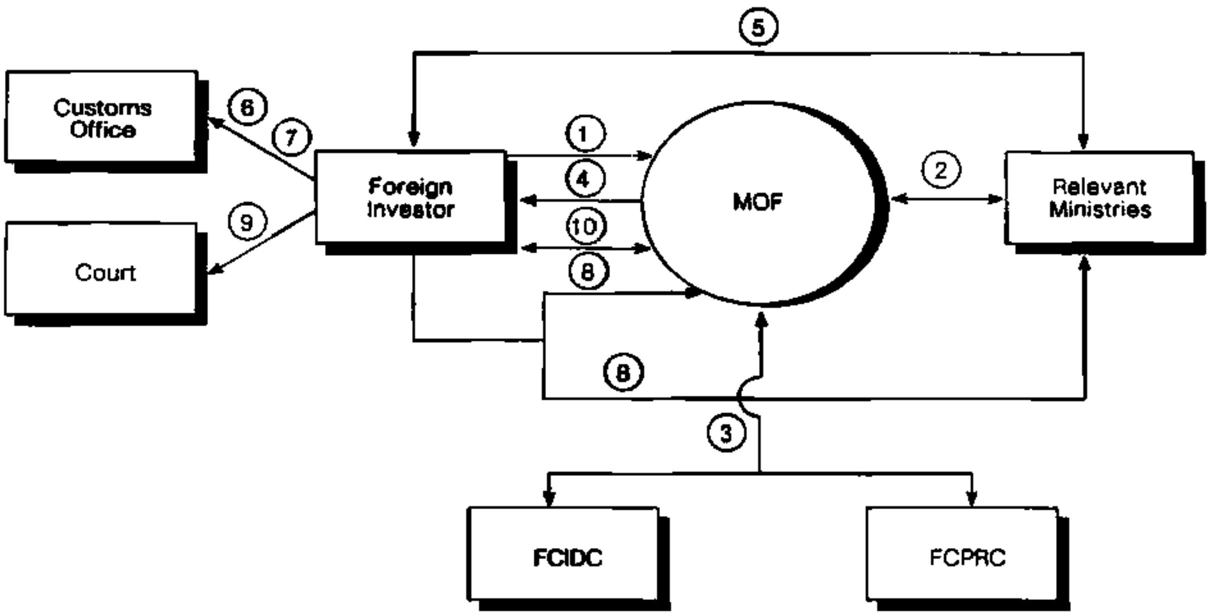
- The minimum foreign investment ratio is less than 50 percent
- The project is not on the Negative List
- The amount of foreign investment is equivalent to US$1 million or less
- A foreign investor does not apply for tax exemption or reduction

Investment Procedure

Figure 1 portrays the procedures of the foreign investment application and implementation process and the offices administering each step.

Figure 1

PROCEDURES FOR FOREIGN INVESTMENT PROPOSALS



(1) Application for authorization

(2) Review of application

(3) Deliberation and approval

(4) Authorization

(5) Application for confirmation of specification of capital goods and issuing the letter thereof

(6) Import declaration

(7) Application for exemption or reduction of customs duty, etc.

(8) Report of foreign capital inducement

(9) Registration

(10) Registration of foreign invested enterprise

Note: Procedures (2) and (3) are omitted in the case of projects eligible for automatic approval.

MOF: Ministry of Finance

FCIDC: Foreign Capital Inducement Deliberation Committee
Advisory body to the Minister of Finance

FCPRC: Foreign Capital Project Review Committee
Chaired by the Minister of Finance

Source: Ministry of Finance

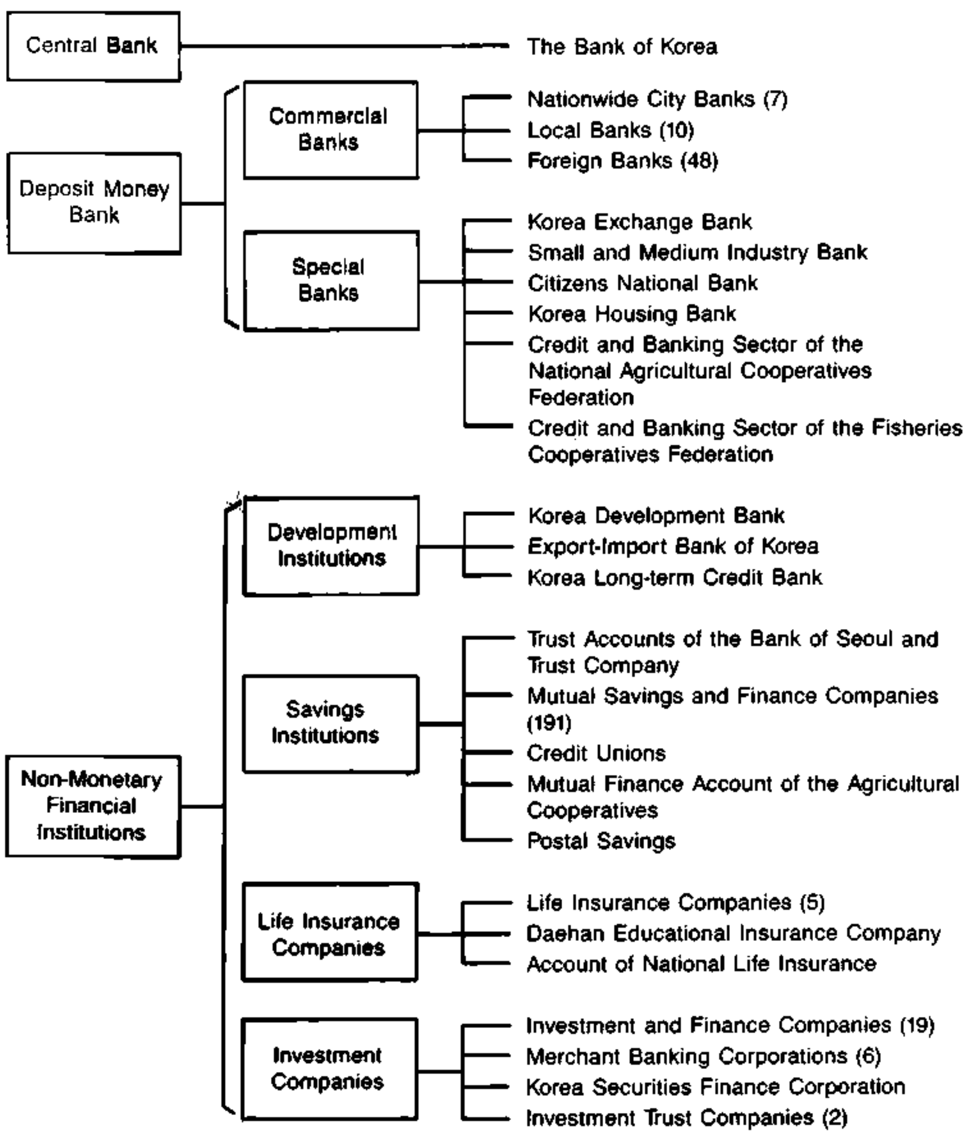
BANKING AND FINANCE IN KOREA

Financial Sector

The financial sector of Korea includes a diversified commercial banking system, a wide range of secondary financial institutions, and a securities market (see Figure 2). There is no discrimination between foreign-invested and domestic business firms in acquiring financial credits from banking institutions.

Figure 2

KOREAN FINANCIAL INSTITUTIONS



Note: Figures in parentheses denote the number of institutions as of the end of 1983

Source: Bank of Korea

Small and Medium-Size Industry Support Organizations

In addition to the financial sector, there are many government and private institutions and organizations that support small and medium-size companies in every aspect of business, including start-up financing and the funding of new product development. Listed below are some of the most commonly used institutions for supporting small and medium-size companies:

- Banking Institutions

  - The Korea Exchange Bank
    Address: 181 2-ka, Ulchi-ro, Choong-ku, Seoul, Korea
    Tel: 771-46

    This is the largest commercial bank in Korea specializing in foreign exchange transactions, trade financing, and all areas of international banking. It maintains an international network of 38 branches, subsidiaries, and representatives.

  - The Small and Medium Industry Bank
    Address: 26-1 2-ka, Ulchi-ro, Choong-ku, Seoul, Korea
    Tel: 771-50

    This bank supports all phases of banking needs for small and medium-size industries, including start-up financing.

  - The Citizen's National Bank
    Address: 9-1 2-ka, Namdaemoon-ro, Choong-ku, Seoul, Korea
    Tel: 771-40

    This bank provides general banking with short-term loans to individuals and small companies. It gives special assistance to start-up companies with new products or technologies by providing long-term loans or equity investments.

  - The Korea Long-term Credit Bank
    Address: 15-22 Yoido-dong, Youngdungpo-ku, Seoul, Korea
    Tel: 783-4431

    This bank supports the commercialization of new technologies by providing long-term loans or equity investments.

- Venture Capital Companies

  There are four private venture capital companies in Korea. However, they are heavily subsidized by the government and their objective is not primarily a high return to their investors. Their profits are mainly put into a revolving fund to support further investments with nominal dividends provided to the investors, who are usually public and private institutions. In addition to financial support, all of these venture capital companies provide services such as arranging private investment, preparing business proposals, handling all of the procedures of business formation, and giving advice on managing the business. These venture capital companies can be of great assistance to foreign investors who wish to do business under a joint ventureship.

- Korea Technology Development Corporation (KTDC)
  Address: 9th Fl., FKI Building
  28-1 Yoido-dong, Youngdungpo-ku, Seoul, Korea
  Tel: 783-7601, 783-7851

  KTDC was established in 1977 under the "Korea Technology Development Act" that provides government support with autonomous, private management. It provides funds to business enterprises at favorable terms, including equity investments needed for developing technology. In most cases it provides up to $1 million a year to a large number of companies.

- Korea Development Investment Corporation (KDIC)
  Address: 12th Fl., Private School Endowment Building
  27-2 Yoido-dong, Youngdungpo-ku, Seoul, Korea
  Tel: 783-9574

  KDIC was established in 1982 by domestic and international investment companies. It is very selective, but provides large amounts of money, depending on the project. It is similar in character to U.S. venture firms. Its primary investment is in new inventions or technologies either from domestic or foreign businesses manufacturing in Korea.

- Korea Technology Financing Corporation (KTFC)
  Address: Industrial Bank Building
  10-2 Kwanchul-dong, Chongro-ku, Seoul, Korea
  Tel: 744-5411

  KTIC is sponsored by domestic private financial institutions. It is similar to the KTDC.

- Korea Technology Advancement Corporation (K-TAC)
  Address: c/o KAIST
  39-1 Hawolgok-dong, Sungbook-ku, Seoul, Korea
  Tel: 962-8197

  K-TAC was established by seven government R&D organizations to commercialize their technological developments. In addition, several domestic banking and investment organizations support the venture. The company also provides funds to those with technologies from sources other than their member R&D firms.

THE BOTTOM LINE

The FCIA guarantees the overseas remittance of profit dividends accruing from the stock or shares acquired by a foreign investor, sales proceeds from stock or shares, principal, interest and fees to be paid under a loan contract or a public loan agreement, and royalties to be paid under a technology inducement contract. When a foreign investor wants to remit abroad, one must file an application with the president of the Foreign Exchange Bank (such as the Korea Exchange Bank) for approval. The president of the bank will approve the application after reviewing the legitimacy of the repatriation.

Should a foreign investor want to invest profit dividends accruing from the stock or shares acquired in accordance with the FCIA in an enterprise in Korea, the investor must report to the Minister of Finance and first obtain approval. Then all properties of foreign-invested enterprise are guaranteed and protected from requisition or expropriation under pertinent laws and decrees.

CONCLUSIONS

It is Dataquest's opinion that there will be many new joint venture companies formed between U.S. and Korean investors in the next five years. Specifically, we see the semiconductor industry growing at a compound annual growth rate of a minimum of 22 percent over the next five years, and with this high rate, local companies will be funded to support its growth.

Gene Norrett
Dr. Mike Bae

Dataquest
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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-29

SEMICONDUCTOR APPLICATIONS: SECOND QUARTER UPDATE

INTRODUCTION

Because of the need for detailed semiconductor application information, DATAQUEST's Japanese Semiconductor Industry Service (JSIS) will issue a quarterly newsletter addressing detailed equipment trends, semiconductor application data, and analysis. This issue marks our first such newsletter. We have chosen to summarize 1985 end-equipment trends in Japan and to examine VTRs in particular.

SUMMARY

Equipment production value in Japan was $69.3 billion in 1985 and semiconductors worth $8.6 billion were consumed. DATAQUEST's JSIS compiled data about semiconductor consumption in Japan and completed our analysis as follows:

- Japanese equipment production value increased from $59.5 billion in 1984 to $69.3 billion in 1985, achieving 16.5 percent growth. So as to show the real growth in production we have presented the figures in yen in Figure 1 and in dollars in Table 1.

- Semiconductor consumption decreased by 2.3 percent, from $8.8 billion in 1984 to $8.6 billion in 1985.

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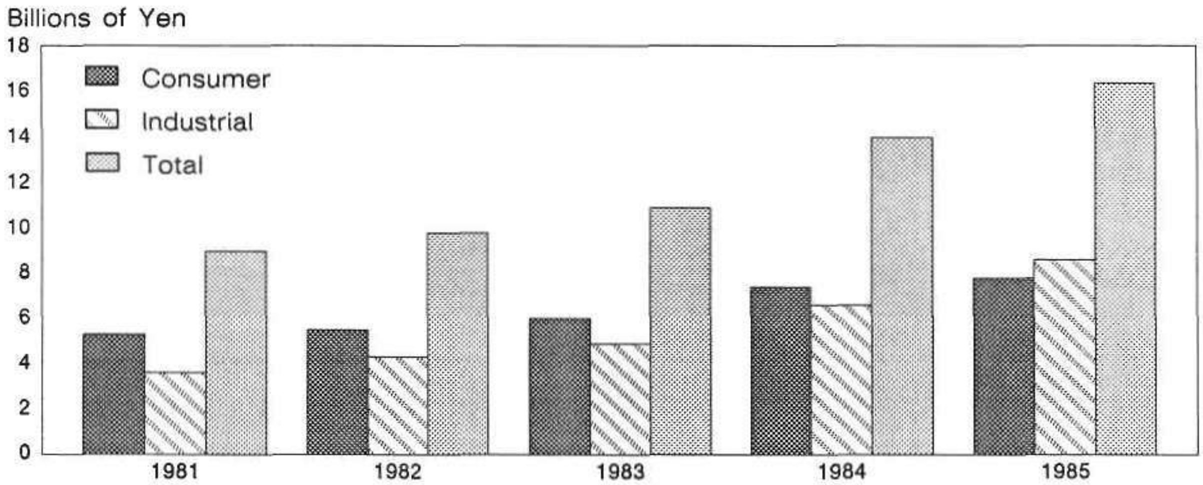
Figure 1

EQUIPMENT PRODUCTION GROWTH IN JAPAN



Source: DATAQUEST
June 1986

Table 1

ESTIMATED JAPANESE ELECTRONIC EQUIPMENT PRODUCTION

	Billions of Yen				
	1981	1982	1983	1984	1985
Consumer	¥5.3	¥5.5	¥ 6.0	¥ 7.4	¥ 7.8
Industrial	3.6	4.3	4.9	6.6	8.6
Total	¥9.0	¥9.8	¥10.9	¥14.0	¥16.4
	Millions of Dollars				
	1981	1982	1983	1984	1985
Consumer	$24.2	$22.2	$25.7	$31.4	$33.0
Industrial	16.7	17.3	21.1	28.1	36.3
Total	$40.9	$39.5	$46.8	$59.5	$69.3
Exchange Rate ¥/US$	221	249	235	237	238

Source: DATAQUEST
June 1986

EQUIPMENT PRODUCTION

DATAQUEST's JSIS data base includes 50 types of end-use products containing semiconductors and captures the production value and quantity. For example, in the consumer electronics category we include products such as VTRs, video cameras, color television sets, and digital audio disk players. In the industrial electronics segment we include computers, copying machines, facsimile equipment, word processors, and communications equipment. Automotive electronics are included where appropriate in the various end markets. For example, car stereo equipment is included in stereo equipment under consumer electronics. In Table 2 we present the semiconductor consumption by end market in both yen and dollars. In local currency we estimate that the market declined by 2.3 percent.

Table 2

ESTIMATED JAPANESE SEMICONDUCTOR CONSUMPTION BY END-USE CATEGORY

	Billions of Yen		
	1984	1985	Percent Change
Consumer	¥ 997.92	¥ 938.04	(6.0%)
Industrial	1,098.48	1,110.12	1.1%
Total	¥2,096.40	¥2,048.16	(2.3%)

	Millions of Dollars		
	1984	1985	Percent Change
Consumer	$4.2	$4.0	(4.8%)
Industrial	4.7	4.6	(2.0%)
Total	$8.9	$8.6	(3.4%)
Exchange Rate ¥/US$	237	238	

Source: DATAQUEST
June 1986

Consumer Electronics

Japanese VTR production value was $8.0 billion in 1985, down 8.6 percent from the previous year, and recorded a negative growth for the first time.

DATAQUEST estimates that the value of semiconductors used for VTRs was $939 million and consumption decreased by 10.7 percent in 1985. Because of the importance of VTRs in the overall video category and the softness in VTRs, the whole video category share dropped 3 percent in 1985 (see Table 3). On the other hand, because of the growth of the compact disk player market, the audio category's gross share grew 2.6 percent in 1985.

Table 3

ESTIMATED SHARE OF JAPANESE SEMICONDUCTOR MARKET BY END-USE CATEGORY (Percent)

	1984	1985
Consumer		
Video	24.5%	21.6%
Audio	7.6	10.2
Home Appliance	2.5	2.7
Others	13.0	11.2
Total Consumer	47.6%	45.7%
Industrial		
Data Processing	26.6%	26.4%
Communications	13.4	13.6
Industrial/Others	12.4	14.3
Total Industrial	52.4%	54.3%
Total	100.0%	100.0%

Source: DATAQUEST
June 1986

Industrial Electronics

Personal computer production in 1985 achieved 23 percent growth, reaching $1.4 billion. At the same time, semiconductor consumption increased 24.6 percent due to increased penetration of semiconductors into this end product. Overall data processing semiconductor consumption achieved approximately the same share in 1985 as in 1984 (see Table 3).

VTR SEMICONDUCTORS

DATAQUEST has completed a detailed analysis of VCRs in terms of semiconductor usage. Semiconductors are classified into MOS logic, MOS MPU, MOS memory, bipolar digital, bipolar linear, discrete, and opto in order to identify more accurate trends.

We chose to analyze the contents of the VTR market because it is the leading semiconductor application market. According to DATAQUEST's analysis, 281 semiconductor devices are used in an average VTR (see Table 4). These devices have an average factory cost of $43. Furthermore, the I/O coefficient (the semiconductor value divided by the ASP of the VTR) is 11 percent.

Table 4

SEMICONDUCTOR CONTENTS IN VTR
(Average Model)

Category	Quantity	Semiconductor Value	ASP of VTR	I/O Ratio
MOS				
Logic	3			
MPU	3			
Memory	0			
Bipolar				
Digital	5			
Linear	22			
Transistor	106			
Diode	118			
Rectifier	10			
LED	14			
Total	281	$43	$390	11%

Source: DATAQUEST
June 1986

In Table 5, we present our estimates of the total production of VTRs in 1985 and show the volume of the five largest Japanese producers. Matsushita is the largest, producing an estimated 7.5 million units. Total 1985 production of VTRs is estimated to be 30.8 million units. In Table 6 we present our estimates of the manufacturers' international production of VTRs. Two observations can be made:

- European VTR production in 1986 will significantly exceed the production in any other region.

- Matsushita is planning to produce 50,000 VTRs in the Peoples' Republic of China.

Nagayoshi Nakano
Gene Norrett

Table 5

TOP FIVE JAPANESE MANUFACTURERS OF VTRs IN 1985
(Millions of Units)

Rank	Company	Units
1	Matsushita	7.5
2	Victor Company of Japan	4.8
3	Hitachi	3.9
4	Sharp	3.6
5	Sony	3.3
	Others	7.7
	Total	30.8

Source: DATAQUEST
June 1986

Table 6

ESTIMATED NON-JAPANESE VTR PRODUCTION
(Thousands of Units)

Company	Geographic Location	Production 1985	1986
Akai Electric	France	0	40
JVC	West Germany	0	480
	United Kingdom	0	360
	United States	0	Plan
Hitachi	West Germany	120	360
	United States	0	10
	United Kingdom	60	120
Matsushita	West Germany	300	300
	United States	0	0
	Peoples' Republic of China	1	50
Mitsubishi	United States	0	12
	United Kingdom	16	240
NEC HE	Europe	0	Plan
Sanyo Electric	United Kingdom	60	60
	Taiwan	48	48
	West Germany	180	180
	Spain	66	66
Sony	West Germany	20	20
	Spain	50	50
	Taiwan	40	40
	Brazil	0	10
	France	0	0
Toshiba	United Kingdom	120	120
	West Germany	0	0
Total		1,081	2,566

Source: DATAQUEST
June 1986

Dataquest
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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-30

JAPANESE MICRODEVICE INDUSTRY UPDATE-- HIGH-PERFORMANCE CMOS TECHNOLOGY IS DRIVING FORCE

INTRODUCTION

Microcomputer Show '86 was held in Tokyo, Japan, in late May. This was the tenth year for this show, organized by the Japanese Electronics Industry Development Association (JEIDA). The participants, which included major Japanese semiconductor manufacturers, showed many new products.

The exhibits at the show made it apparent to DATAQUEST that high-performance CMOS technology is the driving force for new products.

MARKET OVERVIEW

In 1985, Japanese microdevice production declined by 4 percent from the previous year, due to the weak demand by the video cassette recorder (VCR) and personal computer (PC) markets. However, DATAQUEST estimates that this year's growth rate will be high for the following reasons:

- IBM announced a new laptop PC that uses a CMOS MPU (80C88) and memories. CMOS is one of the Japanese semiconductor industry's strong areas.

- Japan has a lion's share of the world consumer electronics market, which is becoming increasingly semiconductor-intensive (due to such products as 8mm VCRs and portable televisions), and, therefore, increasing the consumption of CMOS products.

- In the technology areas, CMOS micro is a powerful negotiation tool for several Japanese companies to establish market leadership with products such as NEC's CMOS V series and Hitachi's high-performance CMOS 6301 8-bit MCU.

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NEW CMOS MPU/MCU/MPR PRODUCTS IN MICROCOMPUTER SHOW '86

At the show, many companies introduced new products (see Table 1). DATAQUEST has observed the following trends among these new products:

- Original design MPUs, such as NEC's V60 (16-bit), Matsushita's MN1617 (16-bit), and Mitsubishi's M63162 (16-bit.) The V60 has very high performance (5 MIPS) and impressive architecture such as vertical storage, on-chip floating-point calculation function, and pipelined hardware. The V60 process technology, with 1.5-micron design rule and 2-layer aluminum circuit, can realize about 375,000 transistors on-chip. Matsushita's MN1617, jointly developed by Matsushita Electronics Corporation and Matsushita Electric Industrial Co., Ltd., is an enhanced version of the MN1613. This high-speed MPU operates at 20 MHz, can address 4 Mbytes of main memory, uses a 2-micron CMOS process with single poly and double-layer aluminum technology, and contains 60,500 transistors on a 6.7mm x 7.0mm chip. Mitsubishi's M63162 has an original design with three levels of pipelined control architecture and uses 2-micron design rule with polycide gate and 2-layer aluminum technology. The chip size is 9.26 x 7.50mm, and contains about 59,000 transistors.

- CMOS versions of existing popular NMOS products, such as Hitachi's HD68HC000 and Fujitsu's Intel-compatible MPRs. DATAQUEST estimates that these CMOS products will be major components for future advanced and very smart office equipment.

- Specific MPRs for the Japanese market for FAX and CAPTAIN (VIDEOTEX). Hitachi's HD63084/HD63085Y has been developed for G3/G4 high-speed facsimile machines. Fujitsu's MB 89323/324 is a multiplex character controller for the CAPTAIN system, and has analog RGB (red, green, blue) outputs and 12 Mbytes of RAM addressing capability.

DATAQUEST ANALYSIS

The world electronic equipment production by major regions is changing now because of lower costs, government promotion, and technology development. As a result of the current changes, we expect the Asian region to become the major production site, not only for consumer equipment, but also for low-cost computer-related products, including PCs. However, the Japanese industry is experiencing hard times because of the high yen. The Japanese semiconductor industry has been hurt by price pressure coming from domestic customers who have had to reduce their costs to maintain their competitive power against the yen increase. Furthermore, trade friction is causing various other pressures against Japanese manufacturers.

Under the circumstances, DATAQUEST believes that the high-performance CMOS microdevices will be a driving force in developing the new demand that is increasing in domestic and foreign markets. We believe that CMOS micros will pull up the Japanese industry to a leadership position in micros in light of the following observations:

- The Japanese manufacturers dominate the high-performance CMOS processes, especially high-geometry processes such as the sub-2-micron area.

- Using strong process technology, there are two directions for new product development to take. One direction is to convert all NMOS devices to CMOS. In this case, the suppliers can increase orders immediately. Another direction is to develop original products to develop new markets.

- We expect high-performance CMOS technology to become the major process for products such as 1Mb DRAMs, 4Mb DRAMs, and micros; this trend means that there is an opportunity for the Japanese to gain leadership not only in micros, but in all semiconductor business.

Osamu Ohtake

Table 1

NEW CMOS MPU/MCU/MPRs AT MICROCOMPUTER SHOW '86

Company Name	MPU	MCU	MPR
NEC	V60 (32-bit CPU)	UPD75206/75208 (4-bit MCU) UPD75104/75104A/75106/75108/75108A/ 75P108 (4-bit MCU)	UPD7281D (Image pipelined processor)
Hitachi	HD64180 (8-bit CPU) HD68HC000 (16-bit CPU)	HD6309 (8-bit MCU) HD401220 (E^2PROM 4-bit MCU)	HD6345/6445CRTC/II (CRT controller) HD63450 (Direct memory access control) HD63084 (Document image preprocessor)
Toshiba		TLCS-90 (8-bit MCU) TMP42C66P (4-bit MCU)	
Fujitsu		MB88200B (4-bit MCU) MB88510 (4-bit MCU) MB88543/544/545/546 (4-bit MCU) MB88551/P552 (OTP PROM 4-bit MCU) MB88560 (4-bit MCU)	MB89351 (SCSI protocol controller) MB89362 (Programmable timer module) MB89341 (Hard disk controller) MB89237A (DMA controller) MB89254 (Interval timer) MB89259A (Programmable interrupt controller) MB89255A (Programmable peripheral interface) MB89251A (SDTR) MB89391 (SIP) MB89288 (Bus controller) MB89323 (HCRTC)
Matsushita	MN1617 (16-bit MPU)		
Mitsubishi		(MELPS740)M50708/744/746/930/931/ 940/941/943/950/951/954 (8-bit MCU) (MELPS720)M50720/721/723/725/726/ 922 (4-bit MCU) (MELPS8-48)M5M80C49A/M5M80C49H/ M5MC49A/M5MC49H (8-bit MCU) M63162 (16-bit MCU)	M5M82C37AP-4/M5M82C51AP/M5M82C54P-6/ M5M82C54AP-5,-2/M5M82C59AP
Sharp	LH5080 (8-bit MPU) LHC80A (8-bit microcomputer)		
Oki	MSM80C88A-2 (8-bit MCU) MSM80C86A-2 (16-bit MCU)		MSM82C88-2 (Bus controller)
Sony	CXQ70108 (8-bit MCU) CXQ70116 (16-bit MCU)		CXQ71011 (Clock pulse generator/driver) CXQ71096/083 (8-bit latch) CXQ71086/087 (Bus driver/receiver) CXQ71088 (System bus controller) CXQ71051 (Serial controller unit) CXQ71054 (Programmable timer/counter) CXQ71055 (Parallel interface unit) CXQ71059 (Interrupt control unit) CXQ71071 (DMA controller)

Source: DATAQUEST
June 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-28

JAPANESE CAPTIVE SEMICONDUCTOR SALES: AN OVERVIEW

SUMMARY

DATAQUEST recently completed its first survey of captive sales by the major Japanese semiconductor manufacturers. It has long been recognized that semiconductors account for only a small portion of total sales for the largest suppliers, such as NEC, Hitachi, Toshiba, and Fujitsu. Most of these semiconductor operations were begun to supply in-house needs, and evolved into merchant supply over time.

DATAQUEST's market estimates and market share data have always included both merchant and captive sales by companies that sell to the merchant market. Because of the heavy Japanese dependence on captive semiconductor supply, foreign suppliers (U.S., European, and ROW) have a need to know what portion of the Japanese market is actually available for merchant sales. When a Japanese company supplies a closely associated company (for example, the same banking group), it is not considered captive in this data.

It is our intention to update this survey on an annual basis. Currently, research is proceeding on a similar study of U.S. and European semiconductor suppliers; we will publish those results upon completion of data collection and analysis.

CAPTIVE SALES BY MANUFACTURER

Table 1 lists the captive and total semiconductor sales of the top nine Japanese semiconductor manufacturers from 1981 through 1985. Matsushita and Sanyo, two large consumer electronics companies, are the most heavily captive of the top nine. We estimate Matsushita's captive portion at 50 percent in 1985, and Sanyo's at 24 percent. Figure 1 shows captive sales versus total semiconductor sales for each of the top nine companies in 1985.

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The average captive percentage for the top nine companies was 22 percent in 1985, down slightly from 23 percent in 1981. In general, captive sales rise as a percentage of total sales during a year of slow growth or recession, and fall during a year of rapid growth, such as 1984. In 1984, captive sales represented only 19 percent of the top nine companies' total semiconductor sales.

Among the companies included in our "Others" category are Fuji, Ricoh, Rohm, Sanken Electric, Seiko-Epson, and Sony. These companies accounted for only 13 percent of all Japanese company revenue, but they accounted for 25 percent of all Japanese captive sales.

As shown in Figure 2, captive sales declined very slightly in absolute value in 1985, but increased as a percentage of total semiconductor sales. In 1982, captive sales were also slightly down, but total semiconductor sales increased 3 percent; thus, the captive percentage decreased three percentage points. Captive sales stood at 30 percent of total sales in 1981. They reached a low point in 1984, at 22 percent, and rose in 1985 to 25 percent.

CAPTIVE PORTION OF THE MARKET

We estimate the captive portion of the Japanese semiconductor market to have been 30 percent in 1985, up from 29 percent in 1984, but down from 33 percent in 1981. We believe that almost all captive semiconductor sales by Japanese companies are in Japan; therefore, these percentages are calculated by dividing total Japanese company captive sales by the size of the Japanese semiconductor market. This is shown graphically in Figure 3.

Patricia S. Cox
Nagayoshi Nakano
Osamu Ohtake

Table 1

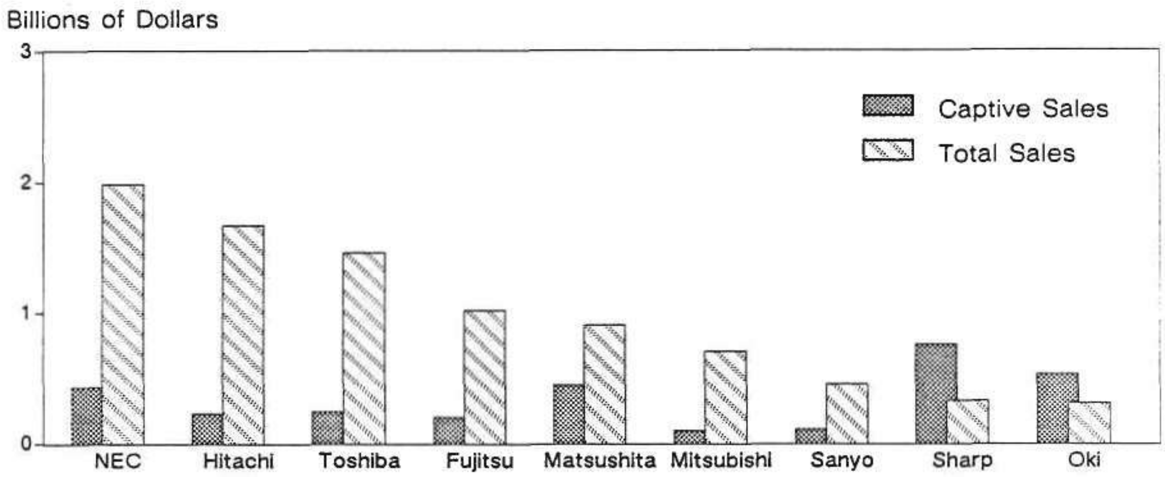
CAPTIVE SEMICONDUCTOR SALES BY SUPPLIER
(Millions of Dollars)

		1981	1982	1983	1984	1985
Fujitsu	Captive Sales	67	98	114	214	204
	Total Sales	375	465	672	1,190	1,020
	% Captive	18%	21%	17%	18%	20%
Hitachi	Captive Sales	105	123	166	246	234
	Total Sales	806	879	1,277	2,051	1,671
	% Captive	13%	14%	13%	12%	14%
Matsushita	Captive Sales	282	231	300	418	453
	Total Sales	487	427	600	928	907
	% Captive	58%	54%	50%	45%	50%
Mitsubishi	Captive Sales	47	46	66	120	103
	Total Sales	321	340	505	965	706
	% Captive	15%	14%	13%	12%	15%
NEC	Captive Sales	219	227	283	450	437
	Total Sales	993	1,080	1,414	2,251	1,984
	% Captive	22%	21%	20%	20%	22%
Oki	Captive Sales	11	25	39	59	53
	Total Sales	98	129	229	362	307
	% Captive	11%	19%	17%	16%	17%
Sanyo	Captive Sales	52	48	63	119	110
	Total Sales	227	241	351	455	457
	% Captive	23%	20%	18%	26%	24%
Sharp	Captive Sales	44	42	64	85	76
	Total Sales	158	192	279	354	329
	% Captive	28%	22%	23%	24%	23%
Toshiba	Captive Sales	132	129	148	234	248
	Total Sales	774	715	983	1,561	1,459
	% Captive	17%	18%	15%	15%	17%
Top Nine Total	Captive Sales	959	969	1,243	1,945	1,918
	Total Sales	4,239	4,468	6,310	10,117	8,840
	% Captive	23%	22%	20%	19%	22%
Others	Captive Sales	608	509	663	628	623
	Total Sales	1,013	907	1,273	1,365	1,270
	% Captive	60%	56%	52%	46%	49%
Total	Captive Sales	1,567	1,478	1,906	2,573	2,541
	Total Sales	5,252	5,375	7,583	11,482	10,110
	% Captive	30%	27%	25%	22%	25%

Source: DATAQUEST
June 1986

Figure 1

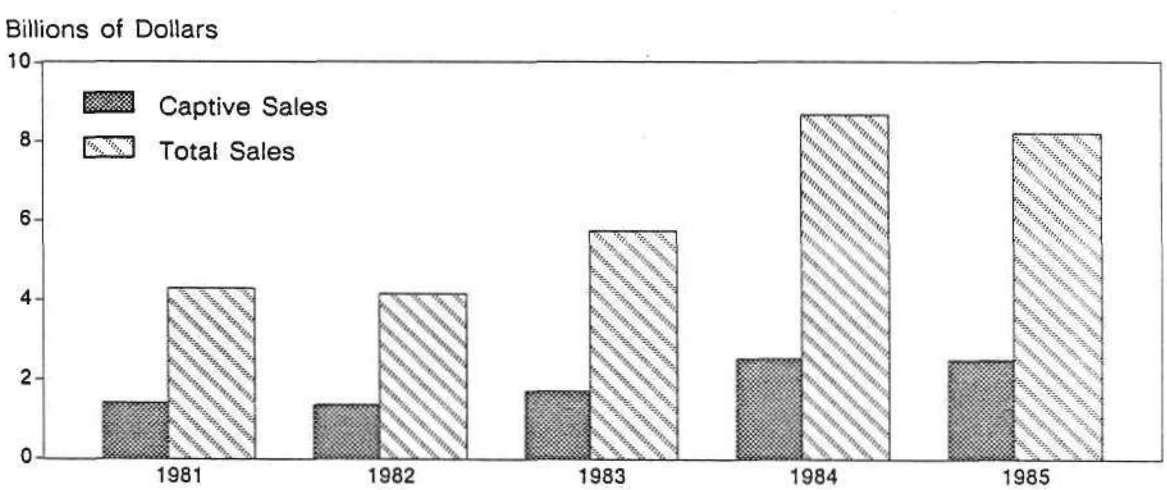
JAPANESE COMPANIES' CAPTIVE SEMICONDUCTOR SALES
COMPARED TO TOTAL SEMICONDUCTOR SALES--1985



Source: DATAQUEST
June 1986

Figure 2

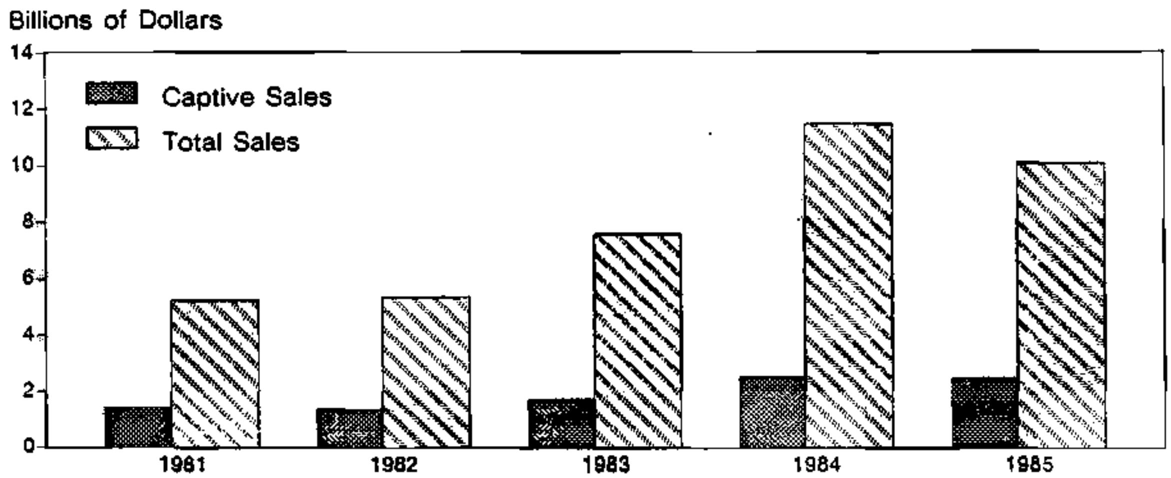
JAPANESE CAPTIVE SEMICONDUCTOR SALES COMPARED TO
TOTAL SEMICONDUCTOR SALES



Source: DATAQUEST
June 1986

Figure 3

CAPTIVE PORTION OF THE JAPANESE SEMICONDUCTOR MARKET



Source: DATAQUEST
June 1986

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-25

JAPANESE SEMICONDUCTOR MARKET QUARTERLY UPDATE: RIGHT ON COURSE

DATAQUEST has made only minor changes to its forecast for the Japanese semiconductor market since our February 11 newsletter. We still foresee moderate growth of 9.4 percent in yen. The wild card in this year's forecast is, of course, the sinking dollar. We have traditionally assumed constant exchange rates for our dollar forecasts; this year, we used the 1986 beginning exchange rate--203 yen per U.S. dollar--throughout 1986 and beyond.

However, the dollar has continued to fall, and has reached a low point of 160 yen per dollar. If this continues throughout the year, it will, of course, affect the dollar value of the Japanese semiconductor market. For instance, at 203 yen per dollar, 9.4 percent growth in yen would equal 28.3 percent growth in dollars; at 175 yen per dollar, dollar growth would be a whopping 48.8 percent.

The strength of the yen has already resulted in pricing pressure in Japan from semiconductor purchasers struggling to keep costs down so they can continue to price competitively in the U.S. market. On the other hand, U.S. semiconductor manufacturers are becoming much more competitive in the Japanese market.

We continue to forecast strong growth in 1987, with the Japanese semiconductor market growing 30.7 percent (both yen and dollars).

Tables 1 and 2 show our quarterly forecast and growth rates through 1987, in yen. Tables 3 and 4 show the same forecast calculated in U.S. dollars.

NOTE: Our complete forecast from 1986 through 1991, plus 1996, is in publication, and should arrive on each JSIS notebook holder's desk in early June.

Patricia S. Cox

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Table 1

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION
PERCENT GROWTH--1985-1987
(Percent of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor		-2.6%	-2.2%	-0.9%	-2.3%	2.2%	6.2%	5.7%	7.2%	9.4%	7.6%	6.8%	7.9%	5.0%	30.7%
Total IC		-2.7%	-3.0%	-2.0%	-1.5%	2.5%	7.4%	6.8%	8.2%	10.2%	8.8%	9.8%	11.5%	6.1%	39.7%
Bipolar Digital		-10.5%	-8.3%	-0.6%	-3.8%	0.0%	8.9%	5.9%	8.2%	3.8%	6.5%	4.7%	4.1%	1.2%	25.6%
Memory		-10.3%	-10.3%	-8.6%	-4.5%	1.6%	6.2%	5.8%	2.7%	-5.7%	2.7%	2.6%	5.1%	2.4%	14.9%
Logic		-10.6%	-8.0%	0.7%	-3.7%	-0.2%	9.3%	6.0%	9.0%	5.2%	7.0%	5.0%	4.0%	1.0%	27.1%
MOS		-3.7%	-4.4%	-5.2%	-3.2%	4.2%	6.6%	7.5%	12.0%	8.8%	10.8%	10.3%	12.9%	7.1%	48.1%
Memory		-12.8%	-17.7%	-5.5%	-19.5%	8.3%	9.7%	11.3%	18.3%	7.1%	7.7%	9.2%	14.4%	7.2%	52.9%
Micro Device		10.9%	10.9%	4.6%	2.2%	0.0%	0.0%	2.0%	3.0%	13.2%	20.0%	15.0%	18.1%	7.1%	53.6%
Logic		-1.1%	-0.1%	-12.2%	17.2%	3.8%	9.2%	7.9%	12.0%	7.5%	8.1%	8.0%	7.0%	7.0%	38.9%
Linear		3.9%	2.2%	3.1%	2.9%	1.0%	8.0%	5.9%	2.0%	15.8%	6.0%	11.0%	12.0%	6.0%	31.6%
Discrete		-3.9%	-2.2%	1.7%	-5.7%	1.9%	3.0%	3.0%	5.1%	6.2%	2.0%	-6.1%	-9.9%	-1.0%	-2.0%
Optoelectronic		2.8%	10.0%	4.5%	-1.3%	-1.3%	0.7%	0.0%	0.0%	8.0%	8.4%	1.2%	0.6%	0.0%	9.9%

Table 2

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION--1985-1987
(Billions of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	529.3	515.4	504.1	499.4	2,048.2	510.4	542.0	573.0	614.5	2,239.9	661.1	705.9	761.8	799.6	2,928.4
Total IC	407.2	396.4	384.5	377.0	1,565.1	386.6	415.2	443.3	479.7	1,724.8	521.7	572.6	638.3	677.0	2,409.6
Bipolar Digital	64.5	57.7	52.9	52.6	227.7	52.6	57.3	60.7	65.7	236.3	70.0	73.3	76.3	77.2	296.8
Memory	8.7	7.8	7.0	6.4	29.9	6.5	6.9	7.3	7.5	28.2	7.7	7.9	8.3	8.5	32.4
Logic	55.8	49.9	45.9	46.2	197.8	46.1	50.4	53.4	58.2	208.1	62.3	65.4	68.0	68.7	264.4
MOS	228.5	220.1	210.4	199.4	858.4	207.7	221.5	238.1	266.6	933.9	295.4	325.8	367.7	393.8	1,382.7
Memory	99.5	86.8	71.4	67.5	325.2	73.1	80.2	89.3	105.6	348.2	113.7	124.2	142.1	152.3	532.3
Micro Device	47.8	53.0	58.8	61.5	221.1	61.5	61.5	62.7	64.6	250.3	77.5	89.1	105.2	112.7	384.5
Logic	81.2	80.3	80.2	70.4	312.1	73.1	79.8	86.1	96.4	335.4	104.2	112.5	120.4	128.8	465.9
Linear	114.2	118.6	121.2	125.0	479.0	126.3	136.4	144.5	147.4	554.6	156.3	173.5	194.3	206.0	730.1
Discrete	96.7	92.9	90.9	92.4	372.9	94.2	97.0	99.9	105.0	396.1	107.1	100.6	90.6	89.7	388.0
Optoelectronic	25.4	26.1	28.7	30.0	110.2	29.6	29.8	29.8	29.8	119.0	32.3	32.7	32.9	32.9	130.8
Exchange Rate	257.0	251.0	243.0	207.0	237.0	203.0	203.0	203.0	203.0	203.0	203.0	203.0	203.0	203.0	203.0

Source: DATAQUEST
May 1986

Table 3

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION PERCENT GROWTH—1985-1987 (Percent of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor		-0.3%	1.0%	16.2%	-2.8%	4.2%	6.2%	5.7%	7.2%	28.3%	7.6%	6.8%	7.9%	5.0%	30.7%
Total IC		-0.3%	0.2%	15.0%	-2.1%	4.6%	7.4%	6.8%	8.2%	29.4%	8.8%	9.8%	11.5%	6.1%	39.7%
Bipolar Digital		-8.4%	-5.2%	16.5%	-4.6%	2.0%	8.9%	6.0%	8.3%	22.1%	6.5%	4.7%	4.1%	1.2%	25.6%
Memory		-8.8%	-6.5%	6.9%	-5.3%	3.2%	6.3%	5.9%	2.8%	11.2%	2.7%	2.6%	5.1%	2.4%	15.1%
Logic		-8.3%	-5.0%	18.0%	-4.5%	1.8%	9.3%	6.0%	9.0%	23.8%	7.0%	5.0%	4.0%	1.0%	27.1%
MOS		-1.3%	-1.3%	11.2%	-3.9%	6.2%	6.6%	7.5%	11.9%	28.0%	10.8%	10.3%	12.8%	7.1%	48.1%
Memory		-10.6%	-15.0%	10.9%	-20.6%	10.4%	9.7%	11.4%	18.2%	26.8%	7.7%	9.3%	14.4%	7.1%	52.9%
Micro Device		13.4%	14.7%	22.7%	2.5%	2.0%	0.0%	2.0%	2.9%	31.7%	20.1%	14.9%	18.0%	7.1%	53.6%
Logic		1.3%	3.1%	3.0%	16.2%	5.9%	9.2%	7.9%	12.0%	26.5%	8.0%	8.0%	7.0%	7.0%	38.9%
Linear		6.4%	5.6%	21.1%	2.8%	3.0%	8.0%	6.0%	2.0%	35.3%	6.1%	11.0%	12.0%	6.0%	31.7%
Discrete		-1.7%	1.1%	19.3%	-6.1%	4.0%	3.0%	2.9%	5.1%	24.5%	2.0%	-6.0%	-10.0%	-1.0%	-2.1%
Optoelectronic		5.1%	13.5%	22.9%	-1.1%	0.7%	0.7%	0.0%	0.0%	26.0%	8.2%	1.3%	0.6%	0.0%	9.7%

Table 4

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION--1985-1987 (Millions of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	2,060	2,054	2,075	2,412	8,600	2,514	2,670	2,823	3,027	11,034	3,256	3,478	3,753	3,938	14,425
Total IC	1,584	1,579	1,583	1,821	6,567	1,904	2,045	2,184	2,363	8,496	2,570	2,821	3,144	3,335	11,870
Bipolar Digital	251	230	218	254	953	259	282	299	324	1,164	345	361	376	380	1,462
Memory	34	31	29	31	125	32	34	36	37	139	38	39	41	42	160
Logic	217	199	189	223	828	227	248	263	287	1,025	307	322	335	338	1,302
MOS	889	877	866	963	3,595	1,023	1,091	1,173	1,313	4,600	1,455	1,605	1,811	1,940	6,811
Memory	387	346	294	326	1,353	360	395	440	520	1,715	560	612	700	750	2,622
Micro Device	186	211	242	297	936	303	303	309	318	1,233	382	439	518	555	1,894
Logic	316	320	330	340	1,306	360	393	424	475	1,652	513	554	593	635	2,295
Linear	444	472	499	604	2,019	622	672	712	726	2,732	770	855	957	1,015	3,597
Discrete	376	370	374	446	1,567	464	478	492	517	1,951	527	496	446	442	1,911
Optoelectronic	99	104	118	145	466	146	147	147	147	587	159	161	162	162	644
Exchange Rate	257	251	243	207	237	203	203	203	203	203	203	203	203	203	203

Source: DATAQUEST
May 1986

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RESEARCH BULLETIN

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JAPAN'S PUSH INTO OPTOCOMPUTING: SEMICONDUCTOR MAKERS FORM OPTOELECTRONICS CONSORTIUM

SUMMARY

In early May, 13 Japanese semiconductor makers announced the formation of a new joint R&D consortium to develop second-generation optoelectronic ICs (OEICs). Called the Optical Technology R&D Corporation, the new venture plans to invest ¥10 billion ($62.5 million) in optoelectronics research during the next 10 years and will involve both government and corporate researchers. The goal of the research consortium is to develop new OEIC process and device technologies for optical communications and future optocomputers.

DATAQUEST believes that this new joint venture highlights the popularity of joint government-industry R&D projects sponsored by private companies. Within the past year, Japanese companies have also formed private R&D consortiums to pursue automotive electronics, diamond substrates, and space-grown materials.

This venture also emphasizes the growing importance of optoelectronic technology. As discussed in our newsletter, "Japanese Technology: The Future Wave" (issued January 7, 1986, see pages 18 and 27), Japanese makers view optoelectronics and optocomputing as the next wave in semiconductor technology during the 1990s. Driven by optical communications, this technology will not only utilize gallium arsenide (GaAs), but also new silicon-GaAs hybrid process technologies.

INCREASING OPTOELECTRONIC IC (OEIC) RESEARCH

Companies involved in the Optical Technology R&D Corporation include Fujikura, Fujitsu, Furukawa Electric, Hitachi, Japan Sheet Glass, Matsushita, Mitsubishi, NEC, Oki Electric, Sanyo, Sharp, Sumitomo Electric, and Toshiba. The venture will initially be capitalized at ¥143 million ($894,000). Of this amount, the participating companies will invest ¥43 million ($269,000), or about 30 percent, with the Japanese government financing the remainder. The company, which begins operations in June, plans to invest about ¥100 million ($625,000) in a Basic Technology Research Promotion Center in the Tokyo area.

As shown in Table 1, many Japanese companies are focusing on OEICs for optical communications. The first-generation OEICs, which consist of LEDs, light-receiving devices, and transistors, have already been introduced. The new research consortium will initially focus on second-generation OEICs capable of handling 1-gigabit-per-second (Gbps) optical transmission, with the ultimate goal of developing OEICs capable of 10-Gbps speeds.

DATAQUEST notes that OEICs will play a key role in Nippon Telegraph and Telephone's (NTT) Information Network System (INS). In 1984, NTT completed installation of a 1,250-mile, 400-Mbps optical-fiber cable from northern Hokkaido to southern Kagoshima. In 1987 or 1988, NTT plans to install a 1.6-Gbps optical-fiber cable between Tokyo and Osaka. A 12-mile experimental cable is now being tested in Kawasaki. With the merger of communications, computer, and optical-storage technology, we believe that OEICs will become a critical semiconductor technology that U.S. and European companies cannot afford to overlook.

Sheridan Tatsuno

Table 1

FIRST-GENERATION JAPANESE OPTOELECTRONIC ICs (OEICs)

Group	Date	Device
Fujitsu	Q2/85	An experimental OEIC transmission method using an integrated semiconductor laser and four FETs on a GaAs substrate
Hitachi	Q1/86	An 1.6 x 1.0mm OEIC incorporating laser diodes, lightwave paths, and optical switch for optical exchanges and optical computers
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Matsushita	Q4/84	World's first optical integrated device consisting of a semiconductor laser and transistors for optical memories and inverters
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Source: DATAQUEST
May 1986

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RESEARCH BULLETIN

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NEW SEMICONDUCTOR ACCORD: YEUTTER'S PRESENT TO THE U.S. SEMICONDUCTOR MANUFACTURERS

Clearly the most important issue in the recent semiconductor accord hammered out by U.S. negotiator Clayton Yeutter and his team on May 27, is the commitment by 11 Japanese computer manufacturers to increase the U.S. share of their semiconductor procurement to 20 percent. We believe that these 11 manufacturers represent about 50 percent of the Japanese semiconductor market, and we expect other manufacturers to follow their lead in stepping up purchases of U.S.-made semiconductors.

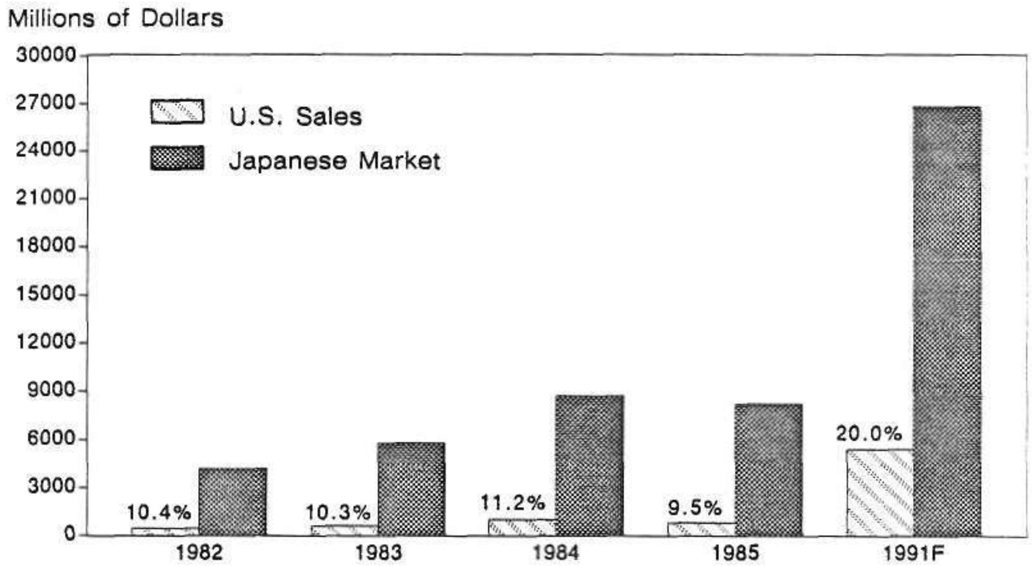
Our figures show that if the U.S. companies obtain 20 percent of the Japanese market in 1991, their sales will be almost $5.4 billion, rising from $784 million in 1985. This is a sevenfold growth in revenues in six years. Figure 1 shows our estimates of the U.S. share of the Japanese market. As shown in Table 1, this plan could result in cumulative additional revenues of $6,232 million for U.S. companies from 1986 through 1991.

The second part of the accord directs the Japanese government to set tight minimum standards for memory prices in export markets, principally in the U.S. market where more than 50 percent of DRAM products are sold. It is too soon to determine the impact on U.S. suppliers, since most of the major manufacturers no longer manufacture DRAM devices. Texas Instruments is the only U.S. supplier among the top ten.

Gene Norrett
Patricia S. Cox

Figure 1

ESTIMATED U.S. SALES IN THE JAPANESE SEMICONDUCTOR MARKET



Source: DATAQUEST
June 1986

Table 1

ESTIMATED U.S. SHARE OF THE JAPANESE SEMICONDUCTOR MARKET: TWO SCENARIOS (Millions of Dollars)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Yeutter's Plan Adopted										
Total Market	4,150	5,752	8,686	8,211	11,034	14,425	17,840	17,825	21,699	26,805
U.S. Sales	431	591	974	784	1,214	1,803	2,498	2,852	3,906	5,361
U.S. Percent	10.4%	10.3%	11.2%	9.5%	11.0%	12.5%	14.0%	16.0%	18.0%	20.0%
Yeutter's Plan Not Adopted										
Total Market	4,150	5,752	8,686	8,211	11,034	14,425	17,840	17,825	21,699	26,805
U.S. Sales	431	591	974	784	1,148	1,500	1,855	1,854	2,257	2,788
U.S. Percent	10.4%	10.3%	11.2%	9.5%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%
Potential Revenue Gain	-	-	-	-	66	303	643	998	1,649	2,573
Cumulative Revenue Gain	-	-	-	-	66	369	1,012	2,010	3,659	6,232

Source: DATAQUEST
June 1986

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RESEARCH BULLETIN

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SUMMARY

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This venture also emphasizes the growing importance of optoelectronic technology. As discussed in our newsletter, "Japanese Technology: The Future Wave" (issued January 7, 1986, see pages 18 and 27), Japanese makers view optoelectronics and optocomputing as the next wave in semiconductor technology during the 1990s. Driven by optical communications, this technology will not only utilize gallium arsenide (GaAs), but also new silicon-GaAs hybrid process technologies.

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Companies involved in the Optical Technology R&D Corporation include Fujikura, Fujitsu, Hitachi, Koga Electric, Matsushita, Mitsubishi, NEC, Nihon Hanshoshi, Oki Electric, Sanyo, Sharp, Sumitomo Electric, and Toshiba. The venture will initially be capitalized at ¥143 million ($894,000). Of this amount, the participating companies will invest ¥43 million ($269,000), or about 30 percent, with the Japanese government financing the remainder. The company, which begins operations in June, plans to invest about ¥100 million ($625,000) in a Basic Technology Research Promotion Center in the Tokyo area.

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Source: DATAQUEST
May 1986

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The Dun & Bradstreet Corporation

JAPANESE
RESEARCH
NEWSLETTER

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1986-23

THE DOUBLE WHAMMY:
YEN APPRECIATION AND U.S. DUMPING MARGINS

SUMMARY

Within the last few months, Japanese semiconductor makers have been hit hard by U.S. dumping margins and the appreciation of the yen. Both factors have pushed up Japanese costs for EPROMs and 64K and 256K DRAMs by 83 to 250 percent since March 1985. To maintain market share, especially in the face of South Korean competition, Japanese companies are adopting several strategies, including:

- Raising component and equipment prices to only what the market will bear
- Moving manufacturing offshore, especially to southeast Asia and the United States
- Investing in new U.S. wafer fabs
- Diversifying into ASICs, MPUs, linear, and other memory areas

DATAQUEST believes that the current dumping margins only provide a temporary breathing space for U.S. makers. By 1987, we expect top Japanese semiconductor makers to be producing a more diversified product line in the United States. As in the automobile market, the price pressure from Japan and South Korea will be strong. U.S. semiconductor makers must increase their R&D, automate their plants, and build stronger ties with users to maintain market share.

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THE DOUBLE IMPACT

Japanese makers have not only been hit hard by U.S. dumping margins, but also by the strong yen. Since last year, fewer yen are required to buy one dollar. The yen has strengthened from ¥262 to the dollar in March 1985 to ¥162 in May 1986, or a phenomenal 61.7 percent increase. (By contrast, the dollar has dropped only 38.2 percent in value.) When added to the dumping margins, the strong yen has a devastating impact on Japanese memory makers, as shown in Table 1.

Table 1

COMBINED IMPACT OF THE DUMPING MARGINS AND STRONGER YEN

	64K DRAM*		EPROM**		256K DRAM**	
Company	Margin	Plus Yen	Margin	Plus Yen	Margin	Plus Yen
Hitachi	11.87%	73.60%	30.0%	91.7%	20.0%	81.7%
Toshiba	20.75%	82.48%	21.7%	83.4%	50.0%	111.7%
Fujitsu	20.75%	82.48%	145.0%	206.7%	75.0%	136.7%
NEC	22.76%	84.49%	188.0%	249.7%	108.0%	169.7%
Mitsubishi	13.43%	75.16%	63.1%	124.8%	40.0%	101.7%
Oki	35.34%	97.07%	63.1%	124.8%	40.0%	101.7%
Overall	20.75%	82.48%	63.1%	124.8%	40.0%	101.7%

*Final
**Preliminary

Source: DATAQUEST
May 1986

THE JAPANESE RESPONSE

In the face of dumping margins and the strong yen, how are Japanese semiconductor makers repositioning themselves? DATAQUEST has observed the following responses.

Short-term Price Increases

Japanese vendors are increasing their prices by 10 to 30 percent. Tokyo distributors report that prices for 256K EPROMs have increased from ¥450 ($2.25) in December to ¥500-¥600 ($3.00-$3.60) in April. Prices for 64K DRAMs have increased from $0.45 last year to more than $1.00 in April. Contract prices for 256K DRAMs, now at $2.50, are expected to increase further. DATAQUEST expects commodity prices to increase temporarily, then decline along the learning curve in mid-1987.

Assembly and Testing in Southeast Asia

To get around the dumping margins, Japanese vendors are shipping DRAMs and EPROMs through Singapore, Hong Kong, and Malaysia, often with the tacit support of major U.S. users. Japanese vendors are also expanding their assembly and testing operations in Southeast Asia to reduce manufacturing costs, since the currencies in these countries are closely tied to the U.S. dollar. Hitachi, for example, recently doubled 256K DRAM production in Malaysia.

More U.S. Production and Investments

DATAQUEST expects Japanese makers to invest in wafer fabs in the United States during 1986 to counter the dumping margins and strong yen. NEC, which has a state-of-the-art fab in Roseville, California, plans to ramp up production of memories, ASICs, and other products. Hitachi is accelerating construction of its Irving, Texas, fab, while Mitsubishi is planning a fab in the Research Triangle in North Carolina. Other Japanese makers have a strong incentive to follow suit, since the yen buys 61.7 percent more U.S. plant and equipment than last year.

Diversification to Higher Value-added Products

Until these new fabs come on-line, Japanese vendors are diversifying their product portfolios. In particular, gate arrays, telecom ICs, microprocessors, and linear ICs are attracting attention. As a result, DATAQUEST believes Japanese product diversification will intensify price pressures on U.S. makers in high-value-added and niche markets. We expect ASICs to become the next major battleground, especially high-volume CMOS gate arrays.

It is possible that Japanese vendors may end up stronger, not weaker, as a result of the dumping margins and yen appreciation. In particular, Japanese companies have a strong incentive to invest in the United States because of the strong yen, while U.S. companies may cut back their Japanese investment plans. The long-term implications of these short-term responses will be serious for both industries.

Sheridan Tatsuno

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-21

DATAQUEST'S SECOND ANNUAL JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE: FUTURE VLSI AND APPLICATIONS

SUMMARY

DATAQUEST's Second Annual Japanese Semiconductor Industry Conference was held April 13-15, 1986, in Hakone, Japan. With Mount Fuji dominating the spring skyline, 243 attendees from Japan, Taiwan, Korea, Hong Kong, China, the United States, France, Italy, the United Kingdom, and Germany gathered to discuss the status and future of the semiconductor industry.

At this conference it was generally agreed that the future lies from the Pacific Basin westward.

Although the conference was held in the wake of preliminary U.S. dumping rulings against Japanese manufacturers and stalled U.S.-Japan semiconductor negotiations, trade was not a major topic of speeches or conversation.

Highlights of the conference included:

- A speech by Wang Zhenghua, a Chief Engineer of the China National Electronic Devices Corporation (Due to Japan-China friction, Mr. Wang and his colleague, He Mingzhang, received their Japanese visas only one day before their flight to Japan)

- A speech by Dr. Yasusada Kitahara, Senior Executive Vice President of NTT and a highly venerated figure in the Japanese semiconductor industry

Keynote Speakers

The conference featured two keynote speakers: Gary L. Tooker, Executive Vice President and General Manager of Motorola, Incorporated; and Hiroshi Asano, Executive Vice President of Hitachi, Limited.

Mr. Tooker targeted his speech directly at the U.S.-Japan trade friction, with the theme "Technology and Trade," or "T&T." He called for the forging of a "win-win" strategy in resolving the technology and trade issues between the United States and Japan, pointing out the strategic importance of the U.S. semiconductor industry to the military defense of the United States, Japan, and the rest of the free world. He called for the Japanese to open their semiconductor market to U.S. suppliers, who have proven their ability to deliver high-quality product on time.

Mr. Asano directed his speech at the growth of the Information Age and the tools that support this growth. Comparing the long-term growth rates of the three major segments of Japan's electronics industry, electronic components and industrial (including information processing) production far outpaced consumer electronics production. Mr. Asano believes that software is the wave of the future, and is a challenge for Japanese industry. Contrary to hardware, which requires mass production and mass sales, software requires a broad product lineup, small-quantity production, and value-added resales. He predicts that the largest software market worldwide will be for small computer terminals and office automation, where he believes demand will outstrip supply.

SPEECHES

Conference attendees listened to two jam-packed days of speeches, simultaneously translated from Japanese to English and vice-versa (or from Chinese to Japanese to English, in the case of Mr. Wang), on a variety of topics germane to today's industry.

Major categories of speeches were as follows:

- DATAQUEST's forecasts and analyses
- Specific VLSI applications
- Chips for the future
- Strategic alliances
- Status of other Far East semiconductor industries

DATAQUEST's Forecasts and Analyses

Osamu Ohtake, Associate Director of DATAQUEST's Japanese Semiconductor Industry Service, opened the conference with an overview of the increasingly important position of Japan and Japanese companies in the worldwide semiconductor industry. Of particular note are:

- NEC's ascent to the number one position among suppliers worldwide
- The fact that the top ten suppliers in the world all had decreased revenues in 1985, the worst semiconductor recession ever

- The continuing loss of market share by U.S. and European manufacturers to Japanese and Asian manufacturers

- The continuing trend toward U.S./European partnerships with Japanese companies, particularly in CMOS

Nagayoshi Nakano, DATAQUEST Research Analyst, presented an overview of semiconductor application trends in Japan. He expects semiconductor consumption to continue to outpace the end equipment market, due to increasing semiconductor pervasiveness. The industrial segment of the market is growing more rapidly than the consumer segment. The fastest-growing end markets are digital audio disk players, word processors, and facsimiles.

Comparing the semiconductor markets of Japan, the United States, and Europe, Mr. Nakano portrayed the Japanese market as the overall leader, due to the differing market structures:

- The U.S. market is oriented toward data processing and industrial uses, resulting in high growth during prosperity and huge decline during recessions--a highly volatile market.

- The European market is well balanced by end use, resulting in years of low growth and small declines--a highly stable market.

- The Japanese market is oriented toward consumer and data processing usage, resulting in high growth during prosperous years and only small declines in recession years such as 1985.

Lane Mason, DATAQUEST Senior Industry Analyst, spoke on the future outlook for MOS memory. He painted a bleak picture, focusing on the horrendous losses suffered by all MOS memory suppliers in 1985. He presented a number of issues facing MOS memory manufacturers, including:

- What are our motives (i.e., technology development, visibility)?

- How can we form a strategy to counter the seemingly inevitable cyclical nature of this business?

- In 1981, the worldwide MOS memory market fell 17 percent; in 1985, it fell 39 percent. DATAQUEST forecasts that the next downturn will be in 1989, when MOS memory will decline at least 11 percent.

VLSI Design, Fabrication, and Testing

Al Stein, Chairman and CEO of VLSI Technology, Inc., spoke on "Design Solutions with ASICs." Focusing on the user-specific portion of the ASIC market (chips designed as proprietary products for specific users), he spoke on the many benefits of using ASIC technology in systems. ASIC technology has become preeminent because of these benefits--such as higher system performance, improved engineering productivity, and reduced system size and cost--combined with new tools to make ASIC production more efficient--such as simpler workstation access, integrated design environment, reduced cycle time, and greater use of automation.

Mr. Stein analyzed the differing design needs of various customers, and classified three major needs:

- High performance: full-custom design, fairly low gate count, driven by a need for very high speed

- High integration: very high gate count, standard and compiled cell design, driven by desire to have a system on a chip

- Simple integration: very low gate count, standard cell design, used to replace TTL, driven by cost reduction

"The Impact of VLSI on Automatic Testing" was the topic presented by Alex d'Arbeloff, President and CEO of Teradyne Incorporated. Mr. d'Arbeloff pointed out the mounting costs of testing as circuits become increasingly complex. For transistors, testing represents only 5 percent of total production cost; for LSI the figure is 20 percent; and for VLSI ICs, 40 percent of product cost is testing. Obviously, cost-cutting strategies for VLSI testing are a necessity. Mr. d'Arbeloff's suggestions on ways to cut test costs include:

- Designing for testability

- Using common simulation software

- Using self-test techniques

- Using parallel/multiplex testing

- Using nonstop testing

James C. Morgan, President and CEO of Applied Materials Incorporated, spoke on "Supporting the Transition to VLSI Fabrication." Mr. Morgan discussed the necessity of orienting semiconductor processing equipment to the needs of sub-1-micron, isolation trenches, and multilevel polysilicon and metal processing. Also, equipment must become more productive in order to reverse the trend toward increasing capital intensity. Mr. Morgan stressed the need for extendable equipment technology, process flexibility, and preventive maintenance as ways of achieving effective, cost-efficient production.

James Springgate, President of Monsanto Electronic Materials Company, addressed the topic, "Silicon and Semiconductors--Partners in the '80s." Mr. Springgate expects significant change in the next five years as silicon suppliers adapt to the needs of VSLI and its manufacturers. Among the significant trends he foresees are 200 and 250mm diameter wafers, wafers tailored to specific IC applications, wafers designed specifically for emerging VLSI applications (this is currently a state-of-the-art research area), and advanced epitaxial wafers.

Specific VLSI Applications

Automotive semiconductor applications were covered in two speeches, one by Dr. Charles Tracy, Chief Engineer at Delco Electronics Corporation; the other by Masao Murayama, Executive Managing Director of Nippondenso Company, Limited.

In both Japan and the United States, nonradio ICs made their first appearance in cars in 1968. In both countries, engine control ICs were introduced around 1980 to comply with U.S. government emission and fuel economy requirements. Functional content has dramatically increased over the intervening years, while die size has seen a comparable decrease.

Both speakers described the "chip of the future" for advanced electronic engine control. This chip would be a single-chip MCU with RAM, ROM, timer, and A-D converter. The chip would also be available in EPROM or E^2PROM versions in order to provide more flexibility and meet customers' demands.

Fumio Kohno, Senior General Manager of Sony Corporation's Semiconductor Group, spoke on "Future VLSI and Consumer Electronics." Mr. Kohno spoke of the "Needs and Seeds" relationship between consumer electronics and semiconductor technology. Semiconductor technology has advanced because of the Needs of consumer electronics, while the Seeds (semiconductor technology innovations) have in turn made it possible to make better, more advanced consumer electronic products. He expects increased use of digital ICs in consumer products to significantly enhance performance.

Mr. Kohno cited several examples of the Needs/Seeds relationship:

- 8mm VTRs were made possible by high-density hybrid ICs and PCM audio signal processing LSIs.

- Digital audio tapes were made possible by low-power linear ICs, A-D/D-A converters for digital audio, and digital signal processing LSIs.

In the past, consumer electronics needs pushed IC technology, but in the future (in Mr. Kohno's opinion), IC technology seeds will drive consumer electronics technology.

Noriaki Shimura, Managing Director of Casio Computer Company, Limited, spoke on "Application Strategies for Success." Casio is a ¥200 billion ($1.1 billion) company that consumes more than 10 million integrated circuits per month, approximately 90 percent of which are custom LSI ICs. Casio designs one-third of the custom chips it uses; however, all production is done by one or two semiconductor vendors. The relationship between these suppliers and Casio engineers is viewed by Mr. Shimura as being of strategic importance to the successful evolution of Casio products.

Dr. Yasusada Kitahara, Senior Executive Vice President of Nippon Telegraph and Telephone Corporation, is a highly revered figure in the Japanese semiconductor industry. Dr. Kitahara's topic was "VLSI Applications, INS, and the Future." Dr. Kitahara spoke of the importance of VLSI and VLSI technology in making Japan's INS (Information Network System) a reality.

Chips for the Future

This subject was taken up by four speakers:

- Dr. Tsugio Makimoto, General Manager of Hitachi Limited's Musashi Works
- Donald W. Brooks, President and CEO of Fairchild Semiconductor Corporation
- Minoru Yoshida, President of Tokyo Electron Limited
- Kimio Sato, Senior Managing Director of Mitsubishi Electric Corporation

Dr. Makimoto of Hitachi coined a new term--UFIC--for User-Friendly Integrated Circuit. UFICs are defined as devices that facilitate movement from a user's concept of a system to implementation of the actual system in the shortest time possible. Hitachi's answer to this is its ZTAT (zero turnaround time) microcontroller with built-in EPROM.

Fairchild's Don Brooks focused on the trend toward CMOS, BiMOS, and GaAs ICs in order to achieve the performance standards required for supercomputers, minisupercomputers, and advanced workstations. He also spoke of the overriding importance of the customer-vendor relationship in producing chips to meet the customers' needs.

Minoru Yoshida of Tokyo Electron Limited (TEL) spoke on "Japanese Initiative and Cooperation in High-Tech Industry." His focus was on cooperation, and he outlined TEL's partnerships with the U.S. equipment makers Thermco, Genrad, Varian, and Lam Research. He pointed out the complementary nature of the Japanese strengths of employee loyalty, good production engineers, and lifetime employment, with the U.S. strengths of conceptual ability in system design and the U.S. educational system.

Kimio Sato of Mitsubishi gave a "Perspective for the 1990s." He believes that in 1990 only 60 percent of semiconductor demand will be related to equipment that exists today. He expects discretes to dramatically decrease as a percentage of total semiconductor consumption. MOS logic, micro devices, and memory will supply many of the new markets: electronic files, electronic "secretaries" (i.e., the ability to schedule appointments remotely via a wristwatch computer), telecomputer conferences, video conferences, telecommuting, artificial intelligence, automatic translation, automatic readers, IC cards, and robots.

Strategic Alliances

The topic of strategic alliances (joint ventures, partnerships, licensing, technology exchange, mergers and acquisitions, and so forth) was addressed by Keiske Yawata, President and CEO of LSI Logic K.K., and James Riley, Senior Vice President of DATAQUEST.

Mr. Yawata focused on alliances in the ASIC area. Japanese "user friendliness" can be used to the advantage of U.S. companies for high-density packaging using surface-mount technology and leadless chip carriers. An ideal corporate alliance is a perfectly complementary relationship without conflict of interest.

Mr. Riley pointed out the necessity of forming international partnerships in order to maintain or gain market share in an increasingly global market. Strategic alliances in the global marketplace can give a company informed market presence and cultural synergy, as well as complementary assets.

Status of Other Far East Semiconductor Industries

Leaders from the semiconductor industries of Taiwan, Hong Kong, and China gave reports on the status and future outlook of their areas. These three speakers were:

- Dr. Chintay Shih, Vice President and ERSO General Manager, ITRI
- C. D. Tam, Vice President and General Manager (Asia), Motorola, Incorporated
- Wang Zhenghua, Chief Engineer of IC Design Center, China National Electronic Devices Corporation

Dr. Shih of ITRI stated that Taiwan currently has 2 silicon wafer manufacturers, 3 fabrication facilities, 1 maskmaking company, 11 design centers, and 26 assembly plants (many are foreign owned). The Taiwanese government is sponsoring a plan to build a large, VLSI wafer fabrication facility to do foundry work. The plant will have 10,000 6-inch wafer starts per month capacity in 1987, expanding to 40,000 starts per month by 1990. Dr. Shih also discussed Taiwan's "Multi Project Chip," which is a national training effort, at the university level, that allows students to design and process ICs. This results in graduates who are ready to contribute to Taiwan's fast-growing IC industry.

Motorola's C. D. Tam spoke on "The Asia/Pacific Electronics Industry--An Industry in Transition." He focused on the "Four Tigers of the Orient"--Hong Kong, Korea, Singapore, and Taiwan. These countries showed higher growth in electronic production from 1977 to 1983 than Japan, the United States, and Europe. While consumer electronics still represents the largest single end market for semiconductors in the Four Tigers, it has steadily decreased, from 89 percent to 44 percent. Growth of personal computers, PCs, and other computers has been steady and dramatic since 1980.

The Four Tigers are now poised to enter the high-level system market--large PABXs, digital televisions, mini and mainframe computers, robotics, and factory automation systems. Design of these systems will be facilitated by two semiconductor technologies:

- New LSI/VLSI chips, such as DSP and 32-bit microprocessors
- ASICs and user-friendly CAD tools

Wang Zhenghua from China's National Electronic Devices Corporation, gave a comprehensive overview of the People's Republic of China's semiconductor industry. China has 450 semiconductor plants located in 28 provinces, mostly near large cities. Two hundred thousand people work in the semiconductor industry. Ten billion semiconductor devices, including 50 million ICs, were produced in 1985.

IC production in China began in 1966, a major quality improvement program was instituted in 1970, and by 1978, quality had reached international standards. China has five bipolar IC techologies--TTL, STTL, LSTTL, HTL, and ECL. There is production of PMOS logic, CMOS, and NMOS. Current capabilities are for 5 to 7u processing, and work is progressing on 3u processing. Research has been completed on 16K DRAMs and SRAMs, and 4- and 8-bit microprocessors are being produced. Linear IC production includes op amps, voltage regulators, and consumer chips for television, audio, and watch applications.

DATAQUEST CONFERENCE NOTEBOOK

All conference attendees received a comprehensive conference notebook with a list of attendees and copies of the conference speeches. This notebook will be mailed this month to all JSIS clients who did not attend the conference. If you wish to read these proceedings, please contact your JSIS notebook holder.

Patricia S. Cox

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RESEARCH
BULLETIN

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1986-22

MITI OFFERS PROPOSAL TO AVOID DUMPING PENALTIES

SUMMARY

Japan's Ministry of International Trade and Industry (MITI) has proposed a semiconductor monitoring system in an effort to avoid the implementation of dumping penalties on Japanese DRAMs and EPROMs. The MITI proposal was published in a prominent Japanese industrial journal, Nihon Keizai, as a "trial balloon" to elicit an official U.S. response. MITI has used this procedure in the past to test public and industry reaction to policies that were later made official. The new proposal includes the following:

- A demand-supply guidepost system to curb overproduction and stabilize prices
- A lowest-export-price system (price floor) to prevent below-cost sales (dumping)
- A uniform minimum price system to prevent circuitous exports to the United States or elsewhere through third countries (Europe and Asia)

Under the new system, similar to MITI's control of Japanese iron and steel production, a select committee will announce a quarterly semiconductor demand-supply outlook. If production plans exceed consumption forecasts, MITI will request Japanese vendors to reduce their production plans. Both the Japanese and U.S. governments will negotiate fully loaded production costs to determine price curves.

DATAQUEST ANALYSIS

The main reason for MITI's proposal can be seen in Table 1. In addition to the dumping penalties, the current dollar/yen exchange rate compounds export difficulties and will continue to be a problem regardless of any decision about dumping penalties. For this reason, MITI believes that dumping penalties are adding insult to injury.

Table 1

COMPOUND EFFECT OF DUMPING PENALTIES AND EXCHANGE RATE

Japanese Device	Penalty Status	Average Penalty %	Current $/Yen Difference	Total Penalty
64K DRAM	Final	20.75%	30.80%	51.55%
256K DRAM	Preliminary	40.00%	30.80%	70.80%
All EPROMs	Preliminary	63.10%	30.80%	93.90%

Source: DATAQUEST
May 1986

MITI's new proposal is a reaction to strong pressure from Japanese semiconductor manufacturers that want to eliminate dumping penalties and improve U.S.-Japanese trade relations. It is also an effort by MITI to reassert its influence over the Japanese semiconductor industry. The key points of this proposal are:

- The end of a free market in commodity semiconductors
- A short-term rise in prices for Japanese commodity semiconductors and a more stable long-term price-reduction schedule
- The elimination of dumping charges and penalties
- Governmental negotiation of fully loaded production costs

It is important to note that South Korean semiconductors and Japanese ASICs are not included in this proposal. The ASIC marketplace is expected to become the next price battlefield soon. In response to that expectation, many ASIC companies are now absorbing their nonrecurring expenses to remain competitive.

The proposal would allow both governments to walk away from the issue without giving up any concessions or losing face. Any effects on prices will be attributed to a nonpolitical area--the dollar/yen exchange rate. Although the proposal is not policy yet, it will be interesting to see whether U.S. or Korean manufacturers will choose to follow the MITI pricing guidelines or to gain market share by setting prices below the agreed-upon rate.

It is the semiconductor user who will likely pay the bill for the market tampering done by the U.S. and Japanese governments. In return for relatively higher prices, they promise stability in the historically volatile commodity semiconductor market.

Sheridan Tatsuno
Mark Giudici

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JAPANESE RESEARCH NEWSLETTER

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KOREAN TAXATION

INTRODUCTION

DATAQUEST recently completed and published its first in-depth analysis of the Korean semiconductor industry. The report showed the total capital investment of the native Korean manufacturers for 1984 and 1985 to be $1.114 billion. This investment was almost four times their combined revenues.

In our Korean report, we also referred to the considerable tax incentives that befall the native companies that are investing in electronics and semiconductors. For example, these companies receive an additional depreciation of 100 percent of normal depreciation on capital goods. This accelerated depreciation is, of course, meant to enable these corporations to enter the world electronics market in the most expedient manner.

We believe that companies that are looking at Korea as a future manufacturing site or at the native manufacturers as competitors should be familiar with the Korean tax legislation and administration. To this end, we have prepared the following review and summary to supplement the initial Korean report.

KOREAN TAXATION

Tax Legislation and Administration

Under the Korean Constitution, tax legislation is enacted by the National Assembly. Proposed tax legislation is drafted by the related ministries (e.g., national taxes by the Ministry of Home Affairs) and submitted to the National Assembly through a resolution by the State Council. Such proposals may also be submitted by members of the National Assembly. The new tax laws are transmitted to the Administration for promulgation by the president. The president is empowered to issue

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presidential decrees concerning matters entrusted within the jurisdiction of the legislative body. The law takes effect 20 days after promulgation, unless otherwise provided. Generally, changes in Korean tax laws become effective on the first day of January of the following year.

The administration of national taxes is under the jurisdiction of the Ministry of Finance, which may issue ordinances for the implementation of the national tax laws and related presidential decrees after being empowered by a presidential decree. However, the authority for issuing the ordinances is delegated to the Office of National Tax Administration. These ordinances frequently cover matters that are too technical or complex to be set forth in detail in the statutes. Such ordinances have the force of law and often contain detailed instructions for the taxpayer to follow in computing and paying his tax.

Within the Ministry, the Office of National Tax Administration (ONTA) is responsible for the actual administration of the tax laws.

Features of the Korean Tax System

The Korean tax system consists of internal taxes, customs duties, and defense tax. The internal taxes encompass, among others, an income tax, a value-added tax, and a special excise tax.

The income tax laws generally distinguish between taxpayers that are legal entities and individuals. Individual income is classified into the categories of global income, timber income, retirement income, and capital gains. Each income category is subject to a separate, progressive income tax, except for capital gains, which are taxed at a flat rate. The tax rates apply to both residents and nonresidents. Corporations are taxed on their income at progressive rates. Tax credits are allowed to corporations for income taxes paid abroad under certain conditions.

Dividends received are taxable. Dividends paid to nonresident foreign shareholders are subject to withholding taxes at source.

The Defense Tax Law was enacted in 1975 to fund government activities related to national defense. The defense tax is a surtax on internal taxes (other than value-added tax) and is also levied on importations that are subject to custom duties. The Defense Tax Law provides an extensive system of withholding tax at source, including withholding from wages, commissions, professional fees, dividends, and interest.

Taxation of Foreign Corporations

A foreign corporation is liable to a corporation tax only on income derived from sources within Korea. However, no corporation tax is levied on the liquidation income of a foreign corporation. Corporation tax on income from domestic sources of a foreign corporation is assessed and collected in the same manner as that applied to a domestic corporation.

With respect to the income from domestic sources of a foreign corporation that has no domestic place of business, the full amount of corporation tax withheld thereon at source is payable to the Korean government.

The provisions of the tax laws with respect to calculation of taxable income and tax amount, assessment, collection, tax withholding, and reportings for domestic corporations are applicable to foreign corporations having a domestic place of business. However, there are special provisions for foreign corporations which are preferentially applied to.

Tax Incentives

General Principle

Foreign-invested enterprises are domestic enterprises as established by domestic law. Therefore, taxes for foreign-invested enterprises as well as domestic enterprises are not levied or are reduced in accordance with the Income Tax Law, Corporation Tax Law, and Tax Exemption and Reduction Control Law (TERCL), etc. However, in order to encourage foreign investment in Korea, the Foreign Capital Inducement Law (FCIL) provides a broad range of exceptional tax benefits for foreign-invested companies and foreign investors.

Foreign investors or foreign-invested companies that cannot receive tax benefits according to FCIL have tax benefits according to TERCL along with domestic investors. Also, foreign enterprises can receive not only tax exemptions of income tax and corporation tax from FCIL, but also tax exemptions from TERCL.

However, to avoid double exemption from FCIL and TERCL on stocks or shares owned by foreign investors, tax credit for investment is exempt in proportion to the ratio of the stock or shares owned by domestic investors.

Tax Incentives under the Tax Exemption and Reduction Control Law (TERCL)

- Tax incentives on key industries
  - A resident individual or a domestic corporation that operates in key industries, such as petrochemical, shipbuilding, machinery, electronics, aerospace, steel manufacturing, and other industries enumerated by the law as well as certain mining industries and defense industries, is entitled to additional depreciation of 100 percent of normal depreciation.
  - In the case of the machinery and electronics industries, an investment tax credit on the cost of machinery and equipment (3 percent if imported; 5 percent if manufactured locally) can be taken instead of the special depreciation mentioned above.

- Tax incentives on small and medium enterprises

  - The additional depreciation, generally 50 percent of normal depreciation, is allowed for a small or medium-size company engaged in manufacturing or mining. Also, a small or medium-size company engaged in manufacturing, mining, construction, transportation, or the operation of a fishery is entitled to a deductible investment reserve of 15 percent of the total machinery and equipment used in the business as of its financial year end.

- Tax incentives on development of technology and manpower

  - Reserves for technological development being counted in losses in calculating an income amount for the business year

  - Tax credit for development of technology and manpower

  - Tax incentives for starting a business using new technology

    - An amount equivalent to 6 percent (10 percent in the case of investment using domestically produced materials) of the amount invested in the business assets is deducted from the income tax or the corporation tax for the business year in which the date of completing said investment falls.

    - An amount equivalent to 50 percent of the ordinary depreciation amount is counted in losses in calculating an income amount for the business year, in addition to the ordinary depreciation.

  - Tax exemption for income for the transfer or lease of a patent

  - Deduction for a technology service business

  - Exemption of a foreign engineer or technician from income taxes on his salary or wages received from a domestic employer for the first five years

- Tax incentives for a business earning foreign currency

  - Reserves falling under the following categories are counted in losses

    - Reserves for export loss

    - Reserves for overseas market development

- Reserves for price fluctuation of export goods

- Special depreciation

- Supply of the goods for exportation and services rendered outside Korea is zero-rated in value-added tax

● Tax incentives for defense industries

  - Special depreciation

  - Exemption of special excise tax

● Tax incentives for the encouragement of investment

  - Tax credit for investment in special equipment--Where a resident or a domestic corporation starting a business using new technology invests in one of the following items, tax incentives described in "Tax incentives for starting a business using new technology" under previous section "Tax incentives on development of technology and manpower" apply:

    - Facilities for increasing productivity

    - Energy-saving facilities

    - Antipollution facilities

    - Facilities for prevention of industrial hazards

    - Mine safety facilities, etc.

  - Temporary tax credit for investment by the government to regulate the business cycle

  - Tax credit for investment in housing for homeless employees

● Tax incentives for an international monetary organization

● Other tax incentives

  - Capital gains

  - Overseas business and overseas investment

  - Resources development business

  - Exemption of special excise tax

    - For materials and goods for equipment required in the construction or repairing of tourist hotels

    - On goods to be used for Seoul Olympic and Seoul Asia Sports meetings, etc.

Tax Privileges under Foreign Capital Inducement Law (FCIL)

- General principle

  - Any foreign-invested project is deemed to contribute greatly to the development of the national economy, and when a request is made to receive tax benefits, adjusted tax benefits may be given if the project meets certain criteria. In such cases, the period of exemption is five years. The government permits a foreign-invested enterprise or foreign investor to choose the period for exemption of corporate and dividend income tax from any consecutive five-year period within ten years from registration of the enterprise in order to give the enterprise the maximum benefit from exemption.

  - Instead of a direct tax exemption, foreign-invested enterprises may choose a special depreciation, which might be more favorable for capital-intensive industries.

  - Foreign-invested projects that are deemed to contribute greatly to the development of the national economy are categorized as follows:

    - A project that makes a significant contribution to the improvement of the international balance of payments

    - A project that is accompanied by advanced technology or large amounts of capital

    - A project in which a non-resident Korean national invests in accordance with the law concerning the registration of non-resident Korean nationals

    - A project that is located in a free export zone in accordance with the Free Export Zone Establishment Law

    - Any other project designated by presidential decree as a project for which tax reduction or exemption is essential in order to induce foreign investment

- Tax exemption and special depreciation

  - The method for tax exemption or special depreciation is as follows:

    - Income tax or corporation tax on a foreign-invested enterprise is exempt in proportion to the ratio of the stock or shares owned by foreign investors to the stock or shares of the enterprise concerned.

- An amount equal to 100 percent of the ceiling of allowable depreciation calculated as determined by income tax law, or corporation tax law, multiplied by the foreign investment ratio, is incorporated into necessary expense or expense as special depreciation for calculating the taxable income for each tax year up to the amount invested by a foreign investor.

- Income tax or corporation tax on dividends accruing from the stock or shares acquired by a foreign investor is exempt up to the income accruing for five years after the tax year commencing following the registration of the foreign-invested enterprise.

- Acquisition tax and property tax on the properties acquired and held by a foreign-invested enterprise is exempt for five years from the date of registration in proportion to the foreign investment ratio of the enterprise concerned only when the properties were acquired and held after the registration of the enterprise concerned. If, however, the foreign-invested enterprise has any property before the registration for the original purpose of the project concerned, acquisition tax and property tax shall be exempt for five years from the date of acquisition of the properties in proportion to the foreign investment ratio of the enterprise concerned.

- Special depreciation expense may be incorporated into necessary expense or expense from the tax year commencing first following the registration of the foreign-invested enterprise.

- Exemption and reduction of customs duties, etc.

  - Customs duties, special excise tax, and value-added tax are exempt with regard to the import of the following capital goods:

    - Capital goods to be induced by a foreign investor as a subject matter of investment

    - Capital goods induced by an enterprise in which a foreign investment invests by means of dividends of a foreign-invested enterprise or by means of payment invested by a foreign investor

- Tax exemption or reduction on royalties

  - Income tax or corporation tax is exempt for five years from the date of acceptance of a report of the contract concerned with the royalties to be acquired by the technology licensor in accordance with the contents of a technology inducement contract.

- Exemption of income tax on wage and salary income
  - Income tax on wage, salary, and bonus of a foreign staff working in Korea under a joint venture agreement is fully exempt for five years from the registration date.
- Exemption of special excise tax on automobiles
  - Special excise tax is exempt on Korean-made automobiles (up to three units) purchased initially by any foreign-invested enterprise prescribed in FCIL.
- Exemption of defense tax
  - Persons who are relieved from taxes by FCIL or various treaties are not liable for a defense tax on those segments of tax relief.
- Non-taxable capital gains
  - Capital gains from investment of land or building, subject to the presidential decree, for the establishment of a foreign-invested enterprise under FCIL

Gene Norrett
Dr. Mike Bae

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1986-19

256K DRAM DUMPING MARGINS ANNOUNCED

U.S. SEMICONDUCTOR MANUFACTURERS WIN TWO IN ONE WEEK

For the second time this week, the U.S. Department of Commerce has ruled that Japanese companies are dumping semiconductors in the United States. Yesterday, the department announced its preliminary ruling on dumping margins to be imposed on Japanese 256K DRAM suppliers. The ruling is the result of a government-initiated antidumping petition filed late last year.

The average weighted dumping margin was determined to be 40 percent, with the margin by company as follows:

- Hitachi--20 percent
- Toshiba--50 percent
- Fujitsu--75 percent
- Mitsubishi--108 percent
- NEC--108 percent

As we stated in our March 11 Research Bulletin, these margins represent the percentage by which each company's price undercut its fully loaded cost of manufacturing plus an 8 percent profit margin. Beginning yesterday, the Japanese manufacturers will be required to post bonds to cover dumping duties on all imported 256K DRAMs; money collected during this period may or may not be refunded, depending on the final ruling by the U.S. International Trade Commission, which could take as long as 120 days from today. One year after the final ruling, the Japanese companies may appeal; if they can prove that they have been overcharged on dumping, money could be returned to them at that time.

DATAQUEST ANALYSIS

We believe that it is very significant that the U.S. government is now establishing a pattern of supporting the domestic semiconductor industry through the EPROM and 256K DRAM antidumping rulings this week. We expect these rulings to give U.S. suppliers 6 to 12 months of breathing room in which to recover their strength and reposition themselves.

Several U.S. suppliers announced their withdrawal from the 256K DRAM market last year; however, in anticipation of yesterday's favorable ruling, Motorola announced last week that it is considering reentering the 256K DRAM market.

It is interesting to note that, although two suppliers (Mitsubishi and NEC) were assessed very high dumping duties (108 percent), the weighted average duty was only 40 percent. We believe that this is partially due to the fact that Hitachi, the number one supplier of 256K DRAMs in the world, was assessed at only 20 percent, possibly because of long-term contracts with large U.S. OEMs, such as IBM, which tend to have higher prices. Also, because Hitachi is the largest 256K DRAM seller in the United States, it is probably further down the learning curve.

We have observed that as a result of increased demand, market prices for the 256K DRAM have risen 10 to 15 percent since September 1985, and, at the same time, costs have been substantially reduced. Because of this, we doubt that there is much dumping actually occurring at current prices.

We expect the market price to increase further by less than 15 percent as a result of yesterday's ruling, and we believe that price erosion will return later this year. Regardless of price, we believe that Intel and National Semiconductor have left the DRAM market for good.

Patricia S. Cox
Lane Mason

Dataquest
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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-18

EPROM DUMPING MARGINS ANNOUNCED

THE UNITED STATES RULES AGAINST JAPANESE EPROM MANUFACTURERS

The U.S. Department of Commerce today announced its preliminary ruling on dumping margins to be imposed on Japanese EPROM suppliers. The ruling is the result of an anti-dumping petition filed last fall by AMD, Intel, and National Semiconductor.

The average weighted dumping margin was determined to be 63.1 percent, with the margin by company as follows:

- Toshiba--21.7 percent
- Hitachi--30 percent
- Fujitsu--145 percent
- NEC--188 percent

These margins represent the percentage by which each company's price undercut its fully loaded cost of manufacturing plus an 8 percent profit margin. The margins will be applied across the board to all densities of EPROM sold in the United States by the assessed companies.

Beginning today, the Japanese manufacturers will be required to post bonds to cover dumping duties on all imported EPROMs; money collected during this period may or may not be refunded, depending on the final ruling by the U.S. International Trade Commission, which could take as long as 120 days from today. Figure 1 describes the procedural timetable for dumping disputes. It must be noted that one year after the final ruling, the Japanese companies may appeal; if they can prove that they have been overcharged on dumping, money could be returned to them at that time.

Still pending at the Commerce Department is the government-initiated 256K DRAM dumping preliminary ruling. That ruling on dumping margins is expected to occur March 14. We will issue a bulletin as soon as the ruling is announced.

DATAQUEST ANALYSIS

DATAQUEST believes that this ruling will result in more EPROM revenue for the major U.S. suppliers--AMD, Intel, National, and TI--because:

- Competition on price alone is softening.

- Prices will go up.
- One or more Japanese companies may choose to stop selling EPROMs in the United States, thereby giving U.S. firms a greater share of the market.

Costs for U.S. manufacturers have been decreasing as they have struggled to remain competitive (particularly Intel, which has spent the recession learning how to build EPROMs on high-yielding 6-inch wafers in Albuquerque); so increased revenues will have a very positive effect on profits.

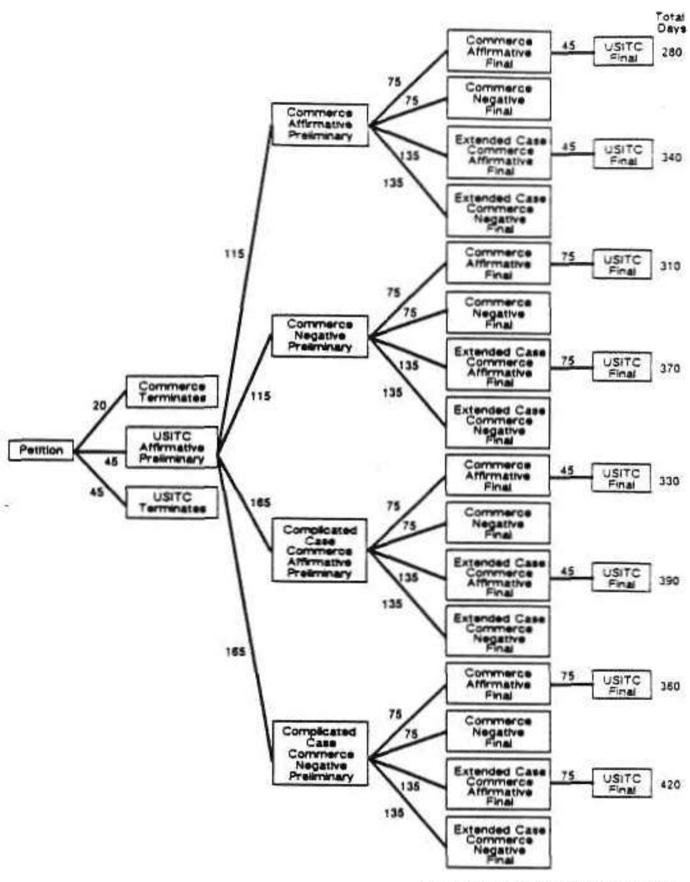
Higher profits will enable the U.S. companies to re-invest more money in efficient manufacturing of higher-density and future-generation EPROMs (i.e., 1Mb and 4Mb).

We believe that it is significant that the U.S. government has supported our domestic semiconductor manufacturers through this preliminary ruling, and we expect future decisions to have equally positive effects on the U.S. semiconductor industry.

Patricia S. Cox
Gene Norrett

Figure 1

STATUTORY TIMETABLE FOR ANTIDUMPING INVESTIGATIONS
(In Days)



Source: International Trade Commission

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

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1986-15

WORLD CONSUMPTION UPDATE:
WORLD SEMICONDUCTOR CONSUMPTION REBOUNDS IN 1986

WORLD OVERVIEW

In 1985, semiconductor sales were down sharply in all major regions of the world. Of the four major regions--North America, Japan, Europe, and Rest of World (ROW)--North American sales showed the strongest decline at 27.0 percent. DATAQUEST believes that the worst is behind us, however. We expect growth in the first quarter of 1986 in all world regions, including North America. This projected first quarter growth should point the industry on the way to recovery and allow it to realize world growth of 16.4 percent in 1986. We believe that 1987 will be an exceptional year in all regional markets, with the world averaging 32.6 percent growth.

JAPAN BECOMES THE LARGEST MARKET

Our regional forecast points to some startling news in market size. As shown in Table 1, the Japanese market is projected to exceed the North American market in 1986.

Table 1

REGIONAL GROWTH RATES AND MARKET SHARE
(In Percent)

	Yearly Growth			Market Share		
	1985	1986	1987	1985	1986	1987
North America	(27.0%)	10.8%	34.9%	38.8%	36.9%	37.5%
Japan	(2.8)	28.4	30.6	34.8	38.4	37.8
Europe	(3.6)	6.3	29.8	18.7	17.1	16.7
ROW	(16.6)	14.7	37.1	7.7	7.6	8.0
Total	(15.0%)	16.4%	32.6%	100.0%	100.0%	100.0%

Source: DATAQUEST
March 1986

The U.S. market is expected to pick up some share again in 1987, although it is not expected to recover its former status. Note that much of the growth that Japan realizes in 1986 is due to currency exchange. Japan gains about 19.0 percent merely from currency exchange because of a strengthening yen to dollar. Our forecast also indicates that European consumption will decline as a percentage of the total between 1985 and 1987. The European market, however, gained considerable market share in 1985 relative to its 1984 level. That market is actually leveling to a normal growth cycle. Our data also indicate that the ROW region will grow slightly to 8.0 percent in 1987.

END MARKETS KEY TO MARKET STRENGTHS AND WEAKNESSES

The severity of regional market declines in 1985 was determined largely by each region's end-market focus. The computer/data processing market was exceptionally weak and, consequently, hurt those markets focusing heavily on this area. More stable were the applications areas of consumer electronics and telecommunications.

North America/U.S. Market

With a heavy 40 percent emphasis on computers, the North American market witnessed the most severe decline of all regional markets. The U.S. market noted a sales decline of 27.0 percent. Key to the weakness of the computer market was the computer OEMs' misjudgement of actual consumption. A buying/production cycle was created at the computer level that impacted component suppliers. Inventory in 1984 was accumulated far in excess of actual needs. This inventory is now perceived to be leveling to a more normal volume, which will lead to steady booking and shipment activity. Booking and shipment levels appear to be correcting in many product areas. It is this expectation that points to a 3.9 percent North American market growth in the first quarter of 1986. DATAQUEST believes that normal inventory depletion will continue the quarterly growth pattern through 1986, for a yearly total of 10.8 percent. In 1987, we expect quarterly growth to continue. We believe that 1987 will be a year of strong growth (34.9 percent) in the U.S. market. In terms of levels of consumption, however, it is not until 1987 that we expect consumption to return to the level of 1984.

Japanese Market

The Japanese market was among the more favorable in terms of the 1985 market decline. A heavy emphasis on consumer applications was largely responsible for this stability. DATAQUEST identifies the sales decline in the Japanese market at a modest 2.8 percent in 1985. As stated earlier, we expect the Japanese market to surpass the U.S. market in dollar volume in 1986. The exchange rate is responsible for a good portion of this increase. In yen, the Japanese market is expected to grow about 9.4 percent. Current exchange notes that the U.S. dollar is worth about 203 yen, down significantly from 1985's average of about 237 yen. Our current forecast, incorporating the yen valuation, shows the Japanese market growing 28.4 percent in 1986, far beyond the world average of 16.4 percent. In 1987, we expect Japanese market growth to be on a par with the world, at 32.6 percent.

European Market

With end-market focus primarily in the relatively stable and growing area of telecommunications, the European market was not as seriously affected as either the North American market or ROW market. The European market declined by approximately 3.6 percent in 1985. This modest decline allowed Europe to pick up market share relative to the world in 1985. It is expected, however, that this market share will revert to its normal level of about 16.6 percent (in 1984) of total sales. Note that Table 1 overstates Europe's market share because Europe gained over 2.0 percentage points in total market size in 1985. The decline in total percentage shown for years 1986 and 1987 brings Europe back to its 1984 market share of 16.6 percent.

ROW Market

The ROW region, like the Japanese market, focuses primarily on consumer-oriented products, a market that was relatively stable in 1985. Yet the ROW region also sees a large amount of activity from foreign and North American companies building computer equipment abroad. It is the balance of these factors that caused a market decline of 16.6 percent in 1985. As in other regions, we expect quarterly growth to be effective throughout 1986 and 1987. DATAQUEST projects ROW growth at 14.7 percent in 1986 and 37.3 percent in 1987.

WORLD PRODUCT TRENDS

In our quarterly world product forecast shown in Table 2, we project that MOS products will make a comeback in 1986. MOS and bipolar digital were the areas most strongly affected in 1985; both were down approximately 21 percent. The product area that noted the strongest decline, however, was MOS memory, which dropped about 36.3 percent worldwide. In this memory area, steep quarterly growth is required to pull it up from its 1985 trench. We believe that this growth is realistic and forecast that MOS memory will be up 12.0 percent in 1986. MOS microprocessor devices and MOS logic are also expected to show good growth that will continue to build momentum into 1987. Our estimated MOS technology growth in 1987 is a lofty 49.5 percent, raised through high recovery expectations for MOS memory and MOS micro devices. Bipolar products are also projected for growth, but they are not as dramatic in percentage terms as MOS digital products. Other product areas of linear, discrete, and optoelectronics that did not decline severely in 1985 are not expected to ramp up as quickly as harder hit product areas.

Patricia S. Cox
Barbara A. Van
Howard Z. Bogert

Table 2

ESTIMATED WORLDWIDE QUARTERLY SEMICONDUCTOR CONSUMPTION
(Millions of Dollars)

	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	% CHG 1985-86
Total Semiconductor	24737	6354	6862	7389	8178	28783	16.4%
Total IC	18858	4751	5176	5642	6334	21903	16.1%
Bipolar Digital	3778	895	962	1053	1172	4082	8.0%
Memory	595	143	154	167	178	642	7.9%
Logic	3183	752	808	886	994	3440	8.1%
MOS Digital	10313	2551	2834	3147	3653	12185	18 2%
Memory	4008	903	1048	1186	1446	4583	14.3%
Micro Devices	2751	735	792	857	971	3355	22.0%
Logic	3554	913	994	1104	1236	4247	19.5%
Linear	4767	1305	1380	1442	1509	5636	18.2%
Discrete	4691	1258	1323	1370	1450	5401	15.1%
Optoelectronic	1189	345	363	377	394	1479	24.4%

	Q1/87	Q2/87	Q3/87	Q4/87	1987	% CHG 1986-87
Total Semiconductor	8657	9240	9827	10439	38163	32.6%
Total IC	6800	7339	7920	8439	30498	39.2%
Bipolar Digital	1233	1275	1302	1299	5109	25.2%
Memory	179	183	188	194	744	15.9%
Logic	1054	1092	1114	1105	4365	26.9%
MOS Digital	3973	4332	4746	5156	18207	49.4%
Memory	1584	1733	1928	2103	7348	60 3%
Micro Devices	1071	1192	1325	1467	5055	50.7%
Logic	1318	1407	1493	1586	5804	36.7%
Linear	1594	1732	1872	1984	7182	27.4%
Discrete	1445	1471	1468	1540	5924	9.7%
Optoelectronic	412	430	439	460	1741	17.7%

Source: DATAQUEST
March 1986

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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-17

MEGACELL FEVER:
JAPANESE DEVELOPING AUTOMATED STANDARD CELL SYSTEMS

SUMMARY

Automated megacell technology--the wave of the future? Japanese vendors have leaped into the standard cell market and are now introducing megacells and design automation systems. In March, Matsushita announced its Standard Layout Design Automation System (STELLA), which runs on a VAX and is capable of handling up to 30,000 gates. Matsushita, which follows Fujitsu and NEC in introducing ASIC design automation tools, offers 200 cells in its standard cell library.

As shown in Table 1, DATAQUEST estimates worldwide merchant consumption of standard cells to grow from $246.8 million in 1985 to $4.0 billion in 1990, representing 20 percent of total ASIC consumption and 10 percent of total semiconductor consumption in 1990.

Japanese companies are rushing to develop standard cell libraries incorporating standard RAMs, ROMs, EPROMs, EEPROMs, and MPUs. "Smart" VTRs, high-resolution television sets, and IC cards are currently hot end uses. Table 2 summarizes Japanese standard cell development activities.

STRATEGIC IMPLICATIONS

DATAQUEST believes that ASIC makers must develop standard cell and megacell technology to remain competitive with Japanese vendors. As discussed in our recent newsletter, "How to Succeed in ASICs," dated February 14, 1986, ASIC makers must develop sub-1.5-micron CMOS technology, automated CAD software, automated manufacturing and inventory control, and strong service support. Excellent service, functionality, user-friendly software, and automation will separate the winners from the losers in this competitive field.

Sheridan Tatsuno

Table 1

WORLDWIDE ASIC CONSUMPTION FORECAST
(Billions of Dollars)

	1985	1986	1987	1988	1989	1990	Percent CAGR (1985-1990)
Total ASICs	$7.6	$9.3	$11.3	$13.5	$16.2	$20.0	21.5%
Captive ASICs	$3.0	$3.5	$ 4.1	$ 4.9	$ 5.8	$ 6.8	18.0%
Semicustom	$1.7	$2.3	$ 3.0	$ 4.0	$ 5.2	$ 6.7	32.3%
Custom	$2.9	$3.5	$ 4.1	$ 4.6	$ 5.3	$ 6.5	17.1%
Standard Cell	$0.2	$0.5	$ 0.8	$ 1.4	$ 2.4	$ 4.0	74.3%
Ful' Custom	$2.7	$3.1	$ 3.3	$ 3.2	$ 2.9	$ 2.5	(1.4%)

Table 2

JAPANESE STANDARD CELL ACTIVITIES

Company	Activity
Asahi Glass	Selling VLSI Technology's megacells in Japan; initial year targeted at ¥1 billion ($5 million)
Asahi Micro-Systems	Developing 2- and 1-micron CMOS process; 1- and 2-layer metal
Fujitsu	CMOS standard cell library with over 100 cells; gate delays of 2.1ns per gate
Fujitsu Busho	Receiving orders with Fujitsu; plans to triple overall technology division staff to 100 people in three years
Hitachi	Automatic floor-planning system for block placement phase
Japan Victor	Developing 16-bit MCU "superchips" for VTRs, television sets, and other consumer goods
Matsushita	Standard Layout Design Automation System (STELLA) capable of 30,000 gates; MN72000 Series offering 2.0-micron CMOS process; 1-layer poly, 2-layer metal technology; library of 200 cells; orders from May 1986; sales goal of ¥7 billion ($40 million) in 1986
Mitsubishi	NMOS 500-cell library, plus CAD system; using a Bi-CMOS, 3-micron building block approach for up to 24,000 gates
Ninon LSI	Adding CAD systems for standard cells and gate arrays
NEC	Standard cell series using 1.5-micron CMOS process; 17,000-gate capability to be expanded to 25,000 gates in 1986; ¥10 million ($50,000) development cost for 3,000 gates; a CAD system (LOMBO) that converts circuits directly from printed circuit boards to LSI circuits for 200,000-gate blocks; accepting orders up to 17,000 gates in 1985 and 25,000 gates in 1986; 300 cells (140 macrocells)
Oki Electric	CMOS standard cell series (MSM91000) up to 24,000 gates using a 1.5ns, 2-micron process; a standard cell 32-bit MPU (MVM6971) on a 224mm-square chip; 12-month design time; six IBM PC-based CAD software packages
Pioneer	CMOS 3-micron process for internal gate arrays and standard cells; entering the merchant market; adding five to six research staff annually
Ricoh	A new method for designing custom single-chip MCUs around Rockwell's 8-bit CMOS MCU; a common design method for gate arrays and standard cells; added Western Design Center's 16-bit CPU core to cell library (65C816); over 150 cells, up to 10,000 gates
Sanyo	Standard cells incorporating LC9500, TTL74, and LC9300 series; NRE cost of ¥4 million ($16,000) for 500 to 1,000 gates; ¥6 million ($24,000) for 3,000 to 4,000 gates
Sharp	A standard cell correction program that allows changes in position of elements after wiring has begun; potential 10 percent reduction in chip size
Toshiba	A triple-layer standard cell wiring program that permits a 10 percent reduction in chip size; a CMOS series capable of mounting 4K RAM and 16K ROM and compatible with Toshiba's ultra-high speed gate arrays (TC22SC); 180-based cells
Yamaha	Company goal of reducing standard cell development time from 20 weeks to 6 weeks

Source: DATAQUEST
March 1986

Dataquest
a company of The Dun & Bradstreet Corporation

RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-16

JAPAN FORMS NEW AUTOMOTIVE MATERIALS RESEARCH PROJECT

SUMMARY

Twenty-five Japanese companies recently formed the Next Generation New Alloys Research Association to develop new automotive materials. Sponsored by Tohoku University's Engineering Department and the Metallurgy Research Association in Sendai City (north of Tokyo), the new joint R&D project involves eight automobile makers (including Toyota and Nissan), six semiconductor companies (NEC, Hitachi, and others), and eleven materials companies. The research consortium will develop alloys for the participating car makers, focusing on four areas:

- Amorphous alloys
- Shaped memory alloys
- Fine ceramics (car engines and IC packaging)
- Hydrogen storage alloys

The Aoba Engineering Promotion Association will investigate the telecommunications and nuclear power applications of these new alloys.

DATAQUEST ANALYSIS

Japanese automotive companies are rapidly pushing into electronics and new materials to develop lighter, stronger, and IC-intensive cars. DATAQUEST estimates that Japanese automobile makers consumed ¥72 billion ($303 million) worth of semiconductors in 1985, which will grow 16 percent to ¥83.5 billion ($464 million) in 1986. In comparison, estimated U.S. automotive semiconductor consumption was about $800 million in 1985, which will grow to $1.2 billion by 1989.

As shown in Table 1, Honda, Mazda, Nissan, and Toyota are enlarging their electronic research centers, expanding IC production, and purchasing supercomputers for automotive design. Nippondenso, a major Toyota supplier, is building a new $160 million plant; Nippon Denso (a different company) opened a research office in Michigan.

DATAQUEST believes that this project will work closely with three MITI Next-Generation Industries projects: the New Materials Project for new alloys and fine ceramics (1981-1990), the New Electron Devices Project for temperature- and shock-hardened ICs (1981-1990), and the New Diamond Substrate Forum (from 1987). Moreover, this project represents a trend toward more privatization and regionalization of joint research.

Sheridan Tatsuno

Table 1

RECENT JAPANESE AUTOMOTIVE ELECTRONICS ACTIVITIES

Date	Company	Activity
Nov. 1984	Honda	Research office in California
Aug. 1985	Nippondenso	Increased production of automotive ICs; $20 million new wafer line at Kariya, Aichi prefecture, headquarters by March 1986; Nippondenso supplies ICs to Toyota on a captive basis
Sept. 1985	Nippondenso	Merchant sales campaign for 1-bit MCUs, previously produced for captive use
Sept. 1985	Toyota	Production of hybrid ICs for electronically controlled suspension systems; dedicated IC plant planned in fiscal 1986
Nov. 1985	Nissan	$8 million electronics R&D lab under development
1985	Nissan	$6.5 million Cray X-MP supercomputer purchased; electronic research center in Yokosuka enlarged from 150 staff to 220 to develop and test-manufacture automotive ICs; S. Komiya, former chief researcher to MITI's Agency of Industrial Science and Technology, to manage the center's research
1985	Toyota	Fujitsu VP100 supercomputer purchase
1986	Mazda	Electronics R&D Lab in Yokohama planned
1986	Nissan	Nissan Techno established in Kanagawa Prefecture to begin IC design and software development; plans to develop sensors and robots for production lines
1986	Nippon Denso	Automotive electronics R&D lab in Michigan; 1-Mbyte DRAM recently developed in Japan for captive use
1987	MITI	Two hundred companies to participate in New Diamond Substrate Forum to develop synthetic diamond substrates for car engines, space, aviation, and nuclear power plants
April 1987	Nippondenso	Automotive IC production to be shifted to new $160 million plant in Koda-cho, Aichi prefecture, in the spring of 1987; IC production of 12 million units per month targeted in 1987
Aug. 1989	Nippon	Electronics R&D lab in Aichi prefecture planned

Source: DATAQUEST
March 1986

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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, JSIA 1986-14

THE ECL-GALLIUM ARSENIDE RACE IN JAPAN: MITI'S SUPERCOMPUTER PROJECT SPINS OFF NEW DEVICES

SUMMARY

The race between gallium arsenide (GaAs) and emitter-coupled logic (ECL) makers is heating up in Japan. At the recent International Solid State Circuits Conference (ISSCC), Japanese participants in MITI's Supercomputer Project presented papers from their GaAs and ECL research. GaAs papers included the following:

- Fujitsu--A 1,500-gate high-electron mobility transistor (HEMT) using an enhancement/depletion-type DCFL circuit, an 8 x 8 parallel multiplier, and 1.2-micron gates

- NEC--A 3,000-gate buffered FET logic (BFL) GaAs gate array using 1.4-micron gates, with 22,392 FETs in a 7.5 x 7.4mm chip

Four companies announced emitter-coupled logic (ECL) and fast bipolar-CMOS (Hi-BiCMOS) RAMs and arrays, as well as Josephson junction logic. Their papers covered the following:

- Fujitsu--A 16K ECL SRAM with 1,248 logic gates in an array using U-groove isolation and 1.0-micron design rule

- Hitachi--A Hi-BiCMOS circuit for 60-MHz digital processing; a 4 x 4 multiplier and 3-bit counter in Josephson threshold logic; a 64K ECL RAM with 13ns access and 500mW operating power, using Hi-BiCMOS technology; and a 3.5ns 16K ECL bipolar RAM

- Mitsubishi--An 18,000-gate ECL variable-size cell masterslice

- NEC--A 16K ECL RAM with a 4ns access time

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DATAQUEST ANALYSIS

Since its establishment in 1981, MITI's Supercomputer Project has accelerated Japan's push into GaAs, high-electron mobility transistors (HEMTs), emitter-coupled logic (ECL), and Josephson junctions, as shown in Table 1. DATAQUEST observes that NEC, Hitachi, and Fujitsu have already announced 4K GaAs SRAMs, which we believe are being designed into their supercomputers; they are currently developing 16K GaAs SRAMs. DATAQUEST expects Japanese companies to announce prototype 16K GaAs SRAMs by 1987 and 64K GaAs SRAMs by 1988 or 1989. However, in the short term, ECL RAMs and arrays will predominate. To avoid undercutting their supercomputer sales, we believe that Japanese makers will restrict their leading-edge GaAs ICs to captive uses for several years before selling them into the merchant market.

Sheridan Tatsuno

Table 1

PAST JAPANESE DEVICE ANNOUNCEMENTS

GaAs Gate Arrays	
Oki	A 1,000-gate GaAs array with 190ps computing speed; 1,000 transistors on a 3.7 x 3.9mm chip (Q1/1985)
GaAs Static RAMs	
Fujitsu	1.7ns SRAM; 27,000 transistors on 5.5 x 3.7mm chip; 600mW power consumption; implanted ions used (Q4/1985)
Hitachi	A 4K GaAs SRAM with 2.2 to 3.0ns response time; 26,000 elements on a 4.7 x 3.7mm chip (Q2/1985)
Mitsubishi	2.5ns SRAM; 3.3 x 3.2mm chip; 200mW power consumption (Q4/1985)
GaAs MESFETs and Multipliers	
NEC	A 12 x 12-bit extended parallel multiplier with 1,813 logic gates of 3,646 transistors and 1,136 diodes (Q1/1985)
Oki	A GaAs MESFET with 14.7ps processing speed (Q1/1985)
High-Electron Mobility Transistors (HEMTs)	
Fujitsu	Resonance tunneling hot electron transistor (RHET) with 1ps theoretical speed; GaAs/AlGaAs layers (Q4/1985)
Fujitsu	Hot electron transistor (HET) potentially faster than a Josephson junction device; MBE used to develop GaAs/AlGaAs seven-layer structure (Q3/1985)
NEC	A 5ps GaInAs transistor using a 5-atom thick AlGaAs film over a GaInAs substrate (Q3/1985)
Oki	"Reverse" HEMT with AlGaAs/GaAs layers over AlGaAs substrate; 0.7-micron elements; 1,000 elements (Q3/1985)
Emitter-Coupled Logic (ECL)	
Fujitsu	16-bit ECL RAMs with 4 x 4-bit architecture; 1.5-micron design rule; 70,000 elements on 6.4 x 4.0mm chip; 15ns access time (Q4/1985); two 16K ECL RAMs with 70,000 elements on a 6.4 x 4.0mm chip and 15ns access time (Q3/1985)
Mitsubishi	1K ECL RAM with 5 and 7ns access times; 4K ECL RAM with 10 and 15ns access times (Q3/1985)
NEC	Two ECL gate arrays; 4,000/5,000 gates; 1.4-micron wide emitter; 0.43ns input buffer delay time (Q3/1985)
Josephson Junctions	
Hitachi	20ps control terminal transistor
NEC	A 4 x 4 multiplier with 80ps speed and 249 gates on 2.7 x 2.7mm chip (Q1/1985); 280ps 4 x 4-bit multiplier; 150ps 4 x 4-bit parallel multiplier with 249 logic gates

Source: DATAQUEST
February 1986

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters, 1985-1986
1986-12

1985 JAPAN CAD/CAM USER SURVEY

SUMMARY

DATAQUEST recently completed its first annual CAD/CAM end-user survey in Japan. The purpose of the survey was to gain insight from users currently using CAD/CAM systems. The survey questions closely paralleled those asked in DATAQUEST's U.S. survey administered early in 1985 (see DATAQUEST's CCIS newsletter No. 84 entitled, "1985 CAD/CAM User Survey Results") and was designed to detect similarities and differences in the two geographical regions.

DATAQUEST surveyed end users using products from the following CAD/CAM vendors in Japan:

- C. Itoh Data Systems (U.S. affiliation: Calma)
- Cadam
- Fujitsu
- Marubeni Hytech (U.S. affiliation: Applicon, Ecad, Zycad)
- Mentor Graphics
- NEC
- Sekio Instruments & Electronics (U.S. affiliation: Daisy Systems, McAuto, Zuken)
- Technodia (U.S. affiliation: Valid Logic)
- Tokyo Electron (U.S. affiliation: Computervision)
- Toshiba

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In 1984, these ten vendors accounted for $441 million in Japanese CAD/CAM revenue (60 percent of total 1984 Japanese CAD/CAM revenue) and 3,685 installed 1984 total workstations shipped in Japan (48 percent of total installed Japanese workstations).

The 1,200 questionnaires were mailed to the CAD/CAM system managers at these installations (sites), and 397 (33 percent) were returned and used in compiling the results. The sum of the workstations at these sites totalled 4,644 units.

SURVEY FOCUS

DATAQUEST chose the following five major issues as the focus of this survey:

- Survey demographics--By industry classification, by type of applications, and by system usage
- Penetration--Number of workstations installed, percentage of trained users, trained users per workstation, number of engineers and draftsmen per site, engineers and draftsmen per workstation, the use of standalone workstations, and the use of color workstations
- Personal computer use in CAD/CAM
- Pricing expectations for workstations relative to the following parameters: main memory, disk storage, screen resolution, screen size, and preference for either color or monochrome screen
- Solids modeling in CAD/CAM

SURVEY DEMOGRAPHICS

Industry Classification

Those surveyed were asked to identify the one industry classification from the following list that best described the type business in which their company was engaged:

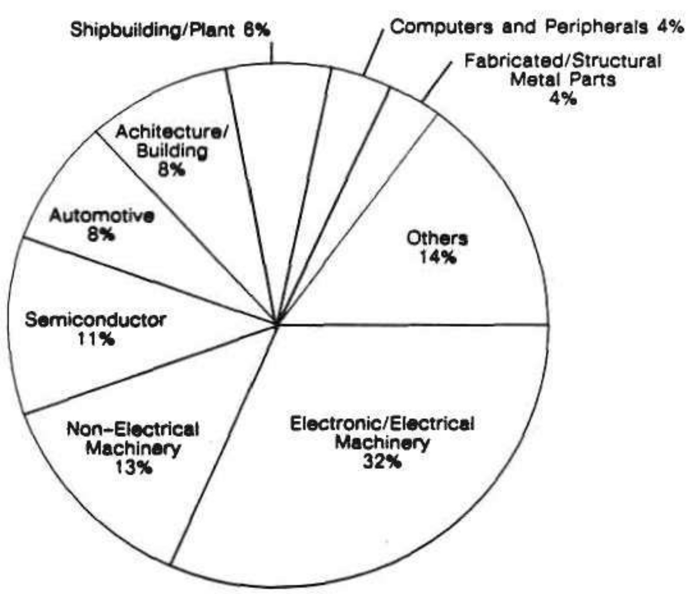
- Aerospace
- Architecture/building
- Automotive
- Chemical and allied products

- Computers and peripherals
- Electrical/electronic machinery, equipment, and supplies
- Fabricated/structural metal parts
- Iron and steel
- Mapping
- Metalworking
- Semiconductor
- Shipbuilding/plant
- Telecommunications
- Transportation (other than aerospace and automotive)
- Other (to be specified)

The distribution of respondents for each industry is shown in Figure 1. Electrical/electronic machinery, equipment, and supplies was the largest response group with nearly one-third of all responses.

Figure 1

INDUSTRY CLASSIFICATION
(Percent of Respondents)



Source: DATAQUEST
February 1986

The only major difference in the CAD/CAM industrial distribution between Japan and the United States is the aerospace industry. The U.S. aerospace industry has been one of the largest and most aggressive groups to implement CAD/CAM technology. Without any appreciable number of companies in this area, Japan obviously does not have this market opportunity.

Applications

Those surveyed were asked to check all applications from the following list that were being performed at their site:

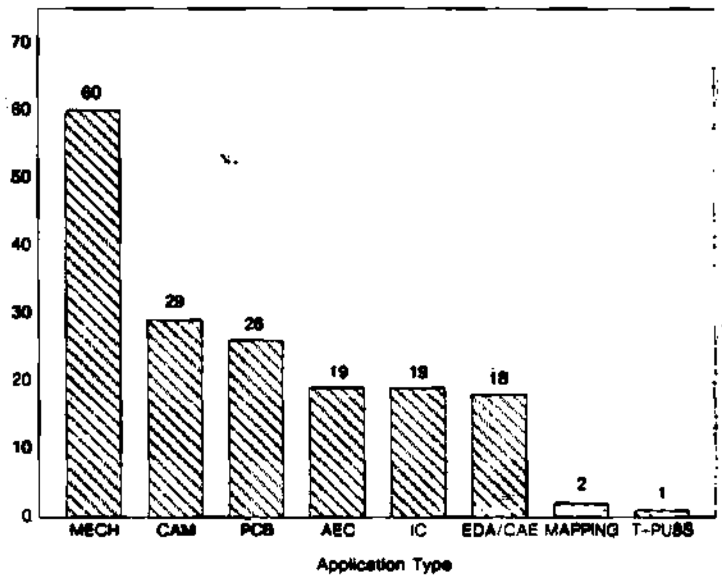
- Architecture, engineering, and construction/2D (AEC/2D)
- Architecture, engineering, and construction/3D (AEC/3D)
- Mechanical/2D (MECH/2D)
- Mechanical/3D (MECH/3D)
- Computer-aided manufacturing (CAM)
- Printed circuit board physical layout (PCB)
- Integrated circuit physical layout (IC)
- Electronic design automation (EDA/CAE)
- Technical publications (T-Pubs)
- Mapping

The distribution of respondents for each application is shown in Figure 2. Table 1 shows the respondents for each application by industry. As expected, mechanical applications dominate, with more than 60 percent of the respondents indicating that they perform some mechanical CAD/CAM work. The distribution illustrated in Figure 2 closely parallels the U.S. application distribution.

Figures 3 and 4 segment 2D and 3D usage for mechanical and AEC applications, respectively. Surprisingly, the use of 3D in AEC (52.7 percent) and mechanical (55.9 percent) was nearly equal. Nevertheless, DATAQUEST believes that 2D applications such as drafting still dominate when measuring the total elapsed time spent on a CAD/CAM workstation.

Figure 2

APPLICATIONS
(Percent of Respondents)



Source: DATAQUEST
February 1986

Table 1

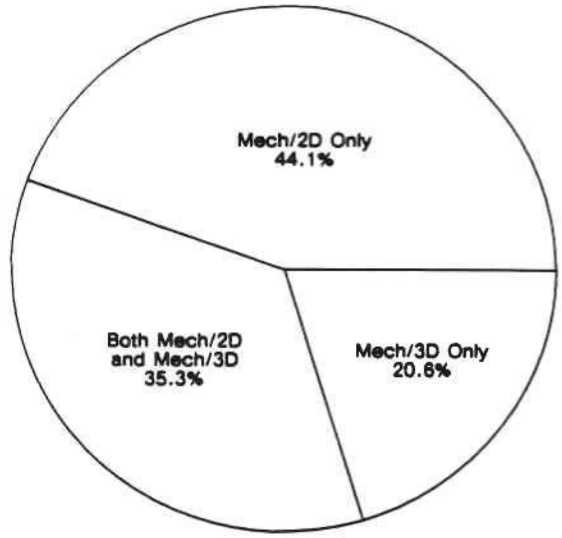
APPLICATIONS BY INDUSTRY
(Percent of Respondents within Each Industry)

Industry	AEC	CAM	MECH	PCB	IC	EDA/CAE	T-Pubs	Mapping
Architecture/Building	87%	3%	20%	0%	0%	0%	0%	0%
Computers and Peripherals	0%	25%	63%	50%	25%	44%	0%	0%
Electrical/Electronic Machinery	7%	37%	43%	53%	21%	23%	2%	0%
Fabricated/Structural Metal Parts	6%	63%	81%	6%	0%	0%	0%	0%
Non-Electrical Machinery	10%	22%	72%	14%	2%	2%	0%	0%
Semiconductor	0%	14%	10%	7%	74%	55%	0%	0%
Shipbuilding/Plant	76%	32%	72%	0%	0%	0%	0%	0%
Transportation including Aerospace & Automotive	2%	35%	72%	19%	5%	12%	0%	0%
Others	28%	28%	57%	21%	19%	13%	2%	11%

Source: DATAQUEST
February 1986

Figure 3

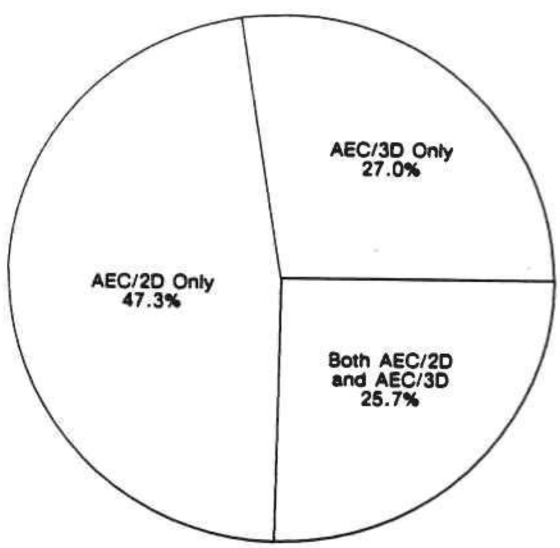
MECHANICAL APPLICATION USAGE



Source: DATAQUEST
February 1986

Figure 4

AEC APPLICATION USAGE



Source: DATAQUEST
February 1986

System Usage

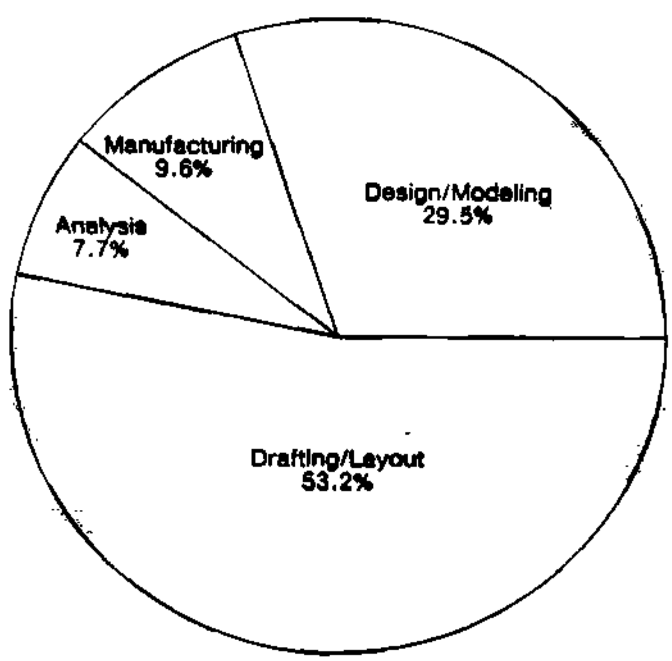
Respondents were asked to indicate system usage percentages among the four following system functions:

- Drafting/layout
- Design/modeling
- Analysis
- Manufacturing

Figure 5 breaks out the system usage categories across all respondents. Across the aggregate of respondents, drafting/layout represents an average of 53.2 percent of system usage followed by design/modeling (29.5 percent), manufacturing (9.6 percent), and analysis (7.7 percent). This usage mix is nearly identical to what was found among surveyed users in the United States. This is not unusual because a high percentage of Japanese CAD/CAM products are U.S.-sourced, and usage is highly dependent on system capabilities.

Figure 5

SYSTEM USAGE
(Averages)



Source: DATAQUEST
February 1986

PENETRATION

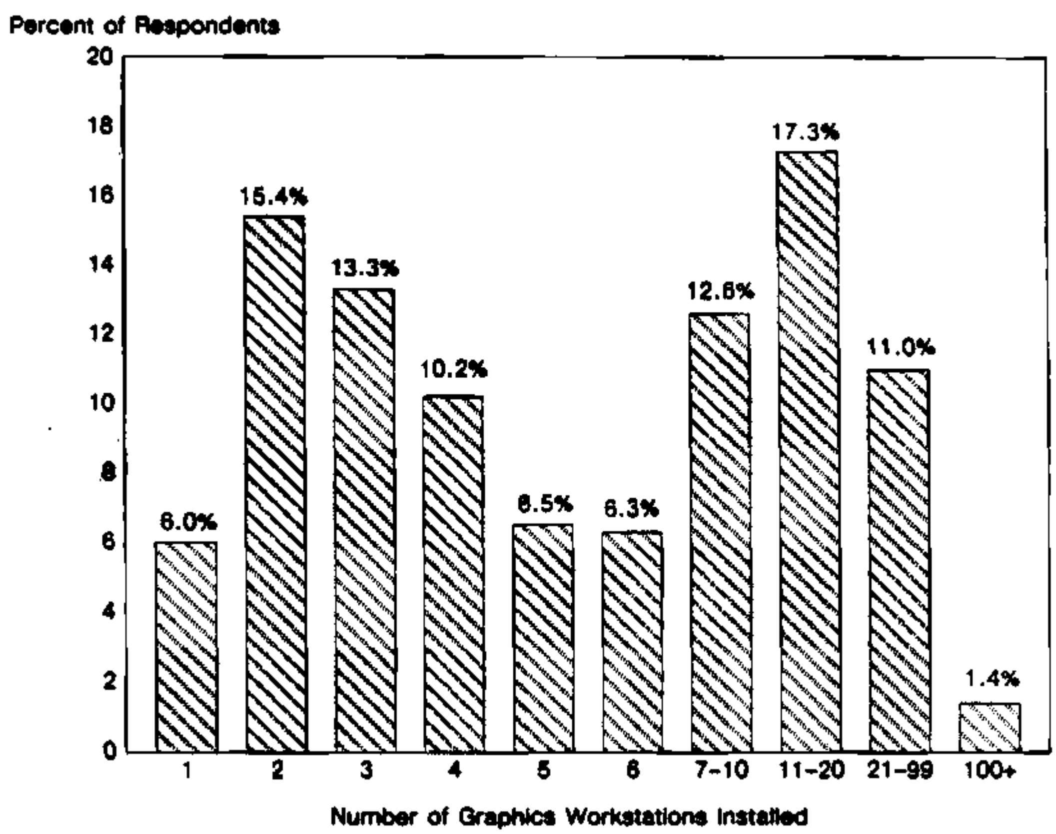
Number of Graphics Workstations Installed

Survey respondents were asked to indicate the number of graphics workstations they had installed at each site. The distribution of respondents by number of workstations installed is illustrated in Figure 6. Greater than half of all CAD/CAM workstations are installed at sites with five workstations or less. The largest single distribution (17.3 percent) is found at sites with between 11 and 20 workstations.

Table 2 lists the average number of graphics workstations installed, by industry. The semiconductor and transportation companies have the largest average number of graphics workstations installed (16) while companies in the fabricated structural/metal parts group had the smallest average number of installed workstations (6).

Figure 6

GRAPHICS WORKSTATIONS INSTALLED
(Distribution of Respondents)



Source: DATAQUEST
February 1986

Table 2

CAD/CAM WORKSTATIONS INSTALLED, BY INDUSTRY

Industry	Average Number
Semiconductor	16
Transportation including Aerospace & Automotive	16
Shipbuilding/Plant	13
Electrical/Electronic Machinery	12
Non-Electrical Machinery	12
Architecture/Building	7
Computers and Peripherals	7
Fabricated/Structural Metal Parts	6
Others	13
Industry Average	12

Source: DATAQUEST
February 1986

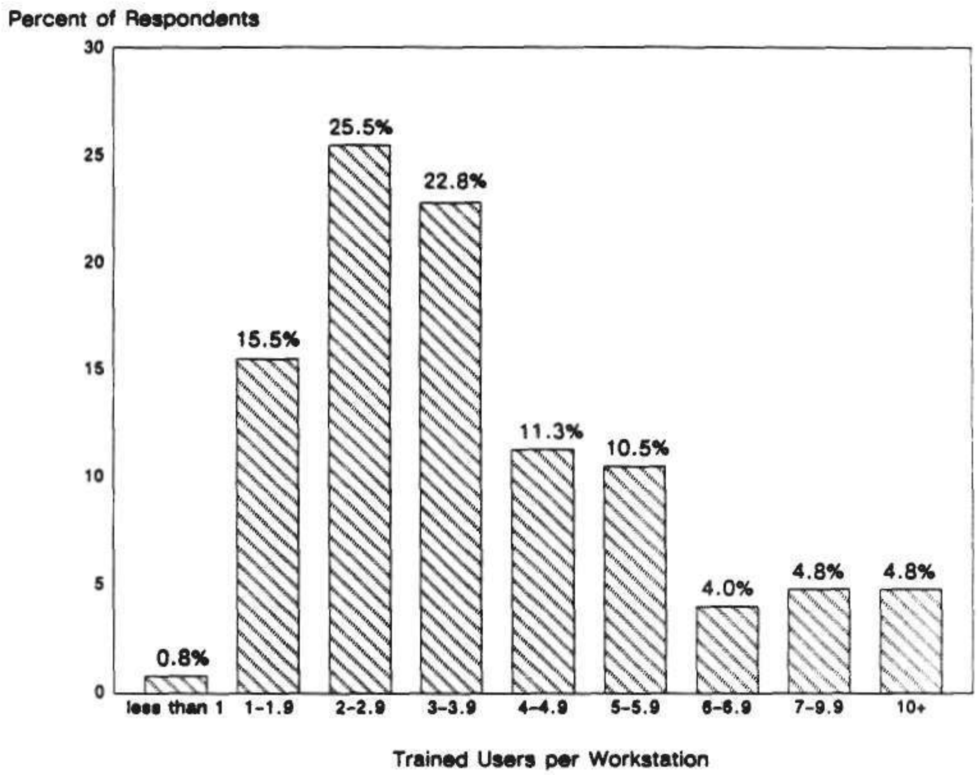
Trained Users/Workstation

DATAQUEST also asked survey respondents to indicate how many trained engineers and draftsmen share a single CAD/CAM workstation. The average number of users per workstation across the aggregate of respondents was 3.6. The distribution of respondents for the number of users per workstation is shown in Figure 7.

Table 3 lists the average number of trained users per workstation, by industry. The semiconductor industry has the highest number of users per workstation (4.3) while the fabricated/structural metal parts industry has the fewest number of users per workstation (2.3).

Figure 7

TRAINED USERS PER GRAPHICS WORKSTATION



Source: DATAQUEST February 1986

Table 3

TRAINED USERS PER INSTALLED WORKSTATION, BY INDUSTRY

Industry	Average Number
Semiconductor	4.3
Architectural/Building	4.1
Shipbuilding/Plant	3.9
Electrical/Electronic Machinery	3.6
Non-Electrical Machinery	3.5
Computers and Peripherals	3.4
Transportation Including Aerospace & Automotive	3.0
Fabricated/Structural Metal Parts	2.3
Others	3.2
Industry Average	3.6

Source: DATAQUEST
February 1986

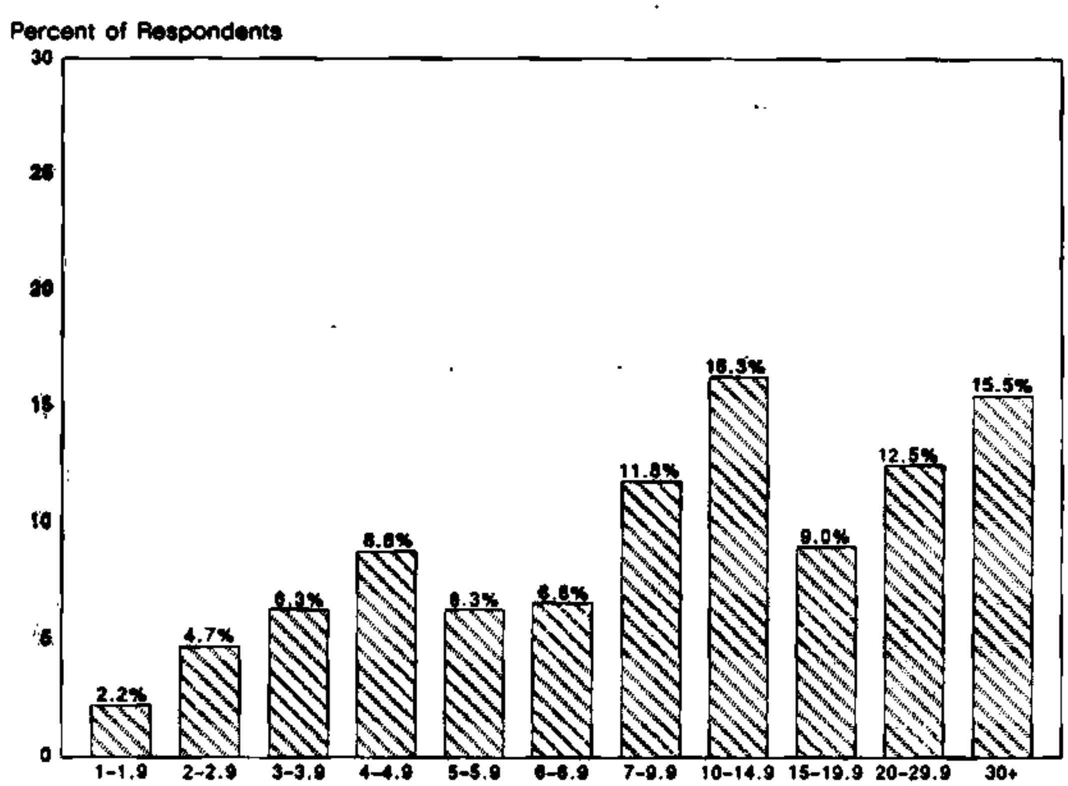
Engineers and Draftsmen/Workstation Penetration

DATAQUEST asked survey respondents to indicate the total number of engineers and draftsmen (trained and untrained) per workstation at their site. The average number of engineers and draftsmen per workstation across the aggregate of respondents was 18. Figure 8 illustrates workstation distribution by the number of engineers and draftsmen.

Table 4 lists the average number of engineers and draftsmen per workstation and the corresponding market penetration by industry. The fabricated/structural metal parts industry has the highest penetration of workstations (12.5 percent) while the architectural/building industry has the lowest (2.6 percent). DATAQUEST believes that the Japanese architectural/building industry has a much lower level of market penetration (2.6 percent) than the U.S. architectural/building industry (6.0 percent).

Figure 8

TOTAL ENGINEERS AND DRAFTSMEN PER GRAPHICS WORKSTATION
(Percent Distribution)



Source: DATAQUEST
February 1986

Table 4

AVERAGE OF ENGINEERS AND DRAFTSMEN PER WORKSTATION
INSTALLED BY INDUSTRY

Industry	Average	Percent Penetration
Fabricated/Structural Metal Parts	9	12.5%
Semiconductor	10	10.0%
Computers and Peripherals	10	10.0%
Transportation Including Aerospace & Automotive	11	9.1%
Non-Electrical Machinery	15	6.7%
Shipbuilding/Plant	20	5.0%
Electrical/Electronic Machinery	21	4.8%
Architectural/Building	38	2.6%
Others	19	5.3%
Industry Average		6.0%

Source: DATAQUEST
February 1986

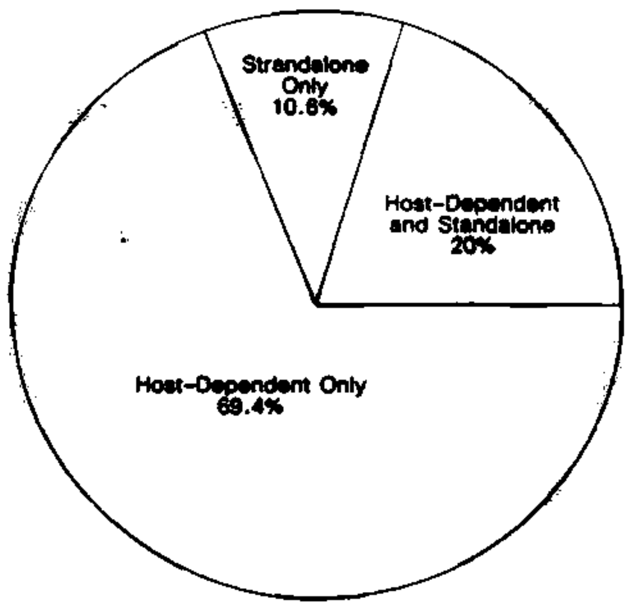
Use of Standalone Workstations

Those surveyed were asked to indicate how many standalone 32-bit engineering workstations versus host-dependent, shared-logic workstations they have installed. Figure 9 illustrates the split between these two system architectures. Figure 9 does not account for the use of personal computers. Standalone workstations account for only 10.6 percent of all installed workstations. However, DATAQUEST believes that this number will rise dramatically in the future since the new 32-bit, workstation-based systems (e.g., Apollo, Sun, MicroVAX) are just now beginning to gain favor in the Japanese market.

Table 5 shows the percentage of standalone workstations out of all workstations installed by industry. The semiconductor and computer industries account for approximately 50 percent of the installed standalone 32-bit workstation population.

Figure 9

HOST-DEPENDENT VERSUS STANDALONE GRAPHICS WORKSTATIONS



Source: DATAQUEST
February 1986

Table 5

STANDALONE GRAPHICS WORKSTATIONS INSTALLED, BY INDUSTRY
(Percent of Standalone Workstations)

Industry	Standalone Workstations
Semiconductor	25%
Computers and Peripherals	25%
Non-Electrical Machinery	15%
Shipbuilding/Plant	12%
Fabricated/Structural Metal Parts	12%
Electrical/Electronic Machinery	7%
Transportation Including Aerospace and Automotive	7%
Architectural/Building	2%
Others	6%
Industry Average	11%

Source: DATAQUEST
February 1986

Use of Color Workstations

Those surveyed were asked to indicate how many color workstations were installed as a percentage of all workstations at each site. The survey revealed that 42 percent of all workstations installed were color units. This compares quite closely to the 40 percent figure in the United States.

Table 6 shows the percentage of color workstations installed by industry. The semiconductor industry has the highest percentage of installed color workstations (64 percent), while the shipbuilding/plant design industry has the lowest (24 percent).

Table 6

COLOR WORKSTATIONS INSTALLED, BY INDUSTRY

Industry	Color Workstations
Semiconductor	64%
Fabricated/Structural Metal Parts	53%
Transportation Including Aerospace & Automotive	51%
Architecture/Structural	46%
Electrical/Electronic Machinery	44%
Computers and Peripherals	41%
Non-Electrical Machinery	27%
Shipbuilding/Plant	24%
Others	31%
Industry Average	42%

Source: DATAQUEST
February 1986

USE OF PERSONAL COMPUTERS IN CAD/CAM

Those surveyed were asked to indicate how many personal computers used for CAD/CAM were installed at each site. Additionally, they were asked who used the personal computers and whether or not they were networked. For those who did not have any personal computer-based CAD/CAM, we asked whether or not they had plans to use personal computers for CAD/CAM in the future.

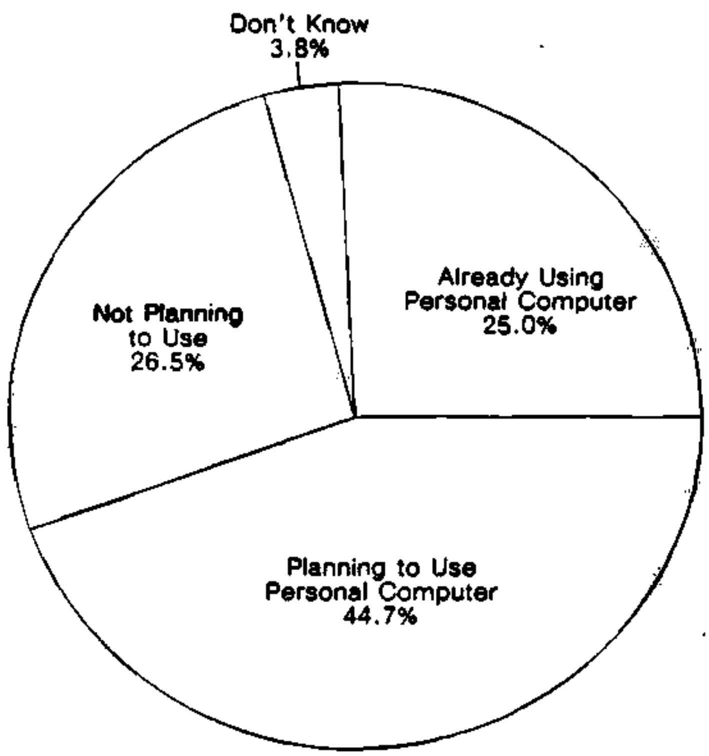
As Figure 10 illustrates, the findings indicate that 25.0 percent of the respondents are using personal computer-based CAD/CAM systems and an additional 44.7 percent are planning to use personal computers for CAD/CAM in the future. The 44.7 percent that plan to use personal computers in the future is much higher than the 30 percent who plan to use personal computers in the United States, which we found in our previous U.S. survey.

Figure 11 illustrates the types of professionals using personal computer-based CAD/CAM. Only 30.3 percent of the respondents indicated that engineers are using personal computers compared to more than 50 percent of those surveyed in the United States.

Table 7 lists our respondents' answers to personal computer use, by industry. The semiconductor industry leads all industry groups with a 90 percent approval rating for using personal computers. The fabricated/structural metal parts industry is least favorable toward personal computer-based CAD/CAM, with only a 50 percent approval rating.

Figure 10

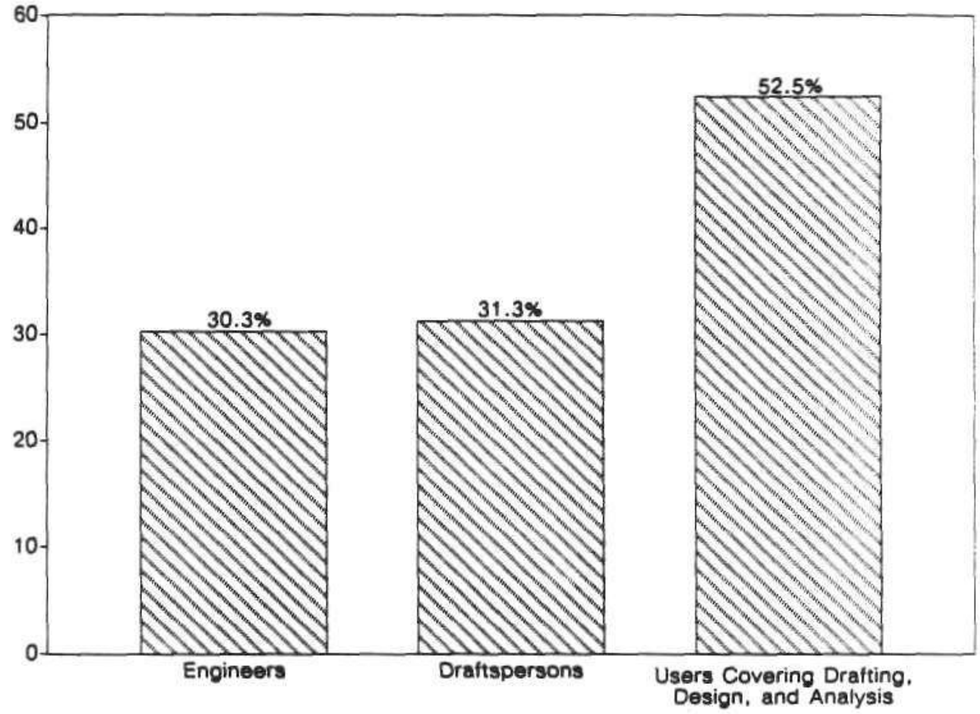
PERSONAL COMPUTER USE IN CAD/CAM



Source: DATAQUEST
February 1986

Figure 11

ACTUAL PERSONAL COMPUTER USERS



Source: DATAQUEST
February 1986

Table 7

PERSONAL COMPUTER USE, BY INDUSTRY
(Percent of Respondents)

Industry	Planning to Use	Already Using	Total
Semiconductor	43%	45%	90%
Shipbuilding/Plant	56%	32%	88%
Architecture/Building	55%	28%	83%
Electrical/Electronic Machinery	48%	25%	73%
Computers and Peripherals	41%	29%	70%
Non-Electrical Machinery	41%	14%	55%
Transportation Including Aerospace & Automotive	37%	14%	51%
Fabricated/Structural Metal Parts	44%	6%	50%
Others	34%	30%	64%

Source: DATAQUEST
February 1986

PRICING EXPECTATIONS FOR WORKSTATIONS

Those surveyed were asked to indicate the graphics workstation unit price from the following price levels that would enable them to install one workstation on every engineer's desk:

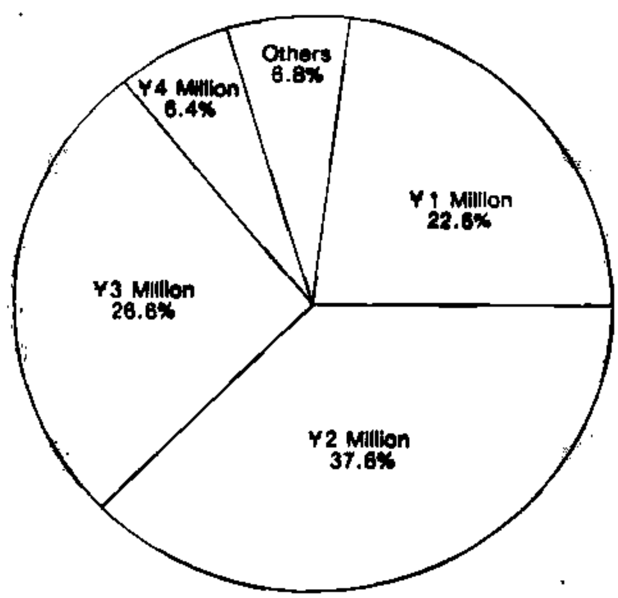
- ¥1 million ($4,200)
- ¥2 million ($8,400)
- ¥3 million ($12,600)
- ¥4 million ($16,800)
- Others (to be specified)

The findings revealed that 64 percent of those who responded wish to pay ¥2 million or less, with 37.6 percent of the respondents indicating ¥2 million as the ideal price. Figure 12 illustrates workstation price levels across the aggregate of respondents.

Respondents also indicated what an acceptable workstation configuration would be at the price level they indicated. Nearly 70 percent of all respondents indicated that color was necessary.

Figure 12

IDEAL PRICE FOR A WORKSTATION ON EVERY ENGINEER'S DESK



Source: DATAQUEST
February 1986

Figure 13 reveals the acceptable main memory capacity levels selected from the following memory capacity levels at ¥2 million:

- 0.5 Mbyte
- 1.0 Mbytes
- 2.0 Mbytes
- Others (to be specified)

Figure 14 reveals acceptable disk storage levels selected from the following disk storage levels at ¥2 million:

- 10 Mbytes
- 20 Mbytes
- 50 Mbytes
- 100 Mbytes
- Others (to be specified)

Figure 15 reveals acceptable screen resolution selected from the following resolution levels at ¥2 million:

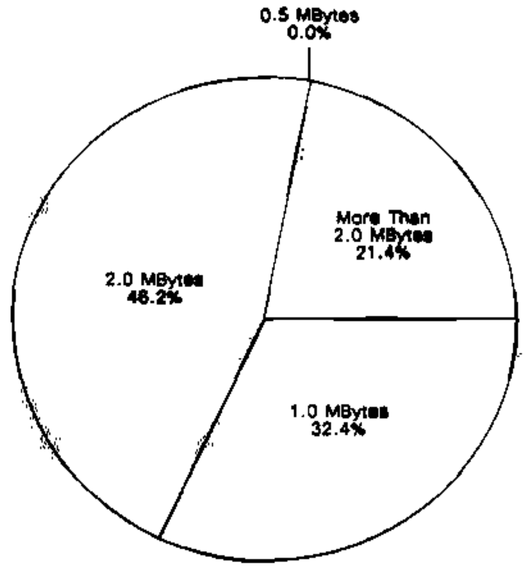
- 512 x 512
- 640 x 512
- 1,024 x 1,024
- 1,280 x 1,024
- Others (to be specified)

Figure 16 reveals acceptable screen size selected from the following size levels at ¥2 million:

- 14 inch
- 17 inch
- 19 inch
- Others (to be specified)

Figure 13

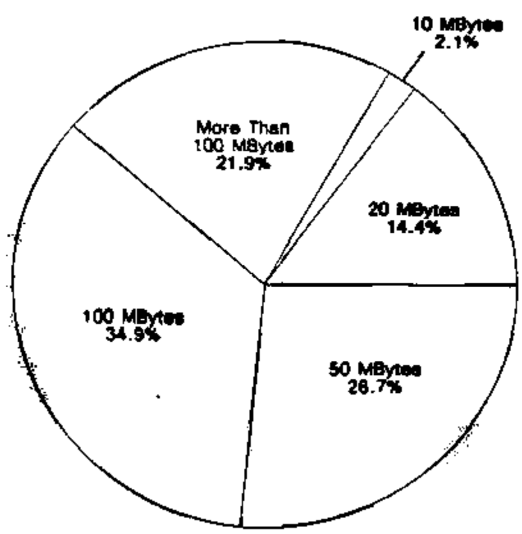
ACCEPTABLE MAIN MEMORY AT ¥2 MILLION



Source: DATAQUEST
February 1986

Figure 14

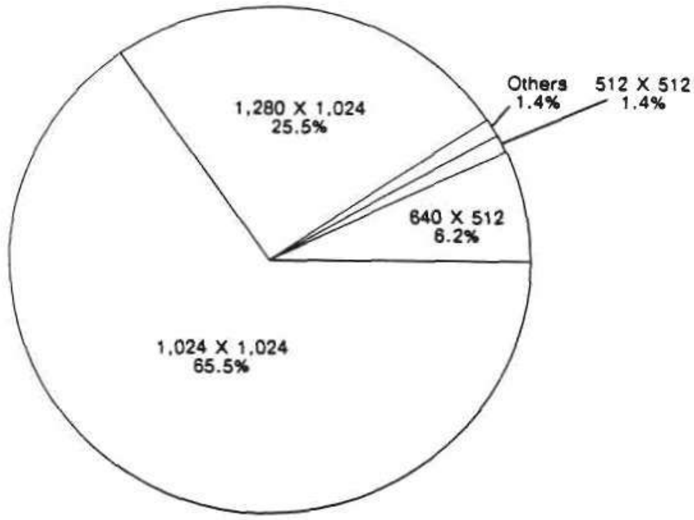
ACCEPTABLE DISK STORAGE AT ¥2 MILLION



Source: DATAQUEST
February 1986

Figure 15

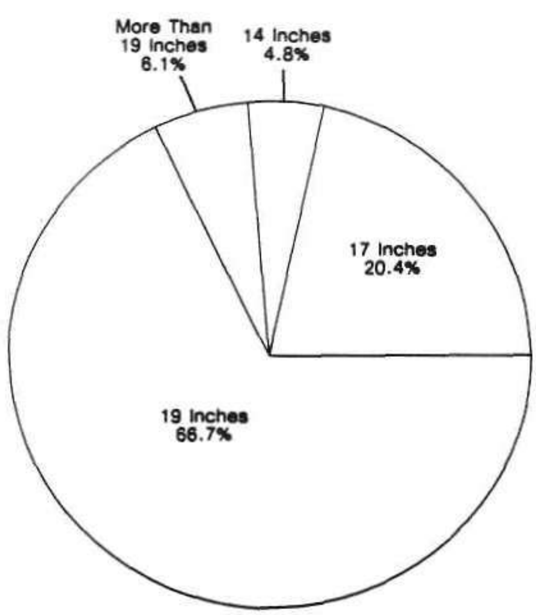
ACCEPTABLE SCREEN RESOLUTION AT ¥2 MILLION



Source: DATAQUEST
February 1986

Figure 16

ACCEPTABLE SCREEN SIZE AT ¥2 MILLION



Source: DATAQUEST
February 1986

The most frequent responses given for each of the features yields the following configuration:

Main Memory	2.0 Mbytes
Disk Storage	100 Mbytes
Screen Resolution	1,024 x 1,024
Screen Size	19 inch
Color or Monochrome	Color

SOLIDS MODELING USE

Those surveyed were asked to indicate their solids modeling usage. Only 10.8 percent of the respondents are currently using, and only 42.4 percent are planning to use, solids modeling. This usage is much lower than the 25 percent who are now using, and the 37 percent who plan to use, solids in the United States.

Figure 17 illustrates the overall distribution of respondents for solids modeling use, while Table 8 breaks out the responses for solids modeling use, by industry. Table 8 indicates some significant market opportunities for filling the solids modeling void in the fabricated/structural metal parts, non-electrical machinery, and shipbuilding/plant industries.

Those currently using solids modeling indicated that they were using it on their sites for the following usages:

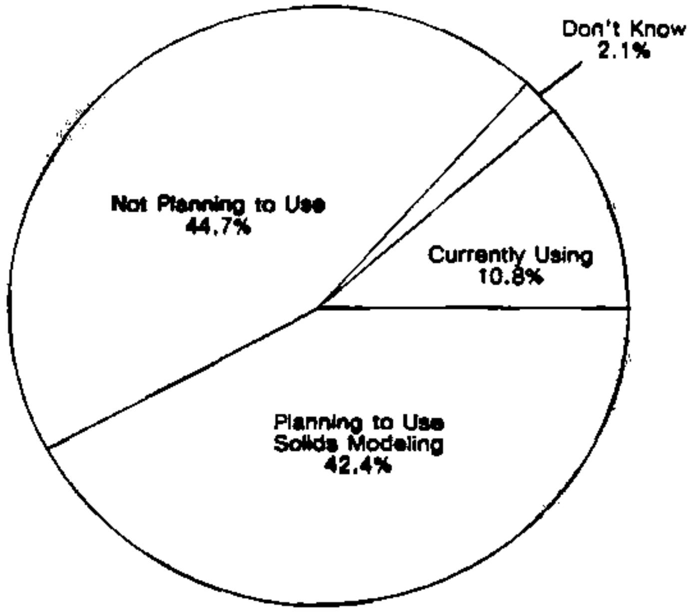
- CAD

- CAM

As illustrated in Figure 18, more than 70 percent of the respondents indicated that they are using solids modeling for CAD applications only.

Figure 17

SOLIDS MODELING USE IN CAD/CAM



Source: DATAQUEST
February 1986

Table 8

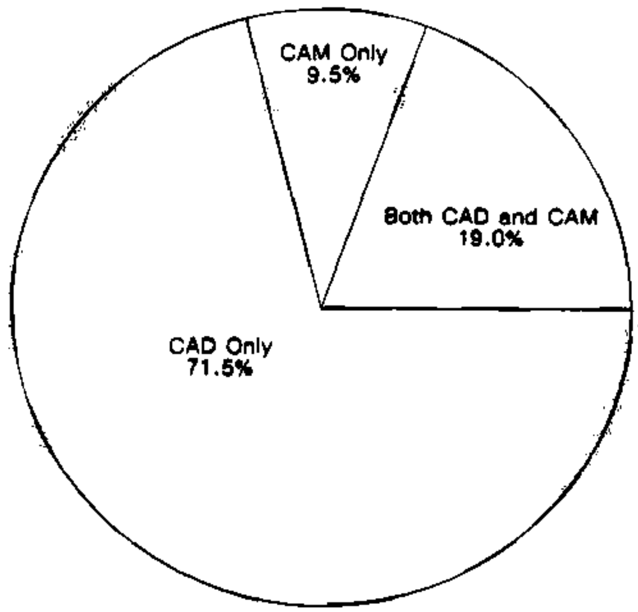
SOLIDS MODELING USE, BY INDUSTRY
(Percent of Respondents)

Industry	Planning to Use	Already Using	Total
Transportation Including Aerospace & Automotive	53%	21%	74%
Architecture/Building	46%	21%	67%
Fabricated/Structural Metal Parts	63%	0%	63%
Non-Electrical Machinery	57%	4%	61%
Shipbuilding/Plant	49%	4%	53%
Electrical/Electronic Machinery	41%	7%	48%
Computers and Peripherals	35%	12%	47%
Semiconductor	17%	21%	38%
Others	35%	9%	44%

Source: DATAQUEST
February 1986

Figure 18

SOLIDS MODELING USAGE



Source: DATAQUEST
February 1986

DATAQUEST CONCLUSIONS

- The 33 percent survey return of the questionnaires is a very high return rate. DATAQUEST believes that end users like to participate in sharing their thoughts and expectations to help vendors develop more cost-effective and efficient products.

- The application and usage mix of CAD/CAM systems by Japanese and U.S. respondents is nearly identical. Because a good deal of the Japanese systems are U.S.-based products, this is not totally surprising.

- The Japanese semiconductor industry appears to be the most progressive industry group in terms of accepting CAD/CAM technology. This group leads in average number of workstations installed (16), average number of trained users per workstation (4.3), standalone workstation installation percentage (25 percent), percentage of color workstation usage (64 percent), and most favorable feelings toward using personal computers (90 percent).

- Standalone workstations and personal computers are beginning to play an important role in Japan. Although respondents indicated that standalone and personal computer usage was quite low, DATAQUEST believes that these two architectures will soon dominate new CAD/CAM systems shipments.

- Overall Japanese market penetration (6 percent) is still very low. DATAQUEST expects that the Japanese market will grow at or above that of the United States over the next five years.

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-11

JAPANESE SEMICONDUCTOR TECHNOLOGY TRENDS
FOURTH QUARTER 1985

SUMMARY

"From copycats-in-kimono to innovators-in-bunny suits." If there is one major theme underlying Japanese technology trends, DATAQUEST believes that it is Japan's growing determination to become more innovative in electronics. During the last quarter of 1985, we observed several developments that suggest Japan is rapidly becoming a technological powerhouse. These events include:

- The establishment of 76 basic research laboratories in electronics (1984-1988)
- The opening of electronics R&D labs by Japanese automobile makers such as Honda and Nissan
- Growing interest in Japanese technology by the United States and Soviet Union
- The competitiveness of Japanese supercomputers and their growing use in VLSI design
- The commercialization of automated language translators (the goal of MITI's fifth-generation computer project) for information gathering, factory automation, and eventually telephone systems
- The establishment of new national R&D projects in laser applications, synchrotron radiation, automated telephone translators, intersatellite laser communications, and explosive pulse electricity
- Joint development of VLSI technology by Nippon Telegraph and Telephone (NTT), Motorola, and Texas Instruments

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DATAQUEST believes that Japanese semiconductor makers are accelerating their basic research programs because of the intense competition to commercialize patents resulting from national R&D projects. Japanese researchers tell us that they have achieved technological parity with the West in many areas and must now innovate on their own. Growing interest in Japanese technology by the U.S. Department of Defense and the Soviet Union attest to their claims. We believe that 1986 will be a major turning point in Japanese technology--the year when Japan shifted from copying to creativity.

CORPORATE R&D LABS

As discussed in our recent newsletter, "Japan's Shift to Innovation: a Boom in Basic Research Labs," dated January 29, 1986, Japanese electronics makers will open at least 76 basic research laboratories between 1984 and 1988. These laboratories will pursue a variety of new technologies, as shown in Table 1. DATAQUEST believes that these laboratories will have a major economic impact on the West within several years.

Table 1

NEW JAPANESE ELECTRONICS R&D LABORATORIES (1984-1989)

Company	Research Activities (Location)	Opened	Millions of Dollars
Asahi Chemical	Gate arrays, std. cells (Atsugi)	12/1985	$ 25.0
Asahi Optical	Optical disks (Englewood, CO)	1985	$ 0.5
Canon	Materials, AI (Atsugi)	2/1985	$ 50.0
Data General Japan	Minicomputers (Koda)	12/1985	$ 5.0
Dupont Japan	Electronics (Yokohama)	11/1986	$ 75.0
Fuji Photo Film	CMOS image sensors	1985	N/A
Fujitsu	CAD, supercomputers, ICs (Kawasaki)	12/1987	$100.0
Fujitsu	Mie R&D building postponed	1985	N/A
Fujitsu	Home electronics (main plant)	9/1986	$ 17.5
Fujitsu/Tohoku Digital	HEMT, opto, GaAs center (Sendai)	1985	$ 0.5
Hitachi	64Mb DRAM, biochips (Tokyo Central)	10/1985	N/A
Hitachi Chemical	Electronics (Tsukuba)	1988	N/A
Hitachi Works	Bioelectronics (Kokubu)	2/1985	N/A
Hokushin Electric	Ceramic components (Showaza)	2/1986	$ 3.5
Honda	Research office (California)	9/1984	N/A
IBM Japan	Computers, OA, workstations (Daiwa)	7/1985	N/A
Japan Automation	CAD/CAM (Fuji)	3/1985	$ 15.0

N/A = Not Available

(Continued)

Table 1 (Continued)

NEW JAPANESE ELECTRONICS R&D LABORATORIES
(1984-1989)

Company	Research Activities (Location)	Opened	Millions of Dollars
Japan Victor (JVC)	3-micron LSIs (Yamato)	4/1985	N/A
JIRA	Laser technology center (Chiba)	1985	$ 1.0
Kanto Electronics	Joint semiconductor R&D (Nagano)	1985	N/A
Kanto Electronics	ICs, peripherals (Silicon Valley, CA)	1984	N/A
Kawasaki Steel	New IC materials (Kawasaki)	3/1985	N/A
KDD	Switching, software (Kamifuku-Oka)	2/1988	$ 25.0
Kobe Steel	Research office (North Carolina)	9/1984	N/A
Konishiroku	New materials (Silicon Valley lab)	3/1985	$ 0.3
Kyocera	Electronic materials (Vancouver, WA)	1985	$ 10.0
Kyowa Electric	New materials (Chofu)	9/1985	$ 5.0
Matsushita Electric	Sub-micron 16Mb DRAMs (Kadoma)	10/1985	$100.0
Matsushita Electric	Biochips, thin film (Kawasaki)	4/1986	$ 3.0
Matsushita Electric	R&D plan (Taiwan and W. Germany)	1986	N/A
Matsushita Electronics	4Mb, next-generation ICs (Tokyo)	9/1985	$ 80.0
Matsushita Reiki	Electronics (East Osaka)	7/1985	$ 10.0
Mazda	Electronics (Yokohama)	1986	N/A
Minolta	Optoelectronics, thin films (Osaka)	11/1984	$ 15.0
Mitsubishi Electric	Optical components (Obune)	8/1985	$ 15.0
Mitsubishi Electric	Semiconductors (Research Triangle)	1984	N/A
Mitsubishi Electric	4Mb DRAMs, X-ray, E-beam (Itami)	12/1985	$ 90.0
Mitsubishi Electric	Original CMOS MCUs	1985	N/A
Mitsubishi Electric/ Mitsubishi Kasei	Joint materials research	11/1985	$ 1.5
MITI/MPT	Basic Technology Research Center	1986	$ 56.0
MITI/STA	New joint R&D system (Tsukuba)	1 5	N/A
MITI/Tokyo University	Bioholonics Computer (Tsukuba)	1985	N/A
Nakamichi	Consumer electronics (California)	9/1984	N/A
NEC	VLSI, AI, bioelectronics (Tsukuba)	6/1987	$ 65.0
NEC	32-bit MPU, GaAs, Opto (Sagamihara)	1985	$100.0
NEC/MOE Physics Lab	Synchrotron for 1Mb+ DRAMs (Tsukuba)	1/1985	N/A
Nippon Denso	Electronics (Aichi Prefecture)	8/1989	N/A
Nippon Denso	Auto electronics (Michigan)	1986	N/A
Nissan Motors	Electronics	10/1985	$ 8.0
NMB Semiconductor	CMOS DRAMs, EEPROMs (Tateyama)	1985	N/A
NTT/Hitachi/Toshiba	64Mb+ DRAM synchrotron (Atsugi)	1988	$ 30.0
NTT/KDD	Transmission think-tank	1985	$ 0.8
Oki Electric	1-micron VLSI R&D center (Hachioji)	1985	$ 46.5

N/A = Not Available

(Continued)

Table 1 (Continued)

NEW JAPANESE ELECTRONICS R&D LABORATORIES
(1984-1989)

Company	Research Activities (Location)	Opened	Millions of Dollars
Oki Electric	CAD, OA, LAN, E-mail (Takasaki)	11/1985	$ 25.0
Ono Measuring	Sensors, measuring (Yokohama)	10/1989	$ 25.0
Osaka Titanium	VLSI wafers (Saga)	9/1985	$ 10.0
Ricoh	Optoelectronics, materials (Yokohama)	4/1986	$ 50.0
Sanken Electric	Semiconductors (Saitama)	1985	$116.0
Sanyo	Bioelectronics, AI, FA (Tsukuba)	10/1985	$ 38.5
Sharp	0.8 to 1.2-micron VLSI (Fukuyama)	9/1985	N/A
Sony	Optical media (Portland, OR)	1984	N/A
Sumitomo Electric	IC materials (Raleigh, NC)	1984	N/A
Tamura Works	Semiconductors (Tokyo)	2/1985	N/A
Tateishi Electric	Telecommunications (Machida)	3/1986	$ 15.0
TDK	Components (Ichikawa)	N/A	N/A
Tokyo Electron (TEL)	Ultra LSI equipment (Nirasaki)	12/1985	$ 8.0
Tokyo Sanyo	Semiconductors	2/1986	$ 15.0
Toshiba	4 and 16Mb DRAMs (Kawasaki)	4/1985	$110.0
Toshiba	ASICs, LANs, CAD (Horikawa)	1/1987	$100.0
Toshiba Ceramics	16Mb ceramic substrates	1985	$ 11.6
Toyo Oxygen	IC gas equipment (Kawasaki)	1986	$ 10.0
Toyo Technica	CAD software (Atsugi)	12/1984	$ 7.4
Yaesu Musen	Satellites, wireless (California)	1985	N/A
Yaskawa Electric	Robots, Factory automation (Okura)	4/1986	$ 7.5
Yazaki Industries	Hybrid ICs (Shizuoka)	6/1985	N/A

N/A = Not Available

Source: DATAQUEST
February 1986

Recent Announcements

NEC has doubled its planned semiconductor R&D budget in fiscal 1985 to ¥20 billion ($100 million), which is about 5 percent of its calendar 1985 sales. NEC plans to expand its basic research to shorten development time for devices produced at its Sagamihara and Tamagawa plants. The Tamagawa plant produces GaAs FETs, ICs, and optoelectronic devices. The Sagamihara plant will handle silicon technology development. In fiscal 1986, NEC will focus on its 32-bit V series MPUs, CMOS gate arrays, and 4Mb DRAMs.

Nissan Motors has established an electronics subsidiary, Nissan Techno, capitalized at ¥100 million ($500,000), to develop ICs and software. Initially staffed at 50, the subsidiary will design ICs for car electronics in 1987. Currently, Nissan buys ICs from Hitachi and NEC, but plans to build its own manufacturing plant within a few years. Other major car makers now in electronics include Toyota, which will build an IC plant by 1988, and GM, which recently bought Electronic Data Systems and Hughes Aircraft. DATAQUEST expects other Japanese car makers to follow suit.

Tokyo Electron (TEL) plans to spend ¥8 billion ($40 million) for plant and equipment in fiscal 1986 (ending September 1986). About $20 million will be spent on semiconductor R&D projects at TEL's new central research institute to be built in Nirasaki, Yamanashi prefecture.

TECHNOLOGY TRANSFERS

Japanese technologies are being sought increasingly by foreign companies and governments. In December, the Soviet Union's Gosplan (State Planning Committee) presented a list of Japanese technologies that it believes can be obtained under the eased COCOM (Coordinating Committee for Export Control) guidelines. Gosplan's goal is to hold a Japanese industrial fair in Moscow in November 1986. As shown in Table 2, the U.S. Department of Defense submitted a similar list in September 1984. Semiconductors ranked relatively high in both lists. DATAQUEST believes that these lists suggest the relative strength of Japanese technologies.

Table 2

JAPANESE TECHNOLOGIES SOUGHT BY THE UNITED STATES AND SOVIET UNION

United States	Soviet Union
GaAs digital and analog ICs	Microprocessors
Microwave circuits	Numerically controlled machine tools
Fiber optic communications system	Robots, flexible manufacturing
Very-high-frequency microwave	New materials (ceramics, building)
Submicron lithography	Latest home electric appliances
Image recognition devices	Inspection equipment
Voice recognition/machine translation systems	Automatic design systems (CADs)
Artificial intelligence	Waste utilization systems
Photoelectronic elements	Biotechnology
Electronic display devices	Anti-corrosion materials
Ceramics (engines/electronics)	Quality control systems
Compound materials	New container transport systems
Heat-resistant materials	Energy and resources conservation
Rocket propulsion technology	Agricultural production complexes
Computer-aided design (CAD)	
Automated production technology	

Source: DATAQUEST
February 1986

TECHNOLOGY PROJECTIONS

Recently, the Journal of Electronic Engineering (JEE) asked five leading Japanese researchers about their views of feasible semiconductor technology by the twenty-first century. As shown in Table 3, the researchers are confident in the feasibility of 64Mb to 100Mb DRAMs, 4- to 5-layer three-dimensional ICs, III-V compound superlattices, GaAs/silicon optoelectronic ICs, and multilayer silicon-on-isolation (SOI). However, most believe that III-V and biochips will not replace silicon as the semiconductor "workhorse." DATAQUEST believes that GaAs will complement silicon, possibly in hybrid devices such as semiconductor lasers, "intelligent" MPUs, and superconducting logic devices.

Table 3

JAPANESE SEMICONDUCTOR TECHNOLOGY PROJECTIONS
BY LEADING JAPANESE RESEARCHERS

Researcher	Projection
Dr. Junichi Nishizawa (Tohoko University, Electrical Communication Research Institute)	• Silicon leading, followed by III-V group • Optical fiber for remote-control home automation • Color LEDs for large-screen television screens • 100Mb DRAMs • 3-D static induction transistors (SITs) • Picosecond GaAs and tunnel injection SITs
Professor Yasuo Tarui (Tokyo University of Agriculture and Technology)	• 64Mb DRAMs by X-ray lithography • 3-D VLSIs for multifunctions and memory gain cells, not higher densities • 2-layer silicon-on-insulation (SOI) • No breakthrough in 3-D VLSIs • Practical SOIs less than five layers • Hetero-epitaxial method for depositing GaAs on silicon substrate • Monolithic signal I/O optoelectronic ICs with silicon memory and signal processing and GaAs superhigh-speed processing
Michiyuki Uenohara (NEC, Executive VP and Director)	• 16Mb possible, but practical 64Mb unsure • NEC focused on 3-D ICs, but at most only four or five layers • Unless 3-D ICs associated with new architectures, no new developments • Materials breakthrough needed for lasers

(Continued)

Table 3 (Continued)

JAPANESE SEMICONDUCTOR TECHNOLOGY PROJECTIONS
BY LEADING JAPANESE RESEARCHERS

Researcher	Projection
Yoshiyuki Takeishi (Toshiba, Director of VLSI Research Center)	• 100Mb DRAM with 0.2-micron geometry • 3- to 5-layer 3-D 100Mb DRAM • Silicon not replaced by biochips
Toshio Tsurushima (MITI Electrotechnical Laboratory, Director of Electronic Device Division)	• III-V "Chirp" superlattice devices

Source: Journal of Electronic Engineering
DATAQUEST
February 1986

GOVERNMENT R&D PROJECTS

The Japanese government has been busy organizing new joint R&D projects and encouraging rapid commercialization from existing projects. The following is a status report on these projects.

MITI Supercomputer Project

MITI's Supercomputer Project has greatly accelerated the pace of Japanese supercomputer development. DATAQUEST observed increased activity in GaAs digital ICs and supercomputers in 1985, as shown in Table 4. We believe that Japanese companies are pursuing the following research in 1986:

- Design of 16K GaAs SRAMs and 32-bit MPU parallel processing architectures into supercomputers by Fujitsu, Hitachi, Matsushita, and NEC

- Announcement of supercomputers over 2 GFLOPS that offer parallel or vector processing from Fujitsu, Hitachi, and Matsushita

- Introduction of entry-level supercomputers (less than 160 MFLOPS) by NEC, Sharp, Sanyo, and other newcomers

- Development of minisupercomputers (less than 100 MFLOPS), possibly with U.S. minisupercomputer start-up companies, for use as VLSI CAD tools

Table 4

1985 JAPANESE SUPERCOMPUTER ACTIVITIES

Company	Announcement
Digital Computer Ltd.	Jointly developed a 60-MFLOP minisupercomputer with Convex Computer Corp. (see discussion in newsletter text)
Fujitsu	Amdahl sold Fujitsu-built 533 MFLOP vector processing supercomputer (Model 1200) to Western Geophysical Company of America; Amdahl offers four Fujitsu supercomputers ranging from 133 MFLOPS to 1.14 GFLOPS under own label (Fujitsu's VP50/100/200/400); Fujitsu has sold 29 VP400 supercomputers (1.14 GFLOPS); prototype lps resonance--tunneling hot electron transistor and 1.7ns 4K GaAs SRAM; working on 16K GaAs SRAM
Hitachi	Announced 160 MFLOP entry-level supercomputer (S-810 Model 5) in September 1985; 2.2ns 4K GaAs SRAM prototype; working on 16K GaAs SRAM
MITI	Prototype GaAs complementary FET (SIS-FET), opening the way for future 4Mb GaAs DRAMs (see memory section of the newsletter)
NEC	Sales of 1.3-GFLOP SX-2 supercomputer to Houston Area Research Corporation in January 1986 (fifth SX-2 sold); SX-2 test demonstration before Tokyo press at Fuchu plant in December; new 285-MFLOP SX-1E supercomputer; 2.4ns 4K GaAs SRAM and 30ps 3,000-gate GaAs array prototypes; working on 16K GaAs SRAM; prototype 4 x 4-bit Josephson junction parallel multiplier (280ps and 350ps)
Nissan	Purchased Cray XMP-2 supercomputer for $6 million and motors supporting software for $6 million
NTT	Purchased second Cray supercomputer (XMP-1); first Cray was XMP-2 in August 1984

Source: DATAQUEST
February 1986

NEC recently sold its $20 million SX-2 supercomputer, which runs at a maximum operating speed of 1.3 GFLOPS, to the Houston Area Research Center (HARC). HARC is a nonprofit research corporation consisting of industry and universities, including Texas A&M, Rice University, the University of Houston-University Park, and the University of Texas. According to HARC, the SX-2 offered better price/performance than machines offered by Cray Research and IBM. In December, NEC demonstrated that its SX-2 supercomputer can operate at 1.3 GFLOPS, the world's highest speed, before a skeptical Tokyo press club at the Fuchu plant.

Hitachi has started marketing its S-810 Model 5 supercomputer, which is capable of performing at up to 160 MFLOPS for complex scientific and technical calculations. It has a main memory capacity of 32 Megabytes. The machine will be leased at ¥40 million ($160,000) per month; sales prices are not available. The new computer can be upgraded at the user's site by adding vector processing cards and reinforcing the forced-air cooling system. Hitachi expects to install 80 machines over the next five years.

Digital Computer Ltd. (DCL), a Tokyo systems house, recently developed a small scientific supercomputer with Convex Computer Corp. of Richardson, Texas, for use as a host computer for local area network (LAN) systems. The computer (VP-1) has a processing speed of 60 MGFLOPS, which is 25 times faster than Digital's VAX780, and will cost 50 percent more. DCL will package the supercomputer into a LAN system incorporating DCL workstations. The supercomputer will handle scientific computations and the workstations will perform interactive processing. The VP-1 supercomputer will cost ¥190 million ($950,000); a LAN system including the VP-1 and 10 workstations will cost ¥240 million ($1.2 million).

MITI Fifth-Generation Computer Project

MITI and the French Ministry of Industrial Reorganization agreed in October to establish a joint artificial intelligence (AI) R&D program in 1986. The Institute for New Generation Computer Technology (ICOT) and France's National Information Processing and Automation Institute (INRIA) will exchange research data and researchers.

One of the major criticisms of MITI's Fifth-Generation Project is that small, innovative companies have not been invited to participate. Systran Corporation, a Tokyo software house, is a classic example. In December, Systran won a ¥2 billion ($10 million) order from the U.S. government for its Systran system, which is capable of translating 1.5 million words (6,000 text pages) of Japanese into English in one hour, with 85 percent accuracy. This system approaches MITI's automatic translation goal for 1990. The U.S. government plans to install the system at the departments of Commerce and Defense, and at NASA. Other companies with Japanese-to-English translation machines include Bravis International, Fujitsu, Hitachi, and NEC.

The European Economic Commission (EEC) also plans to utilize Japanese-to-English translation machines to collect and monitor Japanese technology trends. The EEC visited Fujitsu, Hitachi, Systran, and Bravis International and will decide on a system by fall. Within three years, the EEC plans to incorporate translation software into its own large-scale computers to translate 50,000 to 70,000 theses from public research laboratories and universities.

MITI Sigma Software Project

The Ministry of International Trade and Industry (MITI) approved the basic plans for the Sigma Project, which proposes an industry-wide R&D effort to automate computer software production. About 125 Japanese electronics companies will participate, including Fujitsu, Hitachi, and NEC. For the first time, foreign companies have been invited to join, including AT&T International, Nippon Olivetti, Nippon Univac, Yokogawa Hewlett-Packard, and others. The project will cost ¥25 billion ($125 million) and will be completed by late 1990. DATAQUEST believes that all non-Japanese semiconductor companies should join, since the project will probably develop expert CAD systems for VLSI design.

New MITI Projects

In November, MITI announced six new joint R&D projects that will be run by a new organization. This new MITI-industry joint research system will permit the exchange of researchers, joint use of research laboratories, and equal commercial rights to project results. DATAQUEST believes that the gas cell, new laser applications, synchrotron radiation (SOR), and explosive pulse electricity source should be carefully monitored because of their potential impact on the semiconductor industry. The six projects are shown in Table 5.

Table 5

NEW MITI-INDUSTRY JOINT R&D PROJECTS

Major Participants	Research Theme	Number of Years
Yokogawa-Hokushin	High-performance gas cell for light-wave frequency	4
Not announced	New laser applications	-
Nichicon Capacitor	Explosive pulse electricity	5
Sumitomo Electric Toshiba Mitsubishi Electric Shimadzu Corp.	Small synchrotron radiation device for megabit memories	5
Nippon Kokan	Recycling tar residues from coke ovens	-
Nippon Carbon Koa Oil Maruzen Oil	Pitch carbon fiber-based reinforcing material	-

Source: DATAQUEST
February 1986

IC Card Research Committee

The IC Card Research Committee, a study group involving MITI, the Ministry of Finance, and companies, reports that it will take about 10 years before smart cards become popularly available. Prices for IC cards combining an EPROM or EEPROM with an 8-bit MCU must decline to about ¥1,000 ($5), or one-tenth the current prices. DATAQUEST believes that prices will quickly decline, since most Japanese makers are already using standard cell technology to develop IC cards. The major obstacle will be institutional and public acceptance of the cards. We will issue a newsletter on Japanese IC card trends later this month.

MITI Bioelectronics Project

MITI announced that it will launch a 10-year national project in fiscal 1986 to develop bioelectronic devices. The project will focus on several themes, including analyzing the biochemical reactions of living organisms and the neural systems of lower animals, building molecular structures and thin-film materials, and performing ultrafine fabrication. The project is tentatively budgeted at $40 million, and will include work on biochips, biosensors, bio-resists, and biocomputers. DATAQUEST expects the major Japanese electronics and biotechnology companies to participate in the project.

NTT Artificial Intelligence and INS Computer

Nippon Telegraph and Telephone Corporation (NTT) is teaming up with foreign companies to develop semiconductors, value-added networks (VANs), and artificial intelligence. As shown in Table 6, NTT has recently signed four major agreements.

Table 6

NTT JOINT DEVELOPMENT WITH FOREIGN COMPANIES

Company	Development Focus
AT&T	Joint development and marketing of VAN services
IBM	Link-up of IBM's System Network Architecture (SNA) with NTT's Digital Communications Network Architecture (DCNA)
TI & Motorola	2- to 3-year joint development of LSI substrates for INS Computer, artificial intelligence, and satellites
Westinghouse Stanford GTE Lab Xerox Batelle	Artificial intelligence, semiconductors using new materials

Source: DATAQUEST
February 1986

MPT Automated Translation Telephone Project

The Ministry of Posts and Telecommunications (MPT) recently prepared a master plan to develop a translation telephone within 15 years and a translation telex system in 10 years at a cost of ¥100 billion ($500 million). The planning council, headed by Professor Nagano of Kyoto University, will prepare a concrete plan by April 1986. DATAQUEST believes that this project will be related to MITI's Fifth-Generation Computer Project and NTT's INS Computer, which are both focusing on automated translation and natural language entry technology. Semiconductor research will focus on speech recognition and synthesis, AI chips, and memory storage.

NASDA Inter-Satellite Laser Communications Project

The National Space Development Agency (NASDA) is investigating the use of lasers for intersatellite communications. For the experiment, NASDA chose two satellites: an observatory satellite orbiting the earth at 900km and a geostationary communications satellite orbiting at 36,000km. The distance between them is 40,000km. NASDA plans to develop GaAs lasers with 200mW output to transmit signals at 1 gigabit per second, or 10 times the existing capacity. Although Japan plans to use this technology for peaceful purposes, DATAQUEST believes that the U.S. Department of Defense will be interested in it for its Strategic Defense Initiative (SDI)--"Star Wars"--program.

NEW PRODUCTS AND TECHNOLOGY TRENDS

The following sections summarize the major semiconductor products and technology developments announced by Japanese companies during the fourth quarter of 1985.

Memory

- Fujitsu--A 4K PROM with an output register and 40 percent lower power dissipation (MB7226RA-20L); 15ns access time; 70 milliampere power dissipation; sampling at ¥2,000 ($10); three packages available: 24-pin skinny DIP, 24-pin flat package, and 28-pin leadless chip carrier

  A 1Mb CMOS mask ROM (MB831000); 150ns access time (earlier device with 350ns); 128K x 8-bit structure; TTL-compatible; 220mW power dissipation at operation and 275 milliwatts at standby; 1.7-micron design rule; priced at ¥5,000 ($25) for 500-unit orders

A 1Mb EPROM module; two leadless chip-carrier CMOS 512K EPROMs with their controller circuits into a 600mm wide, 30-pin dual in-line package; compatible with Fujitsu's 1Mb mask ROM; allows upgrading from 512K with slight change in PC board; 45mA maximum power consumption in operating mode and 15mA in standby; 250/300ns access times; sampling at ¥25,000 ($125); 30-pin DIP

- Hitachi--A hybrid bubble memory in a disk compatible with 8-inch flexible disk drives; nonvolatile, stable disk; 250K version (¥160,000/$800); 500K version (¥200,000/$1,000); 1.2MB version (¥260,000/$1,300); Hitachi developing 4MB and 16MB versions compatible with 5-inch flexible disk drives in 1986 and with 3.5-inch drives in 1987

  Conventional capacitance structure to be used in CMOS 1Mb DRAMs; preferred over "Trench-type" structure because of its predictability and higher yield factor; NEC to pursue Trench method

  A Hi-BiCMOS 16K RAM (HM10480L) compatible with ECL RAMs; 16K x 1-bit structure; 350mW power dissipation during operation (half of ECL RAMs); 25ns maximum address access; 20ns minimum write-in pulse; priced at ¥4,000 ($20) in lots of 10,000

- Matsushita--World's first 4Mb mask ROM (MN234001); capable of storing 3,500 Kanji characters; 4.2 million transistors on a 5.7 x 10.4mm chip; 1.4-micron design rule; double polysilicon wiring; NAN multigate memory cells and ROM code formed on depression mode transistors; 150mW power consumption during operation and 35mW at standby; 250 access time; operational character style and other programs stored in remaining 1Mb storage capacity; 16,000 characters of 16 x 16 dot size stored; 250ns access time; compatible with 512K x 8-bit and 256K x 16-bit type 5V power voltage; 150mW power consumption in operation and 35mW in standby; 40-pin plastic DIP; initial monthly production of 50,000 units; sampling at ¥5,000 to ¥10,000 ($25 to $50)

- Mitsubishi--A 2,048-bit electrically alternative ROM that is compatible with multichannel service; for use in television and VCR tuning systems; gate insulator layer made of oxide and nitride films; 128 words x 16 bits; 14-pin dual in-line package; sampling at ¥600 ($3)

  An NMOS 1Mb DRAM using planar 1.2-micron geometry; other sampling being done by Fujitsu, Hitachi, Matsushita, NEC, Oki, and Toshiba

  Two CMOS SRAMs; 256K SRAM (M5M5256P) organized at 32K x 8-bits; 100/120/150ns; 1.3-micron CMOS process; sampling from ¥10,000 to ¥14,000 ($50 to $70); 64K SRAM (M5M5518XP) organized at 64K x 1-bit and 16K x 4-bits; 45ns access time; sampling at ¥8,000 ($40)

- NEC--A CMOS 64K SRAM (MuPD4362C) organized at 16K x 4-bits; 45/55/70ns access times; 1.7-micron design rule; double layer aluminum interconnect; 495mW power consumption during operation and 110mW at standby; priced at ¥5,000 ($25) for 45ns parts in orders of 1,000

  A 4Mb DRAM using 0.8-micron design rule; to be introduced at ISSCC 1986; first samples from mid-1987

  Entry with a 64K EEPROM during first half of 1986 due to huge growth seen for IC card market; others include Hitachi, Oki, and Mitsubishi

  A CMOS 256K EPROM (27C256AD) with 120ns access time (versus Intel's 200ns and Hitachi's 170ns); 1.2-micron design; 4.73 x 4.45mm chip size; 30mA power consumption during operation and 100mA at standby; priced at ¥1,500 ($7.50) in orders of 5,000

- Oki--Two single in-line memory modules; one organized in 262,144 nine-bit words and the other 8-bit wide; 120/150ns row address speed; 4 millisecond refresh period (256 cycles); 138mW power dissipation in standby and 2.75W at high speed

- Ricoh--Two CMOS 256K mask ROMs; 32K word x 8-bit; RP23C256H and RP23C257H pin-compatible with Intel 27256 and TI 2564, respectively; 192.5mW power consumption during operation and 110mW at standby; 5V power supply; sampling at ¥1,000 ($5)

- Sharp--A CMOS 64K EPROM (LH5764J) using an original gate structure that hermetically seals the control gate, reducing data writing time by three-fourths; EPROM technology from Wafer Scale Integration; total bit writing time of 8 seconds; 1 millisecond write-in pulse width; sampling at ¥3,000 ($15); initial production of 50,000 monthly

  Two CMOS EPROMs (LH5764J); 128K and 256K versions; 2-micron rule; 8K x 8-bit organization; 3.4 x 2.5mm chip size; 28-pin dual in-line package; 200/250/300/450ns access times

- Sony--A 512K NMOS nonvolatile memory (CXK1005P); P-channel aluminum gate NMOS process and 32-word x 16-bit structure; 20mW power consumption; 5V power supply; 16-pin plastic DIP; for use as electronic selector for televisions, VCRs, and POS terminal memories; data can be rewritten 100,000 times; priced at ¥700 ($3.50)

  A CMOS 64K SRAM with high-speed processor for signal processing; 45/55/70ns access times; 64K x 4-bit structure; 2-micron design rule; double poly, double aluminum CMOS technology; 22-pin plastic or DIP; 275mW power dissipation during operation; signal processor with processor and multiplier that can perform arithmetic operation for 28-bit word digital signal with 125ns command cycle; 36-bit arithmetic possible by combining two processors and one multiplier; multiplier usable as 32 x 16-bit adder/multiplier with 75ns multiplying time

- Suwa Seikosha--Three CMOS 1Mb mask ROMs using 1.8-micron geometry asynchronous ROM (SMM63100C) with 250ns access time, 30mA power consumption, and 28-pin plastic DIP; synchronous ROM (SMM23100C) with 16mA consumption, 450ns access time, and 28-pin plastic DIP; synchronous ROM (SMM733100C) with 450ns and 40-pin plastic DIP; sampling from ¥3,000 ($15)

- Toshiba--Mass production of CMOS 1Mb DRAMs at Oita plant from April 1986 at rate of 1 million units monthly; 1.2-micron design rule; 4.4 x 12.3mm chip; 2.2 million transistors; 100/120ns speeds

  A 4Mb DRAM using 0.8 micron design rule; to be introduced at ISSCC 1986; DATAQUEST notes that American OEMs have already received samples

Application-Specific Memory (ASM)

- Mitsubishi--A multifunctional CMOS communication control memory for television and VCR remote controls; 1K x 8-bit ROM, 32-word x 4-bit RAM, and two stack levels; 2.2 to 5.5 voltage range; 37.9 and 40 kHz; 30-pin shrink DIP package; sampling at ¥350 ($1.75)

IC Cards

- NEC--An IC card read-write terminal for banks, financial institutions, distributors, transportation companies, hospitals, and recreational businesses as information and access sources; N5256-40 card reader (¥120,000/$600) and N5256-90 code key pad (¥100,000/$500); card with 8-bit MPU and 64K ROM (¥17,500/$87.50 in units of 10,000); card with 8-bit MPU and 16K ROM (¥5,000/$25 in units of 10,000).

- Nippon Shinpan/Visa Japan--Formal tie-up of Visa Japan and Japan's largest credit card company consisting of 21 credit card companies; a new Nippon Shinpan-Visa Card to be issued for shoppers; indirectly linked to Toshiba-Visa joint development of a Super Smart (IC) Card

- Toshiba/Visa International--Agreement to jointly develop a multifunctional IC card, the "Super Smart Card," equipped with number keys, liquid crystal display, and battery; for purchasing and banking transactions; no reading terminal to be required; prototype by summer 1987

Microprocessors/Microcontrollers

- Fujitsu--A CMOS 4-bit MCU with built-in prescaler, PLL synthesizer, A/D converter, and LCD driver for digital tuning systems; priced at ¥980 ($4.90) for 5,000-unit orders

- Hitachi/Motorola--Jointly developed 68HC000 version of Motorola's 68000; sampling since November 1985; 8/10/12.5-MHz versions; ceramic 64-pin dual in-line or 68-pin grid array; 200mW power consumption at 12.5 MHz; production at Motorola's Austin, Texas, plant and Hitachi's Musashi plant

- Hitachi--A 16-bit director memory access (DMA) controller (HD63450); capable of transferring data at 6.25 Mbytes per second; CMOS peripheral device for 68000; 6/8/10/12.5-MHz versions; 500mW power consumption; sampling at ¥12,800 to ¥17,500 ($64 to $87.50)

  A CMOS direct memory access controller with 12.5 MHz-operating frequency (HD63450); DIP model sample priced at ¥16,900 ($84.50) or ¥9,900 ($49.50) in lots of 1,000; PGA model sampling at ¥17,500 ($87.50) or ¥12,000 ($60) in lots of 1,000; 6/8/10-MHz versions available; pin-compatible with Hitachi's NMOS version; 2-micron aluminum double-layer technology; 500mW power consumption; 64-pin ceramic dual in-line or 68-pin PGA packages

  A CMOS 8-bit MCU (HD63705Z) in the 6305 series; built-in A/D converter of 8-bit x 8 channels and dual port RAM; 1/1.5/2-MHz versions; sampling at ¥3,200 to ¥3,600 ($16 to $18)

- Mitsubishi--A proprietary 32-bit MPU planned for 1987; also plans to second source Intel's 32-bit

  A CMOS 16-bit single-chip MCU; 500ns command execution time; memory-mapped I/O system to facilitate future serialization; 64 basic commands and I/O ports; 2-micron CMOS process; 8K ROM and 512K RAM; eleven 16-bit built-in registers; 9.26 x 7.50mm chip; production model with built-in ROM to be 9 x 7mm chip; undergoing evaluation with sampling in fall 1986; shipments and development support system from second quarter 1987

  Five control ICs for Winchester-compatible disk drives; two 3-micron read/write ICs; M51835FP for controlling two magnetic heads; M51838FP for four heads; pulse-peak-detection IC (M51836FP) for converting lead circuit signals into pulses; access servo device (M51829FP); pre-drive for 3-phase AC brushless motors (M51718FP/GP); sample prices of ¥1,300 ($6.50) for read/write ICs, $5.80 for pulse peak detection IC, and $1.86 for access servo IC and motor pre-driver; 16- to 32-pin packages

- NEC--A multifunction CMOS 4-bit MCU incorporating controller and driver for luminescent display tubes and 6K mask ROM (MuPD75206); 0.95 minimum instruction execution time; piggyback EPROM on MuPD75CG208 model; sampling at ¥15,000 ($75)

A 32-bit MPU (V60/70 Series) with a floating-point processor; 325,000 elements, or 50,000 elements more than Intel's 80386; sub-model 70 with floating-point processor and peak processing capability of 5.3 MIPS; incompatible with Intel's 80286/386

V40 and V50 MPUs designed to compete with Intel's 80186 and 80188; 101 types of instruction sets; CP/M and MS-DOS operations; nine peripheral circuits, including a 4-channel DMA controller and 8-level interrupt controller; serial interface and programmable wait functions; 250mW power dissipation; 24 V30 MPUs reducible to seven V50 MPUs in a personal computer; sampling at ¥8,000 ($40) for V40 and ¥10,000 ($48) for V50

A high-speed diagram processing system built around a non-Von Neumann MPU, consisting of a scanner, personal computer, laser printer, and image processor; capable of processing images and diagrams at 10 times most superminicomputers; functions include expansion and contraction of diagrams and characters, automatic conversion of diagram sizes, and unifying character widths; processing speed of 8 seconds per frame (1,100 x 800 dots)

A CMOS 8-bit single-chip MCU (MuPD78312) with twice the performance of Intel's 8096; for real-time control of high-speed printers and car engines; 16-bit ALU and register that performs 16 x 16-bit operation in 3.2ms and 32/16-bit division in 8.4ms; 0.5ms minimum instruction execution time; 30mW power dissipation; sampling at ¥2,000 ($10) in lots of 10,000

A real-time clock MCU (MuPD4990C) for use in personal computers, facsimiles, word processors, and other office equipment; interrupt function that stops sending data to the MCU during designated time frames; 500-KHz clock input frequency; priced at ¥400 ($2) in lots of 10,000

A CMOS general-purpose MCU for serial data transfer; designed for V Series MPUs; converts parallel data into serial data and vice versa; 1.5-Mbytes transmission modulation speed; 75mW power dissipation during operation; multi-protocol operation (bit- and character-oriented protocols); simplified system configuration that includes baud rate generator and digital phase lock loop circuits; 1.6-Mbytes transfer modulation speed; 75mW power consumption; priced at ¥5,000 ($25)

- Okayama Science University/Kobe University--A 256-element parallel processing architecture MPU; processor element (PE) with Z8, 2-Kbyte RAM, 256-Kbyte ROM; 8-bit input bus and 1-bit serial output bus

- Oki--A single-chip 8-bit MCU (80C59) featuring 16K ROM, 256-byte RAM, and 16-MHz operating speed; for multitasking control applications in telecommunications, industrial automation, instrumentation, and automotive skid control systems; capable of addressing 64K bytes of data memory and program memory; priced at ¥3,000 ($15) in lots of 1,000 to 5,000; $3,500 tooling charge per instruction set for minimum 10,000-unit orders

A CMOS 8085A-version 8-bit MPU (MSM80C85A-2) manufactured under Intel license; 5.0-MHz operating frequency with 20mA power dissipation; power down current less than 7mA (compared to 170mA for NMOS version); 40-pin plastic DIP or 44-pin plastic flat package; priced at ¥1,500 ($7.50) in lots of 100

High-speed CMOS MPUs capable of operating at 8 MHz; MSM80C86-2 with 16-bit data bus; MSM80C88-2 with 8-bit bus; both with 20-bit address bus allowing access up to 1-Mbyte RAM; 24 operand addressing modes; fourteen 16-bit registers; both in 40-pin plastic DIP, 40-pin ceramic DIP, and 44-pin LCC packages

- Sharp--A voice pitch control IC (IR3R41) developed with VSC Limited of the United States; sampling at ¥700 ($3.50)

  NMOS and CMOS 8-bit voice recognition MPUs; 40-pin DIP or 44-pin quad flatpack; CMOS version sampling at ¥3,000 ($15); NMOS version at ¥2,000 ($10)

- Sony--Two 4-bit CMOS MCUs (SPC500 series); CP5048 for mechanical and servo control of VCRs and 8mm videos; 8K ROM and 284 x 4-bit RAM; 1.9ms command cycle time; priced at ¥30,000 ($150); CP5040 for piggyback and evaluation modes; 8K external EPROM; ¥900 ($3); 5V power source; 64-pin piggyback and shrink DIP piggyback packages

  V Series MPU shipments beginning; V20 featuring external 8-bit bus and 16-bit internal processing (CXQ70108); sampling at ¥3,000 ($15) for 5-MHz model and ¥3,500 ($17.50) for 8-MHz model; V30 series features 16-bit bus and 16-bit chip; sampling at ¥3,200 ($16) for 5-MHz version and ¥3,600 ($18) for 8-MHz model; both available in 400ns (5-MHz clock variation) and 250ns (8-MHz clock version) types

- Toshiba--Four CMOS serial input MCUs for use with Z80 MPUs featuring built-in circuitry for checking data accuracy, dual channel I/O terminals, and built-in ordering circuits; an asynchronous MCU (TMPZ84C42P) in 40-pin DIP for low-speed transmission; two asynchronous models (TMPZ84C40P/41P) in 40-pin dual in-line packages for high-speed, large-capacity transmission; a fourth model (TMPZ84C43F) incorporating features of other three models packaged in 44-pin flat package; 800-Kbs maximum data transmission; 4-MHz operating frequency range; 4mA power consumption; sampling at ¥2,500 ($12.50)

  Two CMOS LSIs for Multibus II interface under second-source agreement with Intel; model BAC84110 for bus control and MIC84120 for interruption control; sampling at ¥30,000 ($150) per kit

Digital Signal Processors (DSPs)

- Hitachi--Two graphic signal LSIs; graphic signal-reading LSI (HD63084) capable of reading graphic signals with CCD line sensor or facsimile sensor, correcting distortion, and translating into digital signals; reading speed of 5Mb of image signals per second; 300mW power consumption; sampling at ¥7,000 ($35) or ¥5,000 ($25) in lots of 1,000; graphics signal-coding LSI (HD63085Y) capable of codifying/multicodifying MH, MR, and MMR codes of CCITT G3 and G4 standards; sampling at ¥24,000 ($120) or ¥16,000 ($80) in lots of 1,000

- Matsushita Technical Institute--A CMOS half-tone processor that offers excellent gradation and resolution while eliminating moire (ripple pattern); called Correction Density Assignment of Adjacent Pixels (CAPIX); 350ns maximum processing speed per picture element; processing of A4-size picture in 1.5 seconds; 65,536 pixels horizontally and unlimited pixel count vertically is possible; 2.5-micron CMOS process; 22,300 elements; sampling at ¥10,000 ($50) from early 1986

- Mitsubishi--Remote control signal processor (M50461-SP) for television, VTR, and other consumer goods; 3mW power consumption; 5V; 12 x 8 key matrix; 37.9-KHz frequency; 1K x 8-bit ROM; 32-word x 4-bit RAM; sampling at ¥350 ($1.75)

- NEC/Oki--A jointly developed CMOS signal processor compatible with NEC's NMOS MuPD7720 processors; 16 x 16-bit parallel multiplier, 512-word x 23-bit instruction program ROM, and a 128-word x 16-bit RAM; marketed as NEC MuPD77C20 and Oki MSM77C20; priced at ¥3,000 ($15)

- Sharp--A signal processor for stationary head digital audio tape records; sampling since October

- Sony/Toshiba--Two CMOS image processors for still-image graphic reproduction for compact digital audio disks; color graphic control for processing video signals from disks and reducing adapter size for still graphics by three-quarters; graphic data processing LSI with 13,000 elements in a 100-pin package; video synchronization signal-generating LSI with 2,000 elements in a 44-pin package

- Tokyo Sanyo--A telephone dialer LSI (LC7360) with both tone and pulse dialing modes; bi-directional switching; automatic and manual mode switching

  A digital servo controller for hard disk spindle motors (LC7990); sampling at ¥700 ($3.50)

- Toshiba--Three LSIs for character-multiplex television sets based on recently adopted Japan Broadcasting Corp. method; TA8610N waveform equalizer compensates for waveform distortion in incoming character multiplex signals; bipolar LSI using advanced nitride self-alignment (ANSA) process; 2,300 linear devices, 1,300 gates, 42-pin shrink DIP package; TC9016N data recognition and calculating that translates signals into video output; TC9017C graphic display control device that eliminates noise in output signal; both data and graphic ICs are CMOS, 2-micron rule; 64-pink shrink DIP; sample kits priced at ¥20,000 ($80)

A single-chip LSI for compressing and extending digital signals (T7615 in Japan and United States, T7625 in Europe); 33,000 elements; 20-micron CMOS process; 40mW power consumption; sampling from January at ¥30,000 ($150); capable of doubling transmission speed to 32 Kbs

A CMOS voice recognition LSI capable of recognizing 40 words with 80 to 90 percent accuracy; 6mm square chip; conversion from voice data to 4-bit digital data; 4.5mA operating time; 67-pin flat package; sampling at ¥2,000 ($10)

Application-Specific ICs (ASICs)

- Fujitsu--Two CMOS gate arrays series (1.0ns and 1.4ns per gate delay time); 1.0ns series available in two models: 20,000-gate UH series using 3-layer metal wiring, and UM series that is available in 10,000-gate, 12K RAM and 15,000-gate, 6K RAM models; 15ns RAM access time; UH unit price of ¥35,000 ($175); 135/179/256-pin pin grid array packages; the 1.4ns series consisting of AVB (2,640 to 8,000 gates), AV (5,022 gates), and AVM; 2,052-gate AVB priced at ¥1,200 ($6) for 10,000-unit orders; 5,022-gate AV priced at ¥3,000 ($12)

- Hitachi Cable--A multiplex transmission LSI developed with bi-CMOS gate arrays (HD27A026); capable of time-division multiplex transmission up to 64 points; 64-pin dual in-line package; 50mA; 5V power supply; optical data multiplex transmission module (OMX-6400) for building two-way transmission unit capable of transducing parallel signals of 64 points to serial signals by time-split multiplexing

- Mitsubishi--A CMOS gate array utilizing variable track master slice (VTM) technology; three times the integration density of conventional gate array products; 11.96 x 7.72mm chip with 215,000 transistors; interconnect channels replaced by channels filled with transistors that can be used for wiring or circuits; 35,900-gate prototype; 1,496 x 72 organization; commercialization by June 1986

- NEC--Two ECL gate arrays; 5,000-gate version (uPB6350) and 4,000-gate version (uPB6340); 1.4-micron wide emitter; 0.43ns input buffer delay time; 1.32ns output buffer delay time; signal I/O levels correspond to 100K, 10K, and TTL levels; development cost for 5,000 gates (¥15,000/$75,000) and unit price of

¥50,000/$25 for lots of 1,000 units; 4,000-gate development cost (¥9 million/$45,000) and unit price of ¥40,000 ($200) for 1,000-unit lots; maximum of 156 and 72 I/O terminals, respectively; 132-pin and 208-pin pin-grid array packages

Two CMOS gate arrays with option to incorporate RAM, ROM, or both; 2,240-gate array with 2K memory (MuPD65023); 4,400-gate array with 4K memory (MuPD64043); 64 word x 9-bit RAM and 128 word x 9-bit ROM; 20ns access time for RAM; nonrecurring engineering (NRE) cost of ¥6.8 million ($34,000) for MuPD65023, which is priced at ¥2,900 ($14.50) in 5,000-unit lots; NRE for ¥9.3 million ($46.50), which is priced at ¥7,200 ($36) for 5,000-unit lots

A CMOS gate array series with 10 models, using 72- and 132-pin plastic pin grid array packages (except 2,100-gate array that only comes in 72-pin package); 2,100/3,700/4,700/7,100-gate 1.4ns arrays; 2,100/3,300/4,100/6,500/8,000/11000-gate 2.0ns arrays; 8,600/10,000/15,000/20,000-gate 1.4ns array devices in final development phase

A standard cell series; 1.5-micron CMOS process; 1.4ns internal gate delay time; 130 function blocks already demonstrated with gate arrays, including buffer, stable multivibrator, Schmitt trigger circuit, and pull-up/pull-down resistor; maximum of 17,000 gates to be expanded to 25,000 gates in 1986; 256 maximum signal terminals; 20ns maximum RAM access time; 30ns maximum ROM access time; ¥10 million ($50,000) development cost for 3,000 gates, with minimum lot of 100,000 units priced at ¥800 ($4) each

- Oki--A standard cell library (MSM91000) with 84 logic cells, RAMs, ROMs, and PLAs in variable bit lengths; 2-micron CMOS process; 1.7ns gate delay times; RAM access time of 30ns; available in flat, DIP, PLCC, and pin grid array packages; 12 week development time from logic simulation to evaluation sample shipment for 2,000-gate devices

- Oki--Standard cell library (MSM91000 series); up to 25,000-gate devices; 208 terminals; 2-micron CMOS process; 1.5ns access time; 4.5 to 5.5 volts; 2-layer metal

- Sanyo--Standard cells incorporating LC9500, TTL74, and LC9500 series; nonrecurring engineering (NRE) cost of ¥4 million ($16,000) for 500 to 1,000 gates, and ¥6 million ($24,000) for 3,000 to 4,000 gates

CAD Systems

- Hitachi--Two-dimensional CAD simulator using semiconductor laser; color graphics display; animation display of current and voltage characteristics and current output; check for defect densities; AlGaAs/InGaAS laser used; several minutes processing time using S-810 supercomputer; circuit evaluation time reduced from several months to two weeks

- NEC--A CAD system (LOMEO) that converts circuits directly from printed circuit boards to LSI circuits, reducing design time from several months to one week (including check-out time for the design engineer); system consisting of ACOS 1000 host computer and workstations; capable of handling 50,000 functional blocks equal to 200,000 gates, essentially any type of custom IC; no commercialization plans

Optoelectronics

- Fujitsu--An avalanche photo diode for optical communications in 1.55 micro band range; compound material of indium, GaAs, and phosphor with buried indium phosphor for signal amplification; capable of 2Gb/sec transmission rate and 300km repeaterless transmission; 20 GHz sensitivity; 70mA leak current

- Hamamatsu Photonics--Silicon photodiode array with 46 elements; 190 to 1,100nm wavelength; 4.4 x 0.94 x 0.94 per circuit; 1.0mm pitch; 40/48-pin ceramic DIP; S2311/12/13/17/18/19 series

- Hitachi--A 1.55-micron band laser diode developed using conventional buried heterostructure method (HL-1521A); distributed feedback (DFB) type diodes currently by others still several years away; 100km repeaterless transmission capability, twice that of 1.3-micron diodes; 50mW optical output; 30mA threshold current; sampling at ¥350,000 ($1,750) in lots of 100

  A new method for fabricating distributed feedback laser diodes for long-distance, large capacity optical communications; etching performed before crystal layers are formed on the substrate, reducing layer erosion and improving shape precision; 90 percent chip yield achieved

- Matsushita--A coherent light semiconductor laser; 0.9-MHz frequency spread achieved using a resonator

- Mitani Electronics--A static induction photo transistor (SIPT) developed by Tohoko University Professor Junichi Nishizawa, with 1,000 times the sensitivity of bipolar photo transistors; minimum light detection sensitivity of one nano-watt per square centimeter at 655nm; 3- to 5-volt operating range; 400 x 400-micron surface area; capable of detecting 40 to 1,100nm light; for use in camera exposure meters

- NEC--World's first AlGaInP (aluminum-gallium-indium-phosphor) .6nm-band semiconductor laser capable of continuous oscillation at room temperature; air contamination reduced due to a refined MOCVD process; double heterostructure formed using a new crystallization process; 35mA oscillating threshold current at room temperature; 4.1kA-per-square-cm oscillating threshold current density; first NEC AlGaInP laser introduced in 1982

- NTT--A 10-Gbs distributed feedback laser diode capable of converting 144,000 lines of telephone information into optical signals in 1 second (equivalent to 625 million kanji characters); superlattice structure using 60 alternate layers of InGaAs and InAlAs; parasitic capacitance reduced by eliminating 90 percent of the buried layers sandwiching the active layer, changing the crystal substrate from N-type to P-type, and impregnating the active layer with zinc dopants; 10mW DFB laser with 10-Gbs optical signal conversion capacity

- Oki--A laser diode with 2.1-watt output that can theoretically be improved to 20 watts; silicon injected into the laser diode GaAs material to prevent light re-absorption by the diode itself; for use in communications satellites and ships

- Sharp--Two semiconductor lasers based on Sharp's VSIS structure; maximum light output of 200mW continuous operation; 100mW output power achieved by using three channels and 50-micron interval between channels; 830nm oscillation wave length; low cap hermetic package (LT090MD) and low cap hermetic package with fins (LT090MF)

- Stanley Electric--Six new high-power infrared LEDs; three narrow-angle models: 80mW/sr. 850nm, 30mW/sr. 880nm, and 25mW/sr. 950nm; three wide-angle models (30 to 50 degrees): 30mW/sr., 20mW/sr., and 15mW/sr.; 80mW/sr. version sampling at ¥2,000 ($10)

- Toshiba--A 670 to 680nm AlGaInP semiconductor laser using MOCVD process; GaAs substrate; 100mA current; 10mW power output

Image Sensors

Japanese companies are rapidly moving into the charge-coupled device (CCD) field because of its application to 8mm video cameras, optical readers, and inspection and monitoring devices. The major participants in this area include Matsushita, Mitsubishi, NEC, Sanyo, Sharp, Sony, Texas Instruments Japan, and Toshiba. CCDs generally sell for ¥10,000 to ¥20,000 ($50 to $100) and offer high profits.

- Matsushita Electronics/Matsushita Electric--A jointly developed contact bipolar image sensor; 325mm (A3 size) sensor length; 5,120 dots; 0.26ms/line reading speed; 10-chip parallel output

- Mitsubishi--A contact image sensor for office automation equipment; 256mm reading width; 8 lines/mm resolution; 2.5 millisecond reading speed; 43 x 36 x 293mm dimensions; sampling at ¥100,000 ($500); for facsimile machines and electronic blackboards

- NEC--A CCD color image sensor for NTSC (uPD3520D); 1/2-inch 5CD sensor with 220,000 graphic elements and 8-lux maximum sensitivity; sampling at ¥30,000 ($120); initial monthly production of 10,000; 100,000 units monthly in fiscal 1986

- Sanyo--Four CCD black and white solid-state image pickup devices: LC9911 (2/3-inch NTSC), LC9921 (1/2-inch NTSC), LC9923 and LC9925 (PAL); for pricing see I.C. ASIA, November 14, 1985, page 10

- Sigma Corporation--A wet aluminum etching device for mass producing 10-inch liquid crystal display (LCD) boards and high-resolution image sensors for facsimiles

- Toshiba--A full color copier CCD; 780nm; 617 x 470mm; A4 paper; 500W power consumption for copier; copier priced at ¥2.8 million ($14,000)

Gallium Arsenide

Japanese GaAs makers are beginning mass production of 3-inch wafers in anticipation of full-scale production of GaAs ICs, semiconductor lasers, and GaAs FETs. Sumitomo Electric, Shin-Etsu Handotai, Mitsubishi Monsanto, Nippon Mining, Showa Denko, and others are ramping up production in 1986.

- Fujitsu--A 4K GaAs SRAM prototype with 1.7ps access time; 27,000 transistors on a 5.5 x 3.7mm chip; new transistor formation process that implants ions into GaAs substrate through a thin aluminum nitride layer; ions impeded by nitride layer, forming shallow channels for electron path

- Matsushita--A GaAs 1-GHz prescaler with 3.2mA current dispersion at 1 GHz; 1.0 x 1.2mm chip integrating 298 FETs, 56 resistors, and 68 diodes; uses 5V power supply, 1-GHz signal switchable at 128/130/256/258; double-phase-drive source-coupled FET logic (SCFL); each FET constructed using ion injection on a GaAs substrate; uses boundary wall smoothing techniques; 27 x 25-micron cell size; 3.0ns access time; sampling at ¥3,000 ($15); for use in mobile radio equipment

  A 300mV GaAs Hall device (IH005) using high-purity GaAs and a newly developed diffusion process that improves electrode materials and stabilizes ion implantation and annealing; 0.35mm square chips; 1.5 x 2.9 x 1.1mm miniflat packages that can be direct soldered or installed by automatic taped or magazine feeding; 750-ohm input resistance; sampling at ¥80 ($0.40)

- Mitsubishi--A 12-GHz amplifier module for improving reception quality and capability of satellite relays; two GaAs FETs, capacitors, and other devices on thick-film ceramic substrate; 27 x 25.4 x 5.8mm package; 18dB gain with 2.2 to 2.4dB noise index; the FA12201 for 11.7 to 12.2-GHz business communications (¥7,500/$37.50); FA12202 for 12.2 to 12.75-GHz DBS relays (¥8,000/$40); FA12203 for 11.7 to 12.5-GHz for European satellites (¥8,000/$40); 50mA consumption

  A 4K GaAs SRAM with 2.5ns access time; 1K x 4-bit structure; 3.3 x 3.2mm chip; 200mW power dissipation; developed under MITI's Supercomputer Project; other companies with 4K GaAs SRAMs include NTT, Fujitsu, and Hitachi; Mitsubishi now working on 16K GaAs SRAM

  A GaAs prescaler with 1-GHz operating frequency and 2.9mA; 5V power source; the demultiply switchable at 128/129; source-coupled FET logic (SCFL) circuit and recessed FET gate structure; 444 elements on 1.0 x 1.1mm chip; for use in mobile radio equipment; source-coupled FET logic and Mitsubishi's proprietary shallow-recess-structured FET possessing surface n+ layer; 1.2-GHz maximum operating frequency at 4mA, 1.56 GHz at 5.6mA, and 1.9 GHz at 9.2mA

- MITI Electrotechnical Laboratory--A GaAs complementary FET; heat generation suppressed, allowing development of 4Mb-level GaAs devices; new design (SIS-FET) eliminates need for special insulating film between p-type and n-type transistor on a uniform GaAs substrate

  Mitsubishi Monsanto--Mass production of 3-inch nondislocated GaAs wafers from January 1986; initial monthly production of 500 wafers, expanding to 2,000 wafers monthly by second half of 1986; vertical magnetic (VM) imprinting system developed by NTT in 1984 used to attain low-temperature gradient and automatic diameter control for LEC process

- NEC--An InGaAs/InAlAs HEMT with 440mS/mm conductance; InGaAs channel; InAlAs carrier layer; higher mobility than conventional GaAs/GaAlAs HEMTs

- NTT Atsugi Lab--A GaAs FET; 300nm undoped GaAs active layer, 30nm AlGaAs layer, 5nm GaAs storage layer; n-type silicide and two-layer GaAs/n+Ge; p-type silicide; source and drain fabricated using n-type silicon and p-type beryllium; 125ps at 300 degrees Kelvin; 330 MHz; 3.5mW/gate

- Sony--A GaAlAs/GaAs high-electron mobility transistor FET (HIFET) fabricated using metal organic CVD; Model 2SK-676 with 200-micron wide gate for DBS and Model 2SK-677 with 300-micron wide gate for television receivers; same structure as Fujitsu's HEMT; 1.2dB noise at 12 GHz and 11dB standard gain; sampling with ceramic package at ¥100,000 ($500)

- Sumitomo Electric--Mass production of 3-inch GaAs wafers; 3,000 wafers monthly capacity; computerized liquid encapsulated Czochralski (LEC) pulling method used to produce uniform crystal growth; dislocation defects reduced by lowering temperature gradient during pulling and by controlling vertical and lateral movement

  A GaAs substrate with indium additive reduced by two-thirds; for use as material in optical ICs; pilot production of 2-inch ingots beginning; computerized system used to control the temperature for ingot growing, allowing relatively defect-free ingots; plans to develop 3-inch ingot by 1987 and commercial optical ICs within five years

Josephson Junctions

No major announcements.

New Electron Devices

- Fujitsu--A superlattice transistor with a 1ps theoretical switching speed; called resonance tunneling hot electron transistor (RHET); entire NOR circuit on a single RHET, reducing arithmetic logic circuits to one-seventh current levels; combination of a resonance tunnel diode-type element with negative resistance characteristics; quantum well of AlGaAs and GaAs superlattice structure as emitter wall; output twice input frequency; operating from low frequencies to 100 GHz; commercial use 7 to 10 years away; potential for replacing Josephson junction as next-generation chip

- Mitsubishi--A bio-device capable of transmitting electrons in a designated direction, potentially opening the way for bio-computers; a thin protein film (titochrome C molecules from a horse's heart) laid onto an aluminum-deposited glass substrate using the Langmuir-Brochette method; a fluorescent measuring system to confirm the molecular orientation of the protein molecules also developed

Standard Logic

- Nippon Precision Circuits--A research project to develop an ultrahigh-speed molybdenum-gate CMOS device with a maximum clock frequency of over 100 MHz; goal of device three to five times faster than bipolar ECLs using 1.5-micron design rule; ECL speeds already achieved using 2.0- to 2.5-micron design rule; NPC's molybdenum technology jointly developed with Micro Power Systems

Bipolar Logic

- Fujitsu--New Facom M-780 mainframe that is 6.7 times faster than M-380 series; a single-board CPU comprising 336 ultrahigh-speed VLSIs, including 3,000- and 10,000-gate ECLs with 180ps delay time; high-speed RAMs and logic for buffer memory, and 256K SRAMs for 256-Mbyte main memory

- Tokyo Institute of Technology--A 3-layer bipolar transistor with performance of GaAs devices; top layer of silicon carbide in an amorphous state over two layers of silicon; potential use in supercomputers and high-frequency communications equipment

- Toshiba--A bipolar MOSFET that withstands 1,000 volts (MG25N2CS); switching speed of 1.5 microamperes; used for controlling motors with 400 volts of input power supply; sampling at ¥15,000 ($75)

Linear/Analog

- Hitachi--Image recognition and processing CMOS A/D converter; 3.58M sample/second; two RAM types (frame and index); 6.3 x 6.3mm chip; 80-pin flat package; 5V; 250mW power consumption

- Matsushita--A digital filter LSI (MN6618) for compact disk players; 96-order linear phase CMOS that processes stereo signals and handles two-fold oversampling; compatible with parallel and serial D/A converters; 42-pin chip; 75mW power consumption at 4.5V to 5.5V

- Mitsubishi--A voltage-controlled amplifier IC (M5241L) that controls two channels separately; for volume control in stereo receivers, VCRs, car audio equipment, and other audio-video uses; 10-pin, single in-line package; priced at ¥140 ($0.70) each

- Tokyo Sanyo--Three small hybrid ICs for car audio use; 50-micron design rule and high-density bent board; multiplex stereo demodulator with FM noise canceler (STK3400A/B) and 5-band graphic equalizer (STK3600); 7.5mm profile

Discretes

- Kyocera--A 4mm surface-mounted variable capacitor with 1.8mm profile; 4.5x3.2mm chip size; rated at 25 VDC with temperature range of -25 C to +85 C degrees

- Matsushita--A MOSFET for use as digital switch in VTRs and other consumer products; 50ns switching speed; vertical diffusion self-aligned MOS structure capable of withstanding a surge of 1,200V; sampling at ¥30 ($0.15) each

A 2.45-GHz power MOSFET; V-shaped groove formed in the silicon substrate, allowing direct connection between source and substrate; for use in car telephones, wireless portable systems, and solid-state magnetrons for microwave ovens

- Mitsubishi--A prototype FET built using an organic polythiophene material; n-channel silicon wafer substrate covered with silicon oxide film; all electrodes arranged at 10-micron intervals as source and drain electrodes, then covered with polythiophene; for driving liquid crystal devices

- New Technology Development Corporation--A new electrostatic induction thyristor with 1-microsecond switching speed for use in miniature motors

- Sony--Two hetero-interface (HIFET) models for consumer electronics, using MOCVD method; sampling of 200-micron wide devices (2SK-676) from January and 300-micron wide version (2SK-677) from February; sampling at ¥100,000 ($500)

- Tokyo Institute of Technology--A prototype transistor fabricated by sandwiching four insulators and three metal films, each measuring two millionths of a millimeter in thickness; high electron mobility through the insulator layers; use of metal films and electron wave properties to increase speeds; potential use in optocomputer with several hundred times the capacity of current computers

<u>New Processes</u>

- Sharp--A new silicon-on-insulator (SOI) substrate using zirconium oxide single crystal as an insulator film; the zirconium oxide film sputtered onto a sapphire substrate in a vacuum chamber heated at 300 C degrees to obtain low power dissipation and high-speed device; prototype 1,000 Angstrom thick, high-quality insulator film on a 4-inch sapphire wafer; Sharp also working on cheaper silicon substrates

- Toyo Seimitsu--A photoetching method to draw 0.2mm lines on 96 percent alumina ceramic substrates of 0.635mm thickness; two-week turnaround; ¥3,000 to ¥5,000 ($15 to $25) for 80 x 80mm sheets; development on 0.1mm ceramic etching under way

<u>Materials</u>

- Mitsubishi Electric/Mitsubishi Heavy--Thin-film diamond substrate experiments aboard U.S. space shuttle in 1987 to fabricate semiconductors for use in nuclear plants and satellites

- Sumitomo Electric--A diamond semiconductor for possible use in aerospace and other high-temperature, radiation-hazardous environments; plasma CVD used to develop n-type device; methane and hydrogen heated to 800 degrees C to form plasma gas that is deposited onto a single-crystal synthetic diamond substrate; thin layer formed onto which phosphorous is doped at 1,000-ppm concentration; heat-resistant to over 500 degrees C for satellites, cars, and supercomputers

- Toshiba--A new copper paste used in developing multilayer hybrid ICs; substrate cost lowered by 20 percent to 30 percent; printed resistor paste baked at 850 to 900 degrees C in normal atmosphere, then at 600 to 650 degrees C in nitrogen gas; half the material cost of silver palladium pastes

Manufacturing Techniques

- Matsushita--A new film carrier technique, transferred bump tape automated bonding method, for fabricating double-layer LSIs; potential for combining up to three different ICs; prototype display drive LSI combined with high-voltage IC

  A laser VLSI fault-diagnostic system for chips up to 0.8-micron rules and 4Mb DRAMs; 0.6328-micron helium neon laser radiated onto chip to compare electric current induced by the light with condition inside the chip; noncontact method that operates in normal atmosphere and avoids charge-up phenomenon produced by electron beam probing method

- Ricoh--A new chip-mounting technology that inserts packageless ICs directly onto printed circuit board (chip-on-board method); increases PCB density two to four times and reduces production costs by 30 percent; experiments being conducted for facsimiles and printers at Ricoh's Hatano plant in Kanagawa; employs a special sealing resin with protective qualities of conventional plastic or ceramic packages; mounting method useful for memories, MPUs, peripherals, and gate arrays (of less than 160 pins)

- Toshiba--A new process that directly joins silicon substrates to form transistors and diodes within two hours; capable of fabricating power ICs that can withstand high voltage and operate at high speeds; prototype bipolar MOSFET capable of withstanding 1,200 volts; planned commercialization of a 1,200V, 25-ampere bipolar MOSFET within one year

Manufacturing Equipment

- Hitachi--A microwave plasma etching system (M-206A) for 4Mb DRAM mass production; electron cyclotron resonance (ECR) etching system capable of 1.3- to 0.8-micron geometries; future improvements for 0.5-micron 16Mb DRAMs; etching speed of 30 to 50 wafers hourly; priced at ¥140 million ($700,000); deliveries from July; plans to sell 10 systems in first year, 70 to 100 systems in three years, and 200 systems over five years

A wafer stepper with 0.6-micron resolution (RA-101VL) for use in 4Mb DRAMs and above; capable of baking 10.4-square mm circuit in one cycle and handling 5-inch wafers; priced at ¥170,000 to ¥180,000 ($850,000 to $900,000)

A molecular beam epitaxial system that automates wafer-handling operations; for future-generation semiconductors such as GaAs chips, high electron mobility transistors (HEMTs), and super-lattice devices; automated wafer-handling and separate heating and crystal growing chambers that permit two different processes simultaneously; capacity of 10 to 12 wafers per day; sales from late 1986 at ¥150 million ($750,000)

- Matsushita/Denko--A vertical CVD device producing uniform thin films on semiconductor wafers; vertical tunnel-shaped furnace used to introduce depositing gas from above; nitride coatings of 1,500 angstroms achieved; for use on 4Mb DRAMs and large wafers

- NEC Anelva--A sputtering system for megabit VLSI production (ILC-1013MKII); priced at ¥180 million to ¥200 million ($900,000 to $1 million); designed for dual sputtering; double-cathode system for bias sputtering

- Nippon Seiko--A multipurpose semiconductor lithography machine (TZ-310) with four functions: pattern generation, stepping, photo repeating, and direct writing; priced at ¥200 million ($1 million)

  A molecular beam epitaxy system (MBE-8000) capable of processing seven 2-inch wafers or three 3-inch wafers simultaneously, resulting in throughputs of 70 2-inch wafers or 30 3-inch wafers per day; commercial plans not disclosed

- Shimada Rika--An etching system combining reactive ion and plasma etching functions (EP-200RP); anode coupling for plasma etching cathode coupling for RIE; available from summer 1986 at ¥60 million ($300,000)

Clean Rooms

- Seiwa Sangyo--Three dust-proof clean rooms; CBS-100 for Class 10 IC storage; CBS-200 for carrying ICs into Class 10 environment; CBS-300 for Class 100 rooms

Test Equipment

- Advantest--An IC tester capable of testing 16Mb DRAMs (T333), 30-MHz speed and 16 megaword pattern generator; 32-megabit memories testable simultaneously using two test stations; priced at $585,000

- Hochiki/MITI Physical and Chemical Research Institute--An exo-electron analyzer capable of measuring dirt accumulations on ICs; 0.2- to 0.35-micron ultraviolet ray used to gauge amount of electrons discharged from surface of semiconductor metal

- Nihon Den-Netsu--An in-circuit IC tester (NCT-1200) with an automatic guarding system; capable of automatically testing for solder bridge, wrong parts, omitted items, defective elements, disconnected patterns, short circuits, and PCB problems

Packaging

- Sumitomo Electric--An aluminum nitride ceramic for IC package board substrate material; 10 times greater heat conductivity and better thermal expansion coefficient; being promoted by electrical and chemical makers as likely successor to alumina

Sheridan Tatsuno

Nielsen Dataquest
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HOW TO SUCCEED IN ASICs: INDUSTRY LEADERS SHARE THEIR THOUGHTS

SUMMARY

Recently, several top American application-specific IC (ASIC) vendors gathered in Silicon Valley to discuss the future prospects of the ASIC market. Although their strategies vary considerably, DATAQUEST observed a common theme running through their presentations. Most of the speakers emphasized that success in the ASIC market requires the following attributes:

- Leading-edge process technology (1.5-micron CMOS or below)
- Sophisticated CAD software using a common data base that can be run on a variety of personal computers
- Strong corporate commitment and service responsiveness
- Automated manufacturing and inventory control

The following are brief summaries of the major points made by six major ASIC vendors: LSI Logic, Monolithic Memories, Motorola, Oki Semiconductor, Texas Instruments, and VLSI Technology.

LSI LOGIC

Wilfred J. Corrigan, Chairman and founder of LSI Logic, observed that the crowded ASIC market leaves newcomers with no room for experimentation. Unlike LSI Logic, which could afford to learn through trial-and-error in 1981 since it was the only player, ASIC vendors must now be well prepared to survive the tough competition. What are the requirements for entering the ASIC market? Mr. Corrigan listed the following:

- Mainstream 1.5-micron CMOS process with high-density designs and high yields

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- Continuity of staff and products (no "flash-in-the-pan" efforts)
- Defect-free chips within four to five weeks
- Software and designs embedded into the CAD system
- Strong service orientation
- Domestic automated plants
- Large investment ($30 million to $50 million required to become major player)
- Long-term incentives for salespeople (due to long time from design to production)
- Installed customer base

Mr. Corrigan said that LSI Logic competes with only a handful of the 200 ASIC vendors in the marketplace. Most ASIC companies are focusing on niche markets and lack the manufacturing and CAD capabilities to attack larger markets. He expects to see a major shakeout among these vendors soon.

MONOLITHIC MEMORIES

Michael J. Callahan, Executive Vice President and Chief Operating Officer of Monolithic Memories, spoke briefly about MMI's approach to ASICs. Generally, MMI seeks high-volume products with unpredictable features that enable the company to capitalize on its programmable array logic (PAL) technology. Table 1 shows Mr. Callahan's characterization of the ASIC market segments.

Mr. Callahan believes that software must be an integral part of products across the ASIC spectrum. To achieve this goal, vendors must develop a CAD environment with a common data base. Moreover, standard product vendors must establish a separate ASIC manufacturing line (complete with automated inventory control) and a separate organization because of the totally different market demands placed on ASIC managers.

Table 1

ASIC MARKET CHARACTERISTICS

	FPLAs	Gate Arrays	Application-Specific Arrays	Standard Cells
Manufacturing Costs	Low	Moderate	Moderate	High
Nonrecurring Engineering	Normal	$20,000	$20,000	$35,000
Development Time	Real time	4 to 12 weeks	4 to 12 weeks	8 to 20 weeks
Risk	Very low	Medium	Medium	High
Architecture	Structured	Flexible logic	Mixed logic	Any mixed logic

Source: Monolithic Memories, Inc.

MOTOROLA

Kenneth G. Wolf, Corporate Vice President and General Manager at Motorola, discussed Motorola's shift to the ASIC market. From 1982, Motorola has had a timetable for its CMOS process development: 2-micron (1985), 1.5- to 1.25-micron (1987), 1.0-micron (1988), and 0.7-micron (1991). Motorola's ASIC division has the following capabilities: auto test and vector generation, silicon generation, test and fault generation, behaviorized modeling, systems simulation, and mixed mode development. In 1986, Motorola plans the following ASIC thrust:

- A 250-picosecond bipolar device
- A 40,000-gate, 1-micron CMOS array
- CMOS macrocells using 1.5- and 1.0-micron geometries and I/O flexibility
- A shift from standard cells to core-based macrocells (650C02 core in 1985, 650C05 in 1986) using 3-micron, single-layer and 2-micron, 2-layer HCMOS processes developed with NCR
- A 6,000-gate BIMOS array featuring 2.0- to 1.5-micron geometries
- A 125-picosecond ECL gate array (MCA 10,000)

- A "one-month chip" goal in manufacturing

- Utilization of direct-write on wafer and dedicated masks

Motorola also plans to develop "silicon generators" to generate subfunctions to meet function specifications and to combine these subfunctions with standard cells. Mr. Wolf believes that silicon compilers will only be used for selected functions (such as ALUs), not for all chips. Motorola is currently developing a silicon compiler.

OKI SEMICONDUCTOR

Jerry Crowley, President and Chief Executive Officer at Oki Semiconductor in Santa Clara, dispelled myths about the ASIC business by emphasizing the importance of automated manufacturing. He believes that "all creativity degenerates to hard work." Like memory makers, ASIC vendors must totally automate their design, manufacturing, and processes if they want to weather Japanese competition. To achieve this goal, Oki has pursued the following strategy:

- Developed an international CAD network with design centers in Japan, the United States, Europe, Hong Kong, and Singapore

- Developed six CAD software packages that run on IBM PCs (BINALY, ACTAS, FUNTASY, GALLOP, VILLA, and IDEAS)

- Installed a fully automated LSI packaging machine that features curing ovens, plastic molding, process control computer, die attach and bonding, and automatic inspection station

- Built an automated plant that transports 50 wafer lots daily using ceiling tracks to run deliveries

- Installed bar coding and transport in a peopleless ASIC plant using electron-beam, direct-write, and automatic inventory auditing

- Purchased a molding robot that handles 1 million units per month

Recently, Oki Semiconductor has achieved major ASIC breakthroughs using new automated techniques. These breakthroughs include:

- A standard cell 32-bit MPU (MVM6971) using 1.5-micron CMOS process and 224mm-square chip size; total design time was less than 12 months

- A 10,000-gate array (MSM78H000) using 2.0-micron CMOS process and dimensions of 99mm square and 154,450 square mils

- A digital signal processor (MSM6974) using 1.5-micron CMOS process, with dimensions of 124mm square and 191,981 square mils

Mr. Crowley concluded that most Japanese ASIC vendors are highly automated and, unless U.S. and European makers automate their ASIC design and manufacturing processes, they will forfeit the ASIC market to large Japanese vendors.

TEXAS INSTRUMENTS

William N. Sick, Executive Vice President of Texas Instruments, presented slides of TI's 1Mb DRAM (80,000 mil, 1-micron, 0.46-inch line) using 3-dimensional trench capacitors, and its 4Mb DRAM prototype using proprietary cells and a 0.384-inch length. The 4Mb DRAM was completed on schedule to the day using TI's new design automation system. Currently, TI has about 400 cells in its standard cell libraries and a second-sourcing agreement with Fujitsu to develop bipolar and CMOS gate arrays. TI aims at receiving 50 percent of its sales from four areas: ASICs, application processes, military, and CMOS and bipolar VLSI logic. In 1986, TI will use a 1-micron CMOS process from its DRAM work for ASIC devices, Mr. Sick said.

VLSI TECHNOLOGY

Alfred J. Stein, Chairman and Chief Executive Officer of VLSI Technology (VTI), believes that there are three keys to success in ASICs: a leading-edge process, software, and state-of-the-art manufacturing technology. VTI has established all three elements and is pushing its megacell approach. In the future, VTI will offer "full-chip composition," incorporating data path compilers, megacells, logic compilers, and ROM compilers. Common bus protocols will be used to eliminate interface circuits. These chips will feature fixed-height megacells, gate arrays, and standard cells on one chip. VTI is currently extracting megacells from standard products and inserting them into its megacell library, with the goal of developing cell-based structured arrays. In 1986, VTI will offer a 1.5-micron CMOS process, using double metal and poly. In 1987, it will have a 1.25-micron CMOS process using triple metal.

To market its ASIC devices, VTI has recently doubled its field sales force, opened new design centers, and signed agreements with Arrow Electronics, five European distributors, and three Japanese distributors. In addition, Mr. Stein said that Hewlett-Packard will market VTI's software.

QUESTION-AND-ANSWER PERIOD

After these presentations, the audience asked three questions:

- What are the keys to success in ASICs for major semiconductor makers?

  - Wilf Corrigan (LSI Logic) believes that major companies must cannibalize their standard product markets with ASIC products, but they should also focus on developing MPUs and putting them onto boards. Start-ups have already replaced TTL-compatible peripherals.

  - Alfred Stein (VTI Technology) believes that the top software people and systems must be assigned to ASIC development, since software accounts for 10 percent to 15 percent of mask costs.

  - Jerry Crowley (Oki Electric) believes that even the military market will see heavy ASIC competition. To survive, top makers must offer 10,000-gate arrays using 1.0-micron geometries and 100 MHz tolerances.

- Do ASIC vendors need to hook customers on their software?

  - Jerry Crowley believes that ASIC design software must be portable. Vendors should develop kits for various personal computers.

  - Michael Callahan (MMI) believes that customers can support several major software packages, but not too many.

  - Alfred Stein observed that ASIC users want a "total solution," not just software. The keys to success are technical support and first-time prototyping.

  - Wilf Corrigan asserted that if vendors are genuinely serious about the ASIC market, they must appoint a Vice President of Software (like LSI Logic) who reports directly to the President. In addition, ASIC vendors must have a high proportion of software programmers. Of LSI Logic's 1,400 employees, 300 are programmers.

- Will major Japanese makers succeed in the U.S. ASIC market?

  - Jerry Crowley observes that Hitachi, NEC, and other major Japanese companies are aggressively entering the market. He believes that the American perception of ASICs as a "protected market" is a total myth; Japanese companies are capable of penetrating the ASIC market here. Oki Semiconductor, for example, has 300 distributors, 175 representatives, and 20 field engineers with a total of 3,000 years of experience. Its American software director has a Ph.D. from MIT. For years, Japanese software engineers have been "hidden" within systems groups. The real issue is: Can these engineers be easily moved to ASIC groups? The corporate cultural barriers are formidable in Japan, where software development is often considered a proprietary, in-house activity, not a transparent protocol to be released to end users.

- Wilf Corrigan worries about the major Japanese companies because of their consistent focus and determination. American majors ("gorillas") get bored easily and may quickly tire of the competitive ASIC market. He believes that Japan will definitely be a major factor in the high-volume sector.

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA
1986-10

JAPANESE SEMICONDUCTOR MARKET UPDATE: ASCENT OF YEN MAKES JAPAN'S MARKET NUMBER ONE

SUMMARY

DATAQUEST is revising its estimates of Japanese semiconductor consumption for the entire year of 1985 due to stronger than anticipated performance in the third quarter. At this time, we expect 1985 Japanese consumption to be ¥2,048.2 billion, down 2.3 percent from 1984. Table 1 shows quarterly and annual percent changes in yen consumption for 1985 through 1987. Table 2 shows 1985 through 1987 quarterly and annual consumption in yen. Tables 3 and 4 show the same information but in U.S. dollars. Japanese consumption in 1986 will for the first time exceed U.S. consumption, and by $418 million.

EFFECTS OF CURRENCY FLUCTUATIONS

Exchange rate fluctuations have a profound effect on market growth in dollars as opposed to yen. A dollar bought ¥257, on average, in the first quarter of 1985. By the fourth quarter of 1985, it could buy only ¥207, and the new year began with an exchange rate of ¥203 per dollar. That means the dollar fell 21 percent in the course of one year, and it now takes 21 percent more dollars to purchase a given quantity of semiconductors (in constant yen value) than it took a year ago.

Our forecasts use the exchange rate in effect at the beginning of 1986--¥203 per dollar. It must be noted that in recent weeks the dollar has fallen as low as ¥186 per dollar, and it is impossible to predict what the rate will be even one month from now.

INDUSTRY STATUS

The following trends are evident to DATAQUEST at this time

- The 1986 outlook still is for moderate growth of about 9 percent in yen; this translates into 28 percent growth in dollars.
- Expansion is seen for 1987 by the major manufacturers, and we forecast 31 percent growth in 1987.
- Prices are stabilizing in DRAMs.
- MOS fab utilization rate for 1.5u to 2.0u lines is 70 percent.
- Trade friction and a stronger yen will cause creative marketing in Japan's export markets.
- U.S. companies could make large dollar gains in the Japanese market.

After a recent trip to Japan, we have found that most of the major manufacturers are not overly optimistic about a strong first half of 1986. Capital spending is still decelerating and R&D is accelerating. We expect a substantial number of very creative new products in the second half of 1986, boding well for a strong market in 1987.

Even though pricing is still aggressive on most memory products, we see 64K DRAMs up to $0.85 from lows of $0.50 to $0.60. Also, manufacturers are trying to raise prices on 256Ks by 10 to 20 percent, but the customers are still marching to a different drummer. During the slow period in the third and fourth quarters, many of the manufacturers were converting from 4- to 5-inch lines and from 2.5 to 2.0u, which will increase both the capacity and the technology advancements necessary for 1Mb DRAMs and ASICs.

The manufacturers we talked to are confused by different demands coming from the U.S. government and the SIA, as related to the many lawsuits against them. Trade friction is the key rallying issue among the Japanese today. But we are convinced that if the U.S. government tries to limit product imports direct from Japan, it will also have to find ways to keep products from coming in from other regions, such as Hong Kong.

CONCLUSION

For some, 1986 will be almost as memorable a year as 1929, because this is the year that the Japanese market will become the largest market for semiconductors as measured in U.S. dollars. It is our estimate that the total consumption in Japan will be $11.0 billion, surpassing the mighty United States by almost $0.5 billion for the first time in history. Due in part to the rapid ascent of the yen and in part to their rapidly emerging industrial electronic equipment market, semiconductor manufacturers based in Japan will enjoy a 28 percent market growth versus the U.S. market growth of only 11 percent. Looking a little further into the ramifications of this differing growth trend, one sees the second year in a row in which the large Japanese manufacturers, because of their dominant market share in Japan, will gain significant worldwide market share (in dollars) from their U.S. and European competitors.

> NOTE: Look for our complete forecast from 1986 through 1991, plus 1996, to be mailed to all JSIS notebook holders in March.

Gene Norrett
Patricia S. Cox

Table 1

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION PERCENT GROWTH--1985-1987 (Percent of Yen)

Y/Q GRWTH	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor		-2.6%	-2.2%	-0.9%	-2.3%	2.4%	6.0%	5.8%	7.2%	9.4%	7.5%	6.8%	7.9%	5 0%	30.7%
Total IC		-2.7%	-3.0%	-2.0%	-1.5%	2.8%	7.1%	6.8%	8.2%	10.3%	8.7%	9.8%	11.5%	6.1%	39.6%
Bipolar		-10.5%	-8.3%	-0.6%	-3.8%	1.9%	6.9%	5.9%	8.2%	4.2%	6.5%	4.7%	4.1%	1.2%	25.1%
Memory		-10.3%	-10.3%	-8.6%	-4.5%	1.6%	6.2%	5.8%	2.7%	-5.7%	2.7%	2.6%	5.1%	2.4%	15.2%
Logic		-10.6%	-8.0%	0.7%	-3.7%	1.9%	7.0%	6.0%	9.0%	5.7%	7.0%	5.0%	4.0%	1.0%	26.4%
MOS		-3.7%	-4.4%	-5.2%	-3.2%	4.2%	6.5%	7.5%	12.0%	8.8%	10.8%	10.3%	12.9%	7.1%	48.1%
Memory		-12.8%	-17.7%	-5.5%	-19.5%	8.3%	9.7%	11.3%	18.3%	7.0%	7.7%	9.2%	14.4%	7.2%	52 9%
Micro Device		10.9%	10.9%	4.6%	2.2%	0.0%	0.0%	2.0%	3.0%	13.2%	20.0%	15.0%	18.1%	7.1%	53.6%
Logic		-1.1%	-0.1%	-12.2%	17.2%	4.0%	8.9%	8.0%	12.1%	7.5%	8.0%	8.0%	7.0%	7.0%	38 9%
Linear		3.9%	2.2%	3.1%	2.9%	1.0%	8.0%	6.0%	2.0%	15.8%	6.0%	11.0%	12.0%	6.0%	31 6%
Discrete		-3.9%	-2.2%	1.7%	-5.7%	1.9%	3.0%	3.1%	5.0%	6.2%	2.0%	-6.1%	-9.9%	-1.0%	-2.1%
Optoelectronic		2.8%	10.0%	4.5%	-1.3%	-1.3%	1.0%	0.0%	0.0%	8.3%	8.0%	0.9%	1.2%	0.0%	9.6%

Table 2

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION--1985-1987 (Billions of Yen)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	529.3	515.4	504.1	499.4	2,048.2	511.5	542.0	573.3	614.8	2,241.5	661.1	705.8	761.9	799.7	2,928.6
Total IC	407.2	396.4	384.5	377.0	1,565.1	387.7	415.1	443.4	479.9	1,725.9	521.7	572.6	638.3	677 0	2,409.8
Bipolar	64.5	57.7	52.9	52.6	227.7	53.6	57.3	60.7	65.7	237.3	70.0	73.3	76.3	77 2	296.9
Memory	8.7	7.8	7.0	6.4	29.9	6.5	6.9	7.3	7.5	28.2	7.7	7.9	8.3	8 5	32.5
Logic	55.8	49.9	45.9	46.2	197.8	47.1	50.4	53.4	58.2	209.1	62.3	65.4	68.0	68.7	264.4
MOS	228.5	220.1	210.4	199.4	858.4	207.8	221.4	238.1	266.7	933.9	295.4	325.8	367.7	393.8	1,382.7
Memory	99.5	86.8	71.4	67.5	325.2	73.1	80.2	89.3	105.6	348.1	113.7	124.2	142.1	152.3	532 3
Micro Device	47.8	53.0	58.8	61.5	221.1	61.5	61.5	62.7	64.6	250.3	77.5	89.1	105.2	112.7	384 5
Logic	81.2	80.3	80.2	70.4	312.1	73.2	79.7	86.1	96.5	335.5	104.2	112.5	120.4	128.8	465.9
Linear	114.2	118.6	121.2	125.0	479.0	126.3	136.4	144.6	147.5	554.7	156.3	173.5	194.3	206.0	730 2
Discrete	96.7	92.9	90.9	92.4	372.9	94.2	97.0	100.0	105.0	396.2	107.1	100.6	90.6	89.7	387 9
Optoelectronic	25.4	26.1	28.7	30.0	110.2	29.6	29.9	29.9	29.9	119.4	32.3	32.6	33 0	33 0	130.9
Exch. Rt.	257.0	251.0	243.0	207.0	237.0	203.0	203.0	203.0	203.0	203.0	203.0	203.0	203 0	203.0	203 0

Source: Dataquest
February 1986

Table 3

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION PERCENT GROWTH--1985-1987 (Percent of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor		-0.3%	1.0%	16.2%	-2.0%	4.5%	6.0%	5.8%	7.2%	28.4%	7.6%	6.8%	7.9%	5.0%	30.6%
Total IC		-0.3%	0.2%	15.0%	-2.1%	4.9%	7.1%	6.8%	8.2%	29.5%	8.7%	9.8%	11.5%	6.1%	39.6%
Bipolar		-8.4%	-5.2%	16.5%	-4.6%	3.9%	6.9%	6.0%	8.3%	22.6%	6.5%	4.7%	4.1%	1.2%	25.1%
Memory		-6.8%	-6.5%	6.9%	-5.3%	3 2%	6.3%	5.9%	2.8%	11.2%	2.7%	2.6%	5.1%	2.4%	15 1%
Logic		-8.3%	-5.0%	18.0%	-4.5%	4.0%	7.0%	6.0%	9.0%	24.4%	7.0%	5.0%	4.0%	1.0%	26.5%
MOS		-1.3%	-1.3%	11.2%	-3.9%	6.3%	6.6%	7.6%	11.9%	28.0%	10.8%	10.3%	12.8%	7 1%	48 0%
Memory		-10.6%	-15.0%	10.9%	-20.6%	10.4%	9.7%	11.4%	18.2%	26.8%	7.7%	9.3%	14.4%	7.1%	52 9%
Micro Device		13.4%	14.7%	22.7%	2.5%	2.0%	0.0%	2.0%	2.9%	31.7%	20.1%	14.9%	18.0%	7.1%	53 6%
Logic		1.3%	3.1%	3.0%	16.2%	6.0%	9.0%	8.0%	12.0%	26.5%	8.0%	8.0%	7.0%	7.0%	38.9%
Linear		6.4%	5.6%	21.1%	2.8%	3.1%	8.0%	6.0%	2.0%	35.3%	6.0%	11.0%	12.0%	6.0%	31.6%
Discrete		-1.7%	1.1%	19.3%	-6.1%	4.0%	3.0%	3.0%	5.0%	24.5%	2.0%	-6.0%	-10.0%	-1.0%	-2.1%
Optoelectronic		5.1%	13.5%	22.9%	-1.1%	0.6%	1.0%	0.0%	0.0%	26.2%	8.0%	1.0%	1.0%	0.0%	9.6%

Table 4

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION--1985-1987 (Millions of Dollars)

	Q1/85	Q2/85	Q3/85	Q4/85	1985	Q1/86	Q2/86	Q3/86	Q4/86	1986	Q1/87	Q2/87	Q3/87	Q4/87	1987
Total Semiconductor	2,060	2,054	2,075	2,412	8,600	2,519	2,670	2,824	3,028	11,042	3,257	3,478	3,753	3,939	14,426
Total IC	1,584	1,579	1,583	1,821	6,567	1,909	2,045	2,185	2,363	8,502	2,570	2,821	3,144	3,335	11,870
Bipolar	251	230	218	254	953	264	282	299	324	1,169	345	361	376	380	1,462
Memory	34	31	29	31	125	32	34	36	37	139	38	39	41	42	160
Logic	217	199	189	223	828	232	248	263	287	1,030	307	322	335	338	1,302
MOS	889	877	866	963	3,595	1,023	1,091	1,173	1,313	4,601	1,455	1,605	1,811	1,940	6,811
Memory	387	346	294	326	1,353	360	395	440	520	1,715	560	612	700	750	2,622
Micro Device	186	211	242	297	936	303	303	309	318	1,233	382	439	518	555	1,894
Logic	316	320	330	340	1,306	360	393	424	475	1,653	513	554	593	635	2,295
Linear	444	472	499	604	2,019	622	672	712	726	2,733	770	855	957	1,015	3,597
Discrete	376	370	374	446	1,567	464	478	492	517	1,952	527	496	446	442	1,911
Optoelectronic	99	104	118	145	466	146	147	147	147	588	159	161	162	162	645
Exch. Rt.	257	251	243	207	237	203	203	203	203	203	203	203	203	203	203

Source: Dataquest
February 1986

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RESEARCH BULLETIN

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SONY JOINS HANDS WITH AMD

SUMMARY

The Sony Corporation, a newcomer to the merchant semiconductor market, is making its move to become a major participant in this area. On February 12, Sony and Advanced Micro Devices (AMD) announced their plans to enter into a joint technology development program. The companies plan to develop and adopt common specifications for VLSI design and manufacturing. The agreement will enable AMD to enter the Japanese consumer market and strengthen Sony's semiconductor capabilities. DATAQUEST believes that this agreement will affect the following relationships:

- Sony's joint development of CMOS memories with Vitelic, and its ties with Kyocera and NMB Semiconductor
- Sony's second-sourcing of NEC's V Series
- AMD's second-sourcing of Intel microprocessors

As shown in Table 1, Sony has entered numerous strategic alliances since it entered the merchant semiconductor market in 1983. We estimate that in 1985, Sony ranked number 12 among Japanese vendors and number 29 worldwide in this market, with revenues of $168 million. Its revenues declined only 5 percent in 1985, compared to 12 percent for all Japanese vendors. This new agreement will strengthen Sony's position vis à vis its Japanese competitors in the consumer and semiconductor markets, and will expedite AMD's entry into Japan.

A WIDE-RANGING AGREEMENT

Under the terms of the agreement, Sony and AMD will:

- Develop and adopt common specifications for VLSI design and manufacturing
- Share designs and mask sets with each other (products not specified by the companies)

- Develop common process technology that will enable each company to second-source the other

- Purchase ICs made by the other company and market them under their own company name

DATAQUEST OBSERVATIONS

DATAQUEST observes that this agreement is much broader than the recent Toshiba-LSI Logic joint technology agreement for the "Sea of Gates." Although no specific products were mentioned, Sony and AMD are planning to develop high-value-added products for the commodity consumer market. We believe that Sony and AMD may focus on video RAMs (line memory and storage), graphics and video image processors, EPROMs, ISDN (Integrated Services Digital Network) chips, bit-slice processors, and application-specific ICs (ASICs) for television sets, VTRs, and other mass consumer products. Sony and other Japanese video producers are under strong pressure from South Korea to develop "smart" television sets and VTRs with new capabilities.

Moreover, AMD will enable Sony to develop telecom ICs for the "2nd NTT," a joint venture with Kyocera, Mitsubishi, Secom, and Ushio, which will compete against NTT in the VAN market. NTT is allied with IBM, AT&T, Motorola, and Texas Instruments.

Sheridan Tatsuno

Table 1

SONY'S STRATEGIC SEMICONDUCTOR ALLIANCES

Date	Company	Agreement
Oct. 1985	Vitelic	Sony invested $2 million of $7 million second-round financing package; Sony seat on Vitelic board; potential technical, production, and OEM ties in the future
July 1985	Vitelic	Joint development of CMOS 256K, 1Mb DRAMs, and 4Mb DRAMs; assembly and testing by Vitelic; Sony planning 1.5-micron 256K DRAMs; ICs to become 20 to 30 percent of Sony's revenues in future
April 1985	Tomen Electric	Sony to act as sales agent for Tomen in Japan
Feb. 1985	Tektronix	Tektronix announced MPU development support system for NEC V Series, which Sony is second-sourcing
Jan. 1985	NEC	Sony second-sourcing NEC's V20/V30 MPUs; Zilog also second-sourcing V Series MPUs
Dec. 1984	Monsanto	Sony licensed its magnetic field Czochralski method to Monsanto

Source: DATAQUEST
February 1986

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

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PRELIMINARY 1985 U.S.-JAPAN SEMICONDUCTOR TRADE ESTIMATES: WINNERS AND LOSERS

SUMMARY

DATAQUEST recently completed its annual comprehensive survey of the semiconductor sales of the top 100 semiconductor companies worldwide, by region and by product. This newsletter looks at how U.S. and Japanese companies fared in each other's markets in 1985. The results: both U.S. and Japanese suppliers lost share of each other's markets, even as trade friction escalated to warlike dimensions.

U.S. companies' share of the Japanese semiconductor market declined from 11.2 percent in 1984 to 9.5 percent in 1985. Sales were off by 20 percent. Japanese companies' sales in the U.S. semiconductor market were down 37 percent; their market share fell from 15.5 percent in 1984 to 13.4 percent in 1985. In both cases, sales to the market fell substantially more than the total market fell. We will examine some reasons for this in this newsletter.

MARKET SHARE ESTIMATES

Table 1 shows estimated semiconductor sales in Japan by U.S. companies. (Note: Signetics is excluded from U.S. company sales; we now include Signetics' revenues as part of Philips-Signetics, a European-based company.) Sales peaked in 1984 at $977 million, a strong increase of 65 percent from 1983. In 1985, however, sales of MOS ICs plunged 25 percent. Also hard hit were discrete and optoelectronic devices, which fell below 1983 levels. Compound annual growth rates (CAGRs) for the four-year period shown in this table and the two following tables are skewed due to the dramatically large sales decline in 1985.

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Semiconductor sales in the United States by Japanese companies are shown in Table 2. The Japanese companies had enjoyed incredible growth of 80 percent from 1983 to 1984, mainly in MOS ICs, and fueled largely by explosive growth in the U.S. personal computer market. In 1985, sales fell 37 percent, from $2,067 million to $1,295 million. MOS memory sales plunged 44 percent, to $747 million, which was lower than 1983's sales.

SEMICONDUCTOR ACCOUNT BALANCE

The U.S. semiconductor account balance with Japan (i.e., U.S. sales in Japan less Japanese sales in the United States) was negative $511 million in 1985, only about half of the U.S. deficit in 1984. U.S. companies have maintained a surplus for the last four years in bipolar digital logic and linear ICs, due to a dearth of Japanese competition in those areas, particularly in industrial linear, a real U.S. strength. Table 3 shows the U.S. semiconductor account balance with Japan. Figure 1 shows U.S. sales in Japan, Japanese sales in the United States, and the U.S. account balance from 1980 through 1985.

MANUFACTURERS' SALES

Japanese semiconductor sales in the United States are dominated by the top four Japanese manufacturers, Hitachi, Fujitsu, Toshiba, and NEC. All experienced severe revenue declines in 1985, especially Hitachi and NEC, which relied heavily on DRAM sales in the United States. Hitachi, number one among Japanese manufacturers in the United States for the past four years, saw its revenues sink 41 percent in 1985, from $627 million to $367 million. Table 4 shows Japanese manufacturers' semiconductor sales in the United States from 1982 through 1985.

Texas Instruments, Intel, and Motorola, the top three U.S. semiconductor manufacturers in Japan, maintained their rankings in 1985, although all three experienced slumping revenues. AMD, which had achieved 157 percent growth in Japan in 1984, declined 56 percent in 1985, from $54 million to $24 million. National Semiconductor came in fourth in Japan, with revenues of $39 million. Table 5 shows U.S. manufacturers' semiconductor sales in Japan from 1982 through 1985.

TRADE FRICTION

At DATAQUEST's April 1985 Japanese Semiconductor Industry Conference in Hakone, Japan, U.S.-Japan trade friction was a major topic among speakers and in conversation. U.S. and Japanese government speakers at the conference called for increased communication and understanding between the two countries.

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**JAPAN'S SHIFT TO INNOVATION:
A BOOM IN BASIC RESEARCH LABS**

"Good imitators, but poor inventors." For years, Japanese industry has been strong in manufacturing, but weak in innovative research. However, DATAQUEST believes that this situation is rapidly changing. As shown in Table 1, Japanese electronics makers will open at least 76 basic research laboratories between 1984 and 1988. These laboratories will focus on a wide variety of leading-edge technologies, such as 4Mb and 16Mb DRAMs, 32-bit MPUs, standard cells, 3-dimensional CAD systems, VLSI design expert systems, automotive electronics, telecom ICs, optoelectronics, gallium arsenide, bioelectronics, voice recognition/synthesis, ceramic packaging, diamond substrates, and new materials. Given an average investment of $25 million to $33 million each, we estimate that these laboratories represent a total investment of between $1.9 billion and $2.5 billion.

What impact will these laboratories have on the West? DATAQUEST believes that 1986 will be a major turning point for Japanese industry. We expect an increasing flow of innovative products from Japan within the next few years. To remain internationally competitive, western companies must continue investing heavily in R&D and improve their manufacturing capabilities.

Sheridan Tatsuno

Table 1

NEW JAPANESE ELECTRONICS R&D LABORATORIES (1984-1988)

Company	Research Activities (Location)	Opened	Millions of Dollars
Asahi Chemical	Gate arrays, standard cells (Atsugi)	12/85	$ 25.0
Asahi Optical	Optical disks (Englewood, Colorado)	1985	$ 0.5
Canon	Materials, AI (Atsugi)	02/85	$ 50.0
Data General Japan	Minicomputers (Koda)	12/85	$ 5.0
Dupont Japan	Electronics (Yokohama)	11/86	$ 75.0
Fuji Photo Film	CMOS image sensors	1985	N/A
Fujitsu	CAD, supercomputers, ICs (Kawasaki)	12/87	$100.0
Fujitsu	Mie R&D building postponed	1985	N/A
Fujitsu	Home electronics (main plant)	09/86	$ 17.5
Fujitsu/ Tohoku Digital	HEMT, opto, GaAs center (Sendai)	1985	$ 0.5
Hitachi	64Mb DRAM, biochips (Tokyo Central)	10/85	N/A
Hitachi Chemical	Electronics (Tsukuba)	1988	N/A
Hitachi Works	Bioelectronics (Kokubu)	02/85	N/A
Hokushin Electric	Ceramic components (Showaza)	02/86	$ 3.5
Honda	Reseach office (California)	09/84	N/A
IBM Japan	Computers, OA, workstations (Daiwa)	07/85	N/A

(Continued)

Table 1 (Continued)

NEW JAPANESE ELECTRONICS R&D LABORATORIES (1984-1988)

Company	Research Activities (Location)	Opened	Millions of Dollars
Japan Automation	CAD/CAM (Fuji)	03/85	$ 15.0
Japan Victor (JVC)	3-micron LSIs (Yamato)	04/85	N/A
JIRA	Laser technology center (Chiba)	1985	$ 1.0
Kanto Electronics	Joint semiconductor R&D (Nagano)	1985	N/A
Kanto Electronics	ICs, peripherals (Silicon Valley)	1984	N/A
Kawasaki Steel	New IC materials (Kawasaki)	03/85	N/A
KDD	Switching, software (Kamifuku-Oka)	02/88	$ 25.0
Kobe Steel	Research office (North Carolina)	09/84	N/A
Konishiroku	New materials (Silicon Valley lab)	03/85	$ 0.3
Kyocera	Electronic materials (Vancouver, WA)	1985	$ 10.0
Kyowa Electric	New materials (Chofu)	09/85	$ 5.0
Matsushita Electric	Sub-micron 16Mb DRAMs (Kadoma)	10/85	$100.0
Matsushita Electric	Biochips, thin film (Kawasaki)	04/86	$ 3.0
Matsushita Electric	R&D plan (Taiwan & West Germany)	1986	N/A
Matsushita Electronics	4Mb, next-generation ICs (Tokyo)	09/85	$ 80.0
Matsushita Reiki	Electronics (East Osaka)	07/85	$ 10.0
Mazda	Electronics (Yokohama)	1986	N/A
Minolta	Optoelectronics, thin films (Osaka)	11/84	$ 15.0
Mitsubishi Electric	Optical components (Obune)	08/85	$ 15.0
Mitsubishi Electric	Semiconductors (Research Triangle)	1984	N/A
Mitsubishi Electric	4Mb DRAMs, X-ray, E-beam (Itami)	12/85	$ 90.0
Mitsubishi Electric	Original CMOS MCUs	1985	N/A
Mitsubishi Electric/ Mitsubishi Kasei	Joint materials research	11/85	$ 1.5
MITI/MPT	Basic technology research center	1986	$ 56.0
MITI/STA	New joint R&D system (Tsukuba)	1985	N/A
MITI/Tokyo University	Bioholonics Computer (Tsukuba)	1985	N/A
Nakamichi	Consumer electronics (California)	09/84	N/A
NEC	VLSI, AI, bioelectronics (Tsukuba)	06/87	$ 65.0
NEC	32-bit MPU, GaAs, Opto (Sagamihara)	1985	$100.0
NEC/MOE Physics Lab	Synchrotron for 1Mb+ DRAMs (Tsukuba)	01/85	N/A
Nippon Denso	Electronics (Aichi Prefecture)	08/89	N/A
Nippon Denso	Auto electronics (Michigan)	1986	N/A
Nissan Motors	Electronics	10/85	$ 8.0
NMB Semiconductors	CMOS DRAMS, EEPROMs (Tateyama)	1985	N/A
NTT/Hitachi/Toshiba	64Mb+ DRAM synchrotron (Atsugi)	1988	$ 30.0
NTT/KDD	Transmission think-tank	1985	$ 0.8
Oki Electric	1-micron VLSI R&D center (Hachioji)	1985	$ 46.5
Oki Electric	CAD, OA, LAN, E-mail (Takasaki)	11/85	$ 25.0
Ono Measuring	Sensors, measuring (Yokohama)	10/89	$ 25.0
Osaka Titanium	VLSI wafers (Saga)	09/85	$ 10.0
Ricoh	Optoelectronics, materials (Yokohama)	04/86	$ 50.0
Sanken Electric	Semiconductors (Saitama)	1985	$116.0
Sanyo	Bioelectronics, AI, FA (Tsukuba)	10/85	$ 38.5
Sharp	0.8- to 1.2-micron VLSI, (Fukuyama)	09/85	N/A
Sony	Optical media (Portland, Oregon)	1984	N/A
Sumitomo Electric	IC materials (Raleigh, N. Carolina)	1984	N/A
Tamura Works	Semiconductors (Tokyo)	02/85	N/A
Tateishi Electric	Telecommunications (Machida)	03/86	$ 15.0
TDK	Components (Ichikawa)	N/A	N/A
Tokyo Electron (TEL)	Ultra LSI equipment (Nirasaki)	12/85	$ 8.0
Tokyo Sanyo	Semiconductors	02/86	$ 15.0
Toshiba	4 and 16Mb DRAMs (Kawasaki)	04/85	$110.0
Toshiba	ASICs, LANs, CAD (Horikawa)	01/87	$100.0
Toshiba Ceramics	16Mb ceramic substrates	1985	$ 11.6
Toyo Oxygen	IC gas equipment (Kawasaki)	1986	$ 10.0
Toyo Technica	CAD software (Atsugi)	12/84	$ 7.4
Yaesu Musen	Satellites, wireless (California)	1985	N/A
Yaskawa Electric	Robots, factory automation (Okura)	04/86	$ 7.5
Yazaki Industries	Hybrid ICs (Shizuoka)	06/85	N/A

N/A = Not Available

Source: DATAQUEST
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MATCHMAKING JAPANESE STYLE: THE SURGE IN JAPANESE STRATEGIC ALLIANCES CONTINUES

SUMMARY

Marry and conquer! For years, Japanese executives have cemented their business and political ties in Japan through strategically arranged marriages. The nakodo, or professional matchmaker, was the key to this family-style approach to business. Today, Japanese companies are using a similar approach--strategic alliances--to build long-term ties with foreign companies. They are exchanging researchers, sharing technology and plant capacity, and developing new markets with their partners overseas. The emphasis is on building close, family-like relationships. Toshiba's assignment of Dr. Yoshio Nishi to Hewlett-Packard's VLSI Research Lab, Oki Electric's joint venture with Voest Alpine, and the participation of Kyocera's president, Kazuo Inamori, on Vitelic's board are examples of these growing ties.

As shown in Table 1, Japanese companies entered into a record 71 joint ventures and licensing agreements in 1985. Of these, 50 were with U.S. companies, 10 with European companies, 2 with Korean companies, and 9 with other Japanese companies. Significantly, there were 27 joint ventures between Japanese semiconductor makers, more than twice the number in 1984. We believe that stagnant markets, increasing competition, worldwide overcapacity, and growing protectionism are fueling the Japanese push toward joint ventures.

Table 1

JAPANESE SEMICONDUCTOR STRATEGIC ALLIANCES

	1980	1981	1982	1983	1984	1985
Semiconductor Makers						
Joint Ventures	1	1	5	3	11	32
Licensing Agreements	2	5	5	11	19	22
Equipment Manufacturers	0	5	12	8	26	17
	3	11	22	22	56	71

Source: DATAQUEST
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THE SEARCH FOR IDEAL PARTNERS

In the past, Japanese strategic alliances were primarily limited to technology transfers and marketing agreements. In 1985, however, we observed a pronounced shift toward more complex and varied agreements. Japanese companies are systematically entering alliances to diversify their product portfolios, exchange technologies, penetrate markets, and utilize excess plant capacity. They are parlaying their strengths--memory technologies and CMOS wafer processing--in exchange for MPU support systems, CAD systems, and advanced IC designs. Companies like Fuji Electric, NMB Semiconductor, Oki, Ricoh, Seiko, and Sony are using their CMOS processing capabilities as a springboard into technology sharing and joint product development agreements. For many Japanese companies, the ideal partner is a company with leading-edge designs that is seeking low-cost wafer fab capacity.

Japanese semiconductor makers are also mixing their strategies. For example, Hitachi, NEC, and Toshiba are second-sourcing MPUs while jointly designing CAD systems for their proprietary MPUs with other companies. Exar, Seiko, and Sony are investing in or acquiring U.S. start-ups and offering wafer fab capacity. Some companies are simultaneously moving into several new areas. As shown in Table 2, Toshiba was the most active in 1985, signing 12 agreements covering a broad range of products.

The ground swell of strategic alliances has only begun. Because of the growing Japanese interest in Europe, and the coming shakeout in ASIC, CAD, and IC start-up companies, we believe that we will see more strategic alliances between Japanese companies in 1986. As shown in Table 3, there were 10 alliances with European companies in 1985, up from 2 in 1984.

Table 2

1985 JAPANESE STRATEGIC ALLIANCES BY COMPANY

Company	Number	Company	Number
Toshiba	12	Ricoh	3
Hitachi	7	NTT	3
NEC	5	Seiko Group	3
Oki Electric	6	Matsushita	2
Sony	4	Fujitsu	2
Mitsubishi	3	Rohm	2

Source: DATAQUEST
January 1986

Table 3

1985 JAPANESE STRATEGIC ALLIANCES BY COUNTRY AND PRODUCT AREA

	United States	Europe	South Korea	Japan	Total
Memory	7	4	-	-	11
Process	3	-	-	-	3
Microprocessors	10	2	-	4	16
ASICs	8	-	-	1	9
Other Devices	9	3	1	2	15
Equipment	13	1	1	2	17
Total	50	10	2	9	71

Source: DATAQUEST
January 1986

THE RUSH TOWARD PRODUCT GROUPINGS

We have observed that Japanese companies are forming major product groupings, or "camps," with U.S. and European makers to establish themselves worldwide. The race to find partners before being locked out of these camps is especially fierce. In 1985, we noted the following trends:

- Japanese newcomers are offering CMOS wafer fab capacity in exchange for design technology (NMB Semiconductor/Vitelic, Fuji Electric/Mosel, Seiko Epson/Xilinx/Siliconix, Rohm/Zilog, Kawasaki Steel/Nihon LSI).

- New groupings are being formed around shared product families (Sony/NMB/Vitelic, Oki/Voest/Thomson CSF/Siemens, Fuji/Mosel, Sharp/Wafer Scale Integration, Hitachi/Motorola, NEC/Sharp/Sony/Zilog, Fujitsu/Intel).

- Japanese companies are signing up with Japanese partners, an indication of their growing confidence in domestic technology and willingness to cooperate (Kanebo/Mitsubishi, Matsushita/Hayashibara, NEC with Sharp/Oki/Sony, Casio with NEC/Oki/Hitachi, Mitsubishi/Tokyo Electron).

- Japanese-European alliances are on the rise because of Japanese interest in European markets and creative research (Oki/Thomson CSF, Toshiba/Siemens, Oki/Voest, Hitachi/Thomson CSF, Kobe Steel/Trefimetaux, Toshiba/SGS-Ates, Matsushita/Philips, Canon Sales/CIT-Alcatel).

- Japanese-U.S. alliances are heavily focused on microprocessor second-sourcing (10 alliances), joint ASIC development (8), and equipment joint ventures (13).

- Despite strong rivalry, Japanese-Korean ties are emerging because of cost pressures and the growing U.S.-Korean alliance (Ricoh/Hyundai, Toshiba/Pohang Jonghup Steel, Sharp/Samsung).

Overall, it appears that Japanese companies are using strategic alliances to blunt the wave of protectionism that threatens their overseas markets, an approach pioneered by Japanese automobile makers. We believe that this is the wave of the future in semiconductors. In February, we will issue a service section covering trends in Japanese strategic alliances from 1980 through 1985.

MERGERS AND ACQUISITIONS--THE OPENING GAMBIT?

Although Japanese companies are not noted for actively acquiring new companies, we believe that they will look at struggling U.S. start-ups as possible sources of leading-edge technology. Oki's licensing of Exel's EEPROMs and Exar's subsequent acquisition of Exel are cases in point (see Table 4). On the other hand, U.S. equipment makers are buying out their partners to establish majority-owned Japanese subsidiaries.

Table 4

1985 JAPANESE SEMICONDUCTOR MERGERS AND ACQUISITIONS

Date	Japanese	Foreign	Activity
12/85	Exar (Rohm)	Exel	Exar offer to acquire Exel; Exar to exchange $5.7 million in newly issued stock for common and preferred stock held by Exel shareholders; Exel has 5.7 million shares of stock outstanding; agreement awaiting approval of Exel shareholders
12/85	Midoriya	Materials Research	MRC to buy four-fifths of Midoriya's 20 percent stock in 1986, bringing MRC ownership to 98 percent
10/85	Anelva Corp.	Varian	Varian sold remaining 19 percent share of Anelva to NEC, which now owns Anelva completely, ending 18-year joint venture
05/85	Toshiba	Olivetti	Toshiba bought 20 percent of Olivetti Japan to become stragegic supplier to Olivetti

Source: DATAQUEST
January 1986

MEMORY ALLIANCES: TRADING CMOS DRAMS FOR NEW DESIGNS

There were 11 alliances in memory technology (15 percent of all alliances) in 1985. Japanese companies were primarily interested in start-up companies like Exel, Mosel, Vitelic, and Wafer Scale Integration and in large European makers like Siemens, Thomson CSF, and Voest. The hottest technologies were CMOS 256K and 1Mb DRAMs, EEPROMs, and 64K SRAMs. As shown in Table 5, Oki, Toshiba, and Vitelic were the most active companies. An interesting team is being formed by Vitelic (design), NMB Semiconductor (automated CMOS wafer fab), Sony (investor in Vitelic and potential OEM), and Taiwan's Electronic Research and Service Organization (Vitelic's other wafer supplier).

Table 5

1985 JAPANESE MEMORY STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
11/85	NMB Semiconductor	Vitelic	Vitelic to license CMOS 1Mb DRAM technology for one-third NMB plant capacity; NMB licensing 64K SRAM from another U.S. firm; NMB Class 1 fab to ramp up to 4 million chips monthly by late 1986
10/85	Sony	Vitelic	Sony invested $2 million of $7 million second-round financing package; Sony seat on board; potential technical, production, and OEM ties in future
10/85	Fuji Electric	Mosel	Fuji to produce CMOS 64K SRAMs for Mosel under OEM contract using Mosel's 1.5- to 2.0-micron CMOS process; Fuji to also develop custom CMOS LSIs; $74 million Fuji semiconductor investment in 1985 for plant and technology
10/85	Sharp	Wafer Scale Integration	Expansion of 1984 agreement; WSI's 1.6-micron CMOS technology offered for royalties and plant capacity
09/85	Oki	Thomson CSF	Oki to supply 64K and 256K DRAM technology to Thomson's Marseille plant

(Continued)

Table 5 (Continued)

1985 JAPANESE MEMORY STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
09/85	Toshiba	Siemens	Siemens to second-source Toshiba's CMOS 1Mb DRAM; broad-ranging 7-year agreement to include technology sharing and joint development of new devices; production at Siemens' Furth plant from late 1986; strong impact on Siemens/ Philip 4Mb Mega Project
09/85	Toshiba	Hewlett-Packard	Dr. Yoshio Nishi, manager of Toshiba's 1Mb DRAM team, assigned to head HP's VLSI Research Center for 3 years
07/85	Sony	Vitelic	Joint development of CMOS 256K, 1Mb DRAMs, and 4Mb DRAMs; assembly and testing by Vitelic; Vitelic to buy 5,000 wafers monthly from Taiwan's Electronics Research Service Organization (ERSO); Sony planning 1.5-micron 256K DRAMs; ICs to become 20 to 30 percent of Sony's revenues in future
06/85	Oki	Voest Alpine (Austria)	Joint venture to produce 256K DRAMs, Voest MPUs, and gate arrays; overall deal worth $285 million; venture capitalized at $2 million; 51 percent Oki, 49 percent Voest Alpine; Voest has similar venture with Gould AMI (Austrian Microsystems International)
05/85	Oki	Thomson CSF	Oki to supply VLSI assembly line to new Thomson plant in Maxeville, France, and a wafer fab to line at the Eurotech-nique plant in Rousset, France
03/85	Oki	Exel	Oki to produce and market Exel's 16K EEPROMs worldwide

Source: DATAQUEST
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CMOS PROCESSES: THE KEY TO THE INS COMPUTER

One of the major announcements in 1985 was NTT's decision to work with Motorola and Texas Instruments. As shown in Table 6, both companies will work on CMOS processes and VLSI substrates for the INS computer, artificial intelligence, and satellites. We believe that NTT will sign more agreements in 1986 under its Track III procurement procedures (joint R&D), and possibly open R&D centers in Silicon Valley and Europe. As a result of NTT's privatization and of deregulation of the value-added network (VAN) market, NTT is under pressure to keep ahead of its new rivals in the NTT family--Fujitsu, NEC, Oki, Toshiba, and others. To avoid being sold old technology by the NTT family, NTT is now working with foreign companies and licensing its technology through NTech, its subsidiary. Recently, NTT teamed up with IBM and AT&T to develop joint VANs, a move that upset Japanese computer and telecommunications makers. For U.S. and European companies, the new NTT is one of the best potential partners because of its strong R&D labs and $3.2 billion procurement budget.

Table 6

1985 JAPANESE PROCESS TECHNOLOGY TRANSFERS

Date	Japanese	Foreign	Technology Transferred
11/85	NTT	Motorola, Texas Instruments	2- to 3-year joint development of LSI substrates for INS computer, artificial intelligence, and satellites
10/85	NTT	Texas Instruments	Joint development of buried oxide technique for 1.25-micron CMOS devices with 2-layer metal interconnect; potential TI qualification for DOD's VHSIC Phase I program
02/85	Mitsubishi	Standard Microsystems	Global nonexclusive cross-licensing of each other's semiconductor patents and patent applications; Mitsubishi is sixth Japanese vendor to license SMC coplamos process

Source: DATAQUEST
January 1986

MICROPROCESSORS: LAYING THE GROUNDWORK

Japanese companies were busy laying the groundwork in 1985 for their assault on microprocessor markets, especially the 32-bit market, in 1987. As shown in Table 7, NEC was the most active, licensing its V Series to Oki, Sharp, Sony, and Zilog. In 1984, NEC teamed up with Digital Research, Hewlett-Packard, Sophia Systems, Tektronix, and Yokogawa to design MPU development support systems. The Sony/Tektronix system, which handles Intel, Motorola, and NEC MPUs, was recently introduced in Japan.

Hitachi is not sitting on its heels. In 1985, it exchanged MPUs with Motorola, Signetics, and Thomson CSF and is developing an MPU development support system with Sophia Systems.

Toshiba is hedging its bets. It signed agreements in 1985 to second-source Intel interface controllers and to develop an operating system with Zilog. In 1984, Toshiba signed agreements with Zilog and Motorola.

Surprisingly, Fujitsu and Mitsubishi have been very quiet. In 1984, Fujitsu negotiated with Intel to take partial charge of 16/32-bit MPU development, but no announcement has yet been made. Mitsubishi may work with Hitachi and NEC on Tokyo University's TRON Project for 32-bit MPUs.

Table 7

1985 JAPANESE MICROPROCESSOR STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
12/85	NEC, Sharp	----	Sharp to 2nd-source NEC V Series (V20/V30); Sony also NEC 2nd-source
12/85	NEC, Oki	----	Announced jointly developed CMOS signal processor (NEC uPd77C20, Oki MSM77C20) for shipment to U.S. in 1986
12/85	Matsushita	Philips	Matsushita to 2nd-source Philips' 68070
11/85	Toshiba	Intel	2nd-sourcing of Intel MOS interface LSIs (bus and interruption controllers)
11/85	Rohm	Zilog	Long-term joint manufacturing and marketing agreement; Zilog MPUs (Z8/Z80) for Rohm's assembly and use (ROHMZ80)
10/85	Hitachi	Motorola	Both firms announced 2-micron HCMOS version of 68000; Hitachi mask sets for Motorola 2nd-sourcing

(Continued)

Table 7 (Continued)

1985 JAPANESE MICROPROCESSOR STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
10/85	NEC	Zilog	NEC negotiating OEM agreement to supply V20/V30
10/85	Hitachi	Thomson CSF	2nd-sourcing of Hitachi's CMOS 8-bit MCU (6300 Series) in exchange for Thomson's telecommunication LSIs
09/85	Toshiba	Zilog	Sales contract for CP/M 8000 operating system for Z80 MPU; Toshiba to market OS with C compiler
09/85	Hitachi	Signetics	Hitachi's CRT controller (63484) for Signetics' data exchange IC (68562)
09/85	Fujitsu	Intel	Extension of 2nd-sourcing of 80286 MPU to include 80186/80188 and 82288 bus controller and 82284 clock generator
08/85	Hitachi	Microtec Research	Microtec to develop macroassembler, utilities, Pascal and C compilers to run on Hitachi's first standalone in-circuit emulator (H180AS01 Adaptive System Emulator) for the HD64180 8-bit CMOS MPU; HD64180 MPU compatible with Z80/8080 family
03/85	Rohm	Fairchild	Fairchild licensed manufacturing and sales rights of its 8-bit one-chip MCU (F3870 series)
02/85	Sony	Tektronix	Tektronix designed MPU development support system for NEC V Series
01/85	NEC, Sony	----	2nd-sourcing of NEC's V20/V30 MPUs
01/85	Hitachi, Sophia Systems	----	Joint manufacturing of MPU development support system for Hitachi proprietary MPUs; joint commercialization of software development tool and program development emulator in late 1985

Source: DATAQUEST
January 1986

ASICS: THE BATTLELINES ARE FORMING

Japanese companies signed nine agreements for application-specific ICs (ASICs) in 1985, as shown in Table 8. Kawasaki Steel, LSI Logic, and Toshiba were clearly the most aggressive. LSI Logic and Toshiba renewed their ties to develop 50,000- to 60,000-gate "Sea of Gates" technology; Kawasaki Steel and Nihon LSI Logic are building a new CMOS plant. In 1984, Kawasaki Steel acquired silicon producer NBK Corporation, of Santa Clara, to obtain wafer processing know-how. The big question is whether LSI Logic will build its ties with Hewlett-Packard through Toshiba's Dr. Nishi.

The Seiko Group and Casio are quietly building ties of their own. Seiko Epson signed agreements with Xilinx and Siliconix, and Suwa Seikosha has ties with start-ups Applied Micro Circuits (AMCC) and SMOS System. Casio, which uses ASICs for its own products, will have Hitachi, NEC, and Oki produce its custom LSIs.

As a result of numerous joint ventures and licensing agreements, six major ASIC camps are forming. As shown in Table 9, these camps include LSI Logic, TI/Fujitsu, Fairchild/VLSI Technology, Gould/AMI, Motorola/ National, and Seiko/Honeywell. Not all companies in each camp are related, but they often share mutual ties with other companies in the group.

Table 8

1985 JAPANESE ASIC STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
12/85	Toshiba	LSI Logic	Expansion of agreement for wide-ranging cooperation; Toshiba 2nd-sourcing, joint PR and technical seminars; LSI's CAD system for Toshiba ASIC users
12/85	Ricoh	Western Design Center	WDI's 16-bit CPU core to be input into Ricoh's standard cell library; Ricoh to supply devices through OEM deal
12/85	Seiko Epson	Xilinx	Seiko to produce Xilinx logic cell arrays; sample shipments in spring 1986
11/85	Seiko Epson	Siliconix	Siliconix to license Seiko's 2.0- and 1.5-micron gate array production and CAD technology
11/85	Fujitsu, Toshiba	Chips & Technologies	C&T subcontracting with Fujitsu and Toshiba for CMOS and bipolar arrays
10/85	Toshiba	LSI Logic	Joint development of 50,000-gate "Sea of Gates" for sale in 1986; Toshiba's CMOS process and LSI Logic's logic, simulation, and CAD software
09/85	Kawasaki Steel	LSI Logic	Joint venture company (Nihon LSI) to produce gate arrays and standard cells; 55 percent LSI Logic, 45 percent Kawasaki Steel
05/85	Suwa Seikosha	Applied Micro Circuits	AMCC offering CMOS chips under license from Suwa Seikosha
01/85	Casio, Hitachi, NEC, Oki	----	Casio to design custom LSIs that will be produced by Hitachi, NEC, and Oki

Source: DATAQUEST
January 1986

Table 9

MAJOR ASIC CAMPS

LSI Logic Camp	Gould/AMI Camp
AMD	Gould/AMI
GE/Intersil	Mostek
LSI Logic	Asahi Chemical
SGS-Ates	Western Micro Technology
RCA	Intergraph Design System
Toshiba	
Mitsubishi	
Sharp	
Chips & Technologies	
California Devices	
Olympus	
Kawasaki Steel	

TI/Fujitsu Camp	Motorola/National Camp
Fujitsu	International Microelectronic Products
MMI	Motorola
Signetics	National Semiconductor
Texas Instruments	GTE Microcircuits
Harris	Plessey
International Computer Ltd.	

Fairchild/VTI Camp	Seiko/Honeywell Camp
Fairchild	SMOS Systems (Seiko)
VLSI Technology	Applied Micro Circuits Corp. (AMCC)
Ricoh	Xilinx
Lattice	Honeywell
Rockwell Custom MOS Arrays	International Microcircuits (IMI)
Western Digital	Siliconix
Altera	Nippon Precision Circuits
Philips	
Silicon Compilers	
Sierra	
Western Design Center	

Other Camps

Intel/Zymos
Oki/Thomson CSF
NEC
Hitachi

Source: DATAQUEST
January 1986

OTHER SEMICONDUCTOR DEVICES: A POTPOURRI OF ALLIANCES

As shown in Table 10, there were 15 alliances covering a wide variety of other semiconductor devices. Probably the major announcements were Mitsubishi's joint venture with GE and Westinghouse to produce discrete devices, Hitachi's tie-up with Sperry, and Toshiba's joint development of IC cards with VISA International. Toshiba also teamed up with Brooktree, Pohang Jonghup Steel, SGS-Ates, and Sun Microsystems. What distinguishes these alliances are the large number of joint manufacturing and development ventures (9 of the 15 agreements).

Table 10

OTHER JAPANESE SEMICONDUCTOR DEVICE STRATEGIC ALLIANCES IN 1985

Date	Japanese	Foreign	Agreement
12/85	Toshiba	Pohang Jonghup Steel	First major technology transfer with South Korean company (undisclosed)
11/85	Hitachi	Sperry	Technology exchange; joint development effort to study feasibility of using Hitachi's high-speed ICs in Sperry's 1100 system architecture; Hitachi already manufactures Sperry's personal computers
11/85	Kodenshi Corp.	ABM Semiconductor	ABM (San Jose start-up) to sell 200 Kodenshi optoelectronic ICs in exchange for partial Kodenshi funding
11/85	Toshiba	SGS-Ates	Toshiba 2nd-sourcing of 3 SGS telecom ICs, including CMOS single-chip PCM combo, NMOS modem, and NMOS PCM switching matrix (1st phase); joint development of new telecom ICs (2nd phase); also expansion of 1982 CMOS process contract
11/85	Toshiba	VISA Int'l	Joint development of multipurpose IC card (Super Smart Card) for sale in 1987
10/85	Toshiba	Sun Microsystems	Sun to supply $35 million in CAD workstations to Toshiba; Sun's Network File System software to be added to Toshiba's computers to allow communications with Sun workstations; also technology exchange (undisclosed)

(Continued)

Table 10 (Continued)

OTHER JAPANESE SEMICONDUCTOR DEVICE STRATEGIC ALLIANCES IN 1985

Date	Japanese	Foreign	Agreement
09/85	Toshiba	Brooktree	Licensing of Brooktree's digital/analog converters; Toshiba to use Brooktree chip architecture to design high-resolution D/A converters for consumer digital audio uses
09/85	Toko	Motorola (MC13020P)	Toko to 2nd-source Motorola ICs for AM stereo receiver signal decoders
09/85	Mitsubishi	Westing-house, GE	Joint venture to produce diodes, power transistors, and thyristors in the U.S.; 45 percent Westinghouse, 45 percent GE, 10 percent Mitsubishi America; $21 million book value; production at 3 plants (Youngwood, PA; Burabo, Puerto Rico; Le Mans, France)
05/85	Kobe Steel	Trefimetaux (France)	Transfer of Kobe's IC leadframe production technology
05/85	Nippon Precision Circuits (Seiko)	Micro Power	Seiko to produce and sell molybdenum ICs and peripheral ICs for Micro Power's modems
05/85	Kanebo, Mitsubishi	----	Joint venture (Kanebo Electronics) to run IC test and assembly plant in Hyogo area; Mitsubishi to supply TTL chips to plant; production from December 1985; Y15 billion ($75 million), 5-year investment
04/85	Fuji Electric	Thomson	Thomson to second-source Fuji's power modules; Fuji to receive royalties
03/85	Matsushita Hayashi-bara	----	Announced water-soluble photopolymer resist for IC processing by applying bioelectronics technology
01/85	Ricoh	Ixys	Ricoh to license and jointly develop Ixys' MOSFETs and thyristor MOSFETs incorporated in power conversion and motion control applications for home, factory, and office automation products

Source: DATAQUEST
January 1986

EQUIPMENT AND MATERIALS: MARRIAGES STILL BLOOMING

Perhaps the least-noticed trend in semiconductors is the proliferation of U.S.-Japanese alliances among equipment and materials manufacturers. Since 1980, we have recorded 68 alliances; almost all are joint ventures. Why the popularity of these alliances? We believe that the entry of strong Japanese competitors and the service-intensive nature of the business demands a Japanese partner for research, low-cost manufacturing, and after-sales servicing. In 1985, we recorded 17 new alliances and one separation, as shown in Table 11. Most of the ventures are developing equipment for 6-inch wafer lines, including etchers, diffusion furnaces, chemical vapor deposition (CVD) equipment, and spin coaters. One interesting agreement is Hyundai's plan to produce 6-inch wafers for Ricoh as a result of the downturn.

Table 11

1985 SEMICONDUCTOR EQUIPMENT AND MATERIALS STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
10/85	Samco International	March Instruments	Samco to produce plasma CVD, MOCVD, and dry stripper equipment in United States at March's Concord, California, plant
10/85	Shinetsu Handotai, Mitsui & Co.	SM Yttrium Canada, Union Oil, Denison Mines	$9 million investment in plant to produce yttrium for use in microwave communications equipment; Denison to run plant; 100-150 metric ton annual plant capacity
10/85	Nippon Kokan	GE	Joint purchase of Great Western silicon factory for $16 million; new GWS Corp.
09/85	Matsushita Denko Co.	----	Developed vertical CVD equipment for thin-film ULSIs
08/85	Tokuda Works	Tylan Corp.	Production of etchers in United States from 1986
07/85	Ricoh	Hyundai	Hyundai to produce 6-inch wafers for Ricoh
06/85	Hugle Electronics	Zeus Corp.	50/50 joint venture to produce Hugle's CVD equipment, cassette cleaners, and probe cards

(Continued)

Table 11 (Continued)

1985 SEMICONDUCTOR EQUIPMENT AND MATERIALS STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
06/85	Nippon Kokan	GE	Licensing of GE's polycrystal manufacturing technology for Nippon Kokan's Toyama Works
04/85	Kanematsu Semiconductor	Veeco	Kanematsu technical center near Tokyo to develop Veeco ion implanters
04/85	Canon Sales Co.	CIT-Alcatel	Joint venture (Alcantech) capitalized at ¥100 million ($500,000); 50/50 share ownership; assembly and sales of etchers in Japan from 1986
03/85	Mitsubishi, Tokyo	----	Codevelopment of electron cyclotron resonance (ECR) plasma etching equipment for 4Mb DRAMs; existing joint venture
03/85	Itoman Kiki Hanbai, Toyomitsu	Plasma Thermo	Joint venture, Plasma Hitech, to sell Plasma's equipment in Japan to top 30 component makers
02/85	Hugle	Atcor	Japanese joint venture to produce 70 to 80 wafer cassette cleaners annually at new plant
02/85	Koyo Lindberg	General Signal	Joint venture to develop automated vertical diffusion furnaces for 6-inch wafers, based on General Signal's manual model; production from fall 1985 at Koyo's Nara plant; Koyo Lindberg owned equally by General Signal and Koyo Seiko
02/85	Toray Industries	Dexter	50/50 joint venture (Toray Hysol Co.) to produce epoxy-resin package materials for ICs and optoelectronics at Toray's Nagoya Works in 1986; capitalized at ¥1.8 billion ($9 million); plant capacity of 6,000 tons annually

(Continued)

Table 11 (Continued)

1985 SEMICONDUCTOR EQUIPMENT AND MATERIALS STRATEGIC ALLIANCES

Date	Japanese	Foreign	Agreement
02/85	Kanematsu Semiconductor	Semiconductor Systems	Semiconductor Systems (San Jose, California) to license its spin coater production technology for 6-inch wafer photoresist coating
02/85	Kanematsu Gosho	Perkin Elmer	Cancellation of agency agreement in Japan to allow opening of Perkin Elmer Semiconductor Japan to handle sales in Japan; initial staff of 70 to be expanded to 125 by late 1985
01/85	Sumitomo Heavy	Eaton	Expansion of 1983 ion implant agreement to include Optimetrix steppers

Source: DATAQUEST
January 1986

DATAQUEST CONCLUSIONS

In an era of worldwide overcapacity and growing protectionism, DATAQUEST believes that the winners in the semiconductor industry will be those companies that judiciously develop strategic alliances to leverage their technologies and conserve their cash. Like all marriages, these alliances will encounter rocky periods once the honeymoon is over, and we expect many alliances to fall apart. But companies that are able to look beyond short-term difficulties and work hard at developing strong relationships have an opportunity to expand their market shares. Those who choose to go it alone run the risk of forfeiting markets and technologies by default. Some companies may choose not to pursue an aggressive strategy, but we believe that they cannot afford to ignore the many options available to them. In the long run, marketing strategy by omission is just as important as strategy by commission.

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-4

JAPANESE AND EUROPEAN SEMICONDUCTOR AGREEMENTS

Both Japan and the European community recognize the importance of promoting industrial cooperation and averting trade wars. However, over the years, friction between the European Economic Community (EEC) and Japan has increased. The main reason for this friction is the widespread view in Europe that the Japanese are penetrating European markets while restricting the flow of European goods to Japan. Japan's investment in the EEC has been high, particularly in the high-technology area. EEC investment in Japan has been much smaller, and it has been mostly limited to traditional areas such as chemicals.

One of the ways for Japanese companies to broaden their markets in other countries is through agreements with local companies. Especially in the case of Europe, it is important for a Japanese company to be viewed as willing to cooperate locally, for political and economic reasons. For example, for a European state-controlled telecommunications authority (PTT), a Japanese product produced or developed through an agreement with an indigenous company would be viewed far more favorably for procurement than a product having no local link at all.

Thus, through alliances in Europe, the Japanese get increased market penetration. In addition, their major customers get a local supplier and the Japanese company gets access to local technology and/or products for less cost and in a shorter space of time than if a go-it-alone policy was adopted.

The benefits are not one-sided, though. The European partner gets the same advantages: an increased market penetration outside Europe, a quick and low-cost way of acquiring advanced technology and/or products, and a broader customer base.

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Table 1 lists all semiconductor agreements signed between Japanese and European companies in 1985, as well as some agreements from previous years. It is interesting to note that, apart from ICL, there is an absence of U.K. companies in the list of alliances. There seems to be a reticence on their part to get involved with Japanese companies. Two reasons could account for this situation--a general unwillingness to share their unique technologies and an unwillingness or inability to raise the necessary money to finance such alliances.

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Sheridan Tatsuno
Iza Hallberg

Table 1

JAPANESE-EUROPEAN SEMICONDUCTOR AGREEMENTS

Date	Companies	Agreement
1985 (Nov.)	Matsushita, Philips	Matsushita will second-source Philips' 68070 MPU. This device contains a CPU, a memory management unit, direct memory access control, an I2C bus, an RS-232-C interface, and three counters/timers--all on the same chip.
1985 (Oct.)	Hitachi, Thomson	Under this cross-licensing agreement, Thomson will second-source Hitachi's 6800 CMOS 8-bit microcontrollers. In return, Thomson will provide Hitachi with telecommunications LSI technology.
1985 (July)	Toshiba, Siemens	This is a joint venture in DRAMs. Siemens agreed to pay Toshiba for design, testing, and production data on Toshiba's 1-Mbit DRAM. Siemens will thus speed up production of its megabit products. Both companies agreed on a cross-license agreement for the entire field of semiconductor component patents with mutual worldwide rights. Toshiba will gain access to Siemens' telecom technology.
1985 (May)	Oki, Voest Alpine	These companies plan a joint plant to be built in Austria to manufacture DRAMs, MPUs, and gate arrays.
1985 (May)	Oki, Thomson	Oki will supply a VLSI assembly line to the new Thomson plant in Maxeville, France, and a wafer fab line at the Eurotechnique plant in Rousset, France.

(Continued)

Table 1 (Continued)

JAPANESE-EUROPEAN SEMICONDUCTOR AGREEMENTS

Date	Companies	Agreement
1985 (May)	Toshiba, Olivetti	They are taking steps toward an alliance. Toshiba is buying 20 percent of Olivetti Japan to become a strategic supplier to Olivetti and, therefore, to Europe.
1985 (April)	Fuji, Thomson	Thomson will second-source Fuji's power modules. Fuji gets money; Thomson gets technology of high-power modules.
1985 (Mar.)	Kyocera, Philips	Philips will develop, produce, and sell electronic data networks in Japan.
1984	NMB (Minebea), Inmos	NMB acquired a license to manufacture Inmos' 256K CMOS DRAM, and Inmos will buy half of NMB's production. The two companies will also work toward a 1-Mbit chip.
1984 (Feb.)	Oki, Thomson	Under an alternate source agreement, Thomson will manufacture Oki's 2- and 3-micron families of CMOS gate arrays and Oki will manufacture Thomson's 2- and 3-micron families. These products will be simultaneously marketed by both companies on a worldwide basis.
1984 (June)	Fujitsu, ICL	The companies extended their 1981 cooperation agreement until 1991. Fujitsu will supply gate arrays to ICL; both companies will develop new products and become committed to OSI (the computer standard).
1984 (Oct.)	Hitachi, AMI	Gould AMI and Hitachi signed an alternate-source agreement for Hitachi's family of codecs (S44230 series), with AMI (Austria Microsystems International) marketing the products in Europe.
1982 (Ongoing)	Toshiba, SGS	In a continuing joint-venture agreement to develop CMOS process technology, both companies are jointly expanding CMOS logic. Manufacture will be in Italy and Japan jointly. SGS gets a modern, high-yield 3-micron CMOS process; Toshiba gets increased market penetration. The relationship will be extended to other technologies. The latest agreement is for telecom ICs.

Source: DATAQUEST
January 1986

Dataquest
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RESEARCH BULLETIN

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GaAs ASIC AND FOUNDRY ACTIVITIES SPUR SYSTEMS DEVELOPMENT

SUMMARY

ASIC technology provides an inexpensive means of incorporating GaAs into an existing silicon subsystem or system. A user can upgrade system performance by a factor of two or three by making minor changes to existing hardware, such as incorporating GaAs into clock distribution circuits and prescalers. GaAs suppliers that support ASIC and foundry work are offering customers the opportunity to add value to existing designs, thus accelerating the transition from silicon to GaAs in very high-performance systems.

ASIC AND FOUNDRY ACTIVITIES

Application-specific GaAs devices offer a relatively attractive means of evolving system designs from the silicon world to the III-V world. Several companies have mounted substantial R&D and manufacturing programs to support GaAs ASICs, including Vitesse, TriQuint, Plessey, Honeywell, GigaBit, Adams Russell, and captive makers. Table 1 shows the fees of merchant GaAs foundries in the United States and Western Europe that were offering ASIC services in late 1985. There are no announced merchant foundries in Japan.

TriQuint and Honeywell are marketing multiuser prototype programs that allow several customers to design devices to the respective suppliers' ground rules and receive first prototype devices from wafers fabricated during a single run. To accomplish this, the vendor allots standardized reticle areas (e.g., 80 mils x 80 mils) for chip locations, such that several customers' chips can be interspersed on the same wafer. This represents a major breakthrough in economy of scale in developing new GaAs devices. The cost savings to the user can be on the order of 50 percent per wafer run.

Gene Miles
Sheridan M. Tatsuno

Table 1

GaAs MERCHANT MARKET FOUNDRIES

Company	Location	Contact
Adams-Russell	Burlington, MA	Frank Weber, Marketing Director
Avantek	Santa Clara, CA	Len Lea, Marketing Manager
GigaBit Logic	Newbury Park, CA	Michael M. Pawlik, Manager
Harris	Milpitas, CA	Bruce Hoffman, Marketing Manager
Honeywell	Richardson, TX	W. N. Schaunfield, Foundry Manager
M/A-COM	Lowell, MA	Ron Cavalieri, Marketing Manager
Plessey	Towcester, U.K.	Ray Evans, Foundry Marketing
Rockwell	Anaheim, CA	Phil Dee, Marketing Manager
TriQuint	Beaverton, OR	Dr. Ajit Rode, Foundry Manager
Vitesse	Camarillo, CA	Jim Brye, V.P., Marketing

EXAMPLES OF FOUNDRY CHARGES
(Data representative of late-1985 activities)

Adams-Russell	Approximately $40,000 to $45,000 per four-wafer prototype lot; customer owns mask set and tooling. Multiproject design is $10,000 per group (up to four people per group).
Avantek	Two-inch wafers, 0.5 μ process. $40,000 for first wafer includes design rule package and engineering services. Additional wafers $10,000 each (minimum lot size is five wafers).
GigaBit Logic	$50,000 for two prototype runs. $35,000 per production run. Eight wafers per run.
Harris	Two-inch wafers, 0.5 μ foundry. Standard flow $65,000 plus design support and test costs per 25-piece direct current probed, packaged lot for cell arrays. Standard flow $75,000 per two-wafer run for MMICs.
Honeywell	Software tool kit, $25,000. Budgetary prototyping cost $50,000, dependent upon test and package costs.
M/A-COM	0.8 μ fab-only cost $25,000. 0.5 μ fab-only $30,000. Masks--9 to 14 levels at $1.2K/level. Special testing and other services negotiable.
Plessey	Two-inch wafers with capability of 3-inch wafers, £25,000 user guide, plus £10,000 per wafer run; two to five run commitment within first year.
Rockwell	Foundry charges are negotiable.
TriQuint	$55,000 for first five to ten Q-chip samples, including design manual, standard cells on Daisy equipment, and evaluation board. Multiproject wafer cost of $9,900 for MSI-density design samples. Full-custom charges to be announced soon.
Vitesse	E/D foundry. Design manual plus up to 40 hours engineering consultation $25,000, one-time setup charge $9,000 per design, V-Spice software $15,000, rule-check software $7,000, first five wafers $13,000/wafer. Charges for more than five wafers are negotiable.

Source: DATAQUEST
January 1986

Dataquest
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RESEARCH BULLETIN

JSIS Code: Newsletters 1985-1986, EIEJ 1986-7

NEC INSTITUTES TOXIC WASTE SURVEY

SUMMARY

Due to growing concern over toxic wastes, Kyushu NEC recently announced a pollution prevention agreement with Kumamoto City and has implemented a study to investigate measures for preventing toxic waste problems. The basic agreement includes the following provisions:

- Basic understanding regarding pollution prevention
- Prior consultation with Kumamoto City before construction or changes in Kyushu NEC's manufacturing processes
- Urgent countermeasures
- Immediate study to investigate carcinogenic gases and chemicals

Kyushu NEC plans to issue a detailed agreement in June 1986 after investigating the matter. The agreement will cover the existing toxic waste situation, standards for individual gases and chemicals, monitoring systems, and closed water-recycling systems.

DATAQUEST ANALYSIS

DATAQUEST believes that Kyushu NEC's announcement is an indication of the serious concern over toxic wastes among Japanese semiconductor companies. Moreover, it is NEC's step to protect its plant on Kyushu island, Japan's "Silicon Island," where the company is producing 256K and 1Mb DRAMs.

During the last year, DATAQUEST has been visited by Japanese prefectural government officials who are clearly worried about toxic wastes and farmland preservation. Unlike Silicon Valley where IC plants are several miles from housing areas, most Japanese IC plants are located within several hundred yards of prime farmlands and housing areas. Given

Japan's frequent earthquakes, typhoons, and other natural disasters, toxic leaks could trigger a public outcry and seriously hamper Japanese semiconductor makers. According to the Japanese press, most prefectural governments lack toxic waste standards for high-tech industries. Japan's existing environmental regulations, a result of industrial poisoning cases in the mid-1970s, are aimed at heavy industries.

In an effort to protect the public and prevent this issue from becoming a political football, DATAQUEST believes that other Japanese semiconductor makers will also announce agreements with local governments in the future. We applaud NEC for taking the initiative in this difficult matter and believe that MITI and other semiconductor makers are closely examining the Semiconductor Industry Association (SIA) model toxic waste ordinance for possible implementation in Japan.

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: Newsletters 1985-1986, JSIA 1986-1

JAPANESE TECHNOLOGY: THE FUTURE WAVE

At DATAQUEST's recent CAD/CAM Focus Conference in Palo Alto, JSIS Industry Analyst Sheridan Tatsuno gave a presentation on Japanese semiconductor technology trends and national R&D projects to provide an understanding of the CAD systems required for Japan's next-generation ICs. A copy of his speech, entitled Japanese Technology: The Future Wave, is presented on the pages that follow.

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OVERVIEW

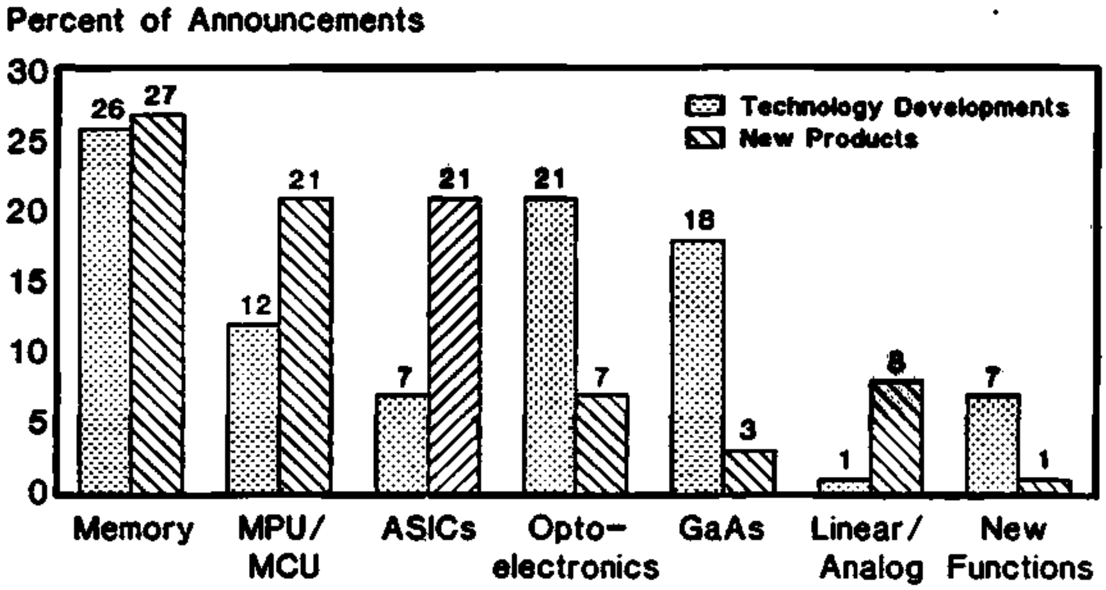
- Leading-edge ICs
- Joint R&D projects
- Next-generation ICs
- Next-generation computers
- Market opportunities

LEADING-EDGE ICs

- Memory
- ASICs
- Microprocessors

JAPANESE SEMICONDUCTOR TECHNOLOGY

1984

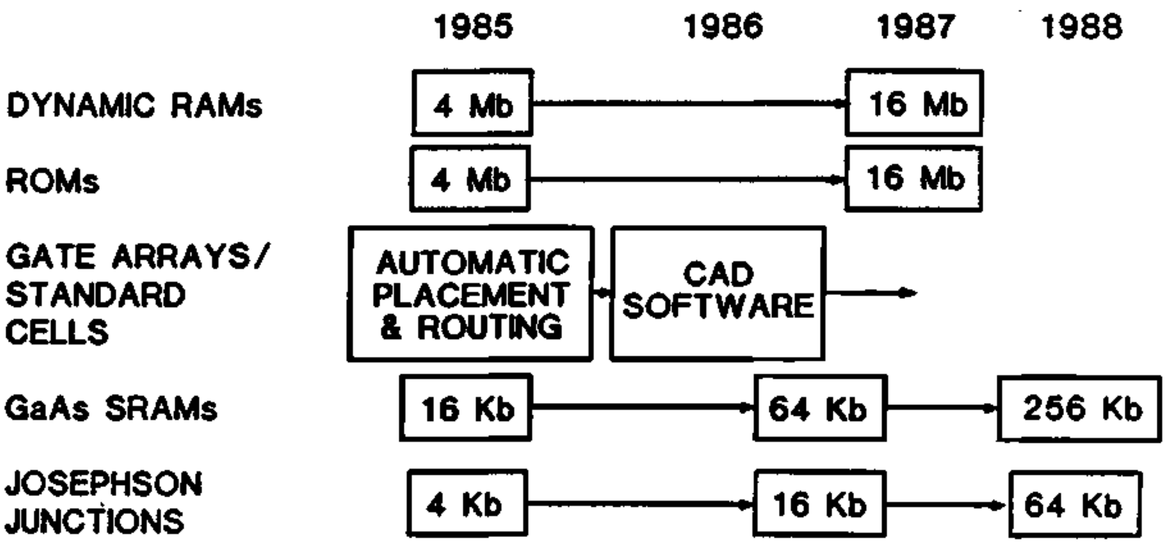


Source: DATAQUEST

Key points to note:

- Memory, MPU/MCU, and ASIC products predominated in 1984, but GaAs and optoelectronics appear to be the next wave in Japanese semiconductor technology.
- Little advanced work is being conducted in linear technology.
- New semiconductor functions research (3-D ICs, superlattices, biochips, and Josephson junctions) is the major focus of MITI and NTT projects.

FORECAST OF NTT RESEARCH PAPERS



Source: DATAQUEST

Key points to note:

- NTT's Atsugi lab is a bellwether for the industry. As a result of privatization, NTT is aggressively developing and licensing its research.
- Toshiba has a 4Mb DRAM prototype; NEC just announced a 4Mb DRAM new cell structure.
- Matsushita announced a 4Mb mask ROM in November (1.4-micron NMOS) for Chinese characters.
- NTT announced a 16K GaAs SRAM prototype in August 1984, six months earlier than our forecast.

MEGABIT DYNAMIC RAM TRENDS

DESIGN RULE

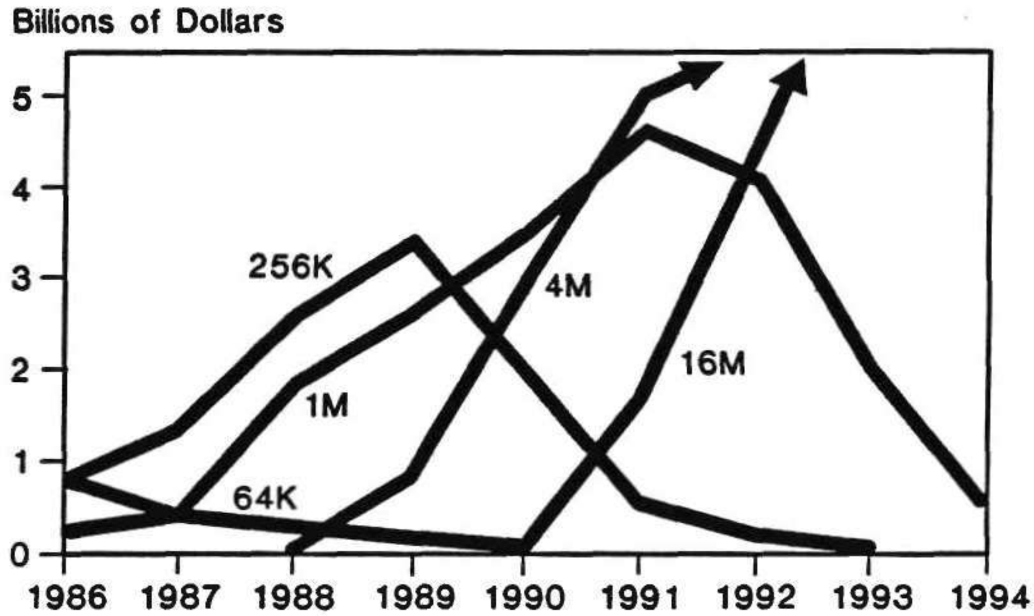
Year	Device	Start	End	Technology
1983	1Mb	1.25	0.80	Steppers (5x, 1x)
1985	4Mb	0.80	0.50	Steppers (5x, 1x)
1990	16Mb	0.50	0.30	Synchrotron X-ray
1995	64Mb	0.25	0.08	Synchrotron radiation
				E-beam overexposure
				Bias exposure photolitho
1998	256Mb	0.10	0.05	Synchrotron radiation
2000+	1Gb	0.05	0.01	Bioelectronics

Source: DATAQUEST

Key points to note:

- 4Mb DRAMs are currently the major research focus.
- Toshiba has developed a 73-stage ring oscillator using a 50kV electron beam generator to utilize the proximity effect.
- Hitachi, NTT, Toshiba, and other companies will invest $4.3 million in a small synchrotron for soft x-rays to jointly develop 64Mb DRAMs beginning in March 1988.
- NEC and NTT are using a 10m-diameter synchrotron at the High-Energy Physics Lab in the Tsukuba Science City.

DRAM MARKET FORECAST



Source: DATAQUEST

Key points to note:

- Japanese companies are positioning themselves to ride the next-generation DRAM waves.
- DATAQUEST believes that the DRAM market will be $7.7 billion in 1990 or 29.5 percent of total semiconductor consumption worldwide.
- U.S. and European companies cannot afford to unilaterally vacate such a large market. They must produce in Japan and automate their plants.

WORLDWIDE EPROM MARKET SHARE

Rank	64K	128K	256K	512K
1	Hitachi	Hitachi	Intel	Intel
2	Mitsubishi	Intel	AMD	AMD
3	Fujitsu	Mitsubishi	Hitachi	Hitachi
4	Intel	AMD	Toshiba	Fujitsu
5	TI	Fujitsu	Fujitsu	--
Japanese Share:	68%	79%	41%	2%
1984 Avg.	68%	56%	18%	0
1985 Market Size:	$286M	$249M	$189M	$23M

Source: DATAQUEST

Key points to note:

- Japanese companies dominate the lower end, while U.S. companies dominate the upper end.
- However, Japan produced 63 percent of all EPROMs in the four categories in 1984.
- Rapid price declines are due to excess capacity and fierce competition.

SMART CARDS--THE NEXT PC MARKET?

Start	Group Leader	Application	IC Device
Dec. 1984	Mitsui Bank	Banking and Shopping	64K EPROM with 8-bit MPU
March 1985	Seibu Bank	Medical	16K EEPROM with CPU
May 1985	Sumitomo Bank	Shopping	64K EEPROM with CPU
July 1985	Toyo Trust Bank	Financial Management	64K EPROM with CPU
Aug. 1985	Dai-Ichi Kangyo	Banking	64K EPROM with CPU
Oct. 1985	Sanwa Bank	Shopping	64K EEPROM with CPU
Oct. 1985	Fuji Bank	Corporate Banking	16K EEPROM with CPU
Oct. 1985	Daiwa Bank	Shopping	16K EEPROM with CPU
Oct. 1985	Toshiba	Point-of-Sale	64K EEPROM with CPU

Source: DATAQUEST

Key points to note:

- Since early 1985, Japanese financial institutions have begun beta test sites for IC cards.

- MITI recently established an IC card committee to discuss ISO standards to "lay the ground rules."

- DATAQUEST believes that IC cards could be the next PC market or next "calculator war." The Japanese press views the United States as an "IC credit card haven." Companies are positioning themselves, and competition to develop commercial parts is fierce.

- The Ministry of Social Welfare is exploring the possibility of using IC cards to reduce national health insurance fraud (120 million card holders).

JAPANESE EPROMs/EEPROMs

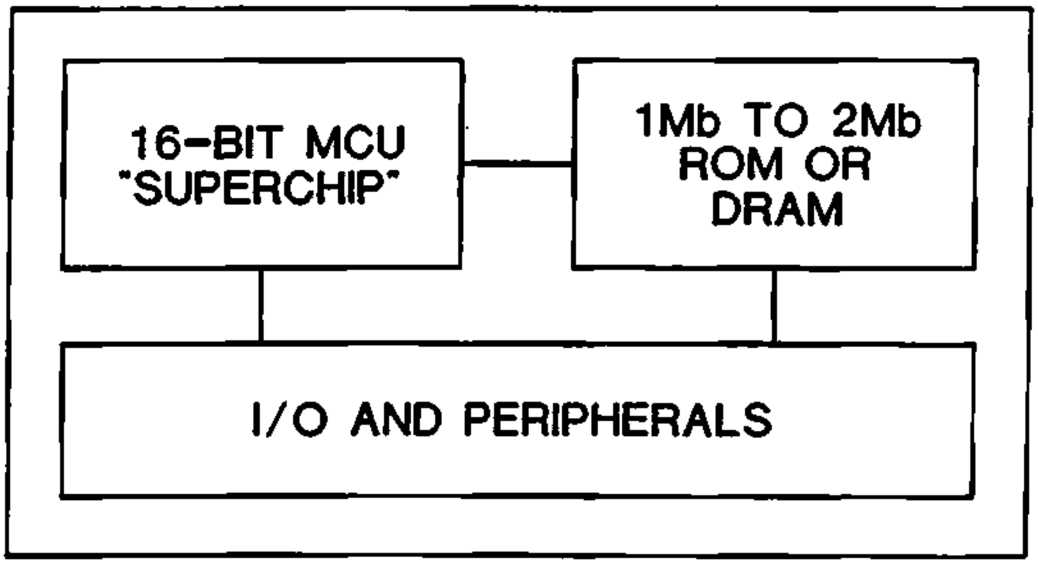
Company	EPROM	EEPROM
Fujitsu	256K CMOS	64K CMOS
Hitachi	256K/1Mb CMOS	64K CMOS
Mitsubishi	1Mb NMOS	256K CMOS
NEC	256K/1Mb CMOS	--
Oki	64K NMOS	16K CMOS (Exel)
Ricoh	256K CMOS	--
Suwa Seikosha	64K/128K CMOS	--
Toshiba	256K CMOS	64K "Flash" CMOS

Source: DATAQUEST

Key points to note:

- Japanese companies are rapidly introducing new EPROM and EEPROM products to position themselves for the coming IC card market.
- Mitsubishi and NEC are the technical leaders, but Toshiba is jointly developing its EPROM/EEPROMs with VISA International for its credit cards.
- DATAQUEST expects rapid price declines in these two markets.

THE SHIFT TO STANDARD CELLS

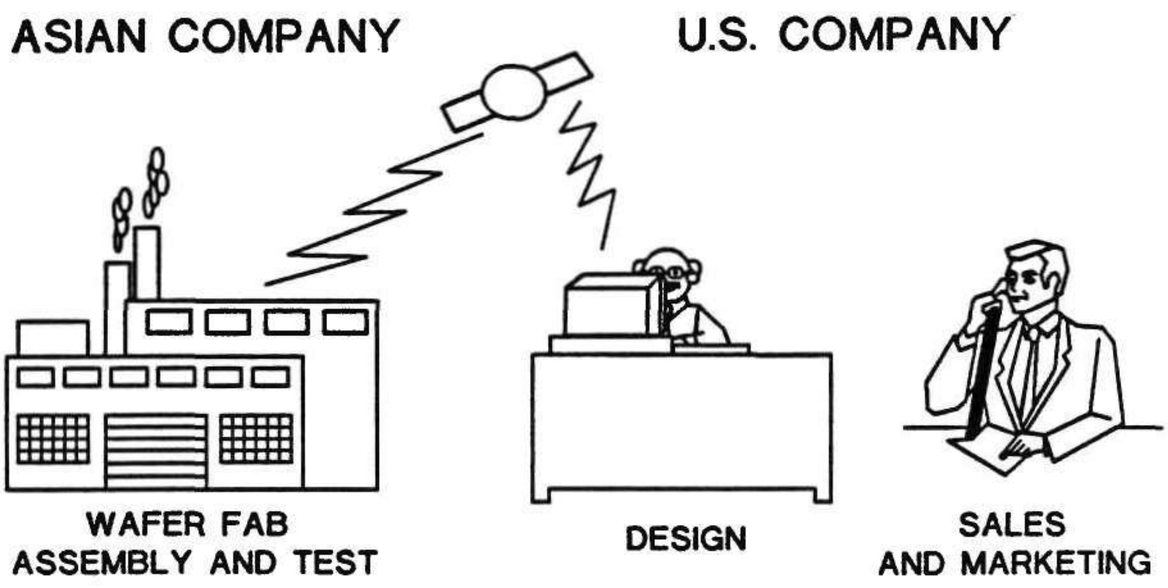


Source: DATAQUEST

Key points to note:

- Standard cells are not only being used for IC cards, but also for VCRs and high-resolution TVs.
- Hitachi, Japan Victor (JVC), Matsushita, NEC, and others are developing the 16-bit MCU "superchip" for VCRs.
- Zilog's Z8000 is a hot product because of its graphics capabilities for VCRs and graphics terminals.
- 1Mb to 2Mb DRAMs will be used for VCR freeze frame and instant replay. Low-cost Korean VCRs are forcing Japanese companies to develop more "bells and whistles."

"DESIGN BOUTIQUE" STRATEGY



Source: DATAQUEST

Key points to note:

- To overcome distance from the customer and reduce operating costs, Japanese ASIC vendors use satellites to send gate array designs for auto placement and routing in Japan.
- U.S. and European companies also use this strategy to penetrate overseas markets.
- However, DATAQUEST observes that this data transfer may violate U.S. export laws if not cleared with the Department of Commerce in advance.

JAPANESE 32-BIT MICROPROCESSORS

Year	Company	Product Line	Ties
1986	NEC	V60 (first generation)	Sony and Zilog
1987		V70 (second generation)	(V20/V30)
1986	Hitachi	68000—Compatible CMOS	Motorola
		TRON Project	Tokyo University
1986	Fujitsu	80286 (16-/32-bit MPU)	Intel
1986	Oki	Proprietary MPU	--
1987	Mitsubishi	TRON Project	Tokyo University
1987	Toshiba	Proprietary MPU	Zilog (Z8000)

Source: DATAQUEST

Key points to note:

- Major Japanese companies plan to introduce commercial 32-bit MPUs by 1987 when the market matures more.
- NEC is jointly developing MPU development support systems with Digital Research, Sophia Systems, and Tektronix for its V-Series.
- Hitachi and Mitsubishi are working with Tokyo University in the TRON project.
- Oki is using proprietary 32-bit MPUs in its system.

JOINT R&D PROJECTS

- MITI
- NTT
- STA

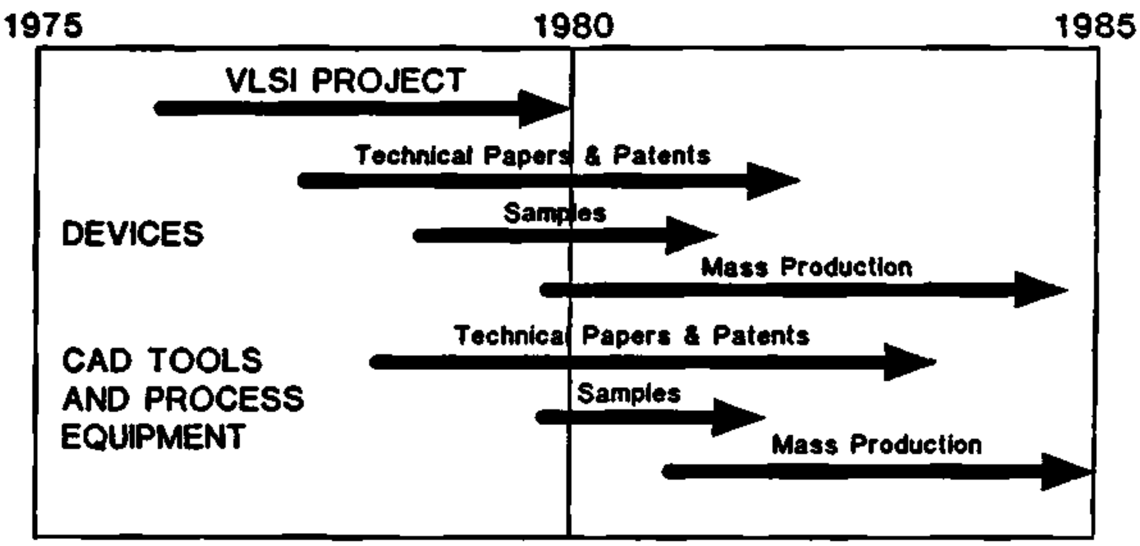
Key points to note:

- DATAQUEST observes that Japanese companies are emphasizing creativity--the industrial slogan for the 1980s--to develop new IC technology that can be used as "bargaining chips" with foreign companies.

- MITI, Nippon Telegraph & Telephone (NTT), and the Science and Technology Agency (STA) are spinning off new patents and technical papers from their joint R&D projects.

- DATAQUEST believes that this technology wave from Japan will accelerate as these projects end around 1990.

JAPANESE IC DEVELOPMENT CYCLE

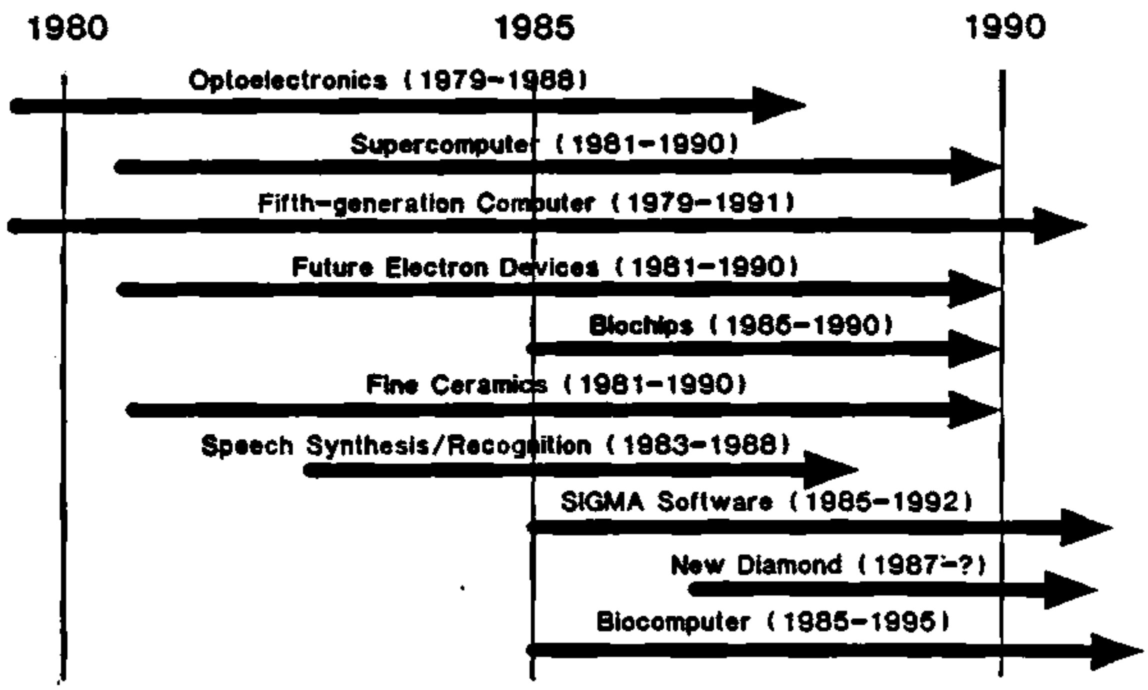


Source: DATAQUEST

Key points to note:

- MITI is using the VLSI Project (1976-1980) as a prototype for its next-generation IC projects.
- Japanese companies are statistically monitoring their progress vis-a-vis the West through patent applications and technical papers.
- Generally, DATAQUEST observes a one-year lag between technical papers and samples, plus another year or more for mass production, depending upon market conditions.
- MITI projects trigger two technology waves: one for IC devices and one for CAD tools and process equipment. We are beginning to see a wave of process equipment products from the VLSI project.

MITI JOINT R&D PROJECTS



Source: DATAQUEST

Key points to note:

- MITI has organized more than 20 joint R&D projects during the 1980s to pursue creative technologies.
- Ten projects are focusing on new semiconductor technologies.
- In fiscal 1985, MITI organized the biocomputer, biochip, and SIGMA software projects.
- The Diamond Substrate Project will develop temperature-hardened substrates for ultrafast circuits beginning in fiscal 1987.
- DATAQUEST believes more Japanese companies and U.S. startup companies will begin developing ICs for speech recognition/synthesis, expert systems, graphics, video processing, and optical transmission and storage.

OTHER GOVERNMENT-SPONSORED R&D PROJECTS

Agency	Project	Time Frame
NTT	INS computer	1984-1990
STA	Perfect GaAs crystals	1981-1986
STA	Amorphous compounds	1981-1986
STA	Nanomechanisms	1985-1990
STA	Solid-state surfaces	1985-1990

Source: DATAQUEST

Key points to note:

- NTT is developing the INS computer, a combination of the fifth-generation computer and supercomputer, for its Information Network System. The project is tentatively budgeted at around $730 million (versus $450 million for MITI's Fifth-Generation Computer Project).

- In addition, NTT has a $3.2 billion annual procurement budget at its disposal.

- The Science and Technology Agency (STA) has four semiconductor joint R&D projects under way.

- The Perfect GaAs Crystal Project is headed by Professor Junichi Nishizawa (consultant to Stanley Electric) of Tohoku University. The project is developing computerized pulling methods using Liquid Encapsulated Czochralski (LEC) technology.

NEXT-GENERATION ICs

- OPTOELECTRONIC ICs
- GaAs
- JOSEPHSON JUNCTION
- 3-D ICs
- SUPERLATTICES
- BIOCHIPS

Key points to note:

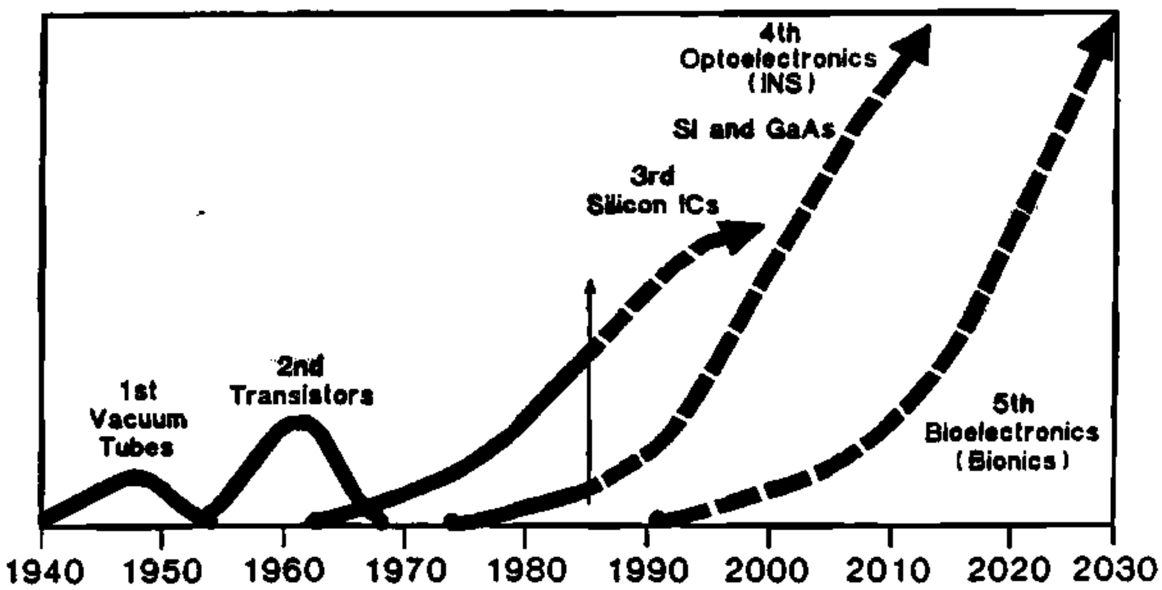
- Japanese companies are investing in next-generation IC research in collaboration with MITI and NTT joint R&D projects. Within the last year, 20 semiconductor companies have established basic research laboratories.

- Many Japanese researchers believe that they have "hit the bottom of the barrel" in western technology and must develop their own technologies in the future.

- Moreover, Japanese companies worry about an informal "technology boycott" by foreign companies concerned about Japanese export drives. Many western companies have been "burned" by Japanese competition and are reluctant to license their leading technologies to Japan.

- The U.S. Department of Defense is also concerned about leakages of advanced American technology to the Soviet bloc via Japan. Recently, many advanced IC programs have been restricted to U.S. citizens to limit technology transfers. Japanese companies are responding to this closure by developing their own technologies.

OPTOELECTRONICS: THE NEXT GENERATION



Source: DATAQUEST

Key points to note:

- Japanese companies view optoelectronics, which will be central to telecommunications, as the next-generation ICs. These devices will be used for fiber-optic cables, optical file memories, compact disk players, robots, flexible manufacturing systems, and sensors.

- GaAs will not replace silicon, but will complement it during the next wave. MITI's Future Electron Devices Project is experimenting with GaAs-on-silicon to take advantage of GaAs' high-speed and laser properties and silicon's low cost and availability.

- Bioelectronics research is beginning, but will not be a major force until after 2010.

GaAs RESEARCH (1985)

Device	Company	Speed
4K SRAM	Fujitsu	1.7 ns
	Hitachi	2.2 ns
	NEC	2.4 ns
3,000-gate logic	NEC	30.0 ps
MESFET	Oki	14.7 ps
Gate arrays	Toshiba (2,000 gates)	42.0 ps
	Oki (1,000 gates)	390.0 ps
HEMT	Fujitsu	0.9 ns

Source: DATAQUEST

Key points to note:

- 4K SRAMs are being designed into Fujitsu, Hitachi, and NEC supercomputers. Advanced work is proceeding on 16K SRAMs.
- DATAQUEST believes that Japanese makers are using GaAs gate arrays as stepping stones into GaAs digital ICs.
- Mitsubishi Monsanto announced that it will market low-defect 3-inch GaAs wafers, using a vertical magnetic imprinting system developed by NTT.

JOSEPHSON JUNCTIONS

Company	Device	Speed
Hitachi	Control terminal transistor	20 ps
NEC	4 x 4-bit parallel multiplier with 249 logic gates	350 ps
NEC	4 x 4-bit multiplier	280 ps

Source: DATAQUEST

Key points to note:

- Despite IBM's pullout from the field, Japanese companies are still pursuing Josephson junctions as a "backup" technology. They are hedging their bets in the event that there is a major breakthrough.
- DATAQUEST has recorded few announcements in this field.

FUTURE ELECTRON DEVICES PROJECT

Themes	81	82	83	84	85	86	87	88	89	90
Superlattices (SL)	PHASE 1 Basic SL Structure New Material System				PHASE 2 Basic Devices			PHASE 3 Integration		
Three-Dimensional ICs (3-D ICs)	PHASE 1 Multilayer Structure Process Technology				PHASE 2 Test Element Group Device Design			PHASE 3 Functional 3-D ICs Basic Technology System Design		
Hardened ICs	PHASE 1 Testing Technique Device, Process Modification			PHASE 2 Test Device		PHASE 3 Integration				

Source: DATAQUEST

Key points to note:

- MITI's Future Electron Devices Project is halfway toward completion. During Phase 1, the project generated more than 373 technical papers (230 for 3-D ICs, 176 for superlattices, and 67 for hardened ICs) and 282 patent applications (33 superlattices, 219 3-D ICs, and 30 hardened ICs).

- During Phase 2, participating companies will develop basic devices, probably beginning with memories (256K and 1Mb DRAMs).

- Toshiba announced 3-D IC technology for 4Mb and 16Mb DRAMs.

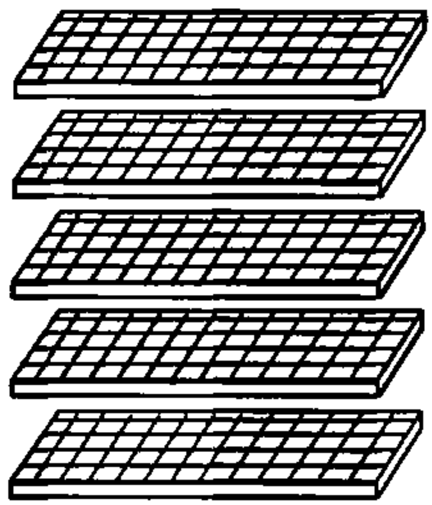
- Matsushita announced 3-layer 3-D technology using a laser-irradiated crystal process (eight optosensors and eight SRAMs).

- Mitsubishi announced a 3-D LSI prototype using laser-activated polysilicon with NMOS/CMOS/NMOS layers.

FIVE-LEVEL 3-D IC

ADVANTAGES:

HIGHER DENSITIES
HIGHER SPEEDS
PARALLEL PROCESSING
MULTIPLE FUNCTIONS



Source: DATAQUEST

Key points to note:

- Mitsubishi recently described the following theoretical structure for 3-D ICs, which combines GaAs-based optical functions with silicon-based memory and logic functions.

- 3-D ICs would have a much smaller die area and offer much higher speeds and multiple functions not possible with current standard cells.

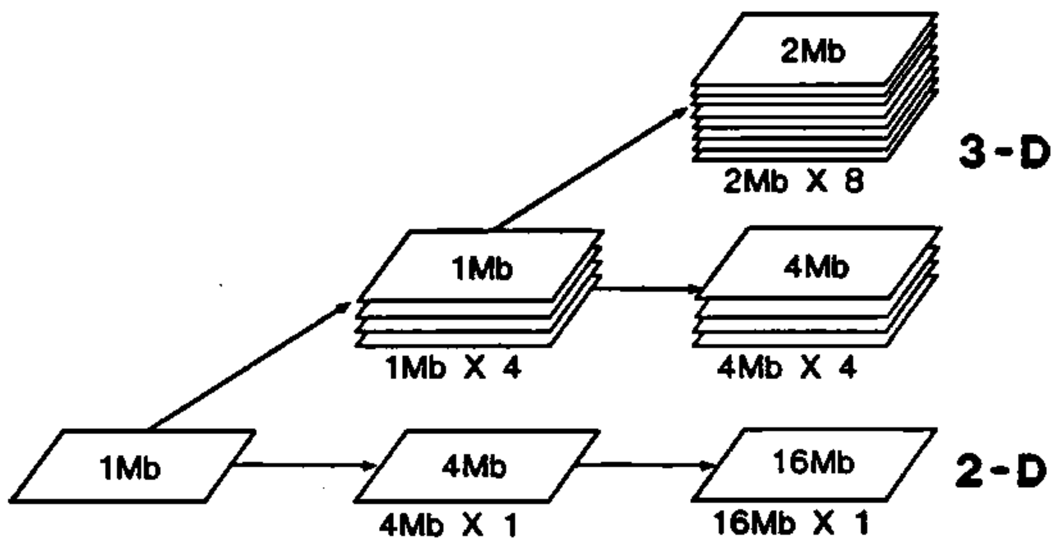
- Electron beam and metal-organic chemical vapor deposition (MOCVD) are being researched for layering GaAs and GaAlAs onto GaAs and silicon substrates.

- CMOS technology will be used to reduce power consumption and heat buildup.

- The major technical problems are through-wall holes for interconnecting layers and alignment of circuits.

- D/A and A/D converters will be required for developing optoelectronic ICs for optical communications and "smart" robots.

MEGABIT MEMORIES--THE SHIFT TO 3-D ICs



Source: DATAQUEST

Key points to note:

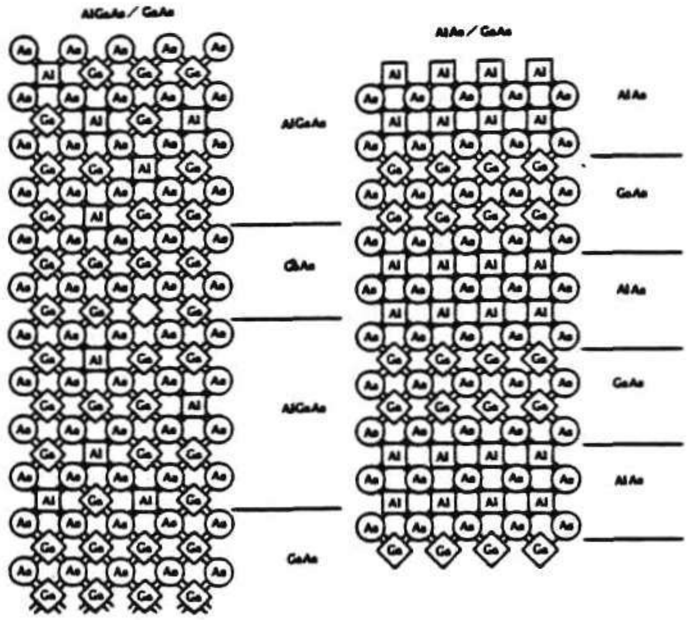
- Although MITI's research goal is to develop 3-D ICs with 8 to 10 layers, DATAQUEST believes that the immediate goal is to develop 4-layer memories that would utilize existing design rules to design larger circuits.

- A 4x structure would allow Japanese memory makers to develop 4Mb DRAMs using 1Mb DRAM design rules. This approach would offer much faster speeds and provide a "fallback" position if researchers encounter problems at the 64Mb+ level.

- 3-D memories will provide more flexibility and organizational variety than current 2-D. Generally, they will be priced higher until mass production techniques are refined.

- Major research efforts are focused on silicon-on-isolation (SOI) as the isolation layer between levels.

SUPERLATTICES



Source: DATAQUEST

Key points to note:

- MITI's Future Electron Devices Project (1982-1990) is investigating superlattices, both III-V and silicon, for next-generation ICs. As of fiscal 1984, the project has generated 176 technical papers and 33 patents.

- Fujitsu, Hitachi, Sony, and Sumitomo have assigned 100 researchers to this project.

- In 1984, MITI's Electrotechnical Laboratory developed a computer-controlled crystal growth technique that lays one atomic layer of crystal at a time; this ultraprecision crystal growth method is the initial step toward developing a supercomputer 100 times faster than current models.

- In 1984, NEC announced a superlattice "superdoped structure" of 10 layers of GaAs and AlGaAs stacked on a GaAs structure using molecular beam epitaxy. Potential applications include supercomputers, blue LEDs, heterobipolar transistors, and high-output semiconductor lasers.

BIOCHIP RESEARCH

COMPANY	RESEARCH FOCUS
ASAHI CHEMICAL	LIGHT-SENSITIVE ORGANIC SEMICONDUCTOR
DOJIN CHEMICAL	THIN-FILM BIOCHIP SUBSTRATE
FUJITSU	BIOSENSORS, THIN-FILMS, BIOCHIPS
HITACHI	BIOCHIPS, ARTIFICIAL INTELLIGENCE
KURARAY	IMPLANTABLE BIOSENSORS
MITI	ORGANIC SUPERCONDUCTORS
MATSUSHITA	WATER-SOLUBLE PHOTORESIST
MITSUBISHI	ENZYME BIOSENSORS
NEC	MEDICAL BIOSENSORS
SHARP	BIOCHIPS, BIOCOMPUTERS
TOSHIBA	MULTI-ION BIOSENSORS

Source: DATAQUEST

Key points to note:

- DATAQUEST observes a convergence of biotechnology and electronics companies in Japan. Biotechnology firms tend to come from the soy sauce, tofu, petrochemical, pharmaceutical, food processing, and medical fields.

- Japanese companies such as Kuraray, Mitsubishi, NEC, and Toshiba are already introducing biosensors for medical and factory automation.

- Matsushita Electronics and Hayashibara, Japan's most creative biotechnology company, are developing water-soluble photoresists using organic materials, capable of 1-micron geometries. DATAQUEST believes that bioresists could replace chemicals, especially in light of Japan's concern over toxic wastes and its limited storage sites.

- DATAQUEST believes that we will see three generations of bioelectronics: biosensors, bioresist, and biochips.

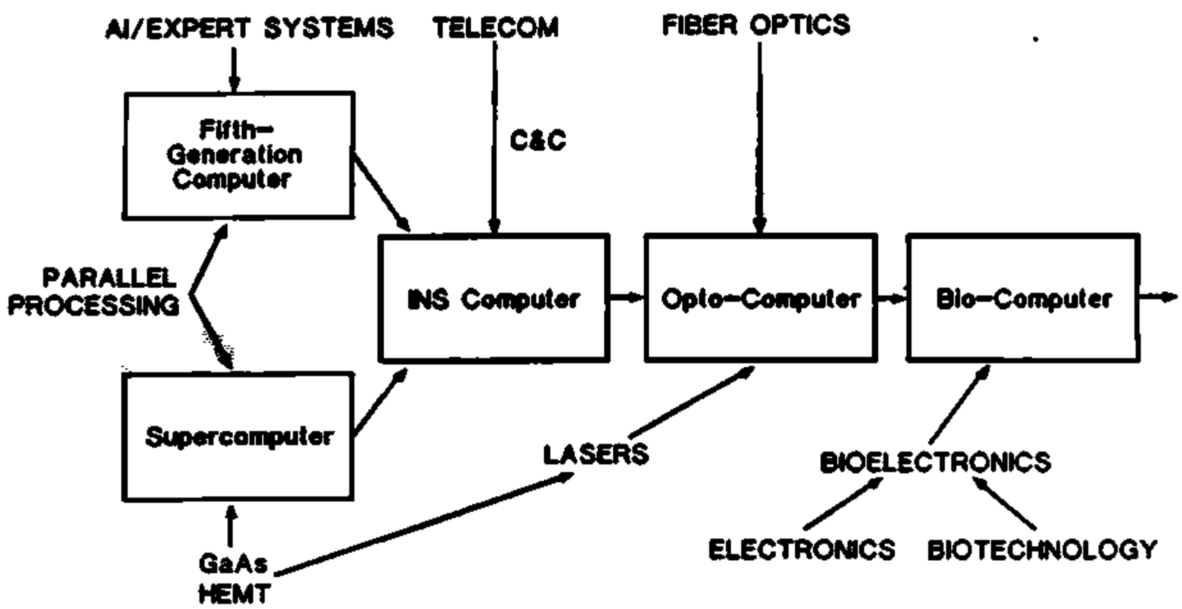
NEXT-GENERATION COMPUTERS

Key points to note:

- MITI's Fifth-Generation Computer Project has been heavily covered in the western press, but DATAQUEST observes that it is only the "tip of the iceberg." The Japanese government is pursuing other next-generation computers, including optocomputers and biocomputers.

- These joint R&D projects will heavily influence the direction of Japanese semiconductor research in the future.

JAPAN'S NEXT-GENERATION COMPUTERS



Source: DATAQUEST

Key points to note:

- The Japanese government is currently exploring future generation computers, such as the optocomputer, biocomputer, and bioholonic computer. DATAQUEST believes that computer research will follow the above path of development.

- The Supercomputer and Fifth-Generation Computer projects are collaborating in parallel processing and envision a merging of the two systems toward the end of the 1980s.

- NTT is developing the INS Computer for its Information Network System, a $150 billion fiber optics-satellite telecommunications network. The INS Computer will combine supercomputer and fifth-generation technologies. NTT is working with Motorola and Texas Instruments to develop VLSI substrate production techniques.

- GaAs research for the Supercomputer Project will be used in future Optocomputer research.

- MITI has established a Biocomputer Project at the Tsukuba Science City, which will involve electronics and biotechnology companies.

MITI SUPERCOMPUTER PROJECT (1981-1989)

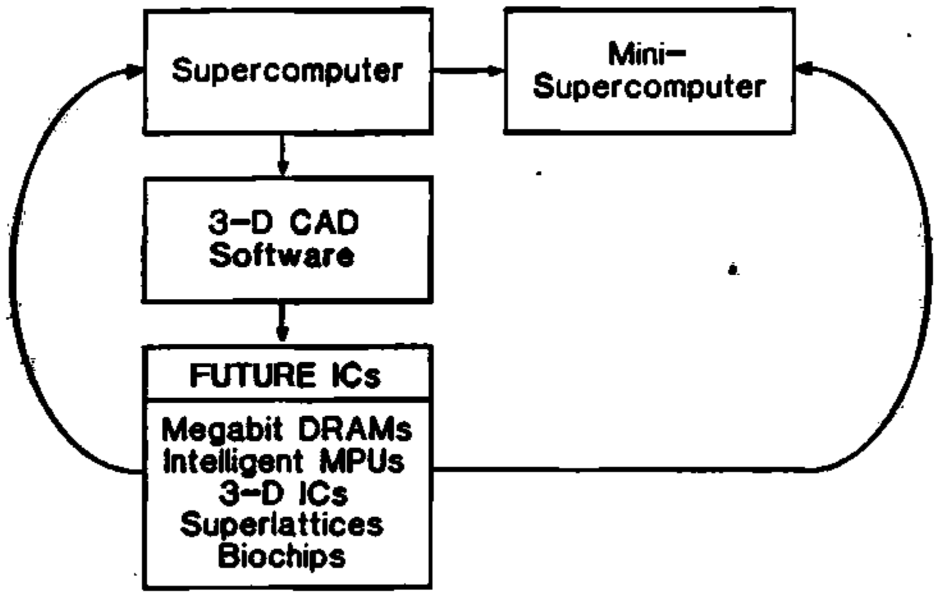
	Fujitsu	Hitachi	Mitsubishi	NEC	Oki	Toshiba
Semiconductors						
Josephson Junction	X	X		X		
GaAs Digital ICs			X	X		X
HEMT	X				X	
ECL Logic		X	X			
Systems						
Architecture	X					
Large-Capacity Storage				X		
Parallel Processors			X		X	X
Software		X				

Source: DATAQUEST

Key points to note:

- MITI's Supercomputer Project has assigned research responsibilities as shown in the table above.
- ECL logic is being investigated despite the emphasis on GaAs and Josephson junctions.
- MITI's goal is to develop a supercomputer that can perform 10 billion floating-point operations per second (gigaflops) by 1989. The project is budgeted at $200 million, with half of the funds provided by MITI.
- Japanese companies have developed 4K GaAs SRAM prototypes, which DATAQUEST believes are being designed into their systems now. NEC announced a 2.4ps device, Fujitsu 1.7ps, and Hitachi 2.2ps.
- NTT announced a 16K GaAs SRAM prototype in September 1984, which is also being designed into systems. MITI's Supercomputer Project manager expects Japanese companies to introduce GaAs-based supercomputers in the near future.

FUTURE SUPERCOMPUTER CAD TOOLS



Source: DATAQUEST

Key points to note:

- Minisupercomputers will be the "workhorses" of IC design in the 1990s. Hitachi recently announced a 3-D CAD software system that runs on its supercomputer to develop 3-D ICs, superlattices, intelligent MPUs, and megabit DRAMs.

- MITI's Future Electron Devices project manager says that foreign CAD systems can handle leading-edge ICs, but are incapable of designing next-generation ICs such as 3-D ICs and superlattices. Japanese companies are now developing their own CAD tools.

- Mitsubishi, Sanyo, Sharp, and other companies are trying to develop 3-D CAD systems, but they lack supercomputer capabilities. Thus, DATAQUEST believes that Fujitsu, Hitachi, and NEC will be the major next-generation CAD makers.

- American companies are functionally separated into supercomputers, ICs, or CAD systems, which makes them vulnerable to vertically integrated Japanese companies for future CAD systems. Cray Research and Gigabit Logic are working together to develop GaAs-based supercomputers, but they are not working on next-generation ICs. Is IBM the dark horse?

MITI FIFTH-GENERATION COMPUTER CHIPS (1979-1991)

FUNCTION	DEVICE REQUIRED
Natural language processing	Voice recognition and synthesis chips Megabit DRAMs and ROMs D/A and A/D converters
Image processing	Graphics chips Optoelectronic ICs (OEICs) Semiconductor lasers CCD image sensors
Parallel processors	32-bit microprocessors (MPUs) "Intelligent" MPUs with lasers (Si/GaAs)
Inference machines and data flow	GaAs and other III-V devices Josephson junctions High-electron mobility transistors (HEMT)
VLSI architecture	VLSI CAD tools VLSI testing equipment

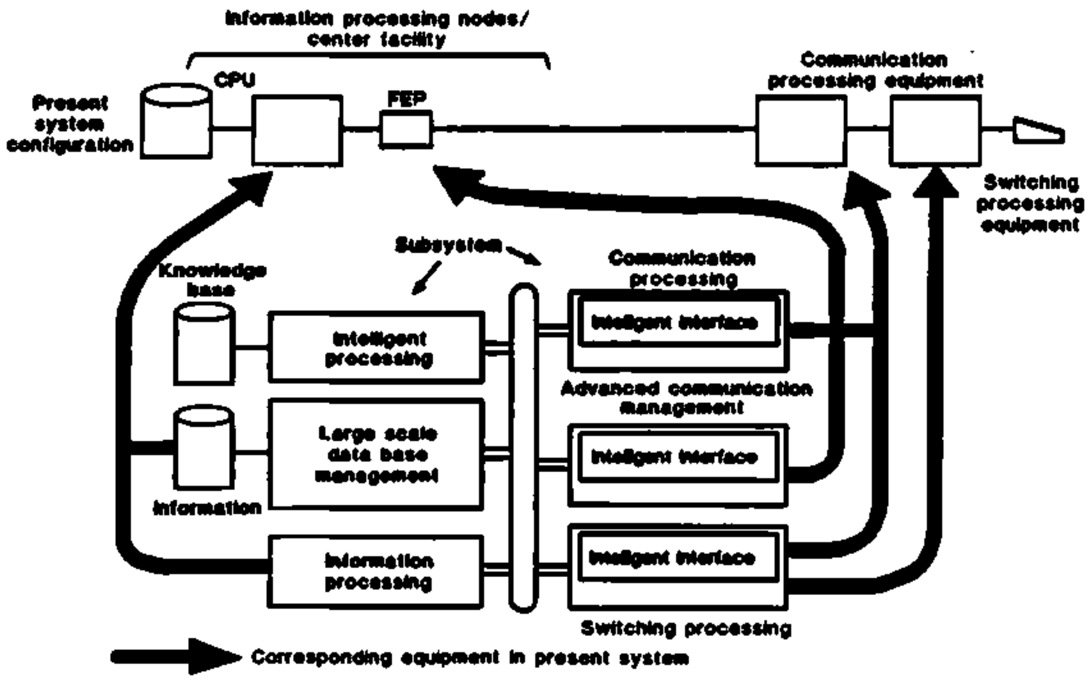
Source: DATAQUEST

Key points to note:

- Based on MITI's description of the Fifth-Generation Computer, DATAQUEST believes that the ICs shown above will be required for the system. Most of these chips are being developed under the Optoelectronic Project, Supercomputer Project, and Future Electron Devices Project.

- Japan's current weakness is in CAD tools, but DATAQUEST researchers observe that Fujitsu, Hitachi, NEC, and other major semiconductor companies are using proprietary CAD tools in-house already. The most advanced CAD system is Hitachi's 3-D CAD that runs on its supercomputer and offers real-time simulation and color displays of heat buildup and electrical properties.

CONCEPT OF INS COMPUTER



Source: DATAQUEST

Key points to note:

- Although MITI's Fifth-Generation Computer has received heavy media coverage, DATAQUEST believes that NTT's INS Computer is Japan's major project.

- NTT plans to spend $730 million to develop the INS computer by 1990 and can procure systems from its $3.2 billion annual procurement budget. Unlike MITI's Fifth-Generation Computer, NTT's INS computer will actually be used.

- The INS computer will combine supercomputer and Fifth-Generation Computer technologies and will be linked to NTT's fiber optics digital network.

- The INS network will cost about $150 billion over the next 15 to 20 years. Distributed INS computers will be eventually placed throughout the system.

IC RESEARCH FOR INS COMPUTER

- MEGABIT MEMORY PROCESSING (4/16/64Mb)--E-BEAM FOR SUBMICRON; SYNCHROTRON OPTICAL RADIATION FOR SUB-HALF-MICRON
- HIGH SPEED LOGIC--GaAs ICs, JOSEPHSON JUNCTIONS, BALLISTIC TRANSISTORS
- OPTICAL TRANSMISSION--SEMICONDUCTOR LASERS AND OPTOELECTRONIC ICs (OEICs)

Key points to note:

- NTT Atsugi Lab researchers are developing next-generation ICs for the INS Computer, as shown above.
- Megabit memories will be used to develop 10-Gbyte memory storage and video processing.
- The INS Computer will utilize high-speed logic developed internally and at MITI's Supercomputer Project.
- Research is heavily focused on 1.3-micron wavelength semiconductor lasers for 400 Mb/sec and 1.6 Gb/sec fiber-optic cables.

IC RESEARCH FOR INS COMPUTER

- MOBILE AND SATELLITE TRANSMISSION--GaAs MICROWAVE
- ELECTRONIC SWITCHING AND DIPS COMPUTER--16-BIT AND 32-BIT MPUs
- VIDEO PROCESSING--CCD SENSORS, WAFER SCALE VIDEO CHIPS
- DIGITAL SUBSCRIBER LOOPS--AUDIO AND VIDEO CODES
- TELEPHONE CIRCUITS--SUBSCRIBER LINE INTERFACE CIRCUITS (SLICs) AND ONE-CHIP TELEPHONE LSIs

Key points to note:

- NTT plans to launch several communications satellites (CS) and direct broadcast satellites (DBS) that utilize GaAs microwave devices. Ground receivers and dish antennas will use low-noise GaAs microwave devices.

- Intensive research on CCD sensors is being conducted for 8mm video cameras that will eventually be utilized in the INS program for video response systems and video conferencing.

- Wafer scale integration is largely experimental and focused on video chips.

THE SIXTH-GENERATION COMPUTER-- MITI'S BIO-COMPUTER PROJECT

- $40 MILLION FUNDING (1985–1995)
- MIMICS HUMAN BRAIN FUNCTIONS (PATTERN RECOGNITION, REASONING, AND LEARNING)
- FOUR RESEARCH AREAS:
  - NEW COMPUTER ARCHITECTURE
  - BIOCHIP DEVELOPMENT
  - NEURAL SYSTEMS OF LOWER ANIMALS
  - NONDESTRUCTIVE, NONCONTACT METHODS FOR MEASURING HUMAN BRAIN ACTIVITY

Key points to note:

- MITI recently established the long-range biocomputer project to develop next-generation ICs and computer architectures.
- Japanese companies are focusing on organic materials layered on silicon substrates to develop biosensors and, eventually, biochips.
- DARPA is also exploring biocomputers in the United States, but they will be limited to military applications. Most U.S. bioelectronics research is being conducted by universities and the Defense Department. In Japan, bioelectronics is a merger of biotechnology and electronics companies.
- The Science and Technology Agency (STA) has a five-year project (1982-1987) to develop a bioholonics computer that will employ organic materials to create holographic-like computer architecture.

MARKET OPPORTUNITIES

Key points to note:

- Despite fierce price competition from Japan, there are numerous market opportunities for foreign companies. What are these?

  - Joint R&D with NTT and subsequent sales of systems

  - Strategic alliances in specific markets (e.g., ASICs)

  - Development and sales of advanced CAD tools for next-generation ICs

  - Semiconductor equipment for next-generation ICs

  - Design-in of semiconductors in U.S. telecommunications equipment tailored to the Japanese market

  - Development of next-generation ICs (speech synthesis and recognition, video processing, expert systems, etc.)

- DATAQUEST believes that U.S. and European makers must establish a major presence in Japan to remain competitive internationally.

WORLDWIDE SEMICONDUCTOR REVENUES

(Millions of Dollars)

	1984	1985	PERCENT CHANGE	1986	PERCENT CHANGE
U.S.A.	13,333	9,729	(27.0)	10,513	8.1
JAPAN	8,687	8,186	(5.8)	9,172	12.0
EUROPE	4,805	4,700	(2.2)	5,454	16.0
ROW	2,073	1,433	(30.9)	1,612	12.5
TOTAL	28,898	24,048	(16.8)	26,751	11.2

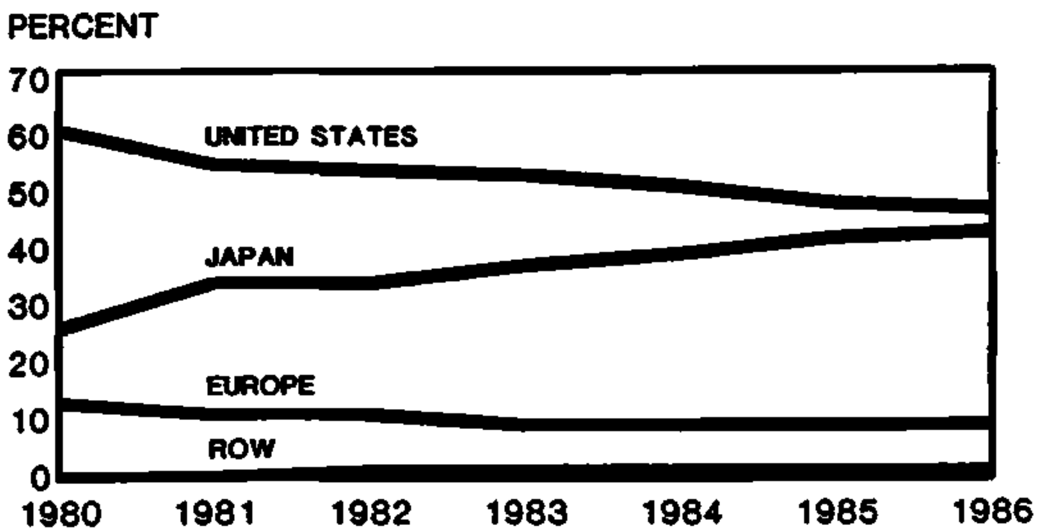
Source: DATAQUEST

Key points to note:

- DATAQUEST believes that the Japanese and European markets will grow faster in 1986 than the U.S. market.
- However, semiconductor equipment sales will remain sluggish through 1986 due to excess worldwide capacity.

REGIONAL MARKET SHIFTS

TOTAL SEMICONDUCTORS



Source: DATAQUEST

Key points to note:

- Since 1980, Japan has increased its worldwide market share by an average of 2 to 3 percent per year.
- Japanese industry leaders are seriously discussing the possibility of overtaking the U.S. industry by 1990. Due to massive layoffs in the U.S. industry, some observers in Japan have pushed the "crossover" point up to 1987 or 1988.
- DATAQUEST believes that the "jury is still out" on worldwide market share. The U.S. industry can maintain its international competitiveness, but this will require a greater presence in Japan, automated plants, accelerated R&D in leading-edge ICs, and more aggressive marketing.
- The question remains: Are U.S. and European managers and financiers willing to invest "patient money" to maintain their long-term competitiveness?

REGIONAL MARKET SHIFT

REGIONAL MANUFACTURERS' SHARE OF
TOTAL SEMICONDUCTORS
(Percent)

	1980	1981	1982	1983	1984	1985	1986
WORLD	100	100	100	100	100	100	100
UNITED STATES	61	55	54	53	51	48	47
JAPAN	26	34	34	37	39	42	43
EUROPE	13	11	11	9	9	9	9
ROW	0	0	1	1	1	1	1

Source: DATAQUEST

Key points to note:

- In 1986, DATAQUEST believes that Japanese manufacturers could capture as much as 43 percent of the worldwide semiconductor market, given current conditions in the industry. A weak market could lessen the Japanese share because of its strength in memories.

- Major "dark horses" are entering the market, including AT&T and more than 100 semiconductor start-up companies.

CAPITAL SPENDING BY JAPANESE SEMICONDUCTOR COMPANIES

(Millions of Dollars)

	Capital Expenditures		Percent of Semiconductor Sales	
	1984	1985 (Est.)	Percent Change	1985 (Est.)
NEC	591	420	(28.9)	23
HITACHI	548	297	(45.8)	20
TOSHIBA	624	480	(23.1)	35
FUJITSU	527	280	(46.9)	38
MATSUSHITA	401	340	(15.2)	39
MITSUBISHI	295	224	(24.1)	28
SHARP	118	160	35.6	47
SANYO	148	184	24.3	37
OKI	118	100	(15.3)	34
TOTAL	3,370	2,485	(26.3)	301

Source: DATAQUEST

Key points to note:

- DATAQUEST believes that Japanese capital spending will be down 26.3 percent in 1985. However, R&D spending is increasing due to U.S. pressure and efforts to develop new products.

- Japanese companies spend 35 to 45 percent of their total semiconductor sales on R&D and capital equipment. This combined investment figure is a better indicator of Japanese spending patterns.

- Japanese companies are also using "creative accounting" by buying CAD tools and equipment for use in R&D. However, these tools can easily be shifted to mass production during the next recovery, especially since much R&D is located in the plants.

- Current capital spending is focused more on upgrading existing facilities and replacing old lines rather than investing in expensive new plant facilities.

STRATEGIC ALLIANCES (1985)

U.S. FIRM	JAPANESE FIRM	RESEARCH FOCUS
Hewlett-Packard	Toshiba	VLSI technology exchange
LSI Logic	Toshiba	"Sea of Gates" development
Westinghouse, General Electric	Mitsubishi	Diodes, power transistors
Tektronix	Sony	MPU development support system for NEC series
Veeco	Kanematsu Semiconductor	Ion implanters
Vitelic	NMB Semiconductor	CMOS 1Mb DRAM
Tektronix, Digital Research, HP (Yokogawa)	NEC	MPU development support system for NEC V series

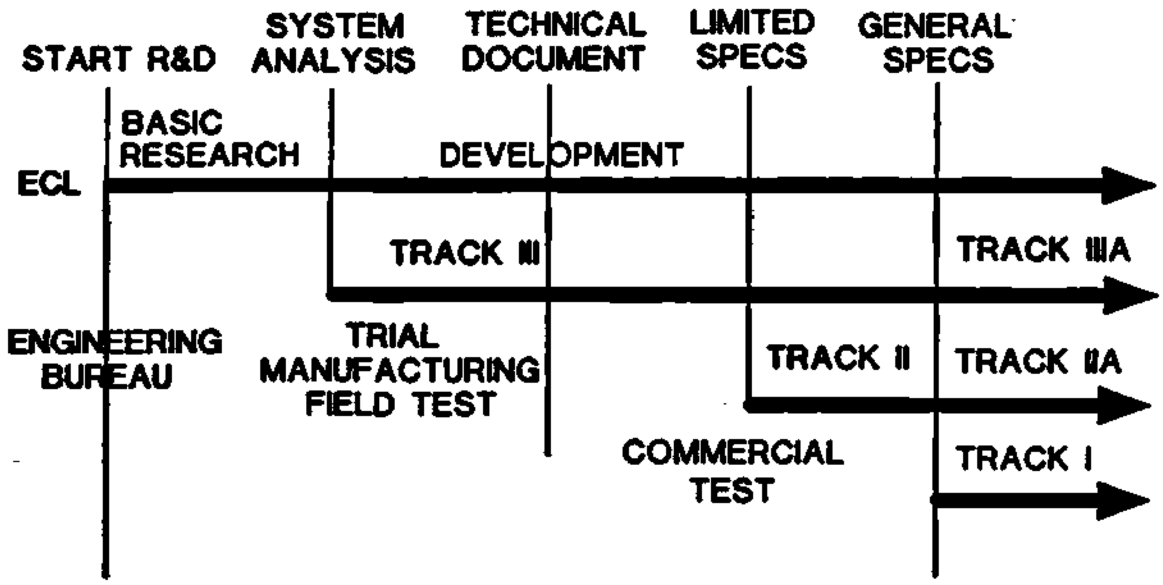
Source: DATAQUEST

Key points to note:

- One way to penetrate the Japanese market is to develop strategic alliances with Japanese companies. The LSI Logic/Kawasaki Steel and RCA/Sharp joint ventures are examples of this new approach.

- DATAQUEST anticipates more strategic alliances of a long-term nature. In 1985, we have already recorded 25 licensing agreements and 22 joint ventures among U.S.-Japanese device makers and 11 joint ventures among equipment makers.

NTT RESEARCH AND DEVELOPMENT



Source: DATAQUEST

Key points to note:

- Since April 1985, NTT has been a private company, although DATAQUEST believes that NTT is really a "quasi-public" company because the Japanese government still retains 33 percent ownership.

- Due to strong competition in the telecommunications market, NTT is actively seeking new technologies from foreign companies. There is some concern in NTT that its rivals (including Fujitsu, Hitachi, NEC, Oki, and others) in the VAN market may not sell NTT the latest equipment. Therefore, foreign companies are viewed as a safe hedge against a potential Japanese "technology boycott" against NTT, especially in light of strong U.S. pressure to open NTT procurement.

JOINT R&D WITH NTT

U.S. COMPANY	RESEARCH FOCUS
IBM	LINK-UP OF IBM'S SYSTEM NETWORK ARCHITECTURE WITH NTT NETWORK
AT&T	JOINT VAN DEVELOPMENT AND MARKETING
EATON	JOINT DEVELOPMENT OF OXYGEN ION IMPLANTERS
MOTOROLA	JOINT IC RESEARCH FOR INS COMPUTER
TEXAS INSTRUMENTS	JOINT IC RESEARCH FOR INS COMPUTER
ENERGY CONVERSION DEVICES (ECD)	JOINT DEVELOPMENT OF AMORPHOUS MEMORIES

Source: DATAQUEST

Key points to note:

- Within the last year, NTT has aggressively teamed up with U.S. companies to develop telecommunications and semiconductor technologies for its INS program.

- Major Japanese companies protested the NTT/IBM alliance because of fears that it would dominate the Japanese telecommunications market. Currently, the Japanese Federal Trade Commission is investigating potential violation of Japan's antitrust laws. The Ministry of Posts and Telecommunications (MPT) is unlikely to prevent the alliance because it would elicit strong protest from the U.S. government and upset current trade talks on market opening.

- In November, Texas Instruments and Motorola agreed to work with NTT researchers to develop bipolar ICs, hardened ICs for satellites, and other devices for NTT's INS computer. DATAQUEST anticipates more NTT alliances next year.

- NTT is exploring the possibility of opening R&D labs in Silicon Valley and other foreign high-tech centers. Special attention is focused on software development for INS.

SUMMARY

- Japanese companies are emphasizing creative research; creativity is Japan's industrial slogan for the 1980s.

- Research is rapidly proceeding on next-generation IC technologies, including 3-D ICs, superlattices, GaAs, and bioelectronics.

- MITI officials emphasize the lack of sophisticated CAD tools to develop these next-generation ICs. As a result, Japanese companies are developing them in-house. DATAQUEST believes that next-generation CAD tools will be "Personal Crays" (PCs) or desktop supercomputers.

- Although media attention is focused on MITI's Fifth-Generation Computer, the real research in future computing is being conducted by NTT and the corporate labs.

- The INS Computer will combine supercomputer and Fifth-Generation Computer technology.

- Initial work is beginning on optocomputers and biocomputers.

- American companies, especially start-ups, are developing the semiconductors needed for Japan's next-generation computers. Now is the time to capitalize on these technologies by strategically entering joint ventures without "giving away the store."

- NTT is aggressively pursuing foreign R&D partners under its Track III procurement guidelines. AT&T, IBM, Motorola, and Texas Instruments are already signed up. DATAQUEST anticipates more joint ventures and licensing by NTT in the future.

- Given the growing strength of the Japanese semiconductor industry, foreign companies have two choices: "ride the wave" or be demolished by the coming Japanese wave. The survivors will be those companies that have strategically positioned themselves to take advantage of Japan's mass production capabilities and next-generation IC research. A good example is IBM's agreement to license patents from MITI's next-generation projects.

Sheridan Tatsuno

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

1985 JAPANESE ELECTRONICS SHOW

SUMMARY

The 1985 Japanese Electronics Show was held in Osaka, Japan, October 17 through 22. The show has been held every year since 1962, alternating between Tokyo and Osaka, the two largest cities in Japan. The show, which is sponsored and organized by the Electronics Industry Association of Japan (EIAJ), is the biggest electronics show in Japan and had its customary large attendance. EIAJ estimated that 341,900 visitors attended, including about 2,924 from foreign nations. A total of 478 companies participated and there were 1,084 booths. This newsletter describes major electronics industry trends observed by DATAQUEST at the show.

A PROLOGUE TO 1Mb DRAM ERA

DATAQUEST believes that the 1985 Japanese Electronics Show indicated the following trends in the Japanese semiconductor industry:

- Major Japanese semiconductor makers have already developed the 1Mb DRAM and are supplying samples (see Table 1).

- Several Japanese semiconductor makers introduced their original MPUs following NEC's V series (see Table 2).

- There were devices displayed dedicated for specific purposes such as high-speed graphic processing.

- Development of smart cards was very much in evidence; major Japanese semiconductor makers displayed smart cards as samples and proposed combinations of CPU and memory for them (see Table 3).

- Major semiconductor makers are beginning to put more emphasis on ASICs and demonstrated significant design capability (see Table 2).

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Table 1

1Mb DRAMS SHOWN AT JAPANESE ELECTRONICS SHOW 1985

Company	Model	Mode	Process	Access Time (ns)	Power Consumption Active	Power Consumption Standby	Package
Hitachi	HM511000-10/12/15	Page	CMOS	100/120/150	300 (mW)	10.0	10-pin DIP
	HM511001-10/12/15	Nibble	CMOS	100/120/150	300	10.0	10-pin DIP
Toshiba	TC511000C-10/12	Page	CMOS	100/120	330/275	5.5	10-pin ceramic
	TC511001C-10/12	S.C.*	CMOS	100/120	330/275	N/A	18-pin ceramic
Fujitsu	MB8811000	Page	N/A	120/150	N/A	N/A	18-pin DPI, 26-pin SOJ
Oki	MSM411000	N/A	NMOS	90	350	N/A	18-pin DIP
Matsushita	MN411000	Page	N/A	100/120	440/385	N/A	18-pin DIP plastic
Mitsubishi	N/A	N/A	N/A	100/120	N/A	N/A	18-pin DIP plastic

*S.C. = Static column
N/A = Not Available
Note: Above devices include ones introduced as "under development"

Source: DATAQUEST

Table 2

NEW SEMICONDUCTOR PRODUCTS SHOWN AT JAPANESE ELECTRONICS SHOW 1985

Company	Memory, MCU, and MPU Devices	Other Devices
Fujitsu	1M DRAM (MB811000/811001) 4-bit MCU (MB88561) 1M Mask ROM (MB831000/831124) 256K dual-port DRAM (MB9461A) 512K EPROM (MDM27C512)	Linear IC (MB3771) LED (FBD086K1WB/L3PB/L4PB etc.)
Hitachi	256K-bit DRAM (HM51258P) 16-bit MPU (HD68HC000) 256K-bit Pseudo SRAM (HM6525GAP) 256K SRAM (HM62256P) 64K Bi-Bi CMOS High-Speed SRAM (HM6768) 1M DRAM (HA511000)	Power MOSFET (2SK646/HS8719) AD Converter (HD19209/HA19210) LCD driver (HD61104/HD61105) Hard disk controller (HD63463)
Matsushita	1M DRAM (MN411000/411001 4-bit MPU (MN1550/1480/1520/1700) 256K SRAM (MN44256/234001) 8-bit dual MPU (MN1880/MN1890); 16-bit MPU (MN1613/1613A/1617)	CMOS standard cell (MN71000/72000) Logical image controller (MN8617) CRT controller (MN8355) GaAs MMIC amplifier (MEL7441) 10-bit A/D converter (AN6859)
Mitsubishi	1M DRAM 8-bit MCU (M50747-XXXBP/M50734BP/M507)	CMOS gate array (M60000)
NEC	1,024-bit PROM (uPB423G) 256K-bit dual port RAM (uPD41264C)	Signal compensation controller (uPD93118) image sensor (uPD3520D) Clock signal generator IC (uPD9310B) CCD horizontal driver interface (uPD6146C/B) Fast sample and hold hybrid IC (MC-5973)
Oki	1M DRAM (MSB111000) 16K EEPROM (MBM2816A AS/RS)	Semiconductor laser (OLI305/1205) Solid-state recording LSI (MBM6258) Voice synthesized LSI with ROM (MSM6243)
Sharp	64K EPROM (LH5764J) 4-bit MCU (SM-5F3) 128K EPROM (LH57128J) 256K EPROM (LH57256J)	CMOS logic (LR74HC)
Sony	16-bit MPU V20/V30 (CXG70108/CXG70116)	Semiconductor laser (BLD101U)
Tokyo Sanyo		Audio power amp (BTK4044 II/V/XI series) Switching regulator IC (BTK7340/7350 series) Communication controller LSI (LC8910 series)
Toshiba	1M DRAM (TC11000C-10/12, TC511001C-10/12)	CMOS gate array (TC180/190 series) 3,200-10,000

Source: DATAQUEST

Table 3

SMART CARDS DISPLAYED AT JAPANESE ELECTRONICS SHOW 1985

Company	Name	Model	Size (mm)	Thickness (mm)	Standard Terminal	Standard MCU	Memory	Capacity
Fujitsu	IC Card I	MB98000	54.0 x 85.6	0.76	Iso	8-bit	CMOS EPROM	64K/256K bit
	IC Card II	MB98000	54.0 x 85.6	0.76	Iso	8-bit	EEPROM	64K bit
Mitsubishi	Melcard	MF1000	54.0 x 85.6	ab.3.0	Iso	8-bit	CMOS SRAM +BATT	2 to 8 Kbyte
		MF2000	54.0 x 85.6	ab.3.1	Iso	8-bit	EPROM/EEPROM	8 to 16 Kbyte
		MF5000	54.0 x 85.6	0.68 to 0.80	Iso	8-bit	EEPROM	2 to 8 Kbyte
Oki	Oki IC Card	N/A	1*	0.8 + 0.1	Iso	N/A	EEPROM	N/A
Sharp	Micon Card	N/A	N/A	N/A	Iso	8-bit	EPROM/EEPROM	16K/64K bit

*1 = 53.92 to 54.03 x 85.47 to 85.72 (mm)
N/A = Not Available

Source: DATAQUEST

Important product introductions of major companies are described below.

Fujitsu

Fujitsu exhibited its 1Mb DRAM, the MB811000/MB811001. The device features 1M-word by 1-bit architecture and 120/150 access times.

Fujitsu emphasized semicustom LSI products with a wide variety of product lines (5 TTL types and 29 CMOS types) at the show. The company also introduced EBB (extended building block) technology as a full-custom oriented method of realizing reduction in design time and high performance.

One of the topics at the Fujitsu booth was a smart card. Fujitsu's smart card, designated the MB98000 series, features an 8-bit microcontroller as the CPU and CMOS EPROM/EEPROM with 64K/256K memory capacity. The card thickness is reported as 0.76mm.

Hitachi

Hitachi showed its 1Mb DRAM, the HM511000. This device uses 1.3-micron rule/CMOS technology, has an architecture of 1M-word by 1-bit, and is housed in an 18-pin, 300-mil, dual-in-line package.

The CMOS EPROM HN27C101 and CMOS EEPROM HN58C65 were introduced as devices under development, with sample shipment scheduled for the first quarter 1986. The HN27C101 has 128K-word by 8-bit architecture and 200, 250, and 300ns access times. The HN58C65, with address data latch, features 8K-word by 8-bit architecture and is available in 200ns and 250ns access times. This device has an on-chip timer.

Hitachi also showed its 256K high-speed CMOS SRAM, the HM62256P-8/-10/-12/-15. This 5V, single power supply device realizes low power consumption of 200 uW at standby and 40 mW (typical) at 1 MHz operation.

In the MPU field, the company displayed its 16-bit CMOS MPU HD68HC000 LSI family with 32-bit data register/address register. This family has devices that operate at 6.0, 8.0, 10.0, and 12.5 MHz and achieves low power dispersion from 0.125 to 1.75 W.

Gate array devices shown included the HG61H series with 448 to 2560 gates and the HG28A through E series. The HG28 series is low power dispersion/high-speed LS-TTL gate array implemented by Hi-BiCMOS technology. Hitachi said the device design is completely automated by a design automation (DA) system, making it possible to reduce the time and cost required for developing custom LSI.

Matsushita

Matsushita Electronics introduced a 1Mb DRAM with 1M-word by 1-bit architecture. The device is tagged MN411000 for the page mode version and MN411001 for the nibble mode version. It features 100 to 120ns access times and 440/385mW power consumption (typical), packaged in 18-pin DIP (plastic).

The company also showed its original 16-bit MPU series, including the MN 1613, MN1613A, and MN1617. This device uses NMOS technology and features 20ns operation speed and low power dispersion. (The power dispersion figure is not available.)

In addition, Matsushita exhibited its gate array series, the MN71000 and MN72000. Both are implemented by silicon gate CMOS technology and use 2.5 uM and 2.0 uM rule. There are 10,000 gates available in each model. The company said that in the future, 30,000 gates would be available.

The Kyoto-based company also showed a broad line of devices for consumer electronics units. Those include ICs for VHD video disk players, for CD players, and for CCD video cameras.

Mitsubishi

Mitsubishi displayed a 1Mb DRAM model that it recently developed. The device is TTL compatible and features 100 and 120ns access times, low power consumption (the consumption figure is not available), and a 5V single power supply. The 18-pin, 300 mil plastic DIP-housed memory is scheduled to start sample shipment in fourth quarter 1985 or first quarter 1986.

In the MCU field, the company showed its 8-bit MELPS740 series, including the M50747-XXXSP, M50734SP, M50753-XXXSP, and M50754-XXXSP. The series integrates 3K to 8K-word by 8-bit ROM and 96K to 256K-word by 8-bit RAM on chip (except the M5073SP), and features 2 usec (minimum) execution time at 4 MHz and 15mW power consumption at 4 MHz.

Mitsubishi also exhibited smart cards under the designation Melcard. The 54 x 85.6mm card uses an 8-bit microcontroller as a CPU and has 2K to 16K memory (CMOS SRAM, EPROM, and EEPROM) with battery.

NEC

NEC showed its broad product line, which ranges from personal computers to passive devices. In the memory area, the 1,024-bit bipolar PROM UPB423G was one of NEC's new products. The 256-word x 4-bit architecture device has program time of 22 microseconds/bit (typical) and read access time of 60ns (maximum). The device, housed in a 16-pin miniature flat package, features double "CS" terminals, which make it easy to expand memory capacity.

NEC also displayed several specialty devices designed for graphic processes, including an image-pipelined processor, the UPD7281D, and a 256K dual-port RAM, the UPD41264C. The UPD41264C has a dual-port architecture consisting of a 64K-word by 4-bit RAM port with 120ns and 150ns access times and a 256K-word by 4-bit serial access port with 40ns and 60ns serial read cycle times.

In the gate array area, the company demonstrated its CMOS-4/4A and TTL-2A/3 gate array families with design processes based on the PC-9801 series and ACOS engineering workstations.

Oki Electric

Oki Electric showed a 1Mb DRAM tagged MSM41000. The device is implemented by N-channel silicon gate technology and features 1,048,576-word by 1-bit architecture. It uses a 5V single power supply and the inputs are TTL compatible. Access time is 90ns.

Other devices displayed were: a 2K x 8-bit EEPROM, the MSM2816A AS/RS; voice-synthesized LSI with ROM, the MSM6243; solid-state recording LSI, the MSM6258; and a semiconductor laser, the OL1305/1205, which has 65mW maximum output and 1.2 to 1.3 uM oscillation wavelength.

Oki also demonstrated a smart card plus a system to read and write into the card. The Oki IC card reader and writer system has 1,200 to 9,600 Bits/sec transfer speed through a RS-232-C start/stop synchronous interface.

Toshiba

Toshiba introduced its 1Mb CMOS DRAMs, the TC511000C-10 and 12 and TC11001C-10 and 12. The company has already announced plans to start 1-million-per-month production of the 1Mb DRAMs in April 1986 at its Oita plant. Toshiba's 1Mb DRAMs have 1,048,576 x 1 architecture and access times of 100 and 120ns.

A new CMOS gate array series, the TC18G/19G, was also exhibited. The TC19G series has 3,200 to 10,000 gates and applies 1.5 uM design rule with features of 1.0 ns/gate. The company will start taking orders in the first quarter of 1986. A new series with up to 47,000 gates is under development and will be introduced as the TC11SG series in 1986.

Toshiba displayed a variety of microwave semiconductors such as semiconductor diodes, low-noise GaAs FETs, power GaAs FETs, and bipolar power transistors. Among them, a high electron mobility transistor, the S8900, was introduced as being under development. The device achieves ultra-low noise figures of 1.3dB at F = 18 GHz and 2.4dB at F = 30 GHz.

DATAQUEST CONCLUSIONS

We believe that 1Mb DRAM development in Japan is clearly under way and that the marketplace will see volume shipments by 1987.

Further, there is a strong feeling in Japan that the IC card and its reader/writer system will be another huge consumer market opportunity.

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JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

PRELIMINARY 1985 JAPANESE COMPANY MARKET SHARE ESTIMATES

SUMMARY

In the worldwide semiconductor industry's most dismal year on record, Japanese-based semiconductor companies performed significantly better than the world market. While the top 50 companies worldwide experienced a revenue decrease of 16 percent, the Japanese companies' semiconductor revenues declined only 12 percent. In the extremely depressed MOS integrated circuit market, Japanese companies' revenues were down 19 percent. This year, the linear IC market was the place to be, and Japanese companies' linear sales were up 5 percent, the only major product category where there were gains.

TOTAL SEMICONDUCTOR

Table 1 shows worldwide total semiconductor sales and worldwide rankings of the top 14 Japanese semiconductor manufacturers. NEC this year became the first Japanese company to be ranked number one worldwide in total semiconductor revenues, with sales of $1,984 million; the company was ranked third in 1984.

Five Japanese companies are in the top ten worldwide, and nine are in the top twenty. The company suffering the greatest decline was Mitsubishi, which paid this year for the tremendous gains it had made in MOS memory in 1983 and 1984.

Overall, Japanese companies gained 2 percentage points of market share worldwide, increasing from 40 percent of the total market in 1984 to 42 percent in 1985. Figure 1 shows the estimated geographic split of Japanese-based companies' total semiconductor sales in 1985. The largest portion of sales, 72.9 percent, were in Japan, 12.9 percent were in the United States, 5.3 percent were in Europe, and 8.9 percent were in Rest of World countries.

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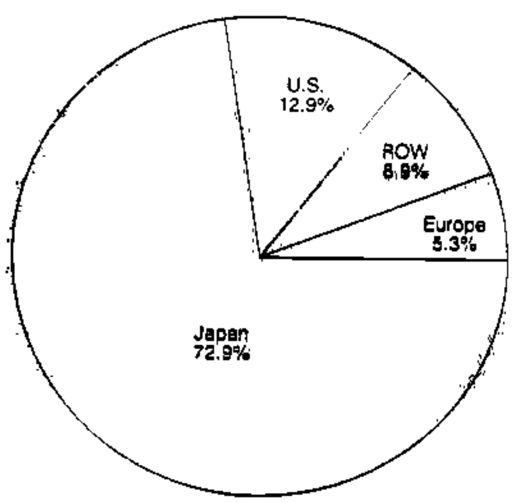
Table 1

PRELIMINARY 1985 WORLDWIDE TOTAL SEMICONDUCTOR REVENUES OF MAJOR JAPANESE COMPANIES
(Millions of Dollars)

Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
1	3	NEC	$1,984	$2,251	(12%)
4	4	Hitachi	1,671	2,052	(19%)
5	5	Toshiba	1,459	1,561	(7%)
7	9	Fujitsu	1,020	1,190	(14%)
10	12	Matsushita	906	928	(2%)
11	10	Mitsubishi	706	964	(27%)
14	15	Sanyo	457	455	0%
16	20	Sharp	329	354	(7%)
19	19	Oki	307	362	(15%)
24	24	Rohm	250	252	(1%)
27	30	Fuji Electric	173	176	(2%)
29	29	Sony	168	177	(5%)
31	32	Sanken Electric	149	162	(8%)
43	39	Seiko Epson	93	115	(19%)
		Other	388	430	(10%)
		Total Japanese Companies	$10,060	$11,429	(12%)
		Japanese Companies as a Percent of World Market	42%	40%	

Figure 1

ESTIMATED 1985 JAPANESE COMPANY SALES BY GEOGRAPHIC AREA



Source: DATAQUEST
December 1985

Total Integrated Circuit

As shown in Table 2, Japanese companies' IC sales were down an estimated 13 percent in 1985, to $7,292 million. Those companies with heavy portfolios of MOS memory ICs, such as Hitachi and Mitsubishi, experienced the most severe declines (down 21 percent and 33 percent respectively), while strong linear companies, such as Matsushita and Sanyo, maintained stronger sales (up 1 percent and 3 percent, respectively).

Table 2

PRELIMINARY 1985 WORLDWIDE TOTAL INTEGRATED CIRCUIT REVENUES OF MAJOR JAPANESE COMPANIES (Millions of Dollars)

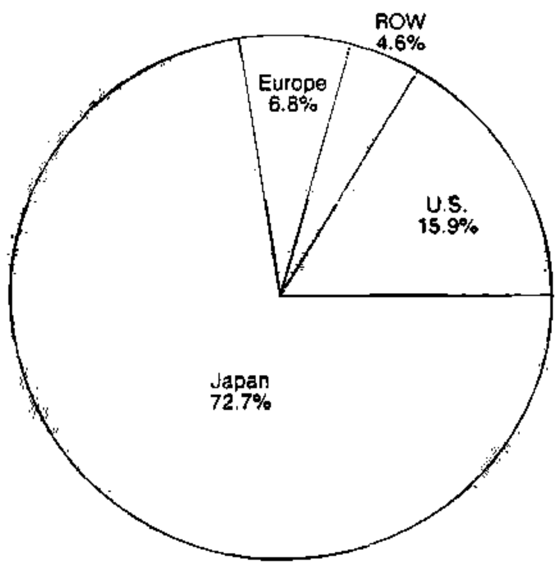
Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
2	2	NEC	$1,603	$1,838	(13%)
4	4	Hitachi	1,236	1,570	(21%)
6	9	Toshiba	995	1,035	(4%)
7	7	Fujitsu	940	1,098	(14%)
11	13	Matsushita	595	592	1%
12	11	Mitsubishi	510	766	(33%)
14	16	Sanyo	314	305	3%
15	15	Oki	289	343	(16%)
21	20	Sharp	201	238	(16%)
27	28	Sony	130	132	(2%)
30	32	Rohm	105	111	(5%)
31	31	Seiko Epson	93	115	(19%)
52	53	Sanken Electric	46	47	(2%)
64	64	Fuji Electric	31	32	(3%)
		Other	204	205	0%
		Total Japanese Companies	$7,292	$8,427	(13%)
		Japanese Companies as a Percent of World Market	40%	37%	

Source: DATAQUEST
December 1985

Because of their dominant position in the relatively strong Japanese market, Japanese-based companies gained an estimated 3 points of worldwide IC market share in 1985, growing from 37 percent of the market in 1984 to 40 percent in 1985. Figure 2 shows the 1985 geographic split of Japanese companies' IC sales. While only 15.9 percent of total sales were in the United States this year, in 1984 the figure was 22.5 percent. The severely depressed U.S. IC market is responsible for the decline.

Figure 2

ESTIMATED 1985 JAPANESE INTEGRATED CIRCUIT SALES BY GEOGRAPHIC AREA



Source: DATAQUEST
December 1985

Bipolar Digital ICs

Japanese semiconductor manufacturers in total are not major suppliers of bipolar digital ICs; however, three Japanese companies--Fujitsu, Hitachi, and NEC--rank in the top ten worldwide, as shown in Table 3. Although Japanese companies' bipolar digital revenues declined an average of 15 percent in 1985, they still managed to pick up one percentage point of world market share, due to their dominance in their home market and a fair portion of the ROW market.

The estimated 1985 geographic sales split is shown in Figure 3.

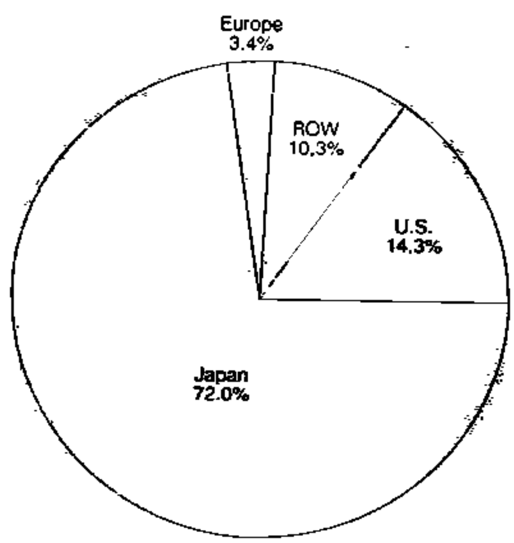
Table 3

PRELIMINARY 1985 WORLDWIDE BIPOLAR DIGITAL IC REVENUES OF MAJOR JAPANESE COMPANIES (Millions of Dollars)

Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
6	6	Fujitsu	$267	$305	(12%)
9	8	Hitachi	194	224	(13%)
10	10	NEC	129	134	(4%)
11	11	Mitsubishi	79	123	(36%)
16	16	Toshiba	33	37	(11%)
22	20	Oki	22	25	(12%)
24	21	Matsushita	21	22	(5%)
25	25	Sanyo	18	18	0%
26	26	Rohm	15	15	0%
29	28	Sony	5	8	(38%)
33	32	Fuji Electric	1	2	(50%)
		Other	21	32	(34%)
		Total Japanese Companies	$805	$945	(15%)
		Japanese Companies as a Percent of World Market	21%	20%	

Figure 3

ESTIMATED 1985 JAPANESE COMPANY BIPOLAR DIGITAL IC SALES BY GEOGRAPHIC AREA



Source: DATAQUEST
December 1985

MOS ICs

Because of their dominance in the MOS IC market, Japanese companies were very vulnerable when the market turned south in 1985. Total Japanese companies' MOS revenues fell 19 percent, from $5,752 million in 1984 to $4,675 million in 1985, as shown in Table 4. However, because of the relatively good performance of their home market, they fared better than the average of the top 50 companies, whose MOS revenues fell 23 percent. Five Japanese companies are among the top ten MOS suppliers worldwide, including NEC, which was ranked number one in both 1984 and 1985.

Table 4

PRELIMINARY 1985 WORLDWIDE MOS IC REVENUES
OF MAJOR JAPANESE COMPANIES
(Millions of Dollars)

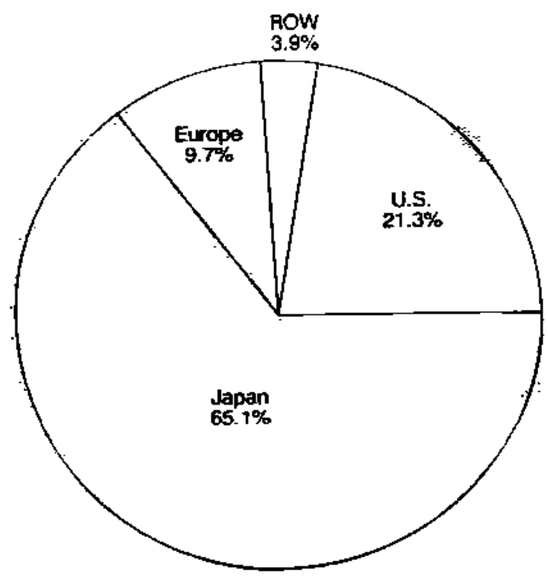
Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
1	1	NEC	$1,174	$1,414	(17%)
3	2	Hitachi	853	1,167	(27%)
4	6	Toshiba	727	770	(6%)
6	7	Fujitsu	631	753	(16%)
8	8	Mitsubishi	320	541	(41%)
11	13	Matsushita	269	283	(5%)
12	12	Oki	264	315	(16%)
14	15	Sharp	173	214	(19%)
22	22	Seiko Epson	93	115	(19%)
29	33	Sanyo	68	67	1%
34	36	Sony	49	51	(4%)
66	63	Fuji Electric	6	6	0%
69	64	Rohm	5	5	0%
		Other	43	51	(16%)
		Total Japanese Companies	$4,675	$5,752	(19%)
		Japanese Companies as a Percent of World Market	46%	43%	

Source: DATAQUEST
December 1985

Japanese MOS suppliers gained 3 percentage points of market share in 1985, accounting for 46 percent of a badly shrinking world market. Figure 4 shows the estimated 1985 geographic split of Japanese companies' MOS IC sales. In 1985, we estimate that 21.3 percent of their MOS sales were in the United States, while in 1984 that figure was 29.3 percent.

Figure 4

ESTIMATED 1985 JAPANESE COMPANY MOS IC SALES BY GEOGRAPHIC AREA



Source: DATAQUEST
December 1985

Linear ICs

Japanese semiconductor manufacturers' strongest product area in 1985 was linear ICs. Because of a strong consumer electronics market in Japan, most Japanese companies' linear revenues increased or stayed flat. As shown in Table 5, their overall linear sales grew 5 percent, to $1,812 million. Five Japanese companies are in the top ten worldwide; of those, two--Matsushita and Sanyo--are heavily captive, major manufacturers of consumer electronics.

As shown in Figure 5, by far the largest portion of Japanese manufacturers' linear IC sales--92.4 percent--were in Japan.

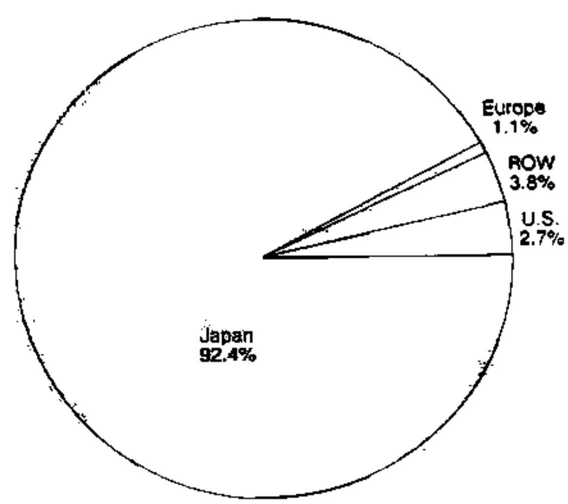
Table 5

PRELIMINARY 1985 WORLDWIDE LINEAR IC REVENUES OF MAJOR JAPANESE COMPANIES
(Millions of Dollars)

Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
3	4	Matsushita	$305	$287	6%
4	3	NEC	300	290	3%
5	7	Toshiba	235	228	3%
7	8	Sanyo	228	220	4%
10	10	Hitachi	189	179	6%
12	13	Mitsubishi	111	102	9%
15	16	Rohm	85	91	(7%)
16	17	Sony	76	73	4%
29	29	Sanken Electric	46	47	(2%)
30	31	Fujitsu	42	40	5%
35	38	Sharp	28	24	17%
36	37	Fuji Electric	24	24	0%
52	52	Oki	3	3	0%
		Other	140	122	15%
		Total Japanese Companies	$1,812	$1,730	5%
		Japanese Companies as a Percent of World Market	42%	38%	

Figure 5

ESTIMATED 1985 JAPANESE COMPANY LINEAR IC SALES BY GEOGRAPHIC AREA



Source: DATAQUEST
December 1985

Discrete and Optoelectronic

Six of the top ten discrete manufacturers worldwide are Japanese companies. As shown in Table 6, total Japanese company discrete sales decreased 9 percent in 1985.

Table 6

PRELIMINARY 1985 WORLDWIDE DISCRETE SEMICONDUCTOR REVENUES
OF MAJOR JAPANESE COMPANIES*
(Millions of Dollars)

Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
2	2	Hitachi	$392	$430	(9%)
3	3	Toshiba	368	418	(12%)
4	4	NEC	351	379	(7%)
6	5	Matsushita	227	247	(8%)
7	7	Mitsubishi	178	185	(4%)
9	9	Fuji Electric	130	132	(2%)
13	14	Rohm	111	112	(1%)
14	16	Sanyo	103	105	(2%)
17	15	Sanken Electric	97	109	(11%)
28	28	Fujitsu	37	40	(8%)
34	30	Sony	28	34	(18%)
45	46	Oki	4	4	0%
		Other	102	135	(24%)
		Total Japanese Companies	$2,128	$2,330	(9%)
		Japanese Companies as a Percent of World Market	45%	46%	

*Excludes optoelectronics

Source: DATAQUEST
December 1985

Table 7 shows Japanese companies' optoelectronic sales and worldwide rankings in 1984 and 1985. We believe that Sharp has regained its position as the number one manufacturer of optoelectronic devices in the world, although much of its production is captive.

Table 7

PRELIMINARY 1985 WORLDWIDE OPTOELECTRONIC REVENUES
OF MAJOR JAPANESE COMPANIES
(Millions of Dollars)

Ranking Worldwide 1985	Ranking Worldwide 1984	Company	1985	1984	Percent Change 1984-1985
1	2	Sharp	$128	$116	10%
3	3	Toshiba	96	108	(11%)
4	4	Matsushita	84	89	(6%)
7	7	Fujitsu	43	52	(17%)
8	8	Hitachi	43	52	(17%)
11	11	Sanyo	40	45	(11%)
13	14	Rohm	34	29	17%
14	13	NEC	30	34	(12%)
19	21	Mitsubishi	18	13	38%
20	19	Oki	14	15	(7%)
21	22	Fuji Electric	12	12	0%
23	24	Sony	10	11	(9%)
26	26	Sanken Electric	6	6	0%
		Other	82	90	(9%)
		Total Japanese Companies	$640	$672	(5%)
		Japanese Companies as a Percent of World Market	59%	56%	

Source: DATAQUEST
December 1985

NOTE

A complete set of market share tables by product ("Appendix B") for Japanese companies will be published in both yen and dollars in January 1986. These tables will be mailed to all JSIS binderholders. Please contact your binderholder for more information.

Patricia S. Cox

Nielsen Dataquest RESEARCH BULLETIN

JSIS Code: JSIA Newsletters

JAPANESE INDUSTRIAL ELECTRONICS PRODUCTION TO REACH ¥11.3 TRILLION IN 1989

INTRODUCTION

The Electronics Industry Association of Japan (EIAJ) predicts in its recent report that Japanese industrial electronics production will be ¥11.3 trillion (US$54.2 billion at ¥240 per US$1) in fiscal 1989 and will achieve an overall 12.4 percent compound annual growth rate (CAGR) from 1984 to 1989. See Table 1.

The computer and computer-related products category will record the highest growth, with a 14.9 percent CAGR. The EIAJ medium-range forecast points out as the reason for this that there will be raised demands for very large scale oriented computer systems and that the number of work-stations connected to these systems will increase because of network expansion. The EIAJ expects production in this category to reach ¥6.0 trillion (US$25.0 billion) in fiscal 1989, which will not only represent half of the total industrial electronics production value at that time but will also be equivalent to the whole industrial electronics production value of fiscal 1984.

By product category, word processors will grow at the highest rate, with a 22.6 percent CAGR. Compared with production size in fiscal 1985, word processor production value in 1989 will be almost three times (2.8 times) larger, or ¥250 billion (US$1,042 million).

OBSERVATIONS

DATAQUEST believes that Japanese electronics production will follow the pattern of U.S. electronics production more and more and will become more oriented toward industrial products, resulting in a 10 percent annual growth rate by 1989. At the same time, consumer electronics is projected to have less than a 10 percent growth rate according to the Japan Electronics Industry Development Association.

Nagayoshi Nakano

Table 1

ELECTRONICS PRODUCTION FORECAST IN JAPAN
(Billions of Yen)

	Result	Forecast		CAGR	Composition		
	1984	1985	1989	1989/1984	1984	1985	1989
Industrial Electronics	6,317.9	7,067.2	11,341.3	12.4%	100.0%	100.0%	100.0%
Telecommunications Systems	1,197.3	1,333.4	1,798.9	8.5%	19.0%	18.9%	15.9%
Radio Communications Systems	612.1	639.3	912.7	8.3%	9.7%	9.0%	8.0%
Broadcasting Equipment	59.6	66.0	89.5	8.5%	0.9%	0.9%	0.8%
Radio Communications Equipment	370.2	376.9	542.7	8.0%	5.9%	5.3%	4.8%
Radio Application Equipment	182.3	196.4	280.5	9.0%	2.9%	2.8%	2.5%
Electronics Application Equipment	3,572.8	4,022.4	6,975.3	14.3%	56.6%	56.9%	61.5%
Computer and Related Equipment	2,993.6	3,360.0	6,000.0	14.9%	47.4%	47.5%	52.9%
Others	579.2	3,360.0	975.3	11.0%	9.2%	9.4%	8.6%
Electric Measuring Instrumentation	549.4	619.2	975.7	12.2%	8.7%	8.8%	8.6%
Electronic Business Machines	386.3	452.9	678.7	11.9%	6.1%	6.4%	6.0%
Word Processors	91.0	135.0	252.0	22.6%	1.4%	1.9%	2.2%

Source: Electronics Industry Association of Japan
DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

JAPANESE END MARKET ANALYSIS

SUMMARY

DATAQUEST's Japanese Semiconductor Industry Service (JSIS) has just updated its analysis of semiconductor sales by end use. We have concluded that if prices were held constant from 1984 to 1985, Japanese semiconductor consumption would increase in value by 20.8 percent. However, this is not a realistic viewpoint, due to the overcapacity problem. The actual consumption in yen value will decline by 5.2 percent. This represents a price decline of 26 percent overall (20.8 percent + 5.2 percent). For details of this actual price decline see our JSIS newsletter dated September 23, 1985, entitled "Japanese Semiconductor Market Update."

The largest Japanese semiconductor end use in 1985 is video and audio products combined, at 36.4 percent, followed by computers. The next product is digital audio disk players. These products are growing faster than VCRs and each one consumes $50 worth of semiconductors. Geographically, we have observed that Kanto is the region and Kanagawa is the specific prefecture that consumes the largest amounts of semiconductors in Japan.

JAPANESE SEMICONDUCTOR CONSUMPTION

While semiconductor consumption will be increased in 1985 by 20.8 percent at constant prices and decrease at 5.2 percent at real prices, the semiconductor industry is facing the most difficult time in its history. There are both excess capacity and significantly lower demand.

In 1984, Japanese manufacturers raised production capacity significantly, trying to meet end-user demands. However, in June 1984, semiconductor prices began to decline sharply, due to oversupply. We believe that this is still the case today.

Consumer Electronics

Table 1 shows monthly Japanese semiconductor consumption classified by industry categories. Video and audio products combined have the lion's share of semiconductor consumption, controlling 38.0 percent in 1984. However, this share has decreased moderately from 41.5 percent in 1982 to 36.4 percent (forecast) in 1985 (constant price).

Japanese semiconductor consumption forms a striking contrast to U.S. semiconductor consumption, as shown in Table 2. In the United States, the data processing and communications categories have shares of 44.1 percent and 14.6 percent, respectively, while consumer electronics has only 8.0 percent. On the other hand, in Japan, the data processing and communications categories have 36.4 percent and 9.8 percent, respectively, and the consumer category has 46.5 percent. In other words, in Japan, consumer electronics ranks in the same position as industrial electronics in the United States.

Digital Audio Disk Players

In 1984, digital audio disk players had a 0.4 percent share of total semiconductor consumption. In terms of semiconductor consumption, this figure is still low compared with VCR semiconductor consumption. We believe that the range of total semiconductors used in the disk players is $40 to $50 per unit.

DATAQUEST further estimates that monthly production of digital audio disk players will show a fivefold increase over 1984 to ¥3.3 billion in 1985.

Other Consumer Products

In Table 3, we have shown the fastest-growing end markets for semiconductors. In Table 4, we show the rankings of the major consumer products.

In Table 5, we have listed the three consumer products that are climbing the ladder of semiconductor consumption the fastest.

End Equipment Trends

Some conclusions on end equipment trends:

- We believe that the combination of the telecom market opening in Japan and the new office automation boom focused on communications will provide significant opportunity for telecom semiconductors.

- The word processing equipment market share has increased because many Japanese makers are now supplying low-end portable versions of Japanese word processors due to a heavy demand to automate previously inefficient offices. In Japan, manufacturers of Japanese word processors that are also capable of handling Chinese characters are now estimated to control more than 80 percent of the demand in the domestic market.

Consumption by Regions

Table 6 shows estimated regional semiconductor consumption. The Kanto region has more than 50 percent share in total semiconductor consumption in Japan. The Tokai region increased its share from 10.5 percent in 1982 to 11.8 percent in 1985. DATAQUEST expects the ratio of semiconductors consumed in the Tokai region to continue to grow.

The average monthly semiconductor consumption in Kanagawa prefecture was ¥34.3 billion in 1984, equivalent to 20 percent of the total Japanese monthly consumption, as shown in Table 7. One interesting observation of Table 7 is that Shizuoka prefecture's rank in semiconductor consumption grew from number 10 in 1982 to number 8 in 1984. We expect Shizuoka to move up to number 5 in 1985 as a result of the increasing importance of the manufacturing of Ando (optical communications), Brother, Nippon Automation (robots), Roland (musical instruments), Suzuki (motorcycles), Toshiba, and Yamaha.

Nagayoshi Nakano
Osamu Ohtake
Gene Norrett

Table 1

ESTIMATED MONTHLY SEMICONDUCTOR CONSUMPTION
IN JAPAN BY APPLICATION
(Billions of Yen)

	1982	Percent of Total	1983	Percent of Total	1984	Percent of Total	1985*	Percent of Total
Video	22.3	26.5%	28.0	25.6%	43.35	26.3%	44.9	22.5%
Audio	12.6	15.0	13.7	12.5	19.27	11.7	27.8	13.9
Home Appliance	1.4	1.7	1.7	1.6	2.59	1.6	2.9	1.4
Other Consumer Electronics	9.2	11.0	9.9	9.1	11.37	6.9	11.3	5.7
Business Machine	6.1	7.2	8.3	7.6	11.82	7.2	15.1	7.6
Computer	12.7	15.2	22.7	20.8	40.91	24.8	55.3	27.7
Peripherals	3.1	3.7	4.7	4.3	7.24	4.4	10.3	5.2
Communications	8.7	10.3	11.4	10.4	16.21	9.8	19.1	9.6
Others	7.9	9.4	8.8	8.1	12.10	7.3	12.7	6.4
Total	84.0	100.0%	109.2	100.0%	164.86	100.0%	199.4	100.0%

*Constant prices for 1984 to 1985

Table 2

SEMICONDUCTOR CONSUMPTION COMPARISON
BETWEEN UNITED STATES AND JAPAN IN 1984
(Percent of Total)

	United States	Japan
Data Processing	44.1%	36.4%
Communications	14.6	9.8
Consumer	8.0	46.5
Others	33.3	7.3
Total	100.0%	100.0%

Note: Others in United States include consumption for military applications (12.4 percent).

Source: DATAQUEST

Table 3

ESTIMATED MONTHLY SEMICONDUCTOR CONSUMPTION BY MAJOR END PRODUCT (Billions of Yen)

	1982	Percent of Total	1983	Percent of Total	1984	Percent of Total	1985*	Percent of Total
VCRs	13.7	16.3%	18.2	16.7%	29.7	18.0%	29.7	14.9%
Color Television	11.2	13.3	11.8	10.8	11.2	6.8	11.8	5.9
Audio	10.8	12.9	11.7	10.7	16.2	9.8	24.4	12.2
Digital Audio Disk Players	0.1	0.1	0.5	0.5	0.7	0.4	3.3	1.6
Computer	12.7	15.1	22.7	20.8	40.9	24.8	55.2	27.7
Personal Computers	2.9	3.5	8.8	8.1	17.9	10.9	16.5	8.3
Automobiles	3.1	3.6	3.6	3.3	5.2	3.2	6.0	3.0
Others	32.6	38.8	41.2	37.7	61.7	37.4	72.3	36.3
Total	84.0	100.0%	109.2	100.0%	164.9	100.0%	199.4	100.0%

*Constant prices for 1984 to 1985

Table 4

RANKING OF MAJOR END PRODUCT BY SEMICONDUCTOR CONSUMPTION IN DOLLARS

	1982	Percent of Total	1984	Percent of Total	1985	Percent of Total
VCRs	1	16.3%	1	18.0%	1	14.9%
General-Purpose Computers	2	9.3%	3	10.1%	2	9.5%
Office Computers	15	2.0%	8	3.0%	3	9.1%
Personal Computers	8	3.5%	2	10.9%	4	8.3%
Tape Recorders	4	7.5%	5	5.6%	5	7.0%
Color TVs	3	8.9%	4	6.8%	6	5.9%
Copying Machines	9	3.4%	6	4.1%	7	4.9%
Peripherals	-	3.1%	9	2.8%	8	3.1%
Automobiles	6	3.5%	7	3.2%	9	3.0%
PBXs	7	3.5%	10	2.7%	10	2.3%

Source: DATAQUEST

Table 5

HOTTEST END MARKETS FOR SEMICONDUCTORS
RANKINGS IN TOP 100

	1982	1984	1985
Digital Audio Disk Players	47	33	18
Word Processors	31	17	12
Facsimile	21	14	13

Table 6

ESTIMATED MONTHLY SEMICONDUCTOR CONSUMPTION BY REGION
(Billions of Yen)

	1982	Percent of Total	1983	Percent of Total	1984	Percent of Total	1985*	Percent of Total
Kanto	44.8	53.3%	58.8	53.8%	94.3	57.2%	111.7	56.1%
Kinki	14.1	16.8	14.9	13.6	24.1	14.6	28.2	14.1
Tokai	8.8	10.5	11.6	10.6	16.3	9.9	23.7	11.8
Shin-Etsu	6.9	8.2	11.3	10.4	13.2	8.0	14.9	7.5
Others	9.4	11.2	12.6	11.4	17.0	10.3	20.9	10.5
Total	84.0	100.0%	109.2	100.0%	164.9	100.0%	199.4	100.0%

*Constant prices for 1984 to 1985

Source: DATAQUEST

Table 7

ESTIMATED MONTHLY SEMICONDUCTOR CONSUMPTION BY PREFECTURE
(Billions of Yen)

	1982	Percent of Total	1983	Percent of Total	1984	Percent of Total	1985*	Percent of Total
Kanagawa	16.8	20.0%	20.3	18.6%	34.3	20.8%	22.5	20.6%
Tokyo	11.3	13.4	15.8	14.5	22.4	13.6	13.0	11.9
Osaka	10.4	12.4	10.2	9.4	13.8	8.4	8.7	8.0
Tochigi	5.3	6.3	7.3	6.7	10.2	6.2	6.0	5.5
Nagano	5.0	5.9	8.2	7.5	9.7	5.9	6.0	5.5
Ibaragi	3.7	4.4	5.7	5.2	9.7	5.9	6.1	5.6
Saitama	3.9	4.6	4.5	4.1	8.9	5.4	8.3	7.6
Shizuoka	2.9	3.4	4.7	4.3	8.1	4.9	7.5	6.8
Gumma	3.0	3.6	4.4	4.0	7.4	4.5	4.7	4.1
Aichi	3.6	4.3	4.5	4.1	5.9	3.6	3.8	3.5
Others	18.1	21.7	23.6	21.6	34.5	20.8	22.8	20.9
Total	84.0	100.0%	109.2	100.0%	164.9	100.0%	199.4	100.0%

*Constant prices for 1984 to 1985

Source: DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPANESE CAPACITY DATA BASE SECOND UPDATE:
1984 CONSTRUCTION BOOM CREATES OVER-CAPACITY

SUMMARY

DATAQUEST's Japanese Semiconductor Industry Service staff in Tokyo recently updated the Japanese semiconductor capacity data base on new factory lines and production capacity in 1984. It appears from company announcements that Japanese and U.S. companies will bring 57 new fabs on-line in Japan from 1983 to 1987, as shown in Table 1. These figures exceed the 32 new fabs recorded in our last newsletter ("Japanese Capacity Data Base First Update," September 12, 1984). These announced factories may be stretched out due to the collapse of the demand for semiconductors. We believe that in fiscal 1985, Japanese capital spending will decline by 23 percent in yen due to the current industry downturn and over-capacity situation. Nevertheless, several companies are still planning plant expansions, especially consumer electronics manufacturers and newcomers to the industry.

RAPID PRODUCTION GAINS IN 1984

In 1984, total average monthly wafer starts increased 44.1 percent, while average monthly unit production was up 47.6 percent, as shown in Table 2. NEC remained the largest producer, but Toshiba added the most wafer capacity and Mitsubishi recorded the fastest production growth.

Our analysis shows the following trends in 1984:

- Average monthly wafer starts grew more slowly than average monthly unit production because of the trend toward usage of larger wafers and higher productivity.

- Overall average "yield" (average monthly production divided by monthly wafer starts) varied widely, but increased for all manufacturers.

The introduction of 5-inch and 6-inch wafer lines and improved wafer processing technology accounts for the jump in monthly unit production per wafer start, especially for Hitachi and NEC. For example, NEC

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produced an average of 1,800 units per wafer start in 1984, up 3 percent from 1,750 units in 1983. Although these ratios mask differences in product mix, wafer size, and wafer yields by production line, they provide an overall comparison of productivity trends among the top nine manufacturers.

REDUCED CAPITAL SPENDING IN FISCAL 1985

Japanese and U.S. manufacturers significantly increased their capital spending in fiscal 1984 by 101 percent! As shown in Table 3, Japanese capital spending doubled from ¥410 billion ($1.80 billion) in fiscal 1983 to ¥820 billion ($3.45 billion) in 1984. DATAQUEST believes that this growth would have been greater if bottlenecks had not occurred in semiconductor equipment production.

However, we believe that Japanese capital spending will decline 23 percent in fiscal 1985 because of excess capacity, weak demand, and growing trade friction with the United States. In March, DATAQUEST estimated that Japanese semiconductor inventory had reached 9 percent of total domestic production. By June, we estimate that Japanese manufacturers were holding 97 million memory devices in inventory, or over 1.5 months' backlog. Further, we believe that the Japanese market will decline by 5.2 percent in yen and approximately 7 percent in dollars. (See JSIA newsletter, "Japanese Semiconductor Market Update," dated September 23, 1985.)

We also believe that U.S. consumption will be down more than 30 percent in 1985, due to a very reduced demand for PCs and small office systems for the office. We believe that underutilization of existing plants and the 24 new Japanese fabs coming on-line in 1985, 1986, and 1987 will be more than enough to handle expected demand. Furthermore, additional capacity from South Korea and Taiwan will put strong price pressure on both U.S. and Japanese manufacturers of RAMs and ASICs.

A FLURRY OF 6-INCH WAFER LINES

From our analysis, we estimate that 47 new Fab lines will have been built by U.S. and Japanese companies in Japan from 1983 to 1985, as shown in Table 1. In our data base we have captured many data points on these factories. In Table 4, we present the production operation, product manufacturer, and estimated investment amount for many of these factories. As shown in Table 5, 45 of these new lines and factories will have an investment of over ¥10 billion ($40 million). This very high level of investment is representative of the Japanese commitment to this industry and the very high cost of new facilities.

We believe that the shift to 6-inch wafer MOS factories is accelerating. As shown in Table 6, 10 new factories will offer 6-inch wafer processing. We believe that several more 6-inch wafer lines will be announced later this year.

DATAQUEST CONCLUSIONS

Due to the tremendous increase in new lines, DATAQUEST believes that Japanese fab capacity clearly exceeds semiconductor consumption needs. We believe that the Japanese industry will continue to revise its capital spending downward to bring it closer to semiconductor consumption forecasts, especially in the MOS memory area. Many of the planned factory expansions for 1985 and 1986 will get stretched out and equipment purchases delayed. Furthermore, the major strategic emphasis of the two Japanese manufacturers is on increased automation and larger wafers. Long term, this bodes well for the equipment industry that is planning to support this industry.

O. Ohtake
Gene Norrett

Table 1

ESTIMATED NEW MANUFACTURING FACILITIES IN JAPAN

	1983	1984	1985	1986	1987	Total
Fabrication	6	18	23	7	3	57
Assembly	5	14	23	6	0	48
Test	7	21	31	7	2	68

Source: DATAQUEST
October 1985

Table 2

JAPANESE PRODUCTION ANALYSIS

	Average Monthly Production (Millions of Units)			Average Monthly Wafer Starts (Thousands of Units)		
	1983	1984	Percent Growth	1983	1984	Percent Growth
Fujitsu	33.0	44.0	33.3%	65.3	86.7	32.8%
Hitachi	587.9	827.3	40.7%	356.2	493.4	38.5%
Matsushita	452.0	652.4	44.3%	418.9	596.0	42.3%
Mitsubishi	96.9	154.3	59.2%	87.0	135.2	55.4%
NEC	752.8	1,099.5	46.1%	429.7	610.2	42.0%
Oki	20.7	26.8	29.5%	26.9	34.5	28.3%
Sanyo	114.0	160.0	40.4%	146.0	203.7	39.5%
Sharp	42.0	57.7	37.4%	39.6	53.6	35.4%
Toshiba	438.7	655.8	49.5%	507.7	742.2	46.2%
Other	1,060.6	1,632.4	53.9%	543.1	821.8	51.3%
Total	3,598.6	5,310.2	47.6%	2,620.4	3,777.3	44.1%

Source: DATAQUEST
October 1985

Table 3

JAPANESE CAPITAL EXPENDITURES
(Billions of Yen)

Company	1982	1983	1984	1985	Percent Growth in 1985
Toshiba	¥ 32	¥ 97	¥148	¥100	(32.4%)
Fujitsu	40	60	125	70	(44.0%)
Hitachi	41	70	130	90	(30.8%)
Matsushita	10	24	95	85	(10.5%)
Mitsubishi	23	35	70	50	(28.6%)
NEC	48	65	140	120	(14.3%)
Oki	12	12	28	25	(10.7%)
Sanyo	11	14	35	46	31.4%
Sharp	9	14	28	30	7.1%
Other	13	15	21	15	(28.6%)
Total	¥239	¥406	¥820	¥631	(23.0%)

Source: DATAQUEST
October 1985

Table 4

NEW JAPANESE FACTORIES

Company	Month of Operation	Production: Line Number	Production: Fab	Production: Assembly	Production: Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1983															
Fujitsu															
Fujitsu VLSI Design	October	-	-	-	-	-	-	-	-	-	-	-	-	-	N/A
Hitachi Ltd.															
Hitachi Factory	September	1	1	-	1	-	1	-	-	-	-	1	1	-	N/A
Hitachi Hokkai Semiconductor Chitose Plant		1	-	1	1	-	-	1	-	-	-	-	-	-	¥ 5.0
Kofu Branch Factory K4 Plant	December	1	1	-	1	-	-	1	1	-	-	-	-	-	15.0
IBM Japan															
Yasu Factory	Late 1983	1	1	1	-	-	-	1	-	-	-	-	-	-	N/A
Matsushita Electronics															
Arai and 3 (C) Line	October	1	1	1	1	1	1	1	-	-	-	-	-	-	16.0
NEC Corporation															
Akita Nippon Denki	September	1	-	1	-	-	-	-	-	1	1	-	-	-	4.0
Oki Electric Industry Co., Ltd.															
VLSI Pilot Production Plant	June	1	1	-	1	-	-	1	-	1	-	-	-	-	10.0
Sanken Electric Co., Ltd.															
Yamagata Sanken	January	1	1	-	1	-	-	-	-	-	-	1	1	-	N/A
Tokyo Sanyo Electronic Co., Ltd.															
Tokyo IC New Factory	January	1	-	1	1	-	-	-	-	-	1	-	-	-	2.0
Total (1983)		9	6	5	7	1	1	5	1	2	2	2	2	0	¥ 52.0
1984															
Fairchild Japan															
Nagasaki Factory	July	1	-	1	1	-	1	-	-	-	-	-	-	-	¥ 6.5
Fuji Xerox															
Suzuka Fuji Xerox	June	1	1	1	1	N/A	-	-	-	-	-	-	-	1	4.0
Fujitsu Ltd.															
Iwate No. 3 Factory	Late 1984	1	1	-	-	-	-	1	-	-	-	-	-	-	15.0
Mie Factory	November	1	1	-	1	-	-	1	-	1	-	-	-	-	20.0
Fujitsu Yamanashi Electronics	September	1	1	1	1	-	-	-	-	-	-	1	1	1	12.0
Wakamatsu Factory	December	1	1	-	-	-	-	-	1	1	-	-	-	-	20.0

(Continued)

Table 4 (Continued)

NEW JAPANESE FACTORIES

Company	Production: Month of Operation	Production: Line Number	Production: Fab	Production: Assembly	Production: Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1984 (Continued)															
Hitachi Ltd.															
Device Development Center	April	1	1	-	1	1	1	1	-	1	-	-	-	-	¥ 7.0
Hitachi VLSI Engineering Co., Ltd.	June	1	-	-	-	-	-	-	-	-	-	-	-	-	1.0
IMT															
Factory	June	1	1	1	1	-	-	-	-	-	-	-	-	1	6.0
Matsushita Electronics Corporation															
Arai Factory No. 4 Plant	October	1	1	1	1	-	1	-	-	-	1	-	-	-	20.0
Mitsubishi Electric Corp.															
Fukuoka Semiconductor Factory	November	1	1	-	1	-	1	-	-	-	1	-	-	-	7.0
Denshi	November	-	1	1	1	-	-	-	-	-	-	1	1	1	N/A
Kita-Itami Works Saijo Plant	June	1	1	-	1	-	-	1	-	-	-	-	-	-	30.5
NEC Corporation															
Fukushia NEC	October	1	-	1	1	-	-	-	-	-	1	-	-	-	N/A
Kita Nihon Denshi New Factory	October	1	-	1	-	-	-	1	-	-	-	-	-	-	N/A
Kyushu Nippon Denki No. 7	Autumn	1	1	-	1	-	-	1	1	1	-	-	-	-	30.0
New Japan Radio Co. Ltd.															
Kawagoe Works Semiconductor	October	1	1	-	1	-	-	-	-	-	-	1	1	1	0.8
Saga Electronics	June	1	-	1	-	N/A	N/A	-	-	-	1	-	-	-	N/A
Nippon Precision Circuits															
HQ Factory New Line	Autumn	1	1	-	1	-	-	-	-	1	1	-	-	-	N/A
Oki Electric Industry Ltd.															
Miyazaki Oki Denki M2	July	1	1	-	1	-	-	1	1	1	-	-	-	-	20.0
Oki Micro Design Miyazaki	April	Design													N/A
Honjyo Factory Thick Film	June	1	-	-	-	-	-	-	-	-	1	-	-	-	2.0
Rohm															
Rohm Anagi	October	1	-	1	-		-	-	-	-	-	1	-	-	2.5
Sanyo Electric Co. Ltd.															
Tokyo Sanyo Denki New Line	Autumn	1	1	-	-	N/A	-	1	1	-	-	-	-	-	15.0
TI Japan															
Miho Factory	Autumn	1	-	1	1	-	-	1	-	-	-	-	-	-	10.0

(Continued)

Table 4 (Continued)

NEW JAPANESE FACTORIES

Company	Month of Operation	Production: Line Number	Production: Fab	Production: Assembly	Production: Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1984 (Continued)															
Toshiba Corporation															
Buzen Toshiba Electronics New Factory	July	1	-	-	1	1	-	-	-	-	-	-	-	1	N/A
Buzen Sangyo New HQ Factory	June	1	-	-	-	-	-	-	-	-	-	-	-	-	¥ 0.1
Iwate Toshiba Electronics	September	1	1	-	1	-	1	1	1	1	-	-	-	-	35.0
Kitsuki Toshiba Electronics	December	1	-	1	-	-	-	1	-	-	-	-	-	-	1.0
Mihara Kinzoku Kogyo	June	1	-	-	1	-	-	-	-	-	-	-	-	-	N/A
Nougata Toshiba Electronics Fukuoka Factory	November	1	-	1	-	-	-	-	-	-	1	-	-	-	4.0
Toshiba Component New Factory	December	1	1	1	1	-	-	-	-	-	-	-	1	-	0.9
VLSI Laboratory	April	-	1	-	1	-	-	1	1	1	-	-	-	-	22.0
Total (1984)		31	18	14	21	2	5	10	6	7	6	4	4	6	¥292.3
1985															
Analog Devices															
New Line	October	1	-	1	1	-	-	-	-	-	1	1	-	-	¥ 2.0
Fujitsu Limited															
Kyushu Fujitsu Miyazaki Factory	Summer	1	-	1	-	-	-	1	1	-	-	-	-	-	10.0
Fujitsu VLSI Gifu Factory	September	1	1	1	1	-	-	-	-	1	-	-	-	-	2.5
Hitachi Ltd.															
Mobara No. 3 Factory	June	1	1	-	1	-	-	1	-	-	-	-	-	-	20.0
Hitachi Hokkai Semiconductor	July	1	1	1	1	-	-	1	-	1	-	-	-	-	35.0
Hitachi Hokkai Assem. Exp.	April	1	-	1	1	-	-	1	-	-	-	-	-	-	2.0
Naka New Factory	August	1	1	-	1	-	-	1	1	1	-	-	-	-	22.0
Hitachi Irima Denshi Gosyogahara New Factory	Summer	1	-	1	-	-	-	-	-	-	-	-	-	-	3.0
Hitachi Microcomputer Eng.	October	1	1	1	1	-	1	-	-	1	-	-	-	-	4.0
Hitachi Ahme Denshi	October	1	-	-	-	-	-	-	-	-	-	-	-	-	3.0
Matsushita Electronics Corporation															
Uozu #1 (A) Line	February	1	1	-	1	-	-	-	1	1	-	-	-	-	40.0
Kyoto Laboratory	September	1	1	-	1	-	-	-	-	-	1	-	-	-	20.0

(Continued)

Table 4 (Continued)

NEW JAPANESE FACTORIES

Company	Month of Operation	Production: Line Number	Fab	Assembly	Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1985 (Continued)															
Matsushita Electric Industry Co. Ltd.															
Semiconductor Research Laboratory	Autumn	-	1	1	1	-	-	-	-	-	-	-	-	-	¥ 20.0
Mitsubishi Electric Co., Ltd.															
Saijo Plant No. 2	June	1	1	-	1	-	-	1	-	1	-	-	-	-	25.0
LSI Laboratory VLSI Build.	December	-	1	-	1	-	-	-	-	-	-	-	-	-	18.0
Fukuoka Factory	Spring	1	1	-	1	1	1	-	-	-	-	-	-	-	9.0
Kanebo Denshi	May	1	-	1	-	-	1	-	-	-	-	-	-	-	4.5
NEC Corporation															
Fukui Nippon Denki	October	1	-	1	-	-	-	1	-	-	-	-	-	-	N/A
Kansai Nippon Denki Ontsu Plant	Autumn	1	1	-	1	-	-	1	-	-	-	-	-	-	30.0
Kitanihon Denshi New Factory	October	1	-	1	-	-	-	1	-	-	-	-	-	-	0.7
Ohita Nippon Denki	April	1	-	1	-	-	-	1	1	1	-	-	-	-	6.0
Yamaguchi Nippon Denki	April	1	1	-	1	-	-	1	1	1	-	-	-	-	62.0
Yonezawa NEC No. 2 New Factory	November	1	-	1	1	-	-	-	-	-	1	-	-	-	1.3
Sagamihara Factory G Line	September	1	1	1	1	-	-	-	-	1	-	-	-	-	30.0
NMB Semiconductor															
Tateyama Factory	June	1	1	1	1	-	-	1	-	-	-	-	-	-	25.0
Oki Electric															
Yoshikawa Semiconductor	April	1	-	1	1	-	-	-	-	-	-	-	-	-	2.5
Ricon Company, Ltd.															
No. 2 Fab Line	Summer	1	1	-	1	-	-	1	-	-	-	-	-	-	10.0
Sansha Electric															
Okayama Factory	October	1	1	1	1	-	-	-	-	-	-	1	1	-	1.0
Sanyo Electric															
Gifu F "82"	January	1	1	1	1	-	-	1	1	1	-	-	-	-	12.0
Sharp Corporation															
Fukuyama Factory	April	1	1	-	1	-	-	1	1	1	-	-	-	-	20.0
Sony Corporation															
Sony Chita	May	1	-	1	1	-	-	1	-	-	-	-	-	-	9.0

(Continued)

Table 4 (Continued)

NEW JAPANESE FACTORIES

Company	Month of Operation	Production: Line Number	Fab	Assembly	Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1985 (Continued)															
Suwa Seikosha Co. Ltd.															
Fujimi Factory New Line	N/A	1	1	-	1	-	-	1	1	1	-	-	-	-	¥ 25.0
Soteck	October	1	-	-	1	-	-	1	-	1	-	-	-	-	N/A
Hino CMOS	December	1	-	-	1	-	-	1	-	1	-	-	-	-	N/A
Texas Instruments Japan															
Hiji New Fab	October	1	1	1	1	-	1	-	-	-	-	-	-	-	10.0
Tokyo Sanyo Electronic Co. Ltd.															
New Transistor Fab.	February	1	1	-	-	-	-	-	-	-	1	1	-	-	6.0
Niigata Sanyo Electronic #1 Line	June	1	1	-	1	-	-	1	1	1	-	-	-	-	35.0
Sanyo Sanyo New LSI Fac.	April	1	-	1	1	-	-	1	1	-	-	-	-	-	4.0
Tokyo IC Akagi Plant	February	1	-	1	1	-	-	-	-	-	1	-	-	-	6.0
Toshiba Corporation															
Himeji New Factory	April	1	1	-	1	-	-	-	-	-	-	1	1	-	25.0
Nougata Toshiba Ele. Miyata Factory	February	1	-	1	-	-	-	-	-	-	1	-	-	-	4.0
Oita Factory	June	1	1	-	1	-	-	1	-	-	-	-	-	-	25.0
Kitakyusyu Factory	April	1	-	1	1	-	-	-	-	-	-	1	-	-	10.0
Toshiba Micon Engineer Design Cen.	Summer	Design		—	—	-	-	—	-	—	-	-	-	-	N/A
Total (1985)		29	23	23	31	0	4	20	9	12	9	4	3	0	¥608.3
1986															
Fairchild Semiconductor															
Nagasaki Fab Line	Spring	1	1	-	-	-	-	1	-	-	-	-	-	-	¥ 22.0
Fujitsu															
Shimane Factory	September	1	-	1	1	-	-	-	-	1	-	-	-	-	N/A
Matsushita Electronics Corp.															
Uozu (#2) Line	N/A	1	1	1	1	-	-	-	-	-	1	-	-	-	N/A
Uozu (#3) Line	N/A	1	1	-	1	1	-	-	-	-	-	-	-	-	N/A
Mitsubishi Electric															
Kouchi Factory	July	1	1	1	1	-	-	-	-	1	-	-	-	-	15.0
Saijyo #3 Factory		-	-	-	-	-	-	-	-	-	-	-	-	-	N/A

(Continued)

Table 4 (Continued)

NEW JAPANESE FACTORIES

Company	Month of Operation	Production: Line Number	Production: Fab	Production: Assembly	Production: Test	Bip Mem	Bip Log	MOS Mem	MOS MPU	MOS Log	Linear	Transistor	Diode	Optoelectric	Estimated Investment Amount Billions of Yen
1986 (Continued)															
Motorola Iwate	Spring	1	1	-	-	-	-	1	-	-	-	-	-	-	¥ 20.0
NEC Corporation															
Chugoku Nippon Denki	Early 1985	1	1	1	1	-	-	1	1	1	-	-	-	-	N/A
Ohtsuki Factory	Summer	1	1	1	1	-	-	-	-	-	-	1	1	1	13.0
Oki Electric															
Miyazaki Oki Electric #3	Autumn	1	1	-	1	-	-	1	1	-	-	-	-	-	20.0
Sharp Corporation															
Fukuyama #2 Line	September	1	1	-	1	-	-	1	1	1	-	-	-	-	20.0
Tokyo Sanyo Electric Co., Ltd.															
Niigata Sanyo Electronics #2	Autumn	1	1	-	-	-	-	1	1	-	-	-	-	-	15.0
HQ New Building	February	-	-	-	-	-	-	-	-	-	-	-	-	-	N/A
Toshiba															
Kaga Toshiba Electronic	April	1	-	1	-	-	-	-	-	-	-	1	1	-	10.0
Total (1986)		10	7	6	7		0	0	5	3	2	2	2	1	¥135.0
1987															
New JRC Co., Ltd.															
Saga Electronics New Fab Line	October	1	1	-	1	-	-	-	-	-	1	-	-	-	¥ 0.8
Ninon Semiconductor Inc.															
No. 1 Foundry	Spring	1	1	-	-	-	-	-	-	1	-	-	-	-	20.0
Oki Electronic Ind. Co., Ltd.															
Miyagi Oki Electric	April	1	1	1	1	-	-	1	1	1	-	-	-	-	30.0
Total (1987)		3	3	0	2	0	0	1	0	1	1	0	0	0	¥ 50.8

N/A = Not Available

Source: DATAQUEST
October 1985

Table 5

NUMBER OF FACTORIES OR LINES
OVER ¥10 BILLION INVESTMENT

	1983	1984	1985	1986	1987
Number	3	14	16	7	2

Source: DATAQUEST
October 1985

Table 6

JAPANESE 6-INCH WAFER LINES

Production	Company	Factory Name
1984	NEC	Kyushu No. 7
1985	Hitachi	Mobara No. 3
	Toshiba	Ohita
	Matsushita	Uozu No. 3
	Mitsubishi	Saijo No. 2
	Ricoh	Osaka No. 2
	NEC	Yamaguchi
	NEC	Kansai
1986	Mitsubishi	Kouchi No. 1
	Oki	Miyazaki No. 3
	Sharp	Fukuyama

Source: DATAQUEST
October 1985

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

JAPANESE SEMICONDUCTOR TECHNOLOGY TRENDS
THIRD QUARTER 1985

SUMMARY

If 1984 was the Year of the Ox (plant investment boom), 1985 is turning out to be the Year of the Dog (R&D spending boom) in Japan. Because of the severe industry downturn, DATAQUEST observes that Japanese semiconductor makers are shifting much of their capital spending to R&D spending (see Corporate R&D section of this newsletter). This R&D strategy is similar to AMD's "Liberty Chips" campaign, which is focused at developing new products. We believe that in 1985, the top Japanese semiconductor makers will spend more than 15 percent of their revenues on new research centers and new technologies. There are many reasons for this rapid shift:

- Poor sales of existing products and excess plant capacity
- U.S. government demands for cutbacks in Japanese capital spending
- The need to move up the technology ladder in light of the Semiconductor Industry Association's 301 petition to open the Japanese market and the challenge from South Korea
- The need to diversify out of the depressed memory market and prepare for the industry recovery
- The need to develop original technology due to a growing western "boycott" on technology flows to Japan
- The desire to catch up and surpass the West in microprocessors, ASICs, and gallium arsenide (GaAs) ICs

DATAQUEST observes that the race to develop next-generation ICs is strongly influencing device testing manufacturers. In a recent survey conducted by the Journal of Electronic Engineering, 36 percent of Japanese measuring instrument makers said they are emphasizing basic research to support new device development, including GaAs ICs, megabit 3-D memories, Josephson devices, ballistic transistors, high-speed D/A

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themselves to prepare for the impact of expert systems, voice recognition and synthesis, new materials, large-capacity storage using vertical magnetization, pattern recognition, and video imaging.

DATAQUEST notes that these findings are consistent with current trends in MITI and NTT-sponsored R&D projects, which are halfway toward completion. Already we see a proliferatión of semiconductor lasers and optoelectronic ICs from the Optoelectronic Project (1979-1988); prototype 3-D ICs, GaAs, and GaAs/silicon superlattices from the New Function Elements Project (1981-1990); and prototype GaAs digital ICs, HEMT, ballistic transistors, and ECL devices from the Supercomputer Project (1981-1989). We believe that these announcements will accelerate as Japanese makers race to commercialize these experimental devices.

CORPORATE R&D LABS

As shown in Table 1, Japanese semiconductor companies are racing to open new semiconductor R&D centers. For instance, within the last year, plans for at least 20 new research centers have been announced:

NEC announced that it will double its semiconductor R&D investment for fiscal 1985. The investment will be made in Sagamihara Works and Tamagawa Works, which are NEC's centers for developing new semiconductor products. NEC researchers will focus on 32-bit MPUs for its V series, high-speed gate arrays over 20,000 gates, 1Mb and 4Mb DRAMs, large-capacity memories, and GaAs logic and memory.

Oki Electric announced that it will invest ¥10 billion ($46.5 million) in a new LSI research laboratory in Hachioji, a Tokyo suburb. At the same time, Oki has revised downward its capital spending plans for fiscal 1985 from ¥32 billion ($148.8 million) to ¥25 billion ($116.3 million), or $32.5 million less. Thus, Oki's overall capital and R&D spending will increase $14 million over fiscal 1984.

The Japan Industry Research Association announced in October that it has opened a Laser Technology Center in Chiba Prefecture. Initially financed at $1 million, the 10 researchers will conduct research in excimer lasers and other next-generation lasers for VLSI fine-line geometries (4Mb to 64Mb DRAMs). Starting in April 1986, 20 researchers will work with a 400 to 500 watt excimer laser at the center.

Table 1

JAPANESE PLANS FOR NEW SEMICONDUCTOR R&D LABORATORIES

Company/Agency	Plans	Millions of Dollars
Fuji Photo Film	CMOS image sensor research	N/A
Fujitsu	Mie R&D building postponed	N/A
Fujitsu/Tohoku Digital Technology	HEMT/Opto/GaAs development center (Sendai)	$0.5
Hitachi	A new research center	N/A
JIRA	Laser Technology Center (Chiba)	$1.0
KDD	Software R&D center	$24.0
Konishiroku	New materials R&D center (Silicon Valley)	$2.5
Kyowa Electric	Satellite sensor technology center and plant	$5.0
Matsushita	Research laboratory in Kyoto (built)	$186
Mitsubishi	Original CMOS MCU Center (Nagoya)	N/A
MITI/MPT	Basic Technology Research Promotion Center	$56.0
NEC	32-bit MPU research (Sagamihara and Tamagawa)	N/A
NMB Semiconductor	NMB Research Institute in Tateyama, Chiba	N/A
NTT/KDD	Information transmission think-tank	$0.7
Oki Electric	New LSI R&D center (Hachioji)	$46.5
Sanken Electric	Sanken Technology Center (Saitama)	$116.0
Sanyo Electric	Sanyo Research Center	N/A
Sharp	IC Research Center (Fukuyama, Hiroshima)	N/A
Tokyo Sanyo	Semiconductor R&D Center by February 1986	$10-$20
Toshiba	Toshiba Technology Center (Kawasaki)	$93.0
Toshiba Ceramics	Center Research Lab for 16Mb substrates	$11.6

N/A = Not available

Source: DATAQUEST

PATENTS

DATAQUEST observes that Japanese companies have been aggressively filing patents for metallization technology. From 1979 to 1983, 96 semiconductor companies worldwide applied for 2,551 patents in Japan, of which 32 companies are shown in Table 2. Of these, non-Japanese manufacturers applied for 74 patents. A significant trend is that within four years, the number of patent applications almost quadrupled.

Table 2

METALLIZATION PATENT APPLICATIONS
FILED IN JAPAN

Rank	Company	1979	1980	1981	1982	1983	Total
1	NEC	49	61	87	123	183	503
2	Toshiba	19	53	66	114	148	400
3	Fujitsu	19	51	60	138	111	379
4	Hitachi	46	34	38	62	72	252
5	Mitsubishi	18	34	46	44	53	195
6	Suwa Seikosha	8	15	28	76	29	156
7	Matsushita	22	16	9	23	30	100
8	VLSI Project	12	31	32	-	-	75
9	NTT	3	7	9	28	25	72
10	Oki Electric	10	3	3	18	27	61
11	Matsushita Electronics	-	4	8	5	15	32
12	IBM	2	5	6	11	8	32
13	Sony	3	5	9	4	3	24
14	Sanyo	1	-	2	12	6	21
15	Kyushu NEC	4	3	6	2	4	19
16	Hitachi Micro	-	-	-	8	7	15
17	RCA	3	4	1	3	-	11
18	NEC Home Electronics	4	2	1	2	1	10
19	Citizen	-	-	-	1	7	8
20	Sharp	-	2	5	-	1	8
21	Siemens	1	-	2	-	4	8
22	Tokyo Sanyo	-	-	3	3	1	7
23	Pioneer	-	1	2	4	-	7
24	Fairchild	-	1	-	5	1	7
25	Ricoh	-	-	-	3	4	7
26	MITI	2	1	-	1	2	6
27	Phillips	1	1	1	2	1	6
28	Nippon Denso	-	2	-	2	2	6
29	NTT/NEC	-	4	1	-	-	5
30	ITT	1	2	1	-	1	5
31	Thomson	2	1	-	-	2	5
32	Hitachi/NTT	-	-	-	-	5	5
	Other companies	10	6	8	11	22	57
	Other individuals	2	-	-	-	-	2
	Other non-Japanese	4	14	6	10	11	45
	Total patents applications	246	363	440	716	786	2,551

Source: VLSI Magazine, June 1985
DATAQUEST

GOVERNMENT R&D PROJECTS

NTT's 64-Megabit DRAM Joint R&D Project

Nippon Telegraph and Telephone's (NTT) Atsugi ECL is working with Hitachi and Toshiba to build a small synchrotron to generate soft X-rays to design sub-micron VLSIs. Located at the Atsugi ECL in Kanagawa Prefecture, the ¥20 billion ($4.3 million) 5-meter-diameter particle accelerator will be ready in March 1988. Currently, NTT and NEC are developing submicron VLSIs using soft X-rays produced by the 10-meter-diameter synchrotron run by the High Energy Physics National Laboratory of the Ministry of Education at the Tsukuba Science City. The goal is to develop 64Mb DRAMs with 0.1- to 0.2-micron lines using soft X-rays with 5- to 10-angstrom wavelengths.

NTT's Information Network System (INS)

On September 25, Shuji Katayama, senior manager of NTT's Engineering Department, gave a presentation at Santa Clara's Marriott Hotel on VLSI requirements for the Information Network System, NTT's $125 billion fiber optics and satellite network. Mr. Katayama said that two key INS features will be network digitization and intelligent processing, requiring the use of new VLSI devices. In particular, the following devices will be essential to the system:

- INS 5th-Generation Computer--Intelligent, parallel processors
- High-speed VLSI--4Mb DRAM and up with 100,000 transistors
- High-speed logic--GaAs ICs, Josephson junctions, and ballistic transistors
- Optical transmission--Semiconductor lasers and optoelectronic ICs
- Mobile and satellite communications--GaAs microwave circuits
- Video processing--Wafer-scale integration (one screen of 64-color graphic data on a 4-inch, 1.5Mb wafer, and natural color display on four wafers recently announced at prototype level)
- Electronic switching and DIPS computer--16-bit and 32-bit MPUs
- Megabit memory processing (4/16/64Mb DRAMs)--Electron-beam etching for submicron and synchrotron optical radiation for sub-half-micron, plus plasma deposition equipment
- Digital subscriber loop--Audio and video codecs
- Telephone circuits--Subscriber line interface circuits (SLIC) and one-chip telephone LSIs

Of particular interest is NTT's INS Computer, a combination of supercomputer and 5th-generation technology, which DATAQUEST believes is more ambitious than MITI's 5th-generation computer because of its planned link-up with communications processing equipment. Currently, the INS Computer is being developed by the Base Intelligence Research Group at NTT's Yokosuka Electrical Communications Laboratory. According to Mr. Katayama, the INS Computer's major technologies include:

- Intelligent processing technology (knowledge base, learning, knowledge acquisition, and inference machine)
- Intelligent man-machine interface (natural language processing, speech recognition and synthesis, image processing, and automatic language translation)
- Software technology (automatic software production and testing)
- Superfast circuits

MITI's 5th-Generation Computer Project

The Science and Technology Agency (STA) and MITI's Agency of Industrial Science and Technology (AIST) announced successful development of a Japanese-to-English automatic translation system with 70 percent translation accuracy. The system runs on a Fujitsu FACOM M380 mainframe computer. The translation rate is 5,000 words per hour, with 3,000 programmed grammar rules and ROM-based Japanese and English 60,000-word dictionaries. The dictionaries will be expanded to 100,000 words. The LISP system is being used by the Japanese Information Center of Science and Technology to translate scientific and technical papers from the West. An English-to-Japanese translation system will be released next spring. DATAQUEST notes that Japanese companies, such as Bravice International and NEC, have already announced similar systems.

MITI Supercomputer Project (1981-1989)

Hitachi has announced a low-end supercomputer capable of 160 million floating point operations per second (MFLOPS), parallel pipe-line processing, and 32-kilobyte vector register. The S-810 Model 5 also offers 31-bit extended addressing capacity, a maximum 32-channel I/O capacity, 96-megabytes/second throughput, and a 128-megabyte maximum memory capacity. Priced at 20 percent less than the Model 10 (315 MFLOPS), the machine has a monthly rental fee of ¥40 million ($186,000) and will be shipped starting in January 1986. DATAQUEST believes that this machine signals a trend by Hitachi and other participants in MITI's Supercomputer Project to develop low-end machines and, eventually, mini-supercomputers.

MITI Optical Reactive Materials Project (1985-1992)

On September 17, MITI disclosed its outline for an Optical Reactive Materials R&D Project that will receive ¥6 to ¥7 billion ($28 million to $33 million) during the next eight years. MITI aims at establishing multilayer technology for photochromic material and photochemical hall burning (PHB) material that can be used for storing 100 million to 100 billion bits per square centimeter. Prospective participants include Hitachi, Mitsubishi, and Toshiba.

NEW PRODUCTS AND TECHNOLOGY TRENDS

Memory

- Fujitsu--A CMOS 72K SRAM with 8K x 9-bit organization (MB81C79); error check parity in the 9-bit part; 1.5-micron design rule; polycide gate technology; NMOS memory cell; 660mW power consumption during operation and 83mW at standby; 28-pin DIP; 5.8 x 7.24mm chip size; 45ns part priced at ¥15,000 ($62.50) and 55ns part at ¥12,000 ($50)

  A 1.7ns GaAs 4K SRAM with 600mW power consumption; faster than NTT 2ns prototype with 900mW power consumption announced last year; for use in supercomputers

  Two 16-bit ECL RAMs with 4Kx4-bit architecture; 1.5-micron design rule; 70,000 elements on 6.4x4.0mm chip; 15ns access time and 8ns device selection access; 1.25 and 1.08 watts power consumption during operation; 18-pin flat or DIP packages; priced at ¥15,000 ($70)

  The first 512K CMOS EPROM (MBM27C512); 200/250/300ns versions; double polysilicon N-channel floating avalanche-injection MOS (FAMOS) construction; 64Kx8-bit organization; 165mW power consumption at 4 MHz and below 42mW at 1 MHz; 28-pin ceramic DIP and 32-point LCC packages; sample price of ¥12,000 ($55.80) for 250ns version

  Two combo SRAM-EEPROM chips with 256x4-bit structure; operates like an SRAM when power is on, with EEPROM as backup memory when electricity shuts off; for use as control storage device; MBM-2212-20 with 200ns access time; MBM-2212-25 with 250ns access time; 18-pin DIP package; sample price of ¥3,200 ($13.30); production since October

  A 1Mb CMOS mask ROM (MB83100); 150ns access speed; 128x8-bit structure; 1.7-micron design rule; 220mW power consumption during operation; 275mW in standby; 122mW power dissipation during operation; sample price ¥5,000 ($23.25); 350ns version already available

A CMOS 256K DRAM (MB51256) in zig-zag inline package (ZIP) and plastic lead chip carrier (PLCC) package; for 100-mil grid PC boards for DIP-chip mounting at densities 50 to 80 percent greater than DIP packages; ZIP sample devices ¥2,700 ($12.55) and PLCC version ¥3,500 ($16.30)

A 4-Mbyte bubble memory being sampled with customers; marketing during second half of 1985

- Hitachi--A prototype 16Mb compound magnetic bubble memory using ion implantation to lay a garnet thin-film surface coating on a gadolinium-gallium-garnet substrate; 3.0 x 3.5mm memory cells; reverse movement prevented by permalloy elements; commercialization planned for 1986; prototype 64Mb bubble memory planned for 1988

  A bubble disk file memory compatible with conventional 8-inch flexible disk systems; three configurations available (0.25MB, 0.5MB, and 1.2MB)--sample prices ¥160,000 ($667), ¥200,000 ($930), ¥260,000 ($1,210), respectively; sales since September

  Two CMOS 256K SRAM samples (HM62256), one with battery backup; 80/100/120ns access times; 28-pin plastic DIP package; pin-compatible with Hitachi's 64K SRAM

- NEC--A 2Mb CMOS mask ROM using 1.2-micron design rule; 2.4 million elements on a 6.63 x 8.42mm substrate; 250ns access time; 40mA power consumption during operation and 100 mmA at standby; 181,072x16-bit organization in word mode and 262,144x8-bit in byte mode; 40-pin plastic or ceramic DIP packages; pin-compatible with 1Mb EPROM under development; priced at ¥8,000 ($33) for lots of 1,000

- Nippon Denso--A 1Mb DRAM by Japan's top automotive electronics maker to enhance its electronics expertise in automotive components; no plans for commercialization

- NMB Semiconductor--CMOS 256K DRAM sampling; 150/200ns access time; N-channel process; technology from Inmos; production at Tateyama plant in Chiba

- NTT--Joint development of 64Mb DRAM using synchrotron equipment with Hitachi, Toshiba, and other makers; goal of 100Mb DRAM by the year 2000

- Oki Electric--A 1Mb CMOS ROM with a 15mA active operating current and 100uA standby current (MSM531000); 131,071x8-bit organization; easy interface with 80C86/88 CMOS MPU that Oki manufactures under license from Intel: 250ns access time; TTL-compatible; 28-pin plastic DIP; priced at $23 in lots of 5,000

A 120ns CMOS DRAM (MSM41256-12); fully decoded; page-mode type with 262,144x1-bit organization; 16-pin dual in-line package; 385mW power consumption during operation and 28mW at standby; priced at $5.80 in lots of 100

- Sony--A 512K EEPROM; 5-volt power supply; 32x16-bit structure; 20mW power dissipation; ¥700 ($3.25)

  Three series of Chinese character generator NMOS ROMs; 682/3755/3800 character capacity; low-scan CRT method; 24x24-bit, sample price of ¥50,000 ($230); low-scan method 16x16-bit; ¥20,000 ($93); column scan method 24x24-bit, ¥30,000 ($140), low-scan CRT display with 350ns access time; 1Mb mask ROM; ceramic 28-pin DIP; column scan with 250ns access time; 1.2Mb mask ROM; ceramic 40-pin DIP

- Suwa Seikosha--3 CMOS 1Mb mask ROMs; a 450ns asynchronous static device (SMM23100C) in 280-pin plastic DIP; a 250ns device (SMM63100C) in 28-pin plastic DIP; and a 450ns synchronous device in 40-pin package

  Two CMOS 64K EPROMs; 100/150ns access time; 28-pin glass window ceramic package

- Toshiba/Siemens--Technical agreement to jointly develop and manufacture Toshiba's 1Mb CMOS DRAM; Siemens to build a new plant in fall of 1985 and sample 1Mb DRAMs by the summer of 1986

__Application-Specific Memory (ASM)__

- Dai Nippon--A 2Mb ROM optical card on a standard plastic card with dimensions of 85.5 x 54 x 0.75mm; first layer printed on a photosensitive surface from a master mask; light-reflective area for the second layer; CCD image sensor reader; 422K memory cards priced at ¥200 to ¥400 ($80 to $1.25)

- Hitachi-Maxell--IC cards with EPROMs and EEPROMs for banking and financial institutions, distributors, medical warehouses, and government agencies; EE-64 IC card with 64K EEPROM priced at ¥15,000 ($62.50); EP-1 64K ROM IC card priced at ¥12,000 ($50); EP-2 256K EPROM priced at ¥15,000 ($62.50); MR-01 card reader-writer priced at ¥50,000 ($208); MR-121 card reader-writer with 10-key entry priced at ¥90,000 ($375)

- Toshiba--A VHS VTR with a built-in digital memory circuit; four 256K DRAMs and two 64K DRAMs; VTR priced at ¥169,800 ($790)

Microprocessors/Microcontroller

- Hitachi/Mitsubishi--32-bit MPU joint development through Tokyo University's TRON Project headed by Professor Ken Sakamura; goal of commercializing devices by 1987

- Hitachi--Two flexible disk drive controllers; HA16656M with a read data reproduction IC and gate signal-generation circuits; HA16652P/MP with a read-write amplification IC; sample prices of ¥2,000 ($8.37) and ¥1,500 ($6.30)

  Joint development of CMOS 16/32-bit MPU with Motorola (68HC000) sampling from November; 8/10/12.5MHz versions; ceramic 64-pin DIP; 68-pin PGA; 100mW power dissipation; 300mw for 12.5 MHz version; 68-pin PLCC; 64-pin DIP plastic from 1986

  A CMOS 16/32-bit 68000 MPU jointly developed with Motorola (68HC000); 8/10/12.5 MHz speeds; 2-micron geometry; 100mW standard and 200mW maximum at 12.5MHz operating speed; 64-pin DIP and 68-pin pin grid array; 68-pin PLCC and 64-pin plastic DIP available from first quarter 1986

  Two fluorescent display controllers using a semi-isolation pattern process that puts a high-resistance transistor on epitaxial layer and a high-speed, bipolar transistor on thin epitaxial layer; anode and grid driver each priced at ¥5,000 ($23); 5-MHz logic circuit with 150V voltage

- Matsushita--A high-performance, bit-map CRT controller (MN8356) that has 64K CMOS RAM for high-speed transfer of picture data at 20ns per dot (monochrome) and 500ns (16-bit color gradation); 2-layer, 2-micron CMOS silicon-on-aluminum; 85,000 transistors; 98mm square device; 84-pin flat package; sample price of ¥20,000 ($93)

- Mitsubishi--A multifunction CMOS controller for video and television remote controls (M50461-SP); 1Kx8-bit ROM, 32x4-bit RAM; 3 nanowatt power consumption; 2.2 to 5.5V operating voltage at 37.9 kHz to 40 kHz; 30-pin shrink-DIP package; sample price of ¥350 ($1.65)

- A one-chip read-write logic controller for flexible disk drives (M52810EP) using a bi-CMOS process; bipolar read-write analog circuits and CMOS digital logic control circuits; 5V or 5V/12V power supply; standard I/O for 3.5-inch drives

  An MCU for VTR and television remote control signals (M50460-P); 500x8-bit ROM, 16x4-bit RAM; sampling at ¥350 ($1.60)

- NEC--A high-speed CMOS interface IC (uPD4701C) for optical mouse data entry and control devices; three switch inputs; data exchange between central processor and peripheral terminal on a CPU-compatible, 8-bit data bus; 10mW power consumption during operation and 250mW at standby

V Series MPUs being sold in Akihabara area in Tokyo at 30 to 40 percent lower prices than Intel products; 16-bit uPD70116-8 (V30) priced at ¥3,400 to ¥4,000 ($15.80 to $18.60); 8-bit uPD70108-8 (V20) priced at ¥3,000 to ¥3,600 ($13.95 to $16.75)

- Sharp--Two CMOS 8-bit single-chip MCUs (SM803 and LU800V1) that are compatible with Zilog's Z8; 7.14 x 5.74mm chip size; 1.5 microsecond minimum command execution time; 4K mask ROM, 60K external memory address space, 144 bits of register file and 32 I/O ports on SM803 model; 64K memory space, 144 bits, and 24 I/O ports on LU800V1; sample price of ¥3,000 ($12.50) and ¥2,600 ($10.80), respectively, 2.0-micron rule using CMOS silicon gate process

- Sony--Two high-speed 4-bit CMOS single-chip MCUs; built-in LCD controller/driver and eight LCD segment outputs in CXP5024; 4,096x8-bit ROM; 224x4-bit RAM; priced at ¥800 ($3.30); general-purpose model CXP5000; 224x4-bit internal RAM; 8,192x 8-bit ROM; 64-pin shrink piggy-back package; for VCRs and CD players

- Suwa Seikosha--Three CMOS 8-bit single-chip MCUs with built-in gate arrays equal to 200 three-input NAND gates; 512 bytes ROM and 16x4-bit RAM in SMC4040C; 1,024 bytes ROM, 32x4-bit RAM in SMC4050C; 24- and 28-pin DIPs; 24-pin mini-flat package

- Two 4-bit MPUs in 9 versions (SMC6000 Series); 1Kx12-bit ROM and 489x4-bit RAM (SMC6110F); 2Kx9-bit ROM and 966x4-bit RAM (SMC6120F); 122ns and 244ns; 60-pin and 80-pin flat packages; priced at ¥360

- Tokyo Sanyo--A high-speed one-chip MCU (LC7980) for dot matrix displays; 640x256-bit LCD panel; 10Mb/sec. data transmission

- Toshiba--Four CMOS serial I/O controllers that function as peripheral LSIs for Z80 MPU; I/O terminals with two channels that permit simultaneous transmission and reception; synchronous data link control that prevents interference of control and data signals and allows standard interface control; two devices in 44-pin flat package for synchronous, high-speed communication; two devices in 40-pin DIP packages for lower-speed communications; sample price of ¥2,500 ($10.40)

  A CMOS voice recognition LSI using switched capacitor filter technology; sample price of ¥2,000 ($9.30)

- Toshiba--A one-chip voice recognition LSI with 4K or 16K RAM (T6658A) using switched capacitor filter technology; combines pre-processing, recognition circuits, and voice registration memory on 6mm square chip in a 67-pin package

Digital Signal Processor (DSP)

- Fujitsu--An ultra-high-speed image processing system capable of processing 30 frames per second (multistage switching network); capable of various image-processing applications; 32-bit 68000-based minicomputer with 16 processor modules that perform histogram computation, light-shade conversion, and image calculations

- Sharp--A DSP LSI for use in stationary-head digital audio tape recorders; sampling in October

- Sony/Toshiba--Two DSP LSIs to provide image playback graphics for compact disk audio systems; one image processor and one for generating horizontal and vertical image synchronous signals; designed under Sony/Philips specifications; comparable to 70 conventional ICs; synchronous signal IC capable of generating signals for television broadcasting in the United States and Japan (NTSC), and in Europe (PAL)

Standard Logic

- Hitachi--Two driver LSIs for fluorescent display tubes; built-in high logic circuits; 150V resistance pressure; sample price of ¥5,000 ($23.25)

- Mitsubishi--A one-chip, read-write, logic control LSI for flexible disk drives (M52810EP) using a Bi-CMOS process; bipolar, read-write analog circuits, and CMOS digital logic-control circuits integrated on the same chip; 5V or 12V power supply

Application-Specific IC (ASIC)

- Hitachi--Bi-CMOS gate array series; 0.8ns delay time; 603 to 2,500-gate products; orders taken starting in September

- NEC--A low-price gate array product line housed in plastic PGA packages that cost 25 percent to 40 percent less than ceramic PGA packages; 2ns 2,100 to 11,000 gate arrays and 1.4ns 2,100 and 20,000 gate arrays in 72-pin packages; 2ns 3,300 to 11,000 gate arrays and 1.4ns 3,700 to 20,000 gate arrays in 132-pin packages; 208-pin packages available by late 1985

  Standard cell orders taken starting in September; 1.5-micron CMOS process; 1.4ns delay time per gate; 120 cells; 12mA buffer; RAM, ROM, bit-slice CPU, and peripheral ICs

Eight CMOS gate arrays with 1.4ns gate delay and 4.5ns output buffer delay time at 5 picoF load; 2,100/3,700/4,700/6,700/8,000/10,500/14,000/20,000 gate devices; development cost of ¥4.4 million ($18,300) for 2,100 gate products priced at ¥1,700 ($7.10) in lots of 10,000

Four CMOS gate arrays featuring 1.5-micron geometry and 1.4ns delay time 320/500/1000/1500 gates; 54-pin package for 320-gate device; 100-pin for 1,500 gate device; $1.00 per unit for 320-gate arrays in 10,000-piece lots; $6,250 development cost

- NTT Atsugi Lab--An experimental 5,000-gate array with 165ps access time; faster than previous record of 265ps; 80ps per gate

- Oki--Four 1.5ns CMOS gate arrays; 3100/4400/6000/8000-gate arrays in 86/102/126/148-pin packages, respectively; ¥6 million ($27,900) development cost and $9.60 unit price for 2,000 units of 3,100-gate device; ¥8.6 million ($40,000) and $9.60 unit price for 8,000-gate device in lots of 1,000

  A CMOS standard cell series (MSM91000) to enter the LSI market in October; 1.5ns, 2-micron process; 30ns standard RAM access time; up to 25,000 gates and 208 pins

- Ricoh--Four CMOS electrically programmable logic arrays (EPLs) for programming logic circuits onto an array of EPROM memory cells; 35ns delay time; logic circuit with AND(fixed)-OR/XOR construction and three with AND-OR/XOR register construction; available in 20-pin plastic DIP and 20-pin ceramic DIP; sample prices of ¥3,000 ($14.00)

- Toshiba--An agreement to jointly develop next-generation gate arrays ("Sea of Gates") with more than 20,000 gates using 1.5-micron process; cooperative R&D agreement to be expanded eventually to 50,000 and 60,000 gate arrays

  Two gate arrays using CMOS silicon-on-sapphire (SOS) technology; 8,370 gate array (T7027) with 35,000 elements on a 9.84 x 9.92mm chip using 1.8-micron CMOS process; 0.75ns gate delay time; 16-word x 16-bit multiplier with 11,500 elements on a 435mm square chip using 1.8-micron CMOS pattern (T9503); 250mW power consumption; T7017 priced at ¥50,000 ($208)

<u>CAD Systems</u>

- Seiko Electronics--A VLSI CAD workstation (SX-8000) that runs on a VAX-II; for single users

Optoelectronics

- Matsushita--Eleven LEDs for glass fiber optic communication links; seven GaAs LEDs in LN180 series for 0.8-micron band at 30- to 70-MHz frequency ranges; four InGaAs LEDs in LN190 series in 80- to 100-MHz frequencies for 1.3-micron, long-distance cable links

  A new thin-film technology to develop 1.3-micron multiquantum well laser diode; 100-angstrom ultra-thin films raised using an improved liquid phase epitaxial growth method at 589 degrees centigrade; prototype 5-layer InGaAsP laser diode operating at a 15-milliampere threshold current

  A In/InAs semiconductor laser for coherent optical communication systems; new device capable of 100,000 times the information of existing lasers; 0.9-MHz wavelength

- Mitsubishi--An AlGaAs/GaAs distributed feedback single-mode laser diode with continuous beam generation; 42-milliampere threshold current; coherence measurement and high-quality pickup for digital audio and video disks; MBE growth method under ultra-high vacuum used; developed for government program

  Two photocouplers; 50mA corrector; 35V corrector/emitter; 5KV I/O voltage; 6-pin DIP; sampling at ¥85 ($0.40) starting in September

- NEC--World's first AlGaInP 689.7nm visible light laser diode that continuously generates light at normal room temperature; developed using special air lock system for metal organic chemical vapor deposition (MOCVD) system; potential for developing 580nm visible yellow-light laser diode; plans for commercial 630nm visible light laser diode in five years

  Two 1.5-micron photodiodes for optical fiber telecommunications; commercialization by 1990; one diode capable of transmitting 2Gb/sec for 161km; second capable of transmitting 565Mb/sec. for 204km; sample photocouplers for general use and high-speed optoelectronic communications; a GaAlAs infrared LED and silicon phototransistor on a 4.0x4.4x2.0mm package (PS2101) in a 4-pin, mini-flat package; 10-microsecond response time; sample price of ¥60 ($0.28); GaAlAs LEDs with photodiode transistors on the same 7.08x7.60x3.50 substrate (PS2041/PS2042); 0.3 microsecond response time; compatible with Matsushita products

- Optical Technology Joint Research Center--A new epitaxial crystal growth technique for optoelectronic ICs (OEICs) integrating laser diodes with transistors; MBE method combined with maskless focused ion beam implant method to form GaAs/AlGaAs crystals by selectively injecting ions to form p/n layers; for use in heterostructure bipolar transistors

- Sanyo--A new method for developing high-purity, large-diameter single crystals of silundum carbon silicon for blue LEDs (the sublimation method); silundum vaporized through high-temperature (2,300 degrees centigrade), low-pressure treatment to grow 33mm diameter single crystal ingots that could yield 10,000 LED chips; commercialization planned for full-color blue LED displays; blue LEDs with 7 to 8 candela brightness at 3.5 volts possible

- Sharp--A photocoupler series that complies with West German VDU 0730 specifications for internal insulation; 5,000V rms insulation resistance, 2.54mm pin pitch, and 8-pin DIP package priced at ¥250 ($1.16) for PC904; PC100 and PC101 priced at ¥200 ($0.93)

- Sony--Four high-output GaAlAs semiconductor lasers produced using MOCVD; multimode type with gain-guide taper stripes (SLD201/SLD202) with maximum light output of 20/25mW and operating wavelength of 780/820nm respectively; self-aligning, narrow-stripes (SLD203/SLD204) with maximum light output of 30/40mW and output wavelength of 780/820nm, respectively

  Two CMOS charge-coupled device (CCD) time-base correctors for video equipment (CXL1003P); 680-element CCD, clock driver, auto bias circuit, and clock frequency adjustable between 6 and 14 MHz; 8-pin, dual in-line package; priced at ¥1,000 ($4.65)

- Stanley Electric--An infrared LED with 15mW output; 70 to 100 times faster response time; low-cost lighting source for optical communications; sample price of ¥2,000 ($9.30)

- Tokyo University--A semiconductor laser for environmental sensing using a CCD line sensor

Image Sensors

- Sony--Two CMOS CCD time-base correctors for video equipment; time base corrector for audio signals (CXKL1003P) with a clock driver, auto bias circuit, and 680 elements in an 8-pin dual-in-line (DIL) package; priced at ¥1,000 ($4.20); time-base corrector for video signals (CSL1004P) with 15.2 to 27.2 MHz frequency range and 680 element in 24-pin DIL; priced at ¥2,400 ($10)

Gallium Arsenide

- Fujitsu--A high-electron mobility transistor (HEMT) low-noise amplifier for 20 to 30 GHz satellite communication ground relay stations; GaAs and AlGaAs heterojunction placed between a Josephson junction and GaAs device; cooled by Peltier effect to -50 degrees centigrade; 1.71dB noise index and 140 degree Kelvin noise temperature; 38dB gain with received power amplified 6,000 times at 200W power consumption

A tunneling hot electron transistor ("chirp" RHET) consisting of multi-layers of AlGaAs and GaAs; potential for 1ps switching speed using tunneling effect

A 4K GaAs SRAM with 600mW power consumption; 1.7ns access time; faster than NTT 2ns prototype with 900mW power consumption announced last year; 27,000 transistors on a 5.5x3.7mm chip

A high-output GaAs FET for the transmission amplifier of a 12-GHz (Ku-band) satellite transmitter; 3-watt output and 6dB power gain, with 40 percent operating efficiency; 0.5-micron gate; gold-plated heat sink through-hole construction with air-bridge electrode wiring in a nonresonant package; priced at ¥1 million ($4,650)

- Institute of Industrial Technology--CMOS-type ultra-high density GaAs LSI transistor described as silicon-insulator-silicon (SIS) FET structure; 3-layer structure consisting of N layers over a layer of insulation deposited on GaAS substrate; MBE method used; theoretically possible to develop 1Mb SIS FET device with 0.6-watt power dissipation and 4Mb with 1 watt

- Japan Aerospace Industry Association--GaAs semiconductor compounds to be raised on U.S. space shuttle in May 1986; space lab experiments to include raising GaAs crystals, examining the effect of bismuth dopants, forming a thin single crystal film of gallium antimony over an insulator substrate, conducting vapor growth experiments with In, Ga, and Al, raising crystals by diffusion method for optoelectronics, and melting and solidifying lead silicon; expected cost of experiments about $1.2 million

- Matsushita--A GaAs Hall element with a 300-millivolt output voltage; for use as rotation controller and position sensor for VTRs and compact disk players; replacement for indium-antimony; sample price of ¥80 ($30)

- Mitsubishi--A high-integration GaAs FET with 0.2-micron gate width; 1.08dB noise index at 12 GHz; mutual conductance of 170 to 180 milliseconds per millimeter; 6- to 12-dB gain; E-beam focusing improved by using 100-KeV double-charged silicon device with ion irradiation through an 0.5-micron thick mask

  Three GaAs FET amplifier modules with 1.8dB gain and 2.2 to 2.4dB noise; FA12201 for business telecommunication systems and DBS in Japan; 11.7 to 12.2 GHz; priced at ¥7,500 ($34.90); FA12202 for DBS in the United States and Australia (12.2 to 12.75 GHz), ¥8,000 ($37.20); FA12203 for DBS in Europe; 11.7 to 12.5 GHz, ¥8,000 (NDJ/300)

- NEC--New technology to fabricate GaAs logic circuits with 3,000 gates and a 30ps delay time; commercial-quality GaAs logic at 16K reached; result of MITI's Supercomputer Project

A prototype high-speed GaAs FET capable of 602 millisiements per square millimeter at room temperature, or three times conventional FETs; reduced resistance in central electrode made with self-aligned gate structure; silicon oxide insulator applied to walls of tungsten silicide gate

A 5ps GaInAs transistor employing a 5-atom thick AlAlAs film over a GaInAs substrate; twice the speed of conventional GaAs; mutual conductance value 1.5 times greater than HEMT; 5ps switching speed achieved at normal room temperature (equal to Josephson device at -270 degrees centigrade); for use in developing high-speed ICs and ultra-high-speed transistors for communications systems

- Nippon Metals--Sampling 2-inch GaAs wafers starting in October; plans for 3-inch wafers in the future

- Oki Electric--A "reverse HEMT" with AlGaAs and GaAs layers over AlGaAs substrate; 0.7 micron elements; 30 millivolts for 1,000-element prototype

  High-purity GaAs crystal grown on silicon substrate; experimental material being developed under MITI New Functions Element Project's superlattice project

- Physical and Chemical Research Institute--A laser beam irradiation MOCVD process for increasing GaAs crystal epitaxial growth by 100 times; crystal growth pattern isolated and epitaxial layer thickness controlled; semiconductor masks fabricated without mask reticles; precise control of GaAlAs doping; argon laser used to irradiate substrate in a chamber filled with gas compound of trimethyl gallium, hydrogenated arsenide, and hydrogen; further work to reduce crystal width from 350 microns to several microns

<u>Josephson Junctions</u>

No major announcements.

<u>Standard Logic</u>

- Mitsubishi--A prototype prescaler IC using silicide-self-aligned silicide base, contact technology (SCOT); 2.1-GHz operation frequency and 56mW power consumption; 27 patents filed two years ago

Bipolar Digital

- Fujitsu--Two 16K ECL RAMs with 4Kx4-bit structure; U-shaped isolation and 1.5-micron pattern; 70,000 elements on 6.4x4.0mm chip; 15ns access time; 8ns device selection access; 1.25 watt (MBM10484-15) and 1.08 watt (MBM100484-15) power consumption during operation; 18-pin flat or DIP packages; priced at ¥15,000 ($70)

- Matsushita--Sampling advanced low-power Schottky (ALS) TTL; 4ns access time; 1mW power dissipation

- Mitsubishi--A pre-scaler IC that can handle 2.1-GHz frequencies at 56mW with a power dissipation of 63mW; frequencies of 1.4 GHz at 30mW and 850 MHz at 19mW also handled; for use in mobile wireless systems and satellite broadcasting receivers; silicide-self-aligned silicide base, contact technology (SCOT); 27 patents filed 2 years ago; SCOT bipolar transistor with 11.5-micron wide emitter capable of reaching 9.6-GHz cutoff frequency

- TDK Corporation--Eight high-output, TTL delay lines; 8-pin DIP packages with Schottky TTL in a transfer-molded, resin unit; 60ns input/output times; low-profile (5.08mm) for automatic insertion mounting

Linear/Analog

- NEC--Two hybrid ICs for satellite microwave amplifiers; 15,000 times amplification of weak signals; ultrasmall earth stations with power supply equipment possible; sample price of ¥132,000 ($614)

- Rohm--A linear IC (BA1610) for frequency-shift keying for local area networks and data communications links; a transmission IC and receiving IC integrated on one chip; half-duplex send-receive capability and a phase-locked loop method to prevent operation errors; 26.3x6.5x3.4mm 20-pin DIP package

  A single-chip digital servo LSI using linear CMOS process for controlling rotation and phase for VCR drums (BU2710S); 40mW power consumption; 4.5V to 6V operating voltage range

Discretes

No major announcements.

New Semiconductor Functions

- Ajinomoto/Tokyo Institute of Technology--A prototype bioelectronic switching device (biochip) that combines protein from fish eyes with an ion-sensitive FET; silicon nitride insulating membrance coated with porous acetyl cellulose membrane film; pores filled with a deep red, photosensitive pigment found in fish retinas (rhodopsin), combined with phosphatidyl choline by ultrasonic wave irradiation, and immobilized; 100mW time electrical potential generated

- Fujitsu--A hot electron transistor (HET) potentially faster than a Josephson junction device; MBE method used to develop multilayer structure of GaAs/AlGaAs laid over a GaAs substrate; total of seven layers; tunneling effect employed to achieve 1.3 amplification of electrical currents

- Hitachi--A semiconductor laser 2-dimensional device simulator called Hitachi Laser Diode Engineering (HILADIE) software; capable of analyzing electron movement and laser oscillation using Hitachi's S-810 supercomputer

- MITI--High-sensitivity biosensor developed at Electrotechnical Laboratory in Tsukuba

- Tokyo University--A 3-dimensional IC using amorphous oxidized silicon; group headed by Professors Takagi and Ishikawa; 0.35-micron thin-film layer; ion beam and plasma CVD methods used

- Toshiba--A new 3-dimensional IC technology for 4Mb and 16Mb DRAMs; 4mm square single crystal silicon film grown on an IC substrate covered with an insulating film; goal of practical use within five years

New Processes

- Toshiba--A prototype 73-stage ring oscillator with a 49ps delay time using a 50KV electron beam generator to achieve a 0.25-micron pattern; use of proximity effect that spreads light and creates an uneven exposure over the pattern; for use in 4Mb, 16Mb, and 64Mb DRAMs

- New Metals National Research Institute--A method to produce large single-crystal tungsten from tungsten polycrystals by injecting calcium and magnesium to polycrystal tungsten powder; pressure molding and sintering at 1,850 degrees centigrade to develop compound, which is then hot-rolled into sheets and annealed at 2,500 degrees

- Toshiba Ceramics--Plans to build central research laboratory to develop silicon substrates for 16Mb DRAMs

Manufacturing Processes

- Toshiba--A bias exposure photolithography method to develop 0.25-micron geometries for 64Mb DRAMs

- Toshiba/Toshiba Ceramics--A high-precision, long-lasting lapidary disk to polish silicon wafers; 105cm diameter for 4-inch wafers; 120cm diameter for 5-inch wafers; priced at ¥950,000 ($4,420) per disk

- Ultrasonic Engineeering--A fully automatic gold wire bonder for hybrid ICs (UBB-7-1A); moving sphere of manipulator plus/minus 35mm in X and Y directions; 64-chip maximum pattern recognition capability; priced at ¥15 million ($69,800)

Manufacturing Equipment

- Fuji Electric--A dust counter capable of measuring 0.11-micron dust particles for 1Mb DRAM class VLSIs

- Institute of Industrial Technology--An X/Y table to detect the accuracy (within 0.01 micron) of placing a wafer mask over the wafer, using synchrotron orbital radiation (SOR) lithography; potential use for developing 0.1-micron geometries for 256Mb DRAMs and up; greater accuracy than steppers, E-beam, and X-ray lithography that are only sufficient for up to 0.3-micron geometries

- Seiwa Sangyo--Three dust-proof clean chambers for producing and storing ICs; Class 10 level for CBS-100 and CBS-200; Class 100 for CBS-300

- Shimizu Construction--A filter system that removes 99.9 percent of the fine salt particles from air, enabling companies to build plants near the ocean; a 3-stage filtering system priced at ¥20 million ($83,000)

- Tamura--A compact automated solderer for soldering lead frames of DIP devices (EC15-42S); capable of soldering 5,200 chips per hour on a 16-pin IC

Test Equipment

- Ando Electric--A VLSI memory tester for 1.6Mb DRAMs and SRAMs (DIC8042); 40-MHz test rate with plus/minus 1.1ns timing accuracy, 100ps resolution, and 100ps strobe resolution; autohandler (AH-633) capable of measuring 16 devices at the same time

- Anritsu Electric/Mitsui--A helium-neon laser probe (Data Probe 2010) to locate defects in logic ICs; 1.8-micron laser operating under 20 MHz without vacuum equipment to inspect chips at 18 to 25 degrees centigrade

- Nihon Den-Netsu--In-circuit IC tester (NCT-1200) with an automatic guarding system; capable of automatically inspecting for solder bridge, poor insertion of mounted parts; disconnected patterns, and short circuits; 2-second testing of short and open circuits on 320 pins

- Takeda Riken--DC analyzer (T661A) to measure DC parameters of MOS devices for up to six channels ranging from 0.01 picoA to 500mA and 10 microV to 1,500V, priced at ¥7.1 million ($29,600); companion system (T661A) for other devices priced at ¥10.79 million ($45,000)

Packaging

- Mitsubishi Metals--A low-void solder suitable for die bonding with a ceramic-sealed package; dissolved gases and oxides reduced to 2 to 5 parts per million

- NEC--A transfer-mold package for Compact Series hybrid ICs; CK24/C42/C64 devices in flat and mini-flat packages with 2.54mm and 1.778mm lead pitches

Sheridan Tatsuno

Nielsen Dataquest RESEARCH BULLETIN

JSIS Code: JSIA Bulletin

THE THIRD WAVE: THE SURGE IN SEMICONDUCTOR START-UPS CONTINUES

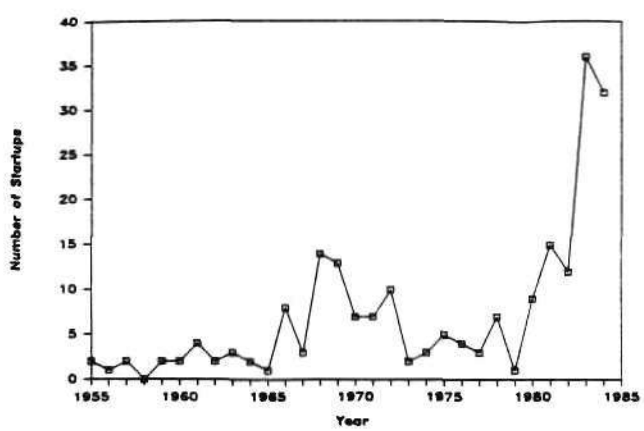
Semiconductor entrepreneurialism is still alive. Despite one of the worst downturns in the industry's history, DATAQUEST observes that semiconductor start-ups are still appearing at a record number. Since 1977, we have recorded 125 start-ups worldwide, an average of one new company every three weeks. Of these 125 companies, 74 start-ups are located in California's Silicon Valley (59 percent), 7 in Southern California, 15 in the Midwest, 9 on the East Coast, 8 in Europe, 8 in Asia, and 4 in Canada. In 1985, there have been 10 new companies, but we expect twice that many by the end of the year. These start-ups have extraordinary staying power. Of the 125 start-ups, only a half dozen have closed their doors.

DATAQUEST believes the industry is witnessing its third wave of technological innovation, as shown in Figure 1. During the 1950s, we witnessed the rise of transistor start-ups. In the late 1960s, PMOS and NMOS device makers appeared. Now, a wave of CMOS, gallium arsenide, ASICs, digital signal processing, and specialized linear, power transistor, and graphics start-ups are opening their doors. These start-ups are securing seed capital from foreign venture capitalists, corporate investors, and OEMs, and pursuing strategic alliances. DATAQUEST believes that 1984 will surpass 1983 as the peak year, since most start-ups maintain a low profile for several years (see Table 1).

Sheridan Tatsuno

Figure 1

SEMICONDUCTOR START-UPS
(1955-1984)



Source: DATAQUEST

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Table 1

SEMICONDUCTOR START-UPS (1983-1985)

Company	Location	Products
1983		
Altera Semiconductor	Santa Clara, California	Erasable PLDs
Bipolar Integrated Tech.	Beaverton, Oregon	Bipolar ICs
Calogic Corp.	Fremont, California	DMOS FET arrays
Custom Silicon	Lowell, Massachusetts	ASICs (std. cells)
Elantec	Milpitas, California	High-performance analog
Electronic Technology	Cedar Rapids, Iowa	CMOS ASICs
Exel Microelectronics	San Jose, California	EEPROMs
Hypres	Elmsford, New York	Josephson junction
Inova Microelectronics	Campbell, California	SRAM modules, MSI
Int'l. CMOS Technology	Cupertino, California	Nonvolatile memory
Int'l. Logic Systems Inc. (ILSI)	Colorado Springs, Colorado Santa Clara, California	CMOS and bipolar logic
Iridian Microwave	Chatsworth, California	GaAs FETs
Ixys Corporation	Santa Clara, California	Power monolithics
Lattice Semiconductor	Portland, Oregon	NMOS/CMOS memory/logic
Laser Path	San Jose, California	CMOS logic
Logic Devices	Sunnyvale, California	CMOS DSP
Maxim Integrated Products	Sunnyvale, California	CMOS linear ICs
Metalogic Corp.	Cambridge, Massachusetts	Silicon compiler
Micro Linear Corp.	San Jose, California	IC filters, D/A, A/D
Microwave Technology Inc.	Fremont, California	GaAs FETs, amplifiers
Modern Electrosystems (Hyundai Electronics)	Sunnyvale, California	N/CMOS memory, logic
Mosel	Sunnyvale, California	MOS memory
Novix	Cupertino, California	RISC MPUs
Opto Tech.	Hsinchu, Taiwan	Discretes
Seattle Silicon	Bellevue, Washington	Silicon compiler
Sierra Semiconductor	San Jose, California	CMOS ASICs
Silicon Design Labs	Liberty Corner, New Jersey	Silicon compiler
S MOS Systems (Suwa Seikosha)	San Jose, California	CMOS memory and logic
Texet Corp.	Richardson, Texas	Power ICs, MOS FETs
Tristar Semiconductor (Samsung)	Santa Clara, California	NMOS/CMOS memory and logic
Vatic Systems (Thomson S.A.)	Mesa, Arizona	ASICs
Visic	San Jose, California	NCMOS memory
Vitelic	San Jose, California	BCMOS memory
Wafer Scale Integration	Fremont, California	ASICs
Xtar Electronics	Elk Grove, Illinois	Graphics ICs
Zoran	Sunnyvale, California	DSP
1984		
Anadigics	Morristown, New Jersey	GaAs A/D converters
Array Logic	Cambridge, United Kingdom	CMOS, bipolar ASICs
Atmel Corp.	Milpitas, California	EEPROMs
Calmos Systems	Kanata, Ontario, Canada	ASICs
China Ling Lang Microelectr.	Mainland China	ASICs
Chips & Technologies Inc.	Milpitas, California	ASICs
Crystal Semiconductor	Austin, Texas	Telecom ICs
Dallas Semiconductor	Dallas, Texas	CMOS memory
Exmos Semiconductor	Calgary, Alberta, Canada	Telecom ICs
Ikos Systems	Sunnyvale, California	ASICs
Inova Microelectronics	Campbell, California	MMICs, megabit memory
Integrated Logic Systems	Colorado Springs, Colorado	ASICs, PLAs
Integrated Power Semiconduc.	Livingston, Scotland Santa Clara, California	Linear
Lea Technologies GMVPE	St. Laurent, Quebec, Canada	GaAs buffers
Micro MOS	Santa Clara, California	CMOS memory
Micron Semiconductor, Ltd.	Lansing, Sussex	Silicon detectors
Modular Semiconductor	Santa Clara, California	CMOS memory & MPR
NMB Semiconductor	Tokyo, Japan	CMOS memory
Pacific Monolithics	Sunnyvale, California	GaAs MMICs
Performance Semiconductor	Cupertino, California	CMOS MPU/mem/logic
Quasel	Santa Clara, California	CMOS ASMs
Silicon Macrosystems	San Jose, California	CMOS memory
STC Components Ltd.	Paignton, England	GaAs, ASICs, foundry
Taisel	Taipei, Taiwan	Hybrid ICs
Teledyne Monolithic Microw.	Mountain View, California	GaAs analog ICs
Topaz Semiconductor (Hytek)	San Jose, California	DMOS ICs
TriQuint Semiconductor	Beaverton, Oregon	GaAs ICs
Vitesse Electronics	Camarillo, California	GaAs ICs
VTC Inc.	Minneapolis, Minnesota	High-perf. bipolar
Yageo	Taipei, Taiwan	Hybrid ICs
Xilinx	San Jose, California	CMOS logic array
1985		
ABM Semiconductor	San Jose, California	AlGaAs opto devices
Acumos (old Semi Processes)	San Jose, California	CMOS gate arrays
Advanced CMOS Devices	Cupertino, California	CMOS memories
Celeritek	San Jose, California	GaAs FET amps
Clarity Systems (Israel)	Sunnyvale, California	ASICs
European Silicon Structures	Munich, West Germany	ASICs
Gain Electronics	Princeton, New Jersey	GaAs ICs
Quodos Ltd.	Cambridge, England	ASICs
Tachonics (Grumman)	Bethpage, New York	GaAs ICs
Unicorn Microelectronics	San Jose, California	ASICs
Wolfson Microelectronics	Edinburgh, Scotland	ASICs, DSP

Source: DATAQUEST

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

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THE NEW MITSUBISHI SAIJO FACTORY-- A FULLY AUTOMATED FACILITY

INTRODUCTION

DATAQUEST recently had the exceptional opportunity to visit Mitsubishi Electric Corporation's impressive new semiconductor factory located in Saijo on the island of Shikoku, Japan. DATAQUEST was escorted on the factory visit by Dr. Hiroyoshi Komiya, Deputy Manager of the Saijo factory, and Mr. Shigeru Funakawa, Semiconductor Overseas Marketing Manager for Mitsubishi. This factory, the first semiconductor facility on the island of Shikoku, was completed in early 1984 and is a fully automated front- and back-end facility dedicated to the production of DRAMs. The entire production process from bare silicon wafer start to final packaged and tested part is completely automated.

Dr. Komiya has been invited to give a talk on the Saijo facility at DATAQUEST's annual Semiconductor Equipment and Materials Conference held October 14 through 17 in Tucson, Arizona. The theme of the conference will be "An Industry in Transition." Dr. Komiya's talk on the Saijo facility at the conference should, indeed, be a very interesting topic, as attested to by the following brief overview of our visit to the facility.

THE SAIJO FACTORY

Presently, the Saijo factory consists of production buildings B and C, each of which has three floors covering 22,000 square meters of floor space. Building B is dedicated solely to the production of 64K DRAMs and has a capacity of 10 million parts per month. It was constructed at a cost of $127 million, including all capital equipment and automation hardware and software. Volume production of 64K DRAMs on 5-inch wafers began in March of 1984. Building C is dedicated to 256K DRAM production and was constructed at a cost of $190 million. It has a capacity of 7 million parts per month and volume production was scheduled to begin in July 1985. Next to Building C is an empty lot--yes, you guessed it--for a 1-Mbit DRAM facility, which is scheduled to be in production in the near future.

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DATAQUEST visited the Building B 64K DRAM facility and the following discussion pertains to that facility. It is our understanding that the 256K DRAM facility is constructed along similar lines.

Device production occurs on two floors. The wafer fabrication area is located on the first floor and is a Class 10/Class 100 facility designed with a "main street" and "side street" concept. Up and down the wide main street move trackless but optically guided, automatically guided vehicles (AGVs) carrying cassettes of wafers. Branching off from main street at right angles are narrower side streets dedicated to the various wafer fabrication processes. For instance, there is a photolithography side street along which are clustered steppers and photoresist processing equipment. Dry etchers are clustered along another side street.

The AGVs in main street transfer their cassettes of wafers to I/O stations located at the junctions of the main and side streets. Robots moving in the side streets transfer the cassettes from the I/O stations to the various pieces of processing equipment located up and down the side street. The entire wafer fabrication production sequence is entirely automated; at no point in the production sequence do operators handle the wafers. Inspection at various points in the production process is done via CCTV by operators outside the clean room.

The first floor also includes the wafer test area laid out in the same main and side street approach. This area was designed to be Class 1000, but because of the reduction of people present (there appeared to be two) Class 100 levels were actually being reached. DATAQUEST noticed that in the wafer test area there were additional stationary robots transferring cassettes among several pieces of equipment clustered about them.

At the completion of wafer fabrication and probing, the wafers are automatically moved in an elevator up to the second floor where assembly and test occurs. On the second floor, overhead robots running on ceiling tracks transfer the devices among the various types of test equipment. All phases of assembly and test are fully automated including encapsulation and burn-in. Optical pattern recognition systems are used for automatic inspection of the marking step.

Communications and Control

The following is a brief overview of the factory automation system. A central factory computer interfaces with two control computers, one for each floor. For the first floor wafer fabrication and test area, the control computer interfaces to several process control CPUs, each of which interfaces with several individual pieces of process equipment. The first floor control computer also interfaces to another CPU for traffic control of the AGVs in main street. The AGVs communicate to the traffic control CPU through the I/O stations. The AGV receives its instructions from the I/O station. This is in contrast to the U.S.-manufactured Veeco and Flexible Manufacturing Systems AGVs, both of which communicate directly to their control computer via an infrared link. The control computer on the second floor has a similar architecture.

In the factory computer control center, operators sit at a long console and monitor factory status via CRT monitors in the console. In front of the console is a large illuminated electronic board that schematically depicts the entire two-floor production process and the various pieces of equipment. Every bare wafer is marked and, although lots are usually tracked, individual wafers can be called up and located in the factory by the monitoring and tracking system.

Process data are collected by the system and analyzed. Dr. Komiya noted that as the human element has been removed, the process data have tended to exhibit a very tight distribution about the mean. The factory central computer also communicates with Mitsubishi's Kita-Itami Works. For instance, quality control data are sent to Kita-Itami for further analysis, the results of which are fed back to the Saijo factory computer.

Mitsubishi built all robots and AGVs in the factory as well as writing the factory automation software. It took Mitsubishi three years to complete the system.

Results of Automation

DATAQUEST was told that the 64K DRAM facility was obtaining a defect density of 0.1 defects/mask level/cm^2. This should be compared to a world class Class 100 facility that can obtain 0.5 defects/level/cm^2. Mitsubishi has paid much attention to the reduction of particulate levels in the fab. All robotic equipment and AGVs were designed to contribute minimum levels of particulates. Mitsubishi worked closely with the equipment vendors to minimize the equipment particulates and, further, the process equipment was cleaned before it was installed in the clean room.

Cycle time for the wafers for the first floor (wafer fabrication and probing) is about three weeks. This should be compared to the 6 to 10 weeks required for an average U.S. fab cycle, with 6 weeks being a very good cycle time. Cycle time for the second floor (assembly and test) is about one week.

Although Mitsubishi would not disclose its device yields, it indicated that automation resulted in about a 20 percent relative increase in yields. Mitsubishi also believes that the Saijo facility can produce the lowest-cost 64K DRAM in the world. Taking all factors into consideration, DATAQUEST estimates that this facility is obtaining yields of between 85 percent and 90 percent for 64K DRAMs. DATAQUEST also estimates that the factory capacity of 10 million parts per month corresponds to 20,000 wafer starts per month at these yields.

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Sheridan Tatsuno
Joseph Grenier

JSIS Code: JSIA Newsletter

TOSHIBA BUILDS R&D BRIDGE

Toshiba Corporation recently announced that Dr. Yoshio Nishi, who led the company's 1Mb DRAM development team, has been assigned to direct Hewlett-Packard's VLSI Research Laboratory for the next three years. HP's Palo Alto VLSI lab houses about 100 engineers. This assignment caps the mutual exchange of a half-dozen researchers over the last five years. DATAQUEST believes that this assignment will not only help Hewlett-Packard to design 1Mb DRAMs into its new computer products, but also give Toshiba valuable computer technology and contacts with IC researchers at Stanford University and Hewlett-Packard.

At our 1985 JSIS conference, Toshiba Semiconductor Group Executive Tsuyoshi Kawanishi emphasized the need for a well-balanced strategy. As shown in Table 1, Toshiba has pursued strategic alliances to implement this strategy. Moreover, we note that Dr. Nishi's assignment is part of a larger trend. Because of the growing "technology boycott" against Japan, Japanese makers such as Mitsubishi, Kyocera, and Sony are setting up R&D centers in the United States to tap American know-how. As shown in Table 2, Toshiba is quietly, but aggressively, building its bridges with the West.

Table 1

STRATEGIC ALLIANCES SUPPORTING TOSHIBA'S BALANCED PRODUCT STRATEGY

	1980	1981	1982	1983	1984	1985
Memory	RCA			Atari	Plessey	Siemens
MPU	AMD		Zilog	Zilog	Zilog Motorola	
Logic		LSI Logic			SGS	LSI Logic
Process			SGS	SMC	Tokuda	
Other				Univ. of Arizona	KEC	Intel Brooktree

Source: DATAQUEST

Sheridan Tatsuno

Table 2

TOSHIBA'S LICENSING AND SECOND-SOURCING AGREEMENTS

Date	Company	Agreement
1985	Brooktree Corp. (start-up)	Licensing agreement for Brooktree to give Toshiba the right to design and manufacture high-resolution DACs for consumer digital audio applications
1985	Siemens	Licensing 1Mb DRAM technology to Siemens for 7 years; alternate source for Siemen's new 1 Mb DRAM plant in 1986
1985	LSI Logic	Four-year agreement to jointly develop "Sea of Gates" gate arrays over 20,000 gates using 1.5-micron design rule; plans to develop 50,000 to 60,000 gate arrays; LSI Logic CAD and Toshiba CMOS work; extension of 1981 agreement
1985	Intel	Licensing multibus II interface ICs
1984	Tokuda Works	Joint development of single-wafer reactive ion etching for 4Mb memories on 6-inch wafers
1984	SGS-Ates	Joint development of super-high-speed CMOS logic; previously Toshiba supplied SGS-Ates with 16K CMOS SRAM technology for SGS' European sales network
1984	Plessey	Supplying Plessey with 16K SRAMs
1984	Korean Electronics Company	Five-year agreement in which Toshiba will supply KEC with linear IC design and production technical documents and train KEC engineers
1984	Motorola	Second-sourcing MC68000 MPU; joint work on stereo receiver chips
1984	Zilog	Zilog to provide CMOS 8-bit MPU (Z8000) on OEM basis; second sourcing of CMOS Z80
1983	Zilog	Zilog lifted licensing restriction on Sharp and Toshiba production of Z8000
1983	Standard Microsystems	Worldwide exclusive cross-licensing agreement
1983	University of Arizona	Medical imaging examination system
1983	Atari	Mask ROM for television games
1982	Zilog	Ten-year cross-licensing of Toshiba CMOS technology and 16K CMOS SRAM for Zilog Z80/Z800/Z8000; Zilog marketing Toshiba products worldwide
1982	SGS-Ates	Toshiba supplied CMOS technology
1981	LSI Logic	Joint development of 1,000- to 10,000-gate CMOS arrays; Toshiba supplied CMOS wafers; produced 6,000-gate array with SRAM on-chip in December
1980	AMD	AMD provided AMZ8000 16-bit MPUs and peripherals
1980	RCA	Provided 1K and 4K DRAMs to RCA using CMOS SOS technology

Source: DATAQUEST

Nielsen Dataquest RESEARCH BULLETIN

JSIS Code: JSIA Newsletters

JAPANESE ELECTRONIC EQUIPMENT PRODUCTION TO REACH ¥18 TRILLION IN 1990

A recent report from the Japanese Electronics Industry Development Association (JEIDA) predicts Japanese electronic equipment production of almost ¥18 trillion (US$75 billion, at ¥240 per U.S. dollar).

The Japanese electronic equipment industry will achieve an overall compound annual growth rate (CAGR) of 9.2 percent from 1984 through 1990. The fastest growing product areas will be computers, electronic measuring instruments, and telecommunications equipment. Table 1 gives 1983 and 1984 historical production, plus JEIDA's forecast for 1985 and 1990.

JEIDA also predicts that total production of new media, home automation, office automation, and factory automation will be ¥7.0 trillion (US$29.2 billion) in 1990, more than doubling to ¥15.0 trillion (US$62.5 billion) by 1995. In 1995, new media and home automation are each expected to account for ¥1.2 trillion (US$5.0 billion), office automation for ¥9.6 trillion (US$40.0 billion), and factory automation for ¥3.0 trillion (US$12.5 billion).

DATAQUEST believes that Japanese telecommunications equipment production will experience faster growth than JEIDA forecasts, largely due to increased competition and easier access to the market brought about by the privatization of Nippon Telegraph and Telephone Public Corporation and the huge growth necessary to support totally integrated office automation (i.e., a network that can connect all kinds of computers among various companies and industries), which will exist in 1990.

Nagayoshi Nakano
Patricia S. Cox

Table 1

ESTIMATED JAPANESE ELECTRONIC EQUIPMENT PRODUCTION
(Billions of Yen)

	History		Forecast		Percent Growth		CAGR
	1983	1984	1985	1990	1983-1984	1984-1985	1984-1990
Total Electronic Equipment	¥8,371.1	¥10,626.5	¥12,248.0	¥17,990.5	26.9%	15.3%	9.2%
Consumer	¥3,742.6	¥ 4,592.2	¥ 4,930.0	¥ 5,430.0	22.7%	7.4%	2.8%
TV	706.1	776.5	820.0	850.0	10.0%	5.6%	1.5%
VTR	1,516.4	2,090.1	2,220.0	2,350.0	37.8%	6.2%	2.0%
Other	1,520.1	1,725.6	1,890.0	2,230.0	13.5%	9.5%	4.4%
Industrial	¥4,628.5	¥ 6,034.3	¥ 7,318.0	¥12,560.5	30.4%	21.3%	13.0%
Telecommunications Equipment	1,475.9	1,756.3	1,988.8	3,016.4	19.0%	13.2%	9.4%
Wired Equipment	938.8	1,157.4	1,317.6	1,999.5	23.3%	13.8%	9.5%
Broadcasting/Wireless Equipment	537.1	598.9	671.2	1,016.9	11.5%	12.1%	9.2%
Computer	1,955.3	2,810.7	3,786.4	7,036.6	43.7%	34.7%	16.5%
Electronic Measuring Instruments	462.2	550.0	626.0	1,147.0	19.0%	13.8%	13.0%
Other Electronic Instruments and Medical Electronics	434.2	553.0	521.8	798.0	27.4%	(5.6%)	6.3%
Business Machines	300.9	364.3	395.0	562.5	21.1%	8.4%	7.5%

Source: Japanese Electronics Industry Development Association
Electronics Industry Association of Japan
Ministry of International Trade and Industry

JSIS Code: JSIA Newsletters

NINTH ANNUAL SIA FORECAST DINNER:
FORECASTING THE RECOVERY

SUMMARY

The Semiconductor Industry Association's ninth annual forecast dinner was held amid a mood of optimism combined with deep concern for the future viability of the U.S. semiconductor industry.

The evening began with a roast of retiring SIA president Tom Hinkelman and was emceed by Charlie Sporck, president of National Semiconductor Corporation. The featured speakers were Dr. Gil Amelio, president of Rockwell International's semiconductor products division, and Dr. Bob Noyce, vice chairman of Intel Corporation.

Mr. Sporck compared the U.S. semiconductor industry to a football player who is bleeding from an injury in a game where the competition is not penalized for breaking the rules. Although the U.S. industry has managed to survive under these conditions, the bleeding has not stopped. He called for forced change through "forms of leverage that some may call protectionist."

FORECAST

Dr. Amelio presented the consensus forecast for 1985 through 1986, which was prepared by the World Semiconductor Trade Statistics (WSTS) forecast committee, comprising representatives from 30 semiconductor manufacturers worldwide.

The WSTS forecast calls for a worldwide consumption decline of 17 percent in 1985, followed by three years of growth: 18 percent in 1986, 23 percent in 1987, and 23 percent in 1988. Over the long term, Japan will be the fastest-growing market, gaining several points in world market share in 1985 and maintaining them through 1988. Dr. Amelio pointed out that NMOS and PMOS memory are still showing no sign of recovery, while analog ICs are doing well, particularly in Japan, where the consumer electronics market is still fairly strong. Bipolar digital ICs are also doing well, having maintained a book-to-bill ratio of 1.0 since May.

Dr. Amelio pointed to several causes of 1985's disastrous market decline:

- A slowdown in the OEM market, particularly computers, which account for 40 percent of the U.S. semiconductor market
- A huge semiconductor inventory at OEMs (estimated to have been between $2 billion and $2.5 billion)

He believes that end users (i.e., consumers and businesses) have slowed consumption because they want more innovative products. OEMs will continue to slim down their semiconductor inventories as part of better asset management, but eventually demand will firm, as will prices. Finally, new, innovative products will spur end-user demand.

U.S.-JAPAN TRADE

Dr. Noyce's topic was U.S.-Japan trade friction. While admitting that many unfair trade practices do exist on the part of the Japanese, he believes that unfair practices are not the sole cause of the U.S. industry's current dilemma. Prior to 1980, the United States enjoyed years of trade surplus. Since 1980, however, the U.S. trade deficit has escalated dramatically. U.S. manufacturers are no longer competitive in the world market, Americans are substituting foreign sources of goods and services for domestic sources, and thousands of formerly U.S. manufacturing jobs are being moved offshore.

Dr. Noyce stated that the high value of the U.S. dollar bears a direct relationship to the current U.S. savings and trade deficits. The implication of this is that if the U.S. savings rate increases to the point of becoming a savings surplus, the U.S. dollar will fall in value and the trade deficit will become a trade surplus. Approximately 65 percent of U.S. corporate profits go into savings, while only 4.5 percent of personal income is saved. If President Reagan's tax proposal is passed, shifting more of the tax burden onto corporations and off of individuals, the resulting decrease in corporate profits would lower the corporate savings rate, decrease net savings in the country, and increase import penetration by $22 billion.

Dr. Noyce concluded that the solution to the problem is in the hands of the United States, which must produce a surplus of goods to send overseas, rather than bringing in goods from other countries. This can be done by increasing personal and government savings.

DATAQUEST ANALYSIS

A dichotomy of opinion on the trade issue was clearly in evidence at the dinner. Although most attendees agreed that free trade is best in the long run, many called for short-term protectionist measures. Even those against any form of protectionism would probably agree with Mr. Sporck's often-repeated rallying cry: "Protectionism beats extinction any day."

Patricia S. Cox

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

JAPANESE SEMICONDUCTOR MARKET UPDATE

DATAQUEST has revised its forecast for Japanese semiconductor consumption in 1985 and 1986 based on recent events that suggest a more prolonged downturn than originally foreseen. Table 1 shows a comparison of this forecast and our previous forecast of June 18, 1985.

One of 1985's major growth markets for both Japanese-made semiconductors and Japanese-made end equipment, such as televisions and refrigerators, has been the People's Republic of China. However, recent government restrictions and a lack of foreign currency have caused cancellation of orders in the second half of 1985. Many Japanese electronics firms were hard hit by the change in policy, which has certainly contributed to the current depressed state of the Japanese market.

Because of Japan's preeminence in consumer electronics, the Japanese semiconductor market is not as dependent on the ups and downs of the computer marketplace as the U.S. semiconductor market is. Thus, while the U.S. market is expected to decline 31.4 percent in 1985 and to grow 9.8 percent in 1986, the Japanese market will decline only 5.2 percent in 1985 and grow 12.0 percent in 1986 (yen basis). This huge delta in growth rates between the two countries means that by the end of 1986, the Japanese market will have grown to 33.9 percent of the world market, up from 30.1 percent in 1984.

Figure 1 shows our estimates of the quarter-to-quarter percentage changes in Japanese semiconductor consumption from 1984 through 1986. Although the second quarter of this year was up a scant 0.6 percent, we believe that the third and fourth quarters will show negative growth. We do not expect shipments to pick up until the first quarter of 1986.

Table 2 shows our quarterly growth forecast for the Japanese market through 1986. MOS memory is clearly the hardest hit product line this year, but it will show good recovery in 1986. Linear ICs and MOS logic devices will show positive growth this year, continuing into 1986.

Table 3 shows actual market values in yen for the same period as Table 1.

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Figures 2 and 3 are 12/12 rate-of-change graphs. They are graphs of the percentage change of a moving 12-month total from the total for the same 12 months one year earlier. The resulting graphs show a smooth picture of the rate of change for a given product line.

Figure 2 shows historical and forecast rates of change for total semiconductor consumption. The point at which the line crosses the Y axis in December of each year is the yearly growth rate for that year. We estimate that this point will be -5.2 percent in December 1985. By December 1986, however, the rate of change is expected to reach 12.0 percent.

Figure 3 shows historical and forecast rates of change for MOS memory, MOS micro devices, and MOS logic. As shown, the growth rate for MOS memory is falling precipitously from 91.1 percent in December 1984 to an anticipated -25.5 percent in December 1985. We believe that the turn in rate of change will occur in the second quarter of 1986.

Patricia S. Cox
Gene Norrett

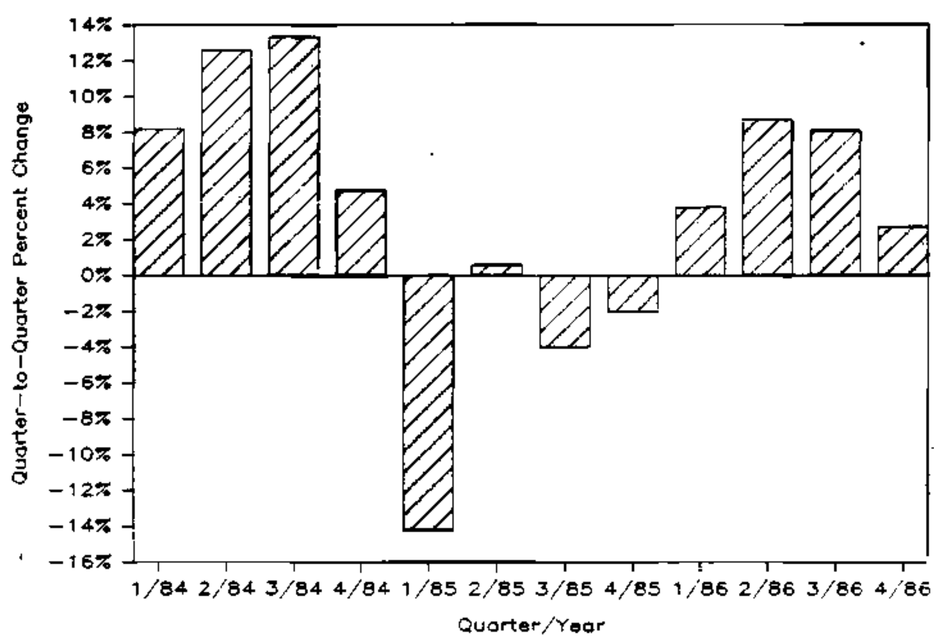
Table 1

FORECAST JAPANESE SEMICONDUCTOR
CONSUMPTION GROWTH--1985-1986
(Percent of Yen)

	June 18, 1985 Annual Percent Change		September 23, 1985 Annual Percent Change	
	1985	1986	1985	1986
Total Semiconductor	(3.2%)	17.3%	(5.2%)	12.0%
Total Integrated Circuit	(4.9%)	21.8%	(4.0%)	12.9%
Total Discrete	0.5%	4.2%	(9.4%)	9.1%
Total Optoelectronic	5.5%	8.3%	(7.3%)	9.3%

Figure 1

ESTIMATED JAPANESE SEMICONDUCTOR CONSUMPTION--1984-1986
(Quarter-to-Quarter Percent Change)



Source: DATAQUEST
September 1985

Table 2

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION PERCENT GROWTH--1984-1986 (Percent of Yen)

	1984					1985					1986				
	Q1	Q2	Q3	Q4	1984	Q1	Q2	Q3	Q4	1985	Q1	Q2	Q3	Q4	1986
Total Semiconductor	8.2%	12.6%	13.3%	4.7%	51.7%	-14.2%	0.6%	-4.0%	-2.0%	-5.2%	3.8%	8.7%	8.1%	2.7%	12.0%
Total Integrated Circuit	8.5%	13.2%	16.3%	5.7%	57.5%	-15.3%	1.7%	-4.1%	-2.2%	-4.0%	4.4%	8.8%	8.5%	2.4%	12.9%
Bipolar Digital	7.8%	18.2%	8.6%	7.9%	41.3%	-18.4%	1.3%	-3.6%	-5.6%	-8.9%	5.8%	6.4%	11.0%	2.1%	10.9%
Bipolar Digital Memory	37.8%	8.8%	0.0%	8.1%	59.0%	9.0%	23.3%	-34.4%	-5.1%	12.1%	12.5%	7.9%	7.4%	2.7%	0.4%
Bipolar Digital Logic	4.7%	19.5%	9.4%	8.3%	39.5%	-21.6%	-2.1%	2.4%	-5.7%	-11.4%	4.9%	6.2%	11.4%	2.0%	12.4%
MOS	11.2%	11.1%	25.3%	6.4%	74.4%	-18.7%	0.4%	-9.0%	-2.7%	-8.0%	5.4%	10.3%	9.8%	2.8%	12.2%
MOS Memory	9.4%	14.6%	45.8%	13.3%	93.8%	-32.2%	-7.7%	-21.5%	-8.3%	-25.5%	8.1%	15.8%	18.1%	3.7%	7.2%
MOS Micro Device	1.2%	8.4%	7.9%	-1.2%	42.6%	-15.7%	10.9%	-0.6%	0.8%	-4.5%	7.0%	6.0%	7.0%	1.9%	19.6%
MOS Logic	27.4%	8.2%	8.7%	-1.1%	79.3%	13.0%	4.9%	1.1%	0.5%	24.1%	1.6%	8.2%	3.0%	2.4%	12.5%
Linear	4.9%	14.2%	5.4%	3.8%	40.6%	-7.0%	4.1%	3.9%	0.0%	5.8%	2.2%	7.5%	5.6%	1.9%	14.9%
Total Discrete	7.6%	11.6%	3.2%	0%	36.7%	-8.8%	-4.0%	-3.0%	-1.1%	-9.4%	3.2%	7.0%	5.9%	3.7%	9.1%
Transistor	5.0%	8.9%	3.9%	0.1%	36.1%	-12.7%	-7.2%	-0.2%	-1.3%	-14.5%	3.6%	7.1%	4.8%	3.1%	9.3%
Diode	10.1%	15.8%	2.2%	-0.8%	36.7%	-6.5%	-2.6%	-5.9%	-1.6%	-7.8%	3.5%	7.7%	8.0%	5.0%	9.9%
Other	14.4%	11.8%	3.2%	2.0%	40.5%	5.0%	5.7%	-5.4%	1.0%	13.0%	0.9%	4.7%	3.6%	1.7%	6.1%
Total Optoelectronic	11.6%	8.4%	10.1%	8.5%	33.5%	-16.0%	0.9%	-5.5%	-2.0%	-7.3%	-3.3%	14.6%	9.4%	5.1%	9.3%

Source: DATAQUEST
September, 1985

Table 3

FORECAST QUARTERLY JAPANESE SEMICONDUCTOR CONSUMPTION--1984-1986 (Billions of Yen)

	1984					1985					1986				
	Q1	Q2	Q3	Q4	1984	Q1	Q2	Q3	Q4	1985	Q1	Q2	Q3	Q4	1986
Total Semiconductor	434.5	489.2	554.4	580.7	2,058.9	498.2	501.0	481.0	471.4	1,951.6	489.1	531.8	574.8	590.6	2,186.3
Total Integrated Circuit	321.2	363.5	422.9	446.9	1,554.5	378.3	384.7	368.8	360.7	1,492.5	376.4	409.4	444.3	454.9	1,685.0
Bipolar Digital	48.3	57.1	62.0	66.9	234.3	54.6	55.3	53.3	50.3	213.5	53.2	56.6	62.8	64.1	236.7
Bipolar Digital Memory	5.7	6.2	6.2	6.7	24.8	7.3	9.0	5.9	5.6	27.8	6.3	6.8	7.3	7.5	27.9
Bipolar Digital Logic	42.6	50.9	55.7	60.3	209.5	47.3	46.3	47.4	44.7	185.7	46.9	49.8	55.5	56.6	208.8
MOS	171.5	190.6	238.8	254.2	855.1	206.7	207.6	188.9	183.8	787.0	193.8	213.7	234.6	241.1	883.2
MOS Memory	74.8	85.9	125.2	141.9	427.8	96.2	88.8	69.7	63.9	318.6	69.1	80.0	94.5	98.0	341.6
MOS Micro Device	49.1	53.2	57.4	56.7	216.4	47.8	53.0	52.7	53.1	206.6	56.8	60.2	64.4	65.6	247.0
MOS Logic	47.7	51.6	56.1	55.5	210.9	62.7	65.8	66.5	66.8	261.8	67.9	73.5	75.7	77.5	294.6
Linear	101.4	115.8	122.1	125.8	465.1	117.0	121.8	126.6	126.6	492.0	129.4	139.1	146.9	149.7	565.1
Total Discrete	89.6	100.8	103.2	103.2	396.8	94.1	90.3	87.6	86.6	358.6	89.4	95.7	101.3	105.0	391.4
Transistor	49.5	53.9	56.0	56.0	215.4	48.9	45.4	45.3	44.7	184.3	46.3	49.6	52.0	53.6	201.5
Diode	31.6	36.6	37.4	37.1	142.7	34.7	33.8	31.8	31.3	131.6	32.4	34.9	37.7	39.6	144.6
Other	8.5	9.5	9.8	10.0	37.8	10.5	11.1	10.5	10.6	42.7	10.7	11.2	11.6	11.8	45.3
Total Optoelectronic	23.7	25.7	28.3	30.7	108.4	25.8	26.0	24.6	24.1	100.5	23.3	26.7	29.2	30.7	109.9

Source: DATAQUEST
September, 1985

Figure 2

ESTIMATED TOTAL SEMICONDUCTOR 12/12 RATE OF CHANGE--1978-1986

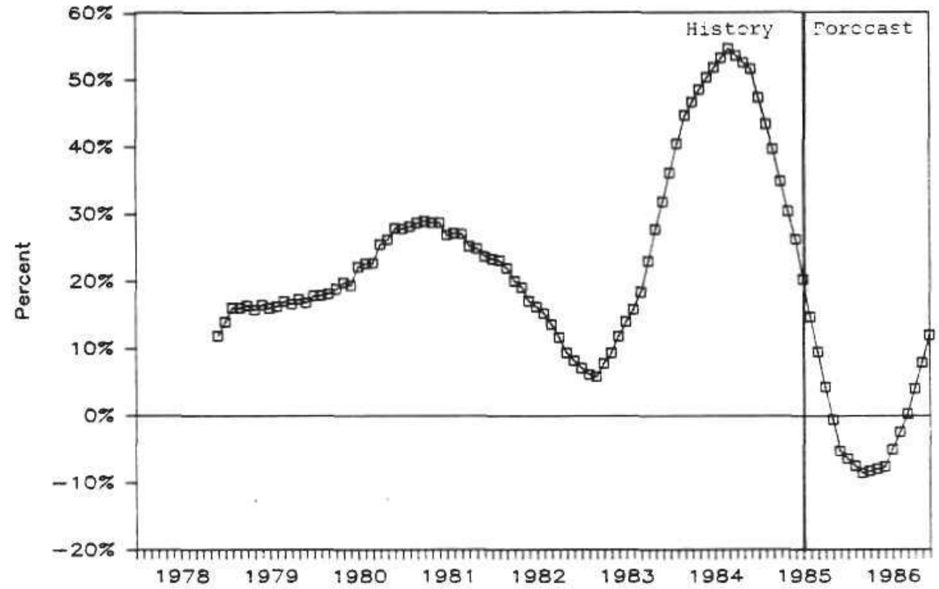
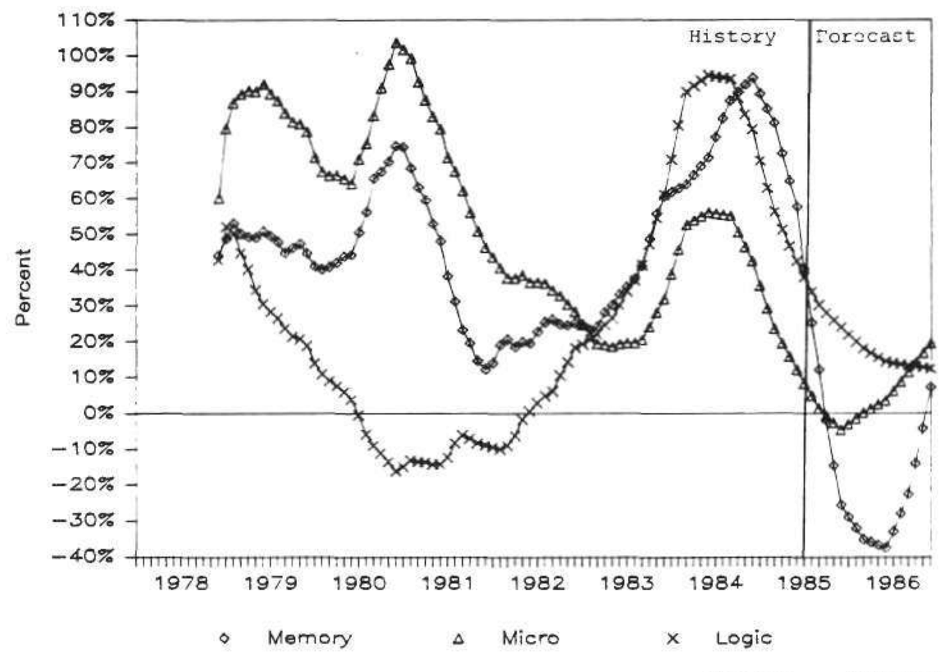


Figure 3

ESTIMATED MOS 12/12 RATE OF CHANGE--1978-1986



Source: DATAQUEST
September 1985

JSIS Code: EIEJ Newsletters

JAPAN PLANS NEW MARKET-OPENING MEASURES

On September 4, Motoo Shiina, Vice Chairman of the Policy Research Commission for Japan's Liberal Democratic Party (LDP), met with members of Stanford University's U.S.-Japan Forum to discuss trade friction issues. Mr. Shiina is a high-ranking LDP official responsible for drafting trade policies for Prime Minister Yasuhiro Nakasone. He is currently touring the United States to gather information and evaluate prevailing attitudes toward protectionism. Mr. Shiina made the following points during the discussion:

- Japanese export restraint may be necessary to defuse explosive trade friction, but it is only a short-term solution. Japanese market opening is the only long-term solution.

- MITI held a conference in June with 60 Japanese companies to request a $5 billion increase in purchases from the United States. These companies are already planning to purchase $2 billion in fiscal 1985, so an "affirmative action program" would only net about $3 billion. MITI is planning to call in another 73 companies to increase total purchases from the United States to $10 billion.

- Americans have requested that Japan implement policies to expand domestic demand, but Japan has limited policy options.

  - Lowering interest rates would weaken the yen further and increase Japanese exports to the United States, while raising interest rates would shut off domestic growth and reduce U.S. imports.

  - Increased public spending runs counter to the government's efforts to reduce its large budget deficits.

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- Private investment in the public sector is being pursued, but it is difficult to implement in practice.

- Re-regulation of Japanese capital outflows would bolster the yen and free up funds for domestic spending. A 2 percent to 3 percent tax on interest income earned abroad might stem the current outflow.

Mr. Shiina said that Japanese officials are extremely worried about a protectionist backlash in the United States this year, which would seriously weaken the Japanese economy. Thus, MITI is asking Japanese companies to help defuse the trade friction by buying more abroad. Even the Ministry of Posts and Telecommunications, which has been very protectionist to date, is beginning to feel the heat.

DATAQUEST believes that Prime Minister Nakasone will make another market-opening announcement this fall based on Mr. Shiina's policy recommendations. This announcement will probably elaborate on his "affirmative action program" and possibly list the procurement plans announced by major Japanese companies. We note that Hitachi has already announced that it will spend $120 million by December 1986, while NEC will increase its purchases from $160 million to $200 million by 1987. Other major companies are expected to make their announcements this fall.

Sheridan Tatsuno

JSIS Code: JSIA Newsletters

TURNING THE TIDE:
U.S. SEMICONDUCTOR ACTIVITIES IN ASIA

The media has bombarded us in recent months with news about the demise of the U.S. semiconductor industry in the face of the Japanese and Korean challenges. How valid is this view? Are American makers destined to gradually decline? DATAQUEST believes that much of this reporting is sensationalism based on old news--the excellent sales achieved by Japanese companies in 1984. However, with the collapse of the computer market, we note that Japanese semiconductor makers are losing share in the United States (see our trade update newsletter of July 10). Sales of MOS memory products, which accounted for 62 percent of total Japanese semiconductor exports to the United States in 1984, dropped 22 percent in the first half of 1985.

Moreover, we see signs of a serious effort by American makers to increase their presence in the Japanese market, as shown in Table 1. We believe that the following recent activities are significant:

- IBM's staffing up of its Tokyo office, its entry into the value-added network (VAN) market with Mitsubishi, and its patent licensing agreement with MITI
- Nihon LSI Logic's tie-up with Kawasaki Steel to enter the gate array and standard cell market
- New Japanese plants announced by Analog Devices, Fairchild, Monsanto, Motorola, and National Semiconductor
- Opening of new design centers in Tokyo by AMI, GE Semiconductor, ITT Semiconductor, National Semiconductor, Nissec Fairchild, and Syntek
- New investments in Taiwan by Mosel, Motorola, Syntek, Unicorn Microelectronics, and Vitelic

DATAQUEST believes that these aggressive marketing and investment plans are crucial for American companies expanding their businesses or getting started in Asia. The irony is that recent announcements by Japanese companies to buy more U.S. products may benefit old-timers in Japan--those with established long-term ties with Japanese customers--more than newcomers just setting up shop.

Sheridan Tatsuno

Table 1

U.S. SEMICONDUCTOR ACTIVITIES IN ASIA

Company	Location	Activity
AMI	Tokyo, Japan	Design center with Asahi Chemical
Analog Devices	Kanagawa, Japan	New building and IC plant in 1987
AT&T	Tokyo, Japan	VAN consortium with 18 companies
General Electric	Tokyo, Japan	New company (GE Semiconductor) and gate array design center
		Sales agreement with Internix
Harris Semiconductor	Tokyo, Japan	Subsidiary (Harris Corp.)
Hewlett-Packard	Tokyo, Japan	Procurement office
High Technology Systems Corp.	Tokyo, Japan	Joint sputtering equipment production with Anelva Corp.
Hugle Electronics	Tokyo, Japan	Wafer cassette plant with Atcor
	Korea	Joint venture with Zeus Corp.
IBM	Tokyo, Japan	Japanese government patent license
Intel	Korea	Samsung manufacturing agreement and new branches in Korea and Taiwan
ITT Semiconductors	Tokyo, Japan	LSI design center
KLA Instruments	Tokyo, Japan	New company (LA Technology Center)
LSI Logic	Tokyo, Japan	Nihon LSI/Kawasaki Steel tie-up
LTX	Tokyo, Japan	Plant acquisition for IC testers
Micron Technology	Tokyo, Japan	Direct sales office
Monsanto	Utsunomiya, Japan	Silicon wafer plant and R&D center
Mosel	Taiwan	1.5-micron VLSI plant
Motorola	Taiwan	$100 million electronic components plant
	Aizu, Japan	New VLSI plant
National Semiconductor	Taiwan	VLSI logic array design center
NCR	Tokyo, Japan	Full-scale sales program
Nissec Fairchild	Nagasaki, Japan	1- to 2-micron CMOS pilot line
	Tokyo, Japan	CMOS and ECL gate array design center
Perkin-Elmer	Tokyo, Japan	Sales and service group
Syntek	Taiwan	Design center in Hsinchu Park
Texas Instruments	Tsukuba, Japan	ULSI plant at Expo 85 site
Unicorn Microelectronics	Taiwan	United Microelectronics funds
Vitelic	Taiwan	Wafer fab contract with ERSO; ties with Sony and Kyocera
		Joint development of 1Mb CMOS DRAM with Taiwan government
Wafer Scale Integration	Tokyo, Japan	Wafers from Sharp

Source: DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPANESE SEMICONDUCTOR TECHNOLOGY TRENDS
Second Quarter 1985

SUMMARY

Despite the severe industry downturn, the outpouring of new Japanese technologies and products is accelerating. During the second quarter, DATAQUEST observed a rapid shift from commodity items to application-specific memories (ASMs), original MPUs/MCUs, gate arrays, standard cells, and optically based sensors and ICs. New applications are also being pursued, such as IC memory cards, 8mm video cameras, high-definition and sound multiplex televisions, facsimiles, medical diagnostic tools, optical communications, voice synthesis/recognition, graphics and television displays, and laser printers. We also note that MITI's 10-year joint R&D projects are half way through completion and spinning off new technologies.

DATAQUEST believes that the following developments in Japanese semiconductor technology are significant.

Basic Research

- Opening of new corporate R&D centers (NEC, Tokyo Sanyo, TDK)
- MITI's planned new synthetic diamond substrate joint R&D project
- Expansion of the installed base of supercomputers
- Progress in 3-dimensional ICs and superlattices at MITI's New Function Elements Project (1981-1990)

New Products and Device Technologies

- Sampling of 1Mb DRAMs (Fujitsu, Hitachi, Oki, and Toshiba)
- Introduction of high-speed bipolar CMOS (Hi-Bi-CMOS) for 64K SRAMs (Hitachi) and gate arrays (Toshiba)

- Rapid growth in IC cards with MPUs, EPROMs, and EEPROMs for banking, credit, and medical identification, and for data processing (Kyodo Printing, Mitsubishi, and Dai Nippon)

- Development of a three-level polysilicon structure for CMOS EEPROMs (Toshiba)

- Proliferation of original 8-bit and 16-bit CMOS MPUs and intense research on application-specific 16-bit MCU "superchips" (Hitachi, Japan Victor, Mitsubishi, and NEC)

- Introduction of a 3-D CMOS 16-bit MPU (Matsushita)

- Development work on 32-bit MPUs (Hitachi, NEC, and Oki)

- Marketing of a V20/V30 MPU development support system (Sony/ Tektronix)

- Development of digital signal processors (DSP) for television and graphics displays and speech recognition (Fujitsu, Hitachi, Mitsubishi, and NEC)

- Introduction of CMOS standard cell libraries (Asahi Microsystems, Fujitsu, Japan Victor, Matsushita, Mitsubishi, NEC, Ricoh, Sharp, Toshiba, and Yamaha)

- Use of semiconductor lasers in car systems (Nissan); optical disks, television animation, audio, and video disks (NEC); copiers, printers, POS, and OA equipment (Sharp)

- Use of CCD image sensors for video cameras, sound multiplex and high-definition televisions, facsimiles, copiers, and computer input (Fuji Photo Film, Matsushita, Mitsubishi, NEC, Olympus, TI Japan, and Toshiba)

- Development of GaAs logic ICs for high-speed multiplexed communication signals (Matsushita)

- Use of biosensors in medical diagnostic tools and artificial human organs (Matsushita); and bioelectronic research (NEC/MITI)

<u>Equipment, Materials, and Packaging</u>

- An excimer laser photolithographic unit for 16Mb DRAMs and electron-beam lithography, and fog exposure technology for 64Mb-level DRAMs (Toshiba)

- New equipment for photomask correction (NEC); wafer particle detection (Hitachi); and fully automatic defect detection (NJS)

- Ultra high-speed electron beam testing (Hitachi)

- Zig-zag in-line packaging (ZIP) for 256K DRAMs (Fujitsu and Mitsubishi)

- Replacement of gold wire bonding with copper wire bonding (Mitsubishi)

CORPORATE R&D LABS

NEC has establish a ¥10 billion ($40 million) R&D center within its Sagamihara Works near Tokyo to develop silicon wafers for next-generation ICs, such as 4Mb DRAMs and 32-bit MPUs. The center comprises 3,000 square meters of space and has highly sophisticated equipment.

Tokyo Sanyo Electric has announced plans to build a new R&D center and laboratory by next spring either in its main plant or in the VLSI plant in Niigata Sanyo Electric. The center will focus on 4Mb and higher VLSIs.

TDK Corporation, the world's largest maker of ferrites and magnetic tapes with ¥178.8 billion ($715 million) in sales in 1984, announced that it will enter the semiconductor market. The company plans to build a Semiconductor Technology Technical Center in Saku, Nagano Prefecture, by the end of this year. The two-storied ¥4.5 billion plant ($18 million) will produce thin-film magnetic heads for its hard disk drives. Its 200 to 300 researchers will focus on GaAs sensors, high-power transistors, and thermal printer drive ICs.

The Japanese government plays a major role in promoting joint research in next-generation semiconductors. During the second quarter, the Ministry of International Trade and Industry (MITI) and Nippon Telegraph and Telephone (NTT) made the following announcements that we believe will greatly affect the semiconductor industry:

GOVERNMENT R&D PROJECTS

Nippon Telegraph and Telephone's (NTT) Information Network System (INS)

NTT announced on May 21 that it will invest ¥1.66 trillion ($6.64 billion) in plant and equipment in fiscal 1985, including ¥480 billion ($1.92 billion) in its nationwide Information Network System. DATAQUEST believes that in 1985, the semiconductor content of the telecommunications equipment procured by NTT will be approximately 12 percent, or $800 million. Of this amount, INS procurement will account for $230 million. In fiscal 1984, NTT invested about ¥380 billion ($1.52 billion) in INS, of which we believe semiconductors accounted for about 11.5 percent, or $175 million. NTT is also increasing its R&D budget. In fiscal 1985, NTT plans to spend ¥170 billion ($680 million) for basic research, which is about six times the amount spent by the Ministry of International Trade and Industry (MITI).

MITI New Diamond Forum

MITI recently held an inaugural meeting of the New Diamond Forum to discuss the possibility of using synthetic diamonds as substrates for future semiconductors. About 200 companies from the electronic, automotive, steel, and other industries are being sought to form a joint government-industry R&D project and to secure budget support starting in fiscal 1987. MITI is attempting to catch up with the United States, which is currently using synthetic diamonds in space electronic equipment. Materials with better heat resistance and thermal conductance are required for faster data processing speeds and extreme conditions, such as space, aviation, nuclear power plants, and automobile engines.

MITI Supercomputer Project (1981-1990)

Fujitsu has added two supercomputers to its VP series. The high-end machine (VP400) executes 1.14 GFLOPS (billion floating-point operations per second) and has a maximum memory of 256 megabytes, 128 kilobytes of vector register, and 2,048-byte mask register. The entry-level machine (VP50) handles 140 MFLOPS (million floating-point operations per second) and offers a 128-megabyte maximum memory, a 32-kilobyte vector register, and a 512-byte mask register. Both machines have 64 kilobytes of buffer storage, a maximum of 32 channels, and a maximum transfer speed of 96 megabytes per second. They are compatible with IBM's M series mainframes and can perform vector processing. The VP400 will be delivered starting in December and leased at ¥79 million ($322,450) per month. The VP50 will be shipped in September and leased at ¥46,000 ($184,000) per month. DATAQUEST observes that the VP400 is competitive with NEC's SX2 (1.3 GFLOPS), the Cray 2 (2.0 GFLOPS), and Hitachi's S810 (630 MFLOPS).

Supercomputer makers are gradually increasing their installed base in Japan. DATAQUEST notes that several companies and research centers have purchased or are planning to purchase a supercomputer, as shown in Table 1.

Table 1

RECENT SUPERCOMPUTER PURCHASES IN JAPAN

Computer Maker	Model	Purchaser
Cray Research	Cray 1	Mitsubishi Central Research Lab Toshiba Research Lab Nippon Telegraph and Telephone
	Cray X-MP	Nissan Motor Company ($6.5 million; planned)
Fujitsu	VP100	Nagoya University Plasma Research Lab Kyoto University Data Processing Center Japan Nuclear Research Lab Power Generation & Nuclear Fuel Development Agency Toyota Motors (planned)
Hitachi	S810 SX-2	Tokyo University Data Processing Center Osaka University

Source: DATAQUEST

MITI New Semiconductor Function Elements Project (1981-1990)

On June 28, Shigeru Fukuda, a Fujitsu employee and current manager of MITI's superlattice research, gave a presentation at DATAQUEST on the status of the New Function Elements Project. DATAQUEST believes this is MITI's VLSI Project for the 1980s, which will introduce next-generation technologies, including 3-dimensional ICs, superlattice devices (silicon and GaAs), and hardened ICs. Due to national budget deficits, the project is only budgeted for ¥1.2 billion ($4.5 million) in fiscal 1985, half the originally scheduled amount. Nevertheless, the member companies are increasing their R&D spending in these areas. We will issue a special newsletter examining the progress of this important project.

To date, the project has generated 373 papers and 282 patents (pending), as shown in Tables 2 and 3, respectively.

Almost two-thirds of the papers and pending patents in Tables 2 and 3 are for 3-dimensional ICs. When asked about this trend, the previous research manager, Mr. Kawashima, explained that MITI has decided to focus its efforts on 3-D ICs, where it believes Japan has a two-year lead over the West. In contrast, he noted that Japan is about six to seven years behind in hardened ICs, and is about equal in superlattices. In addition to developing new "bargaining chips" to trade with the West, DATAQUEST believes that MITI has chosen the 3-D IC because of its immediate applications to 4Mb and 16Mb DRAM research. New 3-D technology will enable Japanese companies to develop faster memory and logic chips using the new configurations.

Table 2

MITI NEW FUNCTION ELEMENTS PROJECT
(Technical Papers)

Fiscal Year	Superlattice Devices	3-Dimensional ICs	Hardened ICs	Total
1981	1	6	0	7
1982	11	53	18	82
1983	31	86	30	147
1984	33	85	19	137
Total	176	230	67	373

Table 3

NEW SEMICONDUCTOR FUNCTION ELEMENTS PROJECT
(Patents Pending Under Contract)

Fiscal Year	Superlattice Devices	3-Dimensional ICs	Hardened ICs	Total
1981	1	6	1	8
1982	6	64	10	80
1983	16	75	12	103
1984	10	74	7	91
Total	33	219	30	282

Source: DATAQUEST

MITI's Institute of Industrial Technology

The Institute of Industrial Technology recently unveiled a prototype reading machine that automatically turns pages, reads books in Japanese, and vocalizes the words synthetically. The system consists of a robot manipulator page turner linked to an optical character reader. MITI plans to develop a commercially viable machine by 1988 for use by the blind and handicapped. The price will be about ¥30 million ($120,000). DATAQUEST believes that a limited market for optical sensors and voice synthesis chips will develop around this product.

NEW PRODUCTS AND TECHNOLOGY TRENDS

In past newsletters, DATAQUEST reported technology trends (advanced research and prototype development) and new products announcements in separate sections. Beginning with this newsletter, we will combine the two sections into a single New Products and Technology Trends section. To monitor Japanese trends, we use the following rule of thumb: Japanese technical papers generally precede prototype devices by 12 to 18 months, product samples by 24 months, and mass production by 30 to 36 months, depending upon the market demand.

Memory

Although production of 256K DRAMs has just begun, Japanese makers have announced that they will begin sampling 1Mb DRAMs. By the end of 1985, DATAQUEST believes that Fujitsu, Hitachi, Oki, and Toshiba will begin sampling, while NEC will take a more prudent stance by not preceding these makers. Matsushita and Mitsubishi will start sample shipments in early 1986.

- Fujitsu--256K DRAMs in zig-zag in-line package (ZIP) and PLCC packages; access times of 100/120/150ns; sample prices of ¥3,700 ($14.80) for ZIP devices and ¥3,500 ($14) for PLCC devices

- Gold Star--Plans to sample 64K CMOS SRAMs starting in August

- Hitachi--A high-speed bipolar-CMOS (HiBiCMOS) 64K SRAM (HM6787) with ECL speeds and CMOS low-power consumption; 25ns access time; 220mW power consumption during operation and 16mA driving output power; TTL-compatible; 8.5x3.4mm; 22-pin CERDIP package 22-pin 300-mil ceramic DIP; sampling price of ¥15,000 ($60), or ¥8,000 ($32) for lots of 1,000; monthly production of 300,000 to 500,000 units

  Six CMOS 256K SRAM models; general types and battery backup type; 85/100/120ns access times; 1.3-micron rule; 1.6 million transistors on a 4.98x9.4mm chip; shipments in June; sample prices between ¥15,000 ($60) and ¥22,000 ($88); monthly production of 200,000 by late 1985

A CMOS 256K EPROM with low program voltage of 12.5 volts (HN27C256); access times of 200/250/300ns; 200ns device sampling at ¥5,000 ($20) for orders of 10,000; developed using polysilicon PMOS technology

Two CMOS 256K SRAM versions, one with battery backup, and three access times (85/100/120ns); 28-pin plastic DIP packages

Sampling of 1Mb DRAMs; static column CMOS type; 4.66x10.1mm

A 64K SRAM in a 300-mil slim-line package (HM6264ASP); access times of 120/150ns; power dissipation of 15mW during operation and 10mW at standby; 8,192x8-bit parts sampling at ¥4,000 ($16)

A prototype 16Mb magnetic bubble memory developed using ion implant technology; conventional Permalloy transfer circuit and ion implanter circuit combined on the chip; commercialization planned for mid-1986, with 64Mb model by 1989

- Matsushita--An 8-bit content-addressable memory (CAM) for use in non-Neumann logic computers; 30x36-micron device with 3-layer blocks for checking data block by block; 236x32-bit memory structure; 99,000 transistor equivalent

  Two NMOS 128K DRAMs using 2-micron silicon gate process; 128Kx1-bit structure; chip size of 3.8 x 5.16mm; 16-pin DIL package; access time of 120ns (MN41128-12) and 150ns (MN41128-15); priced at ¥550 ($2.20); monthly production of 50,000 units to be increased to 500,000 units by late 1985; Zig zag in-line package (ZIP) and PLCC

- Mitsubishi--256K DRAMs in two package types; three access speeds and page or nibble mode available for each type; device in PLCC package one-third the size of DIP-mounted devices (M5M4256J); device in zig-zag in-line package (ZIP) using through-hole mounting (M5M4256L); PLCC versions priced at ¥5000 ($20) for 120ns, ¥4500 ($18) for 150ns, and ¥4000 ($16) for 200ns; ZIP devices priced at ¥3800 ($15.20) for 120ns, ¥3400 (13.60) for 150ns, and ¥3000 ($12) for 200ns

  A NMOS 256K EPROM using 2-micron rule N-channel silicon gate process; 200/250/300ns access times; sample shipments in June; initial monthly production of 50,000 units; priced at ¥4,000 ($16)

  A line of 16K SRAMs (M5M21C67P); 16Kx1-bit and 4Kx4-bit types; 35/45/55ns access times; sample price of ¥2,000 ($8) for 35ns types

  An NMOS silicon gate 1Mb ROM (M5M231000P) available in 250 and 300ns access times; 28-pin DIL plastic package; sample price of ¥6,000 ($24)

- NEC--A pseudostatic 256K RAM combining NMOS and CMOS DRAM functions (uPD42832C); available in 100/120/150ns; 32Kx8-bit structure pin-compatible with similarly structured CMOS SRAMs; 4.6 x 9.0mm; 28-pin DIP package; ¥6,000 ($24) sample price for 150ns type

- Ricoh--A 256K CMOS EPROM with 12.5V write voltage and 150ns access time; 2-layer silicon with 1.5-micron pattern, with a sense circuit to accept wide voltage fluctuation; sample prices of ¥4,000 ($16)

- Toshiba--8 percent to 9 percent yields with free 1Mb DRAMs being given to a limited number of users; sampling expected when yields exceed 10 percent

  A 64K CMOS EEPROM with 50ns access time; 1 transistor, 3-level polysilicon structure; 2-micron n-channel CMOS; 5.95x4.88mm chip; power consumption of 25mW during operation

<u>Application-Specific Memory (ASM)</u>

- Dai Nippon Printing--An optical memory card with 422 kilobytes of storage capacity (160 pages of A4 size text); production cost about $1.20; priced at $20 to 40; enhancement of storage capacity to 2 megabytes possible with fine pattern drawing technology; data read-out only using CCD line sensors

- Fujitsu--A hybrid device combining a 2,375-gate array and 1,024-bit SRAM on a 6.7x7.1mm chip; 2.2ns delay time; four types (256x4/128x8/ 64x16/32x32)

- Kyodo Printing--16K, 64K, and 128K IC cards with EPROMs and EEPROMs in 16K and 64K capacities; two types of 8C card read-write machines for processing data

- Mitsubishi--Five types of IC memory smart cards; sample 1.8mm mask ROM card priced at ¥4,500 ($18); EPROM card with 8-bit MPU at ¥10,000 ($40); card with 8-bit MPU and 64K SRAM for computer data files at ¥15,000 ($60); an ISO-standard 0.75mm thick IC card with MPU and EPROM being developed for banking and credit uses

- NEC--A CMOS 2Mb mask ROM (uPD23C2000C) integrating 2.4 million elements and capable of storing 8,000 kanji characters; 6.63 x 8.42mm chip; 1.2-micron geometry; 250ns access time; power dissipation of 40 milliamperes during operation and 100 microamps at standby; 131,072 x 16-bit for word mode designation and 262,144 x 8-bit for byte mode; plastic or ceramic 40-pin 400 mil DIP; for use in portable Japanese language word processors, hand-held computers, and typewriters; priced at ¥8,000 ($32) each in lots of 1,000

- Sharp--Four 1.2Mb CMOS kanji character generators (LH53012 series); suitable for CRT displays; I/O TTL-compatible; single +5V power supply; 3-state output; 40-pin plastic DIP; priced at ¥13,500 ($54)

- Suwa Seikosha--A CMOS tone-pulse telephone dialing circuit; 10-extension, 18-digit repeat memory devices for telephone number storage and 24-digit redial memory capability; 20,000 devices per month production

Microprocessors/Microcontrollers

- Fujitsu--Three NMOS and one CMOS one-chip MPUs with 256-word RAM capacity and power-on reset circuit; optional selection of 4-bit units; 4,096x8-bit ROM capacity

  Sample shipments of 8-bit and 16-bit MPUs (80186/80188/ 80286) licensed from Intel

  Two CMOS 4-bit MCUs added to a total of 14 series and 40 models; MB88201H with 0.5 Kbyte ROM and 16x4-bit RAM and MB88202H with 1 Kbyte ROM and 32x4-bit RAM; sample shipments at ¥230 ($0.92) and ¥280 ($1.12), respectively; also a low-price, general-purpose MCU with built-in A/D converter (MB88211) priced at ¥360 ($1.44) for 1,000-unit orders; initial monthly production of 200,000

- Hitachi--Two proprietary CMOS 8-bit MPUs with 4K EPROM and memory peripherals for the 6305 series; HD6505V mask ROM and HD6375V with 256K EPROM; 31 I/O ports, serial interface, and two timers; software-compatible and 192-byte RAM; minimum execution times of 0.5, 0.67, and 1ns; 40-pin package

  A CMOS 8-bit single-chip MPU with 4 Kbytes of mask ROM and EPROM (HD6305V); 54-pin flat package; 1.0/1.5/2.0MHz speed; wait mode 10mW; operating mode 35mW; sample price of ¥1,500 ($6); also an 8-bit MCU with an EPROM (HD63705V); sample price of ¥8,000 ($32)

  Two original 8-bit CMOS single-chip MCUs using a 40-pin package; one device with mask ROM (HD6305V) and another with an EPROM; 40-pin package

  Three CMOS 8-bit MCUs (Zero Turnaround Time); plastic package; shipments from May at ¥2,000-¥3,800 ($8-15.20)

  A real-time operating system for measurement and control systems using 16-bit MCUs; parallel program development possible by mounting CP/M-68K as a second operating system; 27 to 28 modules

- Matsushita--An original 3-dimensional CMOS 16-bit MPU (MN1617) developed using silicon-gate, 2-micron gate patterns, and 2-layer, 3-D aluminum wiring patterns; 200ns execution time with 200mW power consumption at 20 MHz; 50mW at standby; 64-pin flat package; priced at ¥10,000 ($40); sales since June

  An original NMOS silicon-gate, 8-bit MPU (MN18900) using 2.5-micron rule; parallel processing with two 8-bit microprocessors and timing based on paired, 16-bit timer counters; 51 I/O parts, 4K ROM, and 256-byte RAM; expandable to 64K; 500ns execution time; 64-pin, shrink DIP package

  A series of CMOS 4-bit MCUs (MN1700 series); 2-micron silicon gate process; multiplication direction function with 1 microsecond direction cycle; MN1758 with 8K ROM and 512-word RAM sampling at ¥2,000 ($8); EP17516 piggyback type at ¥20,000 ($80); MN1799 evaluator with 16K ROM and 512-word RAM at ¥6,000 ($30)

  A CRT controller (MN8355) with a built-in erasable RAM; transfer speed of 30ns/dot in monochrome and 500ns/pixel (16-bit gradation) in color; shipments starting in September; sample price of ¥20,000 ($80)

- Mitsubishi--An 8-bit CMOS MPU incorporating an A/D converter, timer/event counter, and universal asynchronous receiver/transmitter (M50734-SP); for use in electronic typewriters, hand-held computers, copiers, and electronic musical instruments; priced at ¥1,450 ($5.80); monthly production of 100,000

  A flexible disk drive single-chip MCU (M52810FP) designed for portable computers; fabricated using Bi-CMOS wafer processing; 30mW power dissipation; sample price of ¥2,000 ($8); monthly production of 200,000 units

  Plans for sample shipment of 16-bit MCU prototypes within one year; 32-bit MPU also being developed

- NEC--A CMOS 16-bit direct-memory access (DMA) controller (uPD71071C); transmits data at 5.3Mb/sec at 8 MHz without an MPU; four separate DMA channels consisting of 5,000 elements; 2-micron; 16Mb of address space; capable of interfacing with 8- or 16-bit MPUs; four independent built-in DMA channels; monthly production of 50,000 doubling by late 1985

  Sampling of CMOS 8-bit V40 (uPD70208) and CMOS 16-bit V50 (uPD70216) MPUs starting this summer; 68-pin leadless chip carrier; 4-channel CMA controller; DRAM refresh controller; 8-level controller; 16-bit timer/counter; programmable wait function; serial interface; 64 Kbyte I/O space

A CMOS flexible disk format controller (MB89311), which is compatible with NEC's NMOS flexible disk controller (MB8877A); sample shipments in August; priced at ¥2,500 ($10)

Two 4-bit CMOS MPUs with peripherals having the performance of 8-bit MPUs; 0.95-microsecond command execution time for the central processor; first of NEC's uCOMOS-75X series, including the uPDD75106CW with a 6K mask ROM and the uPD75P108DW with an 8K EPROM

- Oki Electric--An advanced 8-bit MCU (80C51) with 4Kx8-bit ROM and 128x8-bit RAM; 12-MHz operating frequency; capable of executing the same instruction set used with Intel's HMOS 8051; 111 instructions, including hardware multiply and divide; 32 I/O lines organized into four 8-bit ports; priced at ¥3,500 ($14); monthly production of 50K to 100K

  Development of proprietary 32-bit MPU for introduction by late 1985; plans for captive use in minicomputers; second-sourcing agreements also being sought

- Sanyo--An NMOS 8-bit, single-chip MPU with built-in 8-bit bus interface for apparatus control (LM8854); 16K ROM; 2K RAM; 5V power supply; 64-pin shrink DIP; priced at ¥700 ($2.80)

- Sony--Three CMOS 4-bit MCU devices; a 64-pin, piggyback MCU (CXP5020) for debugging and evaluating; a general-purpose MCU (CXP5034) with 4K ROM and RAM structure; one MCU with an 8K external EPROM extension

  Sony/Tektronix--NEC V20/V30 MPU development support system that can also handle Motorola 68010 and Intel 80186

  Original 8-bit CMOS single-chip MCU planned for commercialization within one year; 4-bit MCU (SPC-5000 series) available since late 1984; second sourcing of NEC's 16-bit V20 and V30 MPUs

- Suwa Seikosha--4-bit and 8-bit CMOS, one-chip MCUs; 8-bit SMC8340F series with 4K ROM and 128 bytes of RAM; 4-bit SMC4040C MPUs with 512-byte ROM and 16x4-bit RAM

- Toshiba--A CMOS 4-bit MPU for handling truncated dialing and automatic redialing, with a dual-time, multifrequency tone dialer; 38.2x14.2mm; 2K ROM and 256x4-bit ROM configuration for repeat dialing; 31 I/O ports; 42-pin shrink package

  A real-time clock LSI (TC8250P) for constant time control; display timer and refresh for repeated image display at 1mA power consumption; 16-pin DIP package; ¥500 sample price ($2); also a CRT controller LSI (TC8505P) with display timing and memory refresh for repeated image display

Digital Signal Processors (DSP)

- Fujitsu--Two CMOS high-efficiency television display controllers capable of controlling the display of 180 characters and symbols on CRTs; sample prices of ¥1,000 ($4.00) for 1,000-unit orders of the MB88323 and ¥1,300 ($5.20) for the MB88324; shipments from late 1985

- Hitachi--A bipolar CMOS digital signal processing RAM with a LED and 280-bit SRAM; 400-MHz bipolar transistor; 80mA, 9-segment LED; 12.7V power voltage; 1,500 gates; 5-micron silicon gate CMOS; 5.0x5.5mm chip size

- Matsushita--Two speech signal processors connected to a mini-computer; LPC analysis and 2-channel filter analysis performed by DSP-1; input parameter compared to phoneme standard pattern by DSP-2; calculations executed in real time

  A graphics display control processor (MN8350) for CRTs and LCD displays; CMOS silicon gate; 2.0-micron process; shrink DIP and flat package; 10-MHz operating frequency; 300 mmW power consumption; sample price of ¥10,000 ($40); shipments from fall 1985

  Two high-function DSP LSIs with twice the processing capacity as conventional models; MN1909 priced at ¥100,000 ($50); MN1901 with 8K built-in ROM priced at ¥5,000 ($20)

- NEC--A high-performance LSI (uPD7764) for DP matching processes; NMOS chip with 40,000 devices for speech recognition template matching; 40-pin standard package; capable of matching about 300 discrete words and recognizing 30 connected words by two-level DP matching

Application-Specific ICs (ASICs)

- Fujitsu--A hybrid device combining a 2,375-gate array and 1,024-bit SRAM on a 6.7 x 7.1mm chip; 2.2ns delay; four architectures (256x4/128x8/64x16/32x32); 13 package types up to 135-pin grid array; 2.3-micron rule for the SRAM portion

  A standard cell library with 100 cells; CMOS parts with 2.1ns per gate delay time; orders accepted in Tokyo, Osaka, and Santa Clara; new design centers planned for Boston, Dallas, and Manchester, U.K.; recent standard cell entrants include Nippon Gakki (Yamaha), Asahi Microsystems, Toshiba, Sharp, NEC, Japan Victor (JVC), and Mitsubishi

- Hitachi--Six CMOS gate array products with from 448 to 2,560 gates; (HG61H Series); 2ns delay time; capable of mounting SRAMs; can be designed with Daisy and Mentor CAD workstations; $2.00 to $9.40 for 40-pin package devices in lots of 10,000

- Matsushita--An original standard cell CAD system capable of developing full-custom LSIs; cell library of 200 cells, including various functional blocks of RAMs, ROMs, comparators, A/D and D/A converters

  A new CAD program (SMILE) for automatic layout of 10,000-gate class LSIs within 6 minutes; layout time 1/5 to 1/20 of conventional methods due to new method of wiring and block arrangement; developed experimental DSP LSI for portable CD

- Mitsubishi--A 1,100-gate CMOS array using silicon-on-insulator (SOI) and laser recrystallization; 5.37 x 4.9mm prototype chip with 3,432 cells, 66 I/O buffers, and 7,524 transistors; 120ns operations on an 8 x 8 parallel multiplier section; 1.3ns delay per inverter stage with a no-load 19-stage ring oscillator; 0.25mW power consumption; 0.8ns delay possible with 1.5-micron design rule

- NEC--A new CMOS gate array series of 8 models up to 20,000 gates; prices for arrays: development cost of ¥15.5 million ($62,000) for 20,000-gate model priced at ¥36,000 ($144), ¥4.4 million ($17,600) for 2,100-gate model priced at ¥1,700 ($6.80) for 10,000-unit orders, ¥9.4 million ($37,600) for 6,700-gate model priced at ¥5,400 ($21.60)

- Nippon Gakki (Yamaha)--Company goal of reducing standard cell development time to six weeks; turnaround time for 500-gate arrays about two weeks

- Sharp--Orders accepted for CMOS standard cell LSIs; four types (CMOS 1 to CMOS 4); plans to produce 500,000 units monthly

  A standard cell correction program that allows changes in the position of elements even after wiring has begun; potential 10 percent reduction in chip size possible

- Toshiba--CMOS/SOS (silicon on sapphire) gate arrays for captive use; 8,370 gates and 35,000 devices on a 9.84x9.92mm chip; 0.75ns gate delay time; 300 mmW power consumption; also a 16x16-bit multiplier with 11,500 devices on a 4.35x4.35mm chip; 30ns multiplication time; 250 mmW power consumption; multiplier priced at ¥50,000 ($200)

  A triple-layer wiring program for standard cells that permits a 10 percent reduction in chip size

<u>CAD Systems</u>

- Fujitsu--A CAD system that completely automates logic circuit design using artificial intelligence (AI) technology; 200 complex design rules gathered from experts and input into computer's knowledge base

Standard Logic

- Fujitsu--High-speed CMOS standard logic ICs (MB74HC series); TTL-compatible; operating voltage range of 2V to 6V; plastic DIP and mini-flat packages; 75 high-speed CMOS models by end of 1985

Bipolar Digital

- Mitsubishi--Two high-speed ECL RAMs; 1K device (M10422S-5-7) with 256x4-bit structure and 5 to 7ns access time; ¥5,000 ($20) for 5ns version and ¥2,500 ($10) for 7ns version; 4K device M10474S-10-15 with 241,024x4-bit structure; ¥7,000 ($28 4) for 10ns version and ¥3,000 ($12) for 15ns version; interchangeable with 10K ECL series

- Tokyo Sanyo--Two motor driver ICs for 2-phase, bipolar, brushless DC motors; LB1664 in dual in-line, 16-pin package; LB1660 in 8-pin DIL package; priced at ¥240 ($0.96)

Linear/Analog

- Fujitsu--A telephone LSI combining primary audio circuits, filters, and tone ringer (MB4513); can be used with a piezo-ceramic phone transmitter-receiver and DTMF tone generator; sample price ¥1,200 ($4.80)

- New Japan Radio--Two B/C dolby ICs developed with Dolby Research Institute; 1.8 to 6.0V operating voltage; device for high-performance headphone stereos (NJM2065); device for radio cassettes (NJM2075); 20-pin DIP and 20-pin flat packages

- Mitsubishi--Two graphic equalizer ICs for high-fidelity audio equipment (M5227P); 9.5V RMS maximum input voltage; an op-amp in the resonator circuit to expand dynamic range and improve the low-range distortion factor; 0.002 percent total harmonic distortion factor; 16-pin DIP package; ¥280 ($1.12)

- Rohm--A single-chip half duplex-type IC for frequency shift keying linear modems (BA1610); maximum frequency range of 200 KHz; directly connectable to TTLs, DTLs, and ECLs; 26.3x5.0x3.4mm 20-pin package with 2.54mm pin pitch; designed for personal computer communications, LANs, POS, and home automation

Discretes

- Hitachi--World's largest gate turn-off (GTO) thyristor capable of on/off control of 2000A and allowing 1000A to flow in reverse direction

- Mitsumi Electric--A low-priced single 15V switching regulator (LAG626) with power amplifier for multipurpose telephones; 5V output voltage; 50mV maximum ripple current; 40dB power amplifier gain

- NEC--A silicon monolithic microwave amplifier IC (uPC1659) for 0.6 to 2.3 GHz; very high-frequency range with broad bandwidth and high gain; direct-nitride, passivated base surface process; priced at ¥3,000 ($12) for lots of 30,000

  A wide-band, high-output linear power transistor capable of 860 MHz UHF bandwidth

- Ricoh--Two MOS FET series jointly developed with Ixys Corp. of San Jose, California; thyristor MOS FET with 100V to 1,000V rated voltage and 8A to 60A drain current; standard MOS FET with rated voltage of 60V to 1,000V and drain current of 2.5A to 40A

- Tokyo Sanyo--General-purpose operation amplifier ICs; dual low-noise LA6462 sampling at ¥100 ($0.40); dual J-FET LA6082 and LA6083 at ¥150 ($0.60); shipments starting in May

Optoelectronics

- Fujitsu--An experimental optoelectronic IC (OEIC) transmission method using an integrated semiconductor laser and four FETs on a GaAs substrate; 22x38x9mm module used in 4km optical fiber cable connection combining a light sensor, six EETs, two rectifiers and resistors; eliminates need for amplification circuit; developed as part of MITI's Optoelectronics Project for fiber optic control and oil refining management

  An infrared semiconductor laser capable of operating at -70 degrees centigrade; quantum well structure composed of thin layers of lead, tin, and tellurium; for use in detecting methane or sulfurous acid vapors; 6-micron wavelength beam; developed using a hot well epitaxial procedure

  First successful experiment of full-scale optoelectronic transmission using optoelectronic ICs (OEICs) that are considered the most likely next-generation transmission system

- Kodenshi--A 40mW GaAlAs infrared LED for optical remote control; double the light-emitting power of conventional infrared LEDs; epitaxial growth layering in a resist-molded package; priced at ¥100 ($0.40)

- Kokusai Denshin Denwa (KDD)--A quarter-wave shift, window-structure, distribution-feedback 1.3-micron semiconductor laser

- Matsushita Electronics--A high-speed optical communications semiconductor GaAs laser drive IC being developed for introduction next year; 2Gb/sec return-to-zero (RZ) signal; for use in 400Mb/sec optical fibers; sampling price of ¥5,000 ($20)

- NEC--A semiconductor laser with 671-nanometer visible-light oscillation wavelength for use in optical disk files, audio and video disks; 2 to 3mW output and more than 10mW pulsed output; based on crystal with double heterostructure of InGaAsP and InGaP; high crystal defect rate avoided by using a two-chamber, hydride gas, phase-epitaxial growth; plans for a 630-nanometer laser within two years; research into III/V compounds including InGaAsP, AlGaAsP, GaAnAsP

  A bi-stable laser diode for controlling on-off switching functions in optical switching systems; semiconductor laser and photo diode combined on the diode; light generation and amplification when a light signal is applied; 500ps switching speed capable of sending 100 newspaper pages per second; NEC experiments in time division light switching using four parallel laser diodes for optical switching

  A bi-stable laser diode for switching color animated pictures with time division optical switching system; single channel capable of transmitting 64Mb per second

- Nissan Motor/Meisei Electric--A laser radar that allows an automobile to see vehicles 120 meters away; two infrared light beams emitted by laser diodes and detected by a photo diode; use in automatic speed control systems; price about ¥50,000 $200

- Omron-Tateishi--Two photo microsensors with self-contained amplifiers; SX330 switches off with activation by light source; EE-SX430 switches on with light; priced at ¥985 each ($3.94)

- Sharp--A 750-nanometer GaAlAs semiconductor laser for copiers, laser beam printers, point-of-sale terminals, bar code readers, and OA equipment; made with V-channel substrate inner stripe (VSIS structure) with cap layer of 40 to 50 microns; 8 times the brightness of conventional diodes; 50,000-hour life span

- Sumitomo Electric--A high-performance PIN-photo diode capable of receiving signals at 200 million bits/sec; 1.3-micron wave length reception; one watt of light converted to 0.8 amperes of electrical current; initial production of 100 units/month for in-house use in 7km optical communication systems and high-speed optical data links for computers

- Tohoku University--A 2-dimensional coaxial transverse junction LED for ultra high-speed printers and optical computers; 40,000 cylindrical spikes integrated onto a 1 square cm GaAs substrate; each spike 21 microns in diameter and 19 microns high; developed by vapor deposition of an argon-arsenide layer over the substrate and etching with a silicon oxide mask containing minute spikes arranged in 50-micron intervals; potential for improving speed and clarity by 10 to 100 times over current printers

- Tokyo Institute of Technology--A 1.55-micron semiconductor laser with nearly 100 percent transmission efficiency; a unique Bundle Integrated Guide (BIG) arrangement used within the wave guide; 20mW power output and 1 to 2mW continuous emission

- Toshiba--Four types of PIN photo diodes, ¥55,000 ($220) and ¥40,000 ($160); two types of avalanche photo diodes for plastic fibers, ¥70,000 ($280) and ¥50,000 ($200); and LED ¥480 ($1.92)

Image Sensors

- Fuji Photo Film--Development of image sensor with 1.5 million picture elements for practical use in video cameras within five years; a CMOS image sensor with 400,000 elements already available; for captive use only

- Hamamatsu Photonics--Three PCD (plasma-coupled device) linear image sensors; TTL-compatible logic inputs; 10V supply voltage; 30mW power consumption and 2-MHz operation frequency

- Matsushita--A single-element, CdSSe, thin-film sensor for facsimiles, copiers, and computer input devices; photocurrent of 30-microamperes created at 100 lux and 10V; expected to replace optical CCD sensors; 20-second reading rate based on A4 scanning at 10 milliseconds per line

  A color CCD linear image sensor (MN8061C) capable of reading size A4 color documents at a resolution of 8 dots per mm; shipments by late 1985

- Mitsubishi--A 2-layer linear image sensor with 2,500 PN diodes; MOS phototransistor sensors connected in parallel on the outer layer; 404 square micron light-sensitive area; visual sensitivity of 0.45 microamperes per square millimeter at 550 nanometers; signal processing circuits on lower layer

- NEC--Five types of CCD delay line ICs; television noise reduction decoder ICs for sound multiplex televisions in the United States and sound multiplex signal demodulating ICs; sample prices of ¥650-1,100 ($2.60-$4.40) for CCD ICs, ¥500 ($2.00) for decoder ICs, and ¥1,000 ($4.00) for signal demodulator ICs

- Olympus Optical--A static inductance transistor (SIT) image sensor with 10 times the sensitivity of CCD sensors; sensitivity of 0.045 lux (saturated exposure volume) and 100 microampere output; 21,000 picture elements; plans for 400,000 picture elements in two years by reducing size of picture element from 30 to 15 microns; commercialization in two years for astronomical cameras and high-definition television

- Texas Instruments--Four types of image sensors (VID Series), including CCD types capable of 380,000 picture elements; samples of VID 267 color sensor available since May

- Toshiba--A color CCD image sensor that reads A4-size color documents in 2 seconds; 15x90x6mm sensor strip made up of four sensors arranged in a zig-zag pattern; 3,456 picture elements; speed of 0.4 millisecond per line and resolution of 16 lines per millimeter; 16 lines per millimeter reading resolution at 0.4 milliseconds per line; for use in facsimiles and copiers; color samples priced at ¥60,000 ($240) and monochrome at ¥50,000 ($200)

Gallium Arsenide

- Furukawa Electric--A GaAs varied heterostructure semiconductor laser using MOCVD technology; device to be marketed within one year

- Hitachi--A prototype 4K GaAs SRAM with 2.2 to 3.0ns response time; 28,000 elements on a 4.7 x 3.7mm chip; 1 watt power dissipation; compatible with Hitachi's bipolar memories; packaging still to be developed; plans to develop 16K GaAs SRAM within a year

- Matsushita--A high-speed semiconductor laser driver IC for optical communication at 1 to 2 gigabit/sec at the ECL signal level; eight Schottky junction FETs, six diodes, an amplification circuit, and digital signal processor; source-coupled FET logic (SCFL) and multiple-layer processing and wiring; samples in plastic packages for 1Gb/sec speeds priced at ¥1,000 ($4); 2Gb/sec samples in ceramic packages at ¥5,000 ($20); shipments since June

  GaAs logic ICs for high-speed multiplexed communication signals; 4:1 multiplexer with four signal inputs, dual-D flip-flop, half divider binary counter, quad logic with two inputs and NOR gate, and 5-transistor logic array; 0.12 to 0.22ns delay time per gate; available in 16 packages, including ceramic; priced at less than ¥10,000 ($40); shipments starting in September; current work on GaAs 4K SRAMs and 1,000-gate GaAs arrays

  An ultra-low noise GaAs FET using focused ion beam lithography; 1.08dB noise factor in the 12 GHz band; 0.2-micron line width; 1.2dB with 0.3-micron gate widths previously achieved with electron beam lithography; mass production of new GaAs FETs in two years

- Mitsubishi--A GaAs FET with 0.2-micron gate width; 1.08dB noise index at 12GHz; 170 to 180 millisecond mutual conductance; focusing process improved by using a 200 KeV double-charged silicon device with ion irradiation; commercial version within two years

- NEC--Improved GaAs crystal growing method that reduces dislocations and striations by two to three times; modified version of LEC method using indium dopants to reduce dislocations; growth striations reduced by lowering temperature gradient around the crystal by one-third to one-fourth previous levels (30 to 15C/cm), using a crystal forming method that lowers thermal distortions, and optimizing the cooling conditions; dislocations reduced to 10 to 20 per square centimeter; virtually dislocation-free 2-inch wafer produced; prototype FET device with 8 millivolt threshold voltage

- New Japan Radio--GaAs FETs for satellite broadcast television receive-only, low-noise amplifiers; III/V compound semiconductor line completed in 1984 at the Kawagoe Works in Saitama Prefecture

- Toshiba--A high-output, GaAs FET for microwave communications for 20W output; ion-implantation process for planar device structure; 4.9 to 5.1 GHz range; 8.8dB gain

Josephson Junction

No major announcements

New Semiconductor Functions

- Matsushita Electric--A 2-layer, 3-dimensional CMOS device and a 3-layer, 3-dimensional device produced using a laser-irradiated, single crystal process and a flat heat sink structure; 12x200-micron poly- crystal silicon islands converted by two laser beams into one 5cm-square silicon monocrystal; average electron migration of 540 square cm per V/sec; method used to make 10-bit dynamic shift registers with 3-layer, multiple-function, 3-D device with 8 optical sensors and 8 static memories

  A water-soluble polymer material for sub-micron VLSI using ultraviolet light; polymer from chemical synthesis of a saccharide derived from a starch using an enzyme culture technology and an optical bleaching reagent; developed with Hayashibara Biochemical Research Institute of Okayama City; satisfactory results with 0.5-micron lines; for 4Mb and larger VLSIs

  The world's first biosensor comprising an enzyme for detecting sugar; designed as a diagnostic aid for diabetics and potential use as a sensor for an automatic control for an artificial pancreas; enzymes indirectly attached to metal electrode via a layer of high polymer film such as cellulose acetate; glucose sensor of tiny strips of white gold electrodes measuring 1mm by 5 to 10mm

- Mitsubishi--A 3-dimensional LSI built with laser-activated polysilicon to form a single silicon substrate; layer mobility of 753, 528, and 549 square cm per volt-second for top, middle, and base layers respectively; NMOS 2-micron base layer, 3-micron CMOS middle layer, and 3-micron NMOS top layer; independent operation with signal reception by through-hole connection; developed with MITI's New Function Elements Program (1981-1990); goal of commercializing 5-dimensional device by 1990

- NEC/MITI Electrotechnical Laboratory--Joint research into bioelectronics, focusing on the reaction mechanism of eelworms; application of external irritation mechanism to new types of semiconductor sought

- Nissan Motors--A semiconductor vibration sensor incorporating a sensor and IC for analyzing signals on a single chip; ultra-thin vibrational plates used to detect external vibration for use in engine knocking prevention and chassis vibration detection; 10 polycrystalline silicon sheets 1-micron thick and 100 microns wide, varying from 60 to 600 microns in length; capable of detecting 5 KHz to 300 KHz

- Sharp--A 3-dimensional IC capable of video signal processing; 5-level polysilicon prototype structure developed by planarizing a low-viscosity coating material (polymide-like resin); results from MITI's New Semiconductor Functions Element Project (July 3-4 symposium in Tokyo)

- Tokyo Institute of Technology--Basic technology for mass producing single-unit IC enzyme biosensors; use of spin-out photolithography IC method to drip a photosensitive plastic liquid onto a rotating silicon wafer base upon which an ion-sensitive FET is etched; an ultra-thin 0.5-micron enzyme coating obtained using centrifugal action; microsensors possible by coupling enzyme to semiconductor base for monitoring artificial human organs and analyzing blood

<u>New Processes</u>

- Toshiba--Development of self-alignment construction of gate electrodes using metals with high melting points; applicable for aligning circuit patterns on small GaAs FETs and ICs; prevents destructive effects of heat on gate electrode materials and substrates; currently used for GaAs FETs for DBS equipment

  A new electron-beam lithography technology for 64Mb-level DRAMs with 0.25-micron design rules ("over-exposure method"); wafers subjected to two exposure stages, with first E-beam exposure applied lightly as a preparatory step to catalyze chemical reactions for the second exposure; proximity effect lessened; prototype CMOS ring oscillator with 49ps operating speed developed; 50Kv E-beam pattern drawer used; new technology being used to develop masks for 4Mb and 16Mb DRAMs; plans to introduce 16Mb DRAM prototype by 1988

Materials

- MITI Electrotechnical Lab--Silicon single crystal grown by controlling the formation of each successive atomic layer; atomic layers stacked using MBE to produce a maximum 2,200-layer structure; speeds 10 to 100 times possible with 3-D ICs; potential application to superlattice semiconductors, optoelectronic ICs, and high-performance lasers for fiber optic communications; GaAs crystal created last year using this process

- Nippon Mining--An indium-phosphide (InP) 3-inch single crystal with a very low dislocation rate for photosensors and other optoelectronic devices; temperature-controlled, liquid epitaxial coating of a 3-inch sulfur crystal doped with indium

- Sumitomo Denko--A diamond crystal (HS Series) for semiconductor lasers and high-frequency diodes; 3-layer diamond surface (Ti/Pt/Au); largest size of 4x4x1mm; priced at ¥3,000-¥8,000 ($12-32)

- Ricoh--An organic semiconductor material with twice the sensitivity of conventional selenium-type photosensitive drums; a stilbene-based organic compound combined with selenium and amorphous silicon with sensitivity of 1,400 volts square cm/micro-joule; for use in image processing systems, personal computers, color facsimile, laser LEDs, printers, and copiers; cost reduction to 1/30 of current price

- Toshiba--CMOS/SOS (silicon on sapphire) material for gate arrays (See ASIC section)

Manufacturing Processes

- NEC--A chemical deposition vapor phase growth method for photomask correction, using a 266-nanometer neodymium-YAG (yttrium-aluminum-garnet) laser; pine holes and disconnections from 2 to 10 microns detected and repaired in 10 seconds

- Toshiba--Development of a 0.25-micron VLSI pattern using fog exposure technology; chromium film formed over white-spot defects; experimental CMOS ring oscillator with 49ps gate delay time; use planned for NEC lines within two years; potential for developing 64Mb DRAMs

  An excimer laser photolithographic unit that projects an image of the IC mask onto photoresist-covered silicon wafers; use of high-output ultraviolet rays to write fine circuit patterns and a two-way mirror arrangement for focusing; laser generated by exciting xenon and chlorine gas through electron beam bombardment; potential use for designing 0.3 to 0.5-micron geometries for 16Mb DRAMs

Manufacturing Equipment

- Anelva (NEC subsidiary)--Plans to produce sputterers for 5-inch and 6-inch metal thin-film silicon wafers for 256K DRAM production; joint development with Technology Systems of San Jose, California

- Hitachi Engineering--A monitor that detects 0.5-micron particles on polished, unpatterned wafers and 3.0-micron particles on etched wafers; 3-minute inspection for a 6-inch wafer; priced at ¥48.5 million ($194,000); 40 units produced monthly

- Nikon--Full-scale orders of X-ray steppers for next-generation VLSIs; stepper developed jointly with NTT's Atsugi Electrical Communications Laboratory

  A new stepper (NSR-HT3025G) with the processing capacity of a mirror projection aligner; throughput of 85 five-inch wafers per hour; sales of 50 units targeted for 1986

- NJS Corporation--A fully-automatic defect detector (7MD62) for LSI photomask manufacturing, including 1Mb DRAMs; shipments from June; price of ¥98 million ($392,000)

- Sony--A leadless chip-mounting machine (DSH-222A) capable of mounting resistor and capacitor chips on PCB at 0.4 seconds per chip; designed for cylindrical chips; dual mounting heads spaced 90 degrees apart; 50 cassettes holding up to 8,000 (1.25mm diameter x 2mm) chips carried on each feeder; 100 types of chips handled; compact machine measures 1.5 (height) x 2.5 (width) x 1.3 (depth) meters; lower chip mounting cost of $0.0004 to $0.0008 per chip; priced at ¥30 million ($120,000)

- Tokyo Electron--Vertical-type diffusion furnaces being jointly developed with four semiconductor makers to produce commercial model

  A VLSI tester (GR14) with the efficiency of Genrad's GR-16; 30MHz and 144 pins; suitable for gate arrays and standard cells up to 144 pins and MPUs over 16-bit; will be priced at ¥80-200 ($320,000 to $820,000)

- Toshiba/Tokuda Works--Chemical dry etching equipment for LSI production; capable of processing 8-inch wafers at a processing speed 1.5 to 2 times faster than conventional models; shipments since June; priced at ¥35 million ($140,000)

Test Equipment

- Hitachi--An ultra high-speed electron beam tester that produces test data in 10ps increments; electron beam used for probing 0.5-micron pattern lines and measuring the propagation wave shape of high-speed signals; combines newly developed electron beam deflection phase adjustment method with Hitachi's electro-radiation gun; suitable for 1Mb DRAMs and GaAs chips

- Tokyo Seimitsu--An yttrium-aluminum-granat (YAG) laser and probes to isolate and repair memory devices at 145mm/sec; bad elements marked and redundant circuits rerouted around damaged areas; 532-nanometer wavelength beam with 0.1-micron precision; delivery in September; priced at ¥140 million ($560,000)

Packaging

- Hitachi--A 200-mil wide skinny package for 64K SRAMs

- Mitsubishi--A copper wire bonding method that works as well as gold wire bonding; copper ball formed within crude argon medium and bonded with a heater to a capillar chip; precisely controlled aluminum foil electrodes used to reduce bonding stress

- NEC--An aluminum nitride ceramic with a thermal conductivity 10 times higher than conventional alumina ceramics for semiconductor packaging; commercialization by March 1986; new substrates to be used for semiconductor lasers, LED packages, and VLSIs

Sheridan Tatsuno

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIS Code: JSIA Newsletters

U.S. AND JAPANESE SEMICONDUCTOR INDUSTRY INTERRELATIONSHIPS

DATAQUEST has observed that the U.S. and Japanese semiconductor markets are both closely linked to the ups and downs of the U.S. economy. The Japanese economy, which has historically been very stable, seems to have little influence on the course of the Japanese semiconductor market.

We believe that this relationship exists because of the high level of end-equipment exports from Japan to the United States, particularly in the consumer electronics, telecommunications, and automotive areas. These products are large consumers of semiconductors; therefore, during periods of U.S. economic strength, the U.S. end-equipment market can absorb large amounts of Japanese imports, thus strengthening the semiconductor consumption market in Japan.

DATAQUEST believes that the U.S. and Japanese semiconductor markets will be down 20.4 percent and 3.2 percent, respectively, in 1985. During this year, both economies are expected to remain relatively stable, although both are experiencing lower than expected growth so far. The Japanese GNP grew only 0.1 percent in the first quarter of 1985, the most recent data available.

Table 1 shows year-to-date growth rates for the U.S. and Japanese semiconductor markets from 1980 through the projected decreases in 1985. Japanese market growth is shown in both yen and dollars. Because of constantly fluctuating exchange rates, we believe that true growth is shown by looking at growth in yen. For example, Table 1 shows that in 1982 the Japanese market grew 6.6 percent in yen, but declined 5 percent in dollars.

Figure 1 shows this market growth, as well as U.S. and Japanese real GNP growth.

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Figure 2 shows the relationship among Japanese IC consumption, U.S. industrial production, and U.S. IC consumption. This figure is a graph of a rolling 12-month rate of change in each of these three areas. As can be seen, the rate of change in Japanese and U.S. IC consumption is dropping rapidly in 1985, while the rate of change in U.S. industrial production is falling at a slower pace. This graph also shows the greater volatility of the U.S. IC market compared with the Japanese market, and the fact that Japanese IC market downturns have historically lagged downturns in the U.S. market.

Patricia S. Cox

Table 1

YEAR-TO-YEAR GROWTH RATES
OF U.S. AND JAPANESE SEMICONDUCTOR MARKETS
(Growth in Dollars, Yen)

	1980	1981	1982	1983	1984	1985
U.S. Market (Growth in Dollars)	32.7%	6.8%	7.5%	30.3%	53.0%	(20.4%)
Japanese Market (Growth in Yen)	26.7%	23.6%	6.6%	29.2%	51.4%	(3.2%)
Japanese Market (Growth in Dollars)	22.2%	27.0%	(5.0%)	36.4%	50.1%	(8.2%)
Exchange Rate (Yen per US$)	227	221	248	235	237	250*

*Estimate

Source: DATAQUEST

Figure 1

U.S. AND JAPANESE SEMICONDUCTOR MARKET GROWTH
VERSUS U.S. AND JAPANESE GNP GROWTH

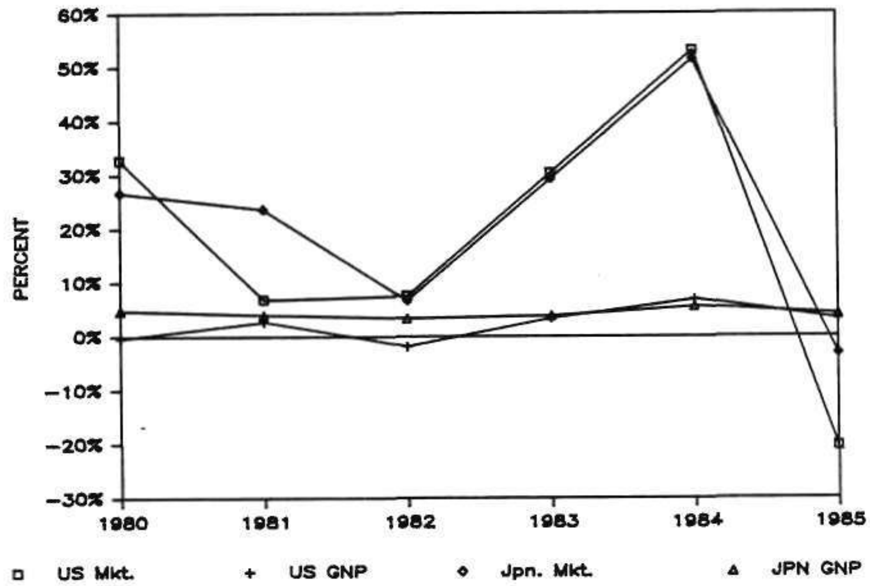
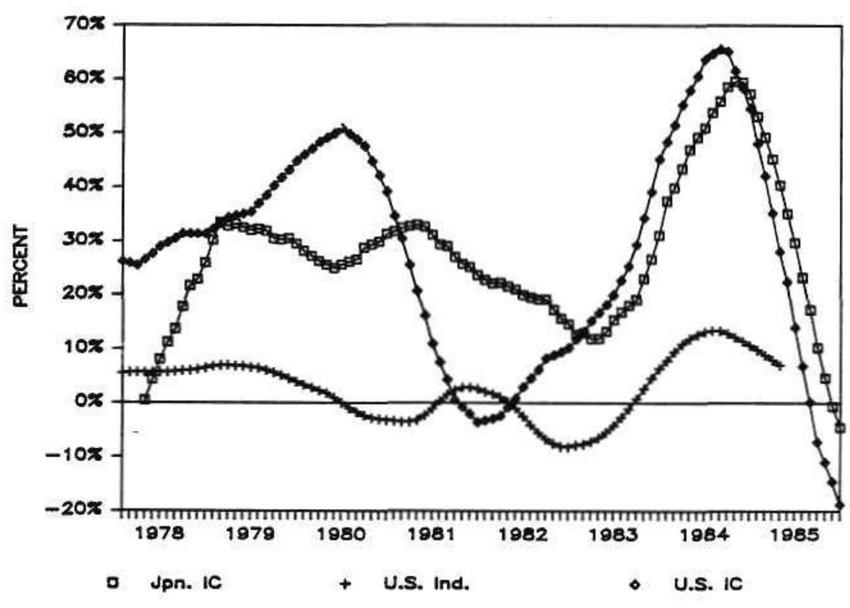


Figure 2

12-MONTH RATE OF CHANGE
JAPANESE IC CONSUMPTION, U.S. INDUSTRIAL PRODUCTION,
AND U.S. IC CONSUMPTION



Source: DATAQUEST

JSIS Code: JSIA Newsletters

HITACHI UNVEILS PLAN TO EASE TRADE FRICTION

Hitachi, Ltd., today announced a three-pronged plan aimed at increasing Hitachi's presence in the United States and easing U.S.-Japanese trade friction.

At a Washington, D.C., press conference teleconferenced live to New York, Boston, and Palo Alto, Toshi Kitamura, Hitachi's executive managing director and group executive of the international operations group, outlined the following plans:

- In August, an import promotion team headed by Shiro Kawada, executive vice president of Hitachi, Ltd., will begin identifying suppliers and negotiating contracts for exporting U.S. products and services to Japan. The team will spend $120 million between August 1985 and December 1986 in this effort. Hitachi plans to procure $400 million in U.S. goods during 1986 as a result of the program.

- Hitachi plans to further expand its extensive manufacturing investment in the United States. Currently, Hitachi operates ten manufacturing plants in five states, including Hitachi Semiconductor (America), Inc., which assembles MOS memory devices. Hitachi directly employs 3,655 people in the United States, of whom 93 percent are U.S. citizens. Three new U.S. plants are planned, to be located in Harrodsburg, Kentucky, Irving, Texas, and at an undisclosed third site.

- Hitachi plans to establish the Hitachi Foundation in the United States with an endowment of $20 million. A prime mission of the Hitachi Foundation will be to promote cultural exchange between Japan and the United States. The foundation will also fund scientific and educational research in the United States.

Mr. Kitamura also announced the appointment of Hiroshi Miyamoto, vice president and corporate secretary of Hitachi America, Ltd., as the first senior representative at Hitachi's soon-to-be-established Washington office for government and corporate affairs.

Mr. Kitamura affirmed Hitachi's belief that free international trade must be maintained and stated that Hitachi has no plans to restrain semiconductor exports to the United States. When questioned about charges of predatory pricing and other criticisms of Hitachi's activities in the United States, he said that the infamous "10 percent memo" was not a memo, but rather, sales promotional material written by an "excessively enthusiastic" young American salesman.

The plan outlined by Hitachi today was independently conceived by Hitachi; however, Hitachi was asked by the Japanese government to contribute in some way to Prime Minister Nakasone's market-opening measures.

Mr. Kitamura believes that other Japanese high-technology companies will follow the lead being set by Hitachi, Japan's largest electrical and electronic equipment company.

Mr. Kitamura also stated that Hitachi is making a profit on its 64K and 256K DRAM sales in the United States. His only explanation for U.S. companies' unprofitable DRAM operations was, "We are working hard."

DATAQUEST believes that Hitachi is by far the leading Japanese semiconductor supplier in the U.S. market, with sales of $627 million in 1984, representing 29.9 percent of all Japanese companies' U.S. semiconductor sales and 30.6 percent of Hitachi's worldwide sales. Hitachi's growth in export markets was 86 percent in 1984, far exceeding its domestic sales growth of 43.2 percent. Hitachi has always publicly stated its desire to be a leading exporter. Table 1 presents Hitachi's worldwide semiconductor sales figures by region.

DATAQUEST applauds Hitachi's positive efforts to ease U.S.-Japanese trade friction. We hope that other manufacturers, both U.S. and Japanese, will take positive steps to improve the current, tense situation.

Patricia S. Cox

Table 1

HITACHI'S WORLDWIDE SEMICONDUCTOR SALES BY REGION
(Millions of Dollars)

	1983	1984	% Growth 1983-1984
Japan	$ 757	$1,084	43.2%
United States	315	627	98.4%
Europe	114	210	84.2%
ROW	91	130	45.1%
Total	$1,277	$2,051	60.6%
Share of World Market	6.7%	7.2%	

Source: DATAQUEST
July 1985

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

SEMICONDUCTOR GARDENING: JAPAN'S RESPONSE TO THE CURRENT DOWNTURN

How are Japanese semiconductor companies responding to the current downturn? Are they laying off people? During the last few months, DATAQUEST has frequently been asked these questions, so we have spoken with Japanese managers to identify major industry trends. Generally, we find that the no-layoff policy applies to only full-time employees in larger companies. Although not reported by the Japanese press, it is common practice to eliminate shifts, shorten the workweek, and reduce part-time and temporary workers and subcontractors. In addition, permanent employees are assigned to paint and repair plant facilities and clean up the grounds, a practice known as "gardening." The Japanese also have a system called ichiji kikyu (translated short-term layoff). This system allows the employees to receive pay while staying at home. It was used in 1975 during the last severe recession in the industry. DATAQUEST believes that Japanese industry is thus able to reduce labor costs by up to 20 to 25 percent. In comparison, American industry has cut 30 percent of its work force, primarily in manufacturing. As shown in Table 1, Japanese semiconductor production dropped 12.8 percent during the first quarter of 1985, so cost-cutting is already taking effect.

Table 1

JAPANESE SEMICONDUCTOR INDUSTRY STATISTICS

	Q4/1984	Q1/1985	Percent Change
Millions of Units			
Production	14,048	12,246	(12.8%)
Inventory	3,244	3,869	19.3%
Millions of Yen			
Shipments	¥ 13,226	¥ 11,621	(12.1%)
Imports	¥ 62,745	¥ 46,926	(25.2%)
Exports	¥232,902	¥183,538	(21.2%)
Consumption	¥553,984	¥478,997	(13.5%)

Source: DATAQUEST

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JAPANESE RECESSIONARY MEASURES

In addition to selective layoffs and redeployment of the labor force, Japanese manufacturers are pursuing the following recessionary measures:

- Reduce costs:
  - Reduced factory overtime (36 to 38 hours/four-day workweek)
  - Layoffs at U.S. and European plants
  - Salary cuts for top executives
  - Middle managers assigned to new subsidiaries, which receive low-interest government loans
  - Reduced travel and entertainment budgets
  - Accelerated attrition and reduced new hires
  - Reduced bonuses
- Increase marketing efforts:
  - Key factory application engineers assigned to marketing
  - Gate arrays, standard cells, and PLAs emphasized (due to 65 percent decline in the MOS memory market)
  - OEM strategies pursued in China and Taiwan
  - Increased sales to the United States through Hong Kong
  - European marketing activities expanded
- Allow inventory buildup:
  - Inventory allowed to build up for next recovery
  - Preparation for Korean challenge in 1985 and 1986
- Reduce trade conflict:
  - Reduced exports to the United States (see Table 2)
  - Reduced capital spending (DATAQUEST estimates that spending is off 25 percent)
  - Government "affirmative action" program (Nakasone)
  - Increased procurement of imported ICs (Hitachi)

- Improve long-term competitiveness:

  - Highly automated plants (Mitsubishi's Saijo plant)

  - Increased R&D investments for basic research centers

  - Longer-term financing for new investments sought

Table 2

JAPANESE REGIONAL EXPORTS
(Millions of Dollars)

	Q4/1984	Q1/1985	Percent Change
United States	$482	$341	(29.3%)
Europe	149	149	0.0%
Asia	222	185	(16.7%)
ROW	119	99	(16.8%)
Total	$972	$774	(20.4%)

Source: DATAQUEST

DATAQUEST OBSERVATIONS

DATAQUEST believes that Japanese manufacturers are biding their time until the next recovery. Until then, they are repositioning their product lines and squeezing out excess production costs to become price-competitive with South Korea. The recession has hit Japanese vendors as hard as American companies, but the Japanese have attempted to protect their manufacturing base. We believe that this approach may enable them to capture market share during the next upturn.

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Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

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THE JAPANESE MARKET: SALES BY ALL MANUFACTURERS IN 1984

SUMMARY

The year 1984 was one of record growth in the Japanese semiconductor industry, record sales by companies worldwide, and large opportunities for foreign suppliers--especially U.S. companies--to capitalize on a booming Japanese market.

Our data show that overall, Japanese companies sacrificed high growth in their home market--which grew 50.1 percent in 1984--in order to achieve phenomenally high growth in overseas markets. Sales by Japanese suppliers grew only 49.0 percent in their home market, while their worldwide sales increased 60.8 percent. At the same time, U.S. companies' sales in Japan grew 65.2 percent, higher than their worldwide growth of 44.9 percent. Sales in Japan by European and Rest of World companies grew 25.5 percent versus 36.8 percent worldwide and 23.0 percent versus 23.6 percent worldwide, respectively. All data in this newsletter are stated in terms of U.S. dollars.

TOTAL SEMICONDUCTOR

Table 1 lists 1984 sales in Japan of integrated circuits, discretes, and optoelectronics, by the leading suppliers to the Japanese market. Leading the list as the top five suppliers are NEC, Toshiba, Hitachi, Matsushita, and Mitsubishi. Texas Instruments, Number 7, is the only non-Japanese company in the top ten, with total 1984 sales of $344 million. It is also interesting to note that TI is one of the top ten producers of semiconductors in Japan, with 1984 production of approximately $400 million.

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Japanese companies held 87.6 percent of their home market in 1984, a drop of 0.8 percentage points from 1983, while U.S. companies gained 1 percentage point, to hold 11.4 percent of the Japanese market (see Figure 1). Table 2 lists 1982 through 1984 Japanese total semiconductor sales for the leading suppliers, plus yearly growth rates. Companies exhibiting phenomenal growth include AMD, growing 176.2 percent to overtake National Semiconductor, General Instrument, Fairchild, and Signetics; Harris, growing 80.0 percent; and MMI, growing 200.0 percent.

Total Integrated Circuit

Figure 2 shows the geographic split by company base for sales of ICs in Japan. In this arena, U.S. companies enjoy their highest market share, 14.0 percent. Because of their relatively high concentration of discrete sales in Japan, Japanese suppliers hold only 85.4 percent of the Japanese IC market.

Table 3 lists sales in Japan by the leading IC suppliers to that market.

Total Bipolar Digital

Figure 3 shows the geographic split by company home base for bipolar digital IC sales in Japan. U.S. companies hold 33 percent of this market, which is the largest U.S. market share in the Japanese semiconductor market. U.S. companies' bipolar digital sales in Japan grew 71.2 percent versus worldwide growth of 60.4 percent. Japanese companies' bipolar digital IC sales in Japan grew 28.4 percent, while the Japanese market grew 39.9 percent. Thus, U.S. companies gained significant market share in this field, picking up 6 percentage points in one year.

Table 4 lists the leading bipolar digital suppliers to the Japanese market. The Number 2 supplier is TI, with 1984 sales of $180 million.

Total MOS

As shown in Figure 4, U.S. companies held 10.5 percent of the Japanese MOS market in 1984, while Japanese companies held 89.3 percent, and European companies had only 0.2 percent. Amazingly, U.S. companies' growth in Japan was 86.3 percent, considerably larger than their worldwide growth of 52.6 percent. Growth by Japanese companies in Japan was 71.7 percent, less than their 76.4 percent growth worldwide; this is because Japanese companies concentrated their MOS sales heavily in export markets--44 percent of all Japanese MOS production was exported in 1984.

Table 5 lists MOS revenues of the leading suppliers to the Japanese market. Intel and TI are the only foreign companies among the top ten, with MOS sales of $103 million and $100 million, respectively.

Linear

U.S. companies' sales of linear ICs in Japan grew 46.0 percent in 1984, higher than their worldwide growth of 34.1 percent. Japanese companies, on the other hand, experienced growth in Japan of only 39.0 percent, lower than their worldwide growth of 45.3 percent. We attribute these facts to the increasing Japanese demand for high-end, industrial linear ICs, in which U.S. linear suppliers excel, coupled with high Japanese exports of consumer linear ICs to Asia.

Figure 5 shows that U.S. companies held 10.8 percent of the 1984 Japanese linear market, Japanese companies held 88.2 percent, and all others held 1.0 percent. Table 6 lists Japanese linear revenues by the leading suppliers to the Japanese market. Three U.S. companies--TI, National Semiconductor, and Analog Devices--number among the top ten. We believe that about 30 percent of the Japanese linear market is supplied by a very large number of relatively small Japanese companies.

Discretes and Optoelectronics

Figure 6 shows that U.S., European, and Rest of World suppliers hold only 5.7 percent of the Japanese discrete market, while Japanese suppliers have a 94.3 percent market share. Table 7 lists the leading suppliers to the market.

Similarly, U.S., European, and Rest of World companies have only 5.7 percent of the Japanese optoelectronics market, as shown in Figure 7, while Japanese companies hold 94.3 percent of the market. Table 8 lists the top suppliers to the Japanese optoelectronics market, which is heavily dominated by the three leaders--Sharp, Matsushita, and Toshiba.

CONCLUSION

The Japanese semiconductor market remained the province of Japanese manufacturers, dominated by the big nine, in 1984. The European and Rest of World presence was hardly felt, accounting for less than 1 percent of the total market. U.S. companies picked up a small amount of market share, as a result of massive Japanese exports diverting potential domestic sales to overseas markets (i.e., the exports left a partial void, which the U.S. companies filled).

As Japan/world trade tension heats up, we believe that Japanese industry as a whole, and electronics in particular, will be forced to open its domestic markets to more foreign goods. One portent of this is Hitachi's recent announcement that it plans to increase its procurement of foreign-produced semiconductors from 1 percent of total procurement to 5 percent during the current fiscal year. We believe that policies like this could lift the "12 percent barrier" that many U.S. suppliers believe exists (so that the future U.S. share of the Japanese semiconductor market may grow to be more than 12 percent). It may also help other companies--including the Europeans and the emerging Korean suppliers--gain a larger foothold in Japan.

Patricia S. Cox

Note: Complete tables listing sales in Japan for all companies, by product, in both dollars and yen, have been published in Appendix B of the JSIA volume. If you wish to see these tables, please contact your JSIS notebook holder.

Table 1

ESTIMATED 1984 JAPANESE SEMICONDUCTOR REVENUES
OF LEADING SUPPLIERS
(Millions of Dollars)

	IC	Discrete	Opto	Total
NEC	$1,238	$308	$25	$1,571
Toshiba	731	309	63	1,103
Hitachi	711	351	22	1,084
Matsushita	524	195	68	787
Mitsubishi	584	165	8	757
Fujitsu	686	30	32	748
Texas Instruments	340	2	2	344
Tokyo Sanyo	192	113	16	322
Oki	203	13	11	224
Sharp	115	0	100	215
Intel	107	0	0	107
Motorola	97	6	0	103
AMD	58	0	0	58
National Semiconductor	49	0	0	49
General Instrument	15	25	7	47
Fairchild	41	4	0	45
Signetics	30	0	0	30
Analog Devices	26	0	0	26
Harris	18	0	0	18
ITT	16	1	0	17
Mostek	14	0	0	14
Ferranti	11	1	0	12
MMI	12	0	0	12

Source: DATAQUEST

Figure 1

ESTIMATED 1984 SHARE OF JAPANESE TOTAL SEMICONDUCTOR MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

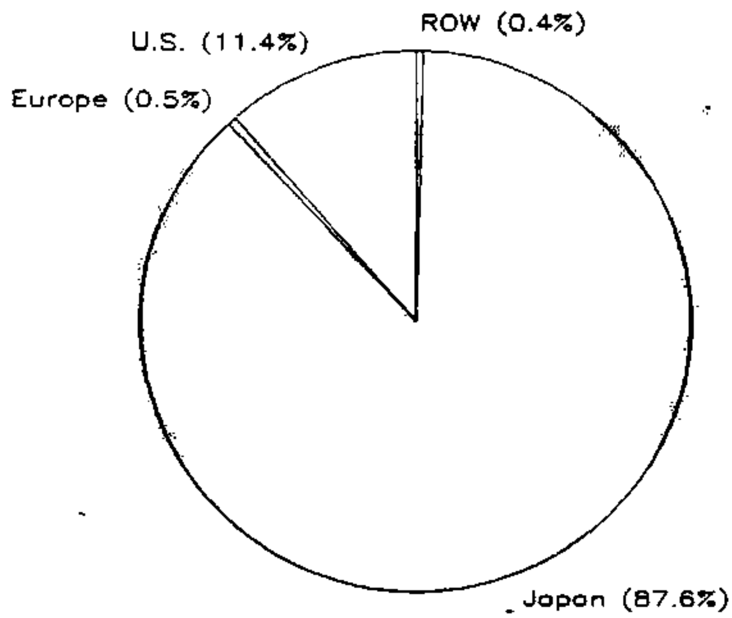


Table 2

ESTIMATED JAPANESE TOTAL SEMICONDUCTOR REVENUES OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
NEC	$737	38.9%	$1,024	53.4%	$1,571
Toshiba	517	32.9%	687	60.6%	1,103
Hitachi	576	31.4%	757	43.2%	1,084
Matsushita	333	42.3%	474	66.0%	787
Mitsubishi	294	45.2%	427	77.3%	757
Fujitsu	330	52.1%	502	49.0%	748
Texas Instruments	165	23.6%	204	68.6%	344
Tokyo Sanyo	163	44.2%	235	37.0%	322
Oki	93	72.0%	160	40.0%	224
Sharp	102	52.0%	155	38.7%	215
Intel	35	88.6%	66	62.1%	107
Motorola	38	39 5%	53	94.3%	103
AMD	13	61.5%	21	176.2%	58
National Semiconductor	24	41.7%	34	44.1%	49
General Instrument	28	14.3%	32	46.9%	47
Fairchild	20	30.0%	26	73.1%	45
Signetics	23	21.7%	28	7.1%	30
Analog Devices	9	66.7%	15	73.3%	26
Harris	8	25.0%	10	80.0%	18
ITT	8	50.0%	12	41.7%	17
Mostek	6	50.0%	9	55.6%	14
Ferranti	9	11.1%	10	20.0%	12
MMI	4	0.0%	4	200.0%	12

Source: DATAQUEST

Figure 2

ESTIMATED 1984 SHARE OF JAPANESE TOTAL INTEGRATED CIRCUIT MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

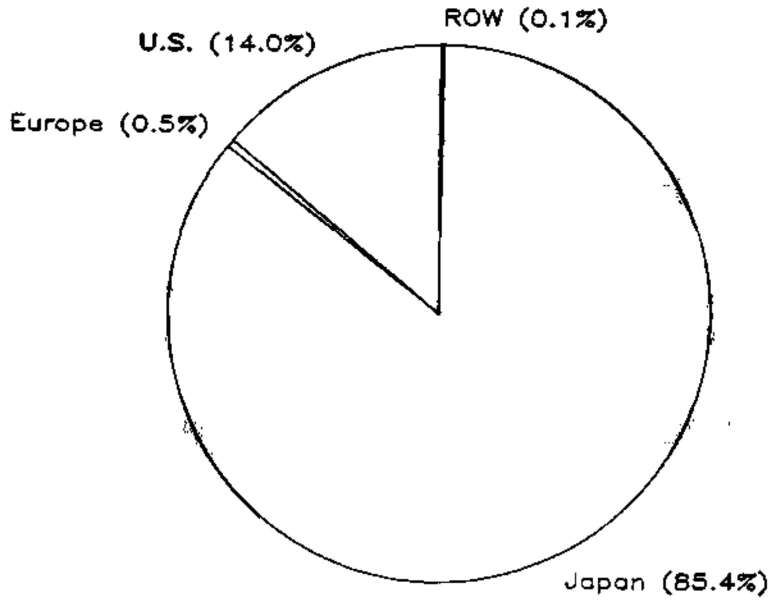


Table 3

ESTIMATED JAPANESE INTEGRATED CIRCUIT REVENUES OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
NEC	$516	41.7%	$731	69.4%	$1,238
Toshiba	298	37.2%	409	78.7%	731
Hitachi	396	35.4%	536	32.6%	711
Fujitsu	301	51.5%	456	50.4%	686
Mitsubishi	201	55.7%	313	86.6%	584
Matsushita	193	42.0%	274	91.2%	524
Texas Instruments	156	25.6%	196	73.5%	340
Oki	81	79.0%	145	40.0%	203
Tokyo Sanyo	93	50.5%	140	37.1%	192
Sharp	52	57.7%	82	40.2%	115
Intel	35	88.6%	66	62.1%	107
Motorola	34	44.1%	49	98.0%	97
AMD	13	61.5%	21	176.2%	58
National Semiconductor	24	41.7%	34	44.1%	49
Fairchild	18	33.3%	24	70.8%	41
Signetics	23	21.7%	28	7.1%	30
Analog Devices	9	66.7%	15	73.3%	26
Harris	8	25.0%	10	80.0%	18
ITT	7	57.1%	11	45.5%	16
General Instrument	9	22.2%	11	36.4%	15
Mostek	6	50.0%	9	55.6%	14
MMI	4	0.0%	4	200.0%	12
Ferranti	8	12.5%	9	22.2%	11

Source: DATAQUEST

Figure 3

ESTIMATED 1984 SHARE OF JAPANESE TOTAL BIPOLAR DIGITAL MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

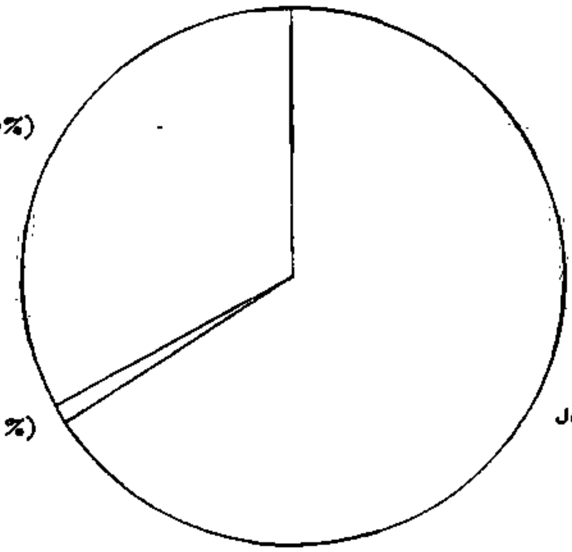


Table 4

ESTIMATED JAPANESE BIPOLAR DIGITAL REVENUES OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
Fujitsu	$118	40.7%	$166	24.7%	$207
Texas Instruments	96	20.8%	116	55.2%	180
Hitachi	75	37.3%	103	12.6%	116
Mitsubishi	42	54.8%	65	78.5%	116
NEC	85	29.4%	110	3.6%	114
AMD	9	66.7%	15	173.3%	41
Toshiba	20	5.0%	21	76.2%	37
Fairchild	12	33.3%	16	68.8%	27
Matsushita	7	85.7%	13	69.2%	22
Oki	14	21.4%	17	23.5%	21
Motorola	6	33.3%	8	150.0%	20
Tokyo Sanyo	10	30.0%	13	30.8%	17
MMI	4	0.0%	4	200.0%	12
Ferranti	8	12.5%	9	22.2%	11
National Semiconductor	4	50.0%	6	66.7%	10
Signetics	9	0.0%	9	11.1%	10
Harris	2	0.0%	2	100.0%	4
Intel	2	0.0%	2	100.0%	4

Source: DATAQUEST

Figure 4

ESTIMATED 1984 SHARE OF JAPANESE TOTAL MOS
MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

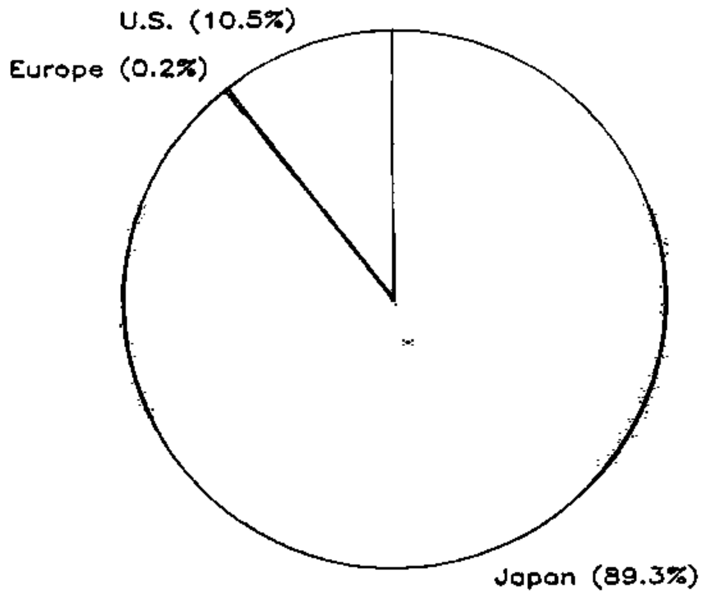


Table 5

ESTIMATED JAPANESE MOS REVENUES
OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
NEC	$285	57.5%	$449	88.6%	$847
Toshiba	188	39.4%	262	83.2%	480
Hitachi	227	44.1%	327	35.5%	443
Fujitsu	165	60.6%	265	66.4%	441
Mitsubishi	100	83.0%	183	102.7%	371
Matsushita	65	84.6%	120	107.5%	249
Oki	63	95.2%	123	37.4%	169
Intel	33	93.9%	64	60.9%	103
Texas Instruments	21	66.7%	35	185.7%	100
Sharp	38	65.8%	63	49.2%	94
Tokyo Sanyo	20	95.0%	39	48.7%	58
Motorola	20	45.0%	29	86.2%	54
AMD	4	50.0%	6	183.3%	17
General Instrument	9	22.2%	11	36.4%	15
Mostek	6	50.0%	9	55.6%	14
National Semiconductor	5	60.0%	8	25.0%	10
ITT	3	100.0%	6	50.0%	9
Rockwell	6	0.0%	6	50.0%	9
Harris	3	33.3%	4	75.0%	7
RCA	-	-	4	25.0%	5
AMI	2	50.0%	3	0.0%	3
Inmos	1	0.0%	1	200.0%	3

Source: DATAQUEST

Figure 5

ESTIMATED 1984 SHARE OF JAPANESE TOTAL LINEAR MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

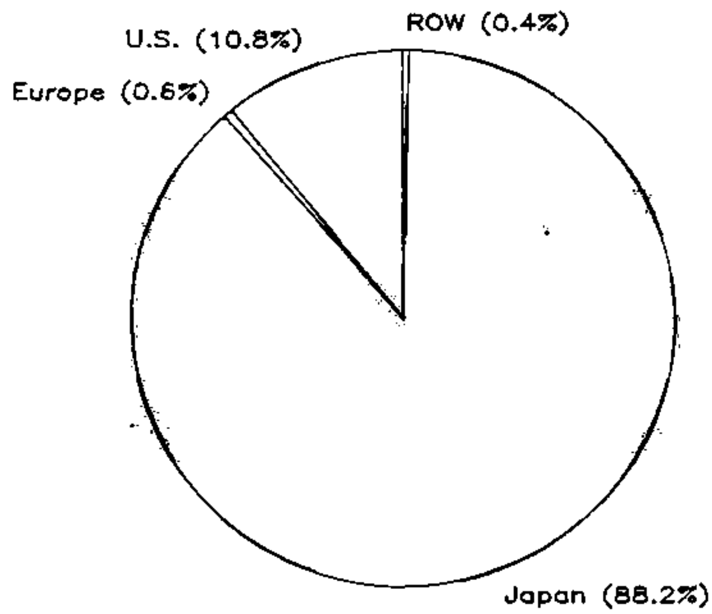


Table 6

ESTIMATED JAPANESE LINEAR REVENUES OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
NEC	$146	17.1%	$171	62.0%	$277
Matsushita	121	17.4%	142	78.2%	253
Toshiba	90	40.0%	126	70.6%	215
Hitachi	94	12.8%	106	43.4%	152
Tokyo Sanyo	63	39.7%	88	33.0%	117
Mitsubishi	59	11.9%	66	47.0%	97
Texas Instruments	38	18.4%	45	33.3%	60
Fujitsu	18	44.4%	26	46.2%	38
National Semiconductor	15	33.3%	20	45.0%	29
Analog Devices	9	66.7%	15	73.3%	26
Motorola	8	50.0%	12	91.7%	23
Sharp	15	20.0%	18	16.7%	21
Signetics	15	26.7%	19	5.3%	20
Fairchild	6	33.3%	8	75.0%	14
Oki	4	0.0%	4	225.0%	13
Harris	3	33.3%	4	75.0%	7
ITT	4	25.0%	5	40.0%	7
Siliconix	2	50.0%	3	33.3%	4
Philips	2	50.0%	3	0.0%	3
RCA	0		2	50.0%	3
SGS-Ates	1	200.0%	3	-33.3%	2

Source: DATAQUEST

Figure 6

ESTIMATED 1984 SHARE OF JAPANESE TOTAL DISCRETE
MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

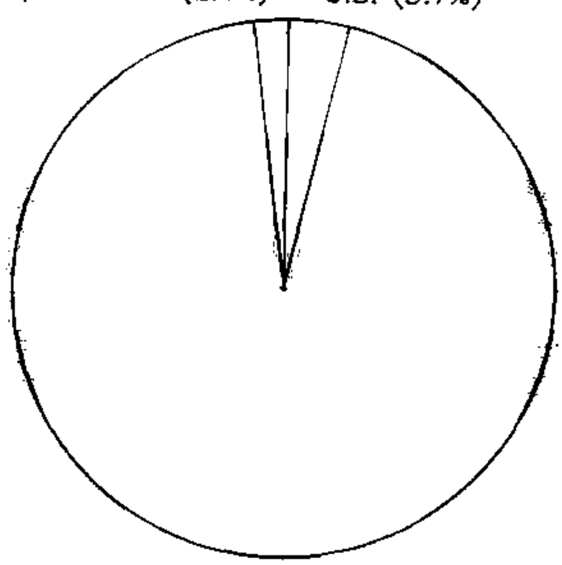


Table 7

ESTIMATED JAPANESE DISCRETE REVENUES
OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
Hitachi	$159	24.5%	$198	77.3%	$351
Toshiba	177	26.0%	223	38.6%	309
NEC	208	31.3%	273	12.8%	308
Matsushita	117	37.6%	161	21.1%	195
Mitsubishi	91	23.1%	112	47.3%	165
Tokyo Sanyo	58	39.7%	81	39.5%	113
Fujitsu	15	66.7%	25	20.0%	30
General Instrument	16	6.3%	17	47.1%	25
Oki	4	50.0%	6	83.3%	11
Motorola	4	0.0%	4	50.0%	6
Fairchild	2	0.0%	2	100.0%	4
Thomson	2	50.0%	3	33.3%	4
Semikron	2	0.0%	2	50.0%	3
Siliconix	1	0.0%	1	200.0%	3
Texas Instruments	4	-25.0%	3	-33.3%	2

Source: DATAQUEST

Figure 7

ESTIMATED 1984 SHARE OF JAPANESE TOTAL OPTOELECTRONIC MARKET FOR JAPANESE, U.S., EUROPEAN, AND ROW SUPPLIERS
(Percent of Dollars)

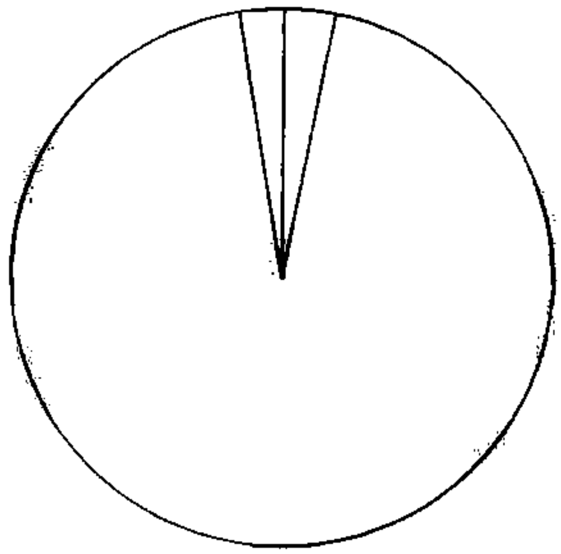


Table 8

ESTIMATED JAPANESE OPTOELECTRONIC REVENUES OF LEADING SUPPLIERS
(Millions of Dollars)

	1982	Percent Growth	1983	Percent Growth	1984
Sharp	$50	46.0%	$73	37.0%	$100
Matsushita	24	58.3%	38	78.9%	68
Toshiba	42	31.0%	55	14.5%	63
Fujitsu	13	69.2%	22	45.5%	32
NEC	14	42.9%	20	25.0%	25
Hitachi	21	9.5%	23	-4.3%	22
Tokyo Sanyo	13	7.7%	14	14.3%	16
Oki	8	12.5%	9	22.2%	11
Mitsubishi	1	100.0%	2	300.0%	8
General Instrument	3	66.7%	5	40.0%	7
Siemens	1	0.0%	1	100.0%	2
Texas Instruments	5	0.0%	5	-60.0%	2

Source: DATAQUEST

Nielsen Dataquest RESEARCH BULLETIN

JSIA Code: Newsletters

U.S.-JAPAN SEMICONDUCTOR TRADE UPDATE FIRST QUARTER 1985

The global semiconductor slump is severely cutting into sales by U.S. and Japanese semiconductor suppliers in each other's markets. DATAQUEST believes that U.S. companies are losing market share in Japan and that Japanese manufacturers are faring even worse in the U.S. market. We see the following situations:

- U.S. sales in Japan were down 16.5 percent in the first quarter of 1985 from the fourth quarter of 1984, while the Japanese market fell 14.3 percent. At the same time, Japanese sales in the United States fell 29.1 percent in the first quarter of 1985, while the U.S. market dropped 19.5 percent.

- Japanese companies, which gained more than three percentage points of market share in the United States in 1984 due to their dominance in the MOS memory market, are paying for that now as the market drops precipitously. We believe that the Japanese share of the U.S. semiconductor market was only 12.5 percent in the first quarter of 1985.

- Inventories of imported finished goods are high, expecially in the United States. We believe that many parts are being sold at very low margins in order to deplete inventory.

- Because of the reduced semiconductor trade between the United States and Japan, the U.S. deficit has also been reduced, to $155 million in the first quarter of 1985, from $261 million in the fourth quarter of 1984.

Table 1 shows semiconductor sales in Japan by U.S. companies and semiconductor sales in the United States by Japanese companies. Figure 1 shows quarterly semiconductor trade between the United States and Japan from first quarter 1983 to the first quarter of 1985. All numbers used in this newsletter are DATAQUEST's estimates of actual sales of finished goods by U.S.-based companies and Japanese-based companies in each other's markets.

Patricia S. Cox

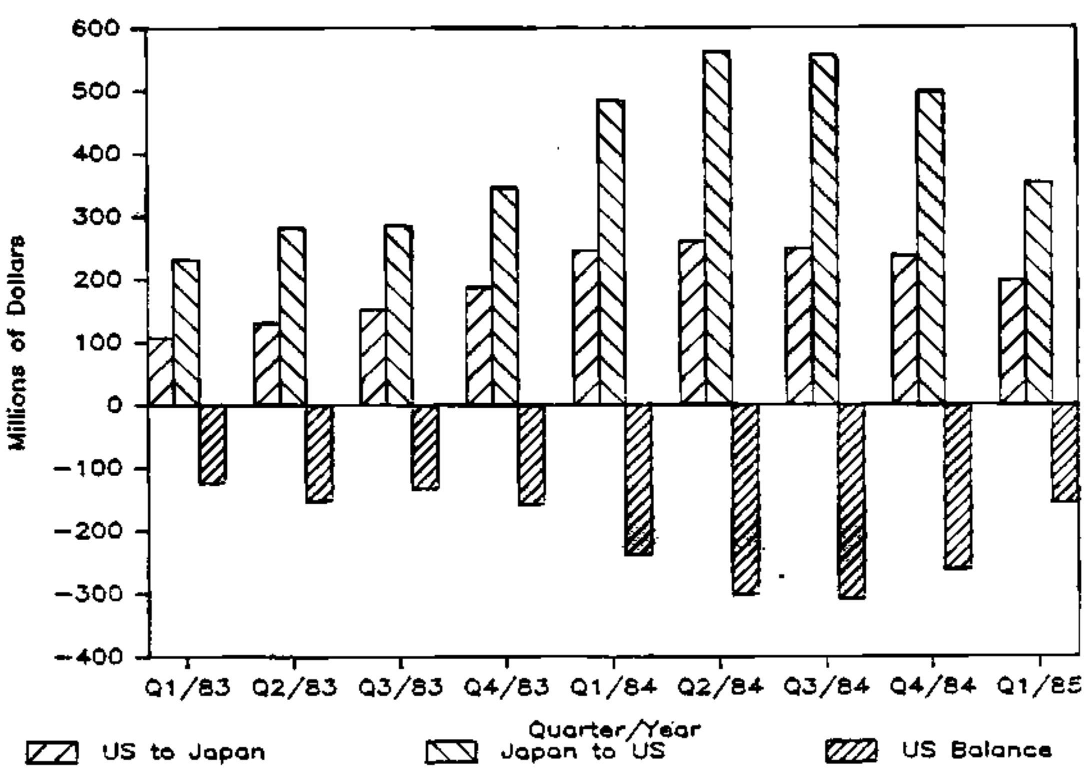
Table 1

ESTIMATED U.S.-JAPAN SEMICONDUCTOR TRADE
(Millions of Dollars)

	U.S. Sales in Japan			Japanese Sales in U.S.			
	Q1/85	% Chng. from Q4/84	% Chng. from Q1/84	Q1/85	% Chng. from Q4/84	% Chng. from Q1/84	U.S.-Japan Trade Balance Q1/85
Total Semiconductor	$198	-16.5%	-19.5%	$353	-29.1%	-27.1%	($155)
Total IC	$188	-14.2%	-17.5%	$325	-31.0%	-28.7%	($137)
Bipolar Digital	$65	-16.7%	-18.8%	$23	-20.7%	-39.5%	$42
MOS Memory	$20	-44.4%	-48.7%	$205	-33.0%	-40.4%	($185)
MOS Logic	$55	1.9%	0.0%	$79	-32.5%	38.6%	($24)
Linear	$48	-5.9%	-11.1%	$18	-5.3%	5.9%	$30
Total Discrete	$10	-44.4%	-44.4%	$28	3.7%	0.0%	($18)

Figure 1

ESTIMATED U.S.-JAPAN SEMICONDUCTOR TRADE



Source: DATAQUEST

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPANESE SEMICONDUCTOR TECHNOLOGY TRENDS
First Quarter 1985

SUMMARY

The outpouring of Japanese papers at the 1985 International Solid State Circuits Conference (ISSCC) was the highlight for the first quarter of 1985. As discussed in our newsletter dated March 18, 1985, "Japan Takes Center Stage at ISSCC 1985," Japanese research teams presented 44 percent of all papers presented at the conference. However, the announcement of 1Mb DRAMs and 256K SRAMs only signals the beginning of the race for the next-generation devices. DATAQUEST notes the following developments in Japanese semiconductor technology:

- Opening and expansion of corporate basic research centers (Konishiroku Photo, Matsushita, Mitsubishi, Oki, Sanyo, Sharp, Tokyo Electron, Toshiba)
- Shift to submicron processes and 3-dimensional structures (multilevel memory cells and stacked capacitor cells) for 4Mb and 16Mb DRAMs)
- Triple-layer polysilicon and hot electron technology (Toshiba's "flash" EEPROM)
- Joint development of original MPU software development tools (Hitachi/Sophia and NEC/Sophia)
- Emergence of GaAs gate arrays as a stepping-stone to GaAs digital ICs (Oki, Toshiba)
- Introduction of standard cell methods and libraries (Mitsubishi, NEC, Ricoh)
- Heated competition to open ASIC design centers and develop PC-based workstations
- Accelerating research in semiconductor lasers for NTT's optically based Information Network System (INS) and private value-added networks (VAN)

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- Reductions in GaAs wafer defect densities (Hitachi, MITI Optoelectronics Project, NTT, Show Denko, Sumitomo Metal Mining, Tohoku University)

- Development of laser CVD or defect corrections (NEC) and laser recrystallization for 3-dimensional silicon-on-insulator (Mitsubishi)

- Introduction of water-soluble photopolymer resists (Matsushita/Hayashibara) and molybdenum silicide photomask materials for 4Mb and over

GOVERNMENT R&D PROJECTS

DATAQUEST staff visited MITI's New Semiconductor Functions Elements Project (1981-1990), their Supercomputer Project (1981-1990), their Light Reactive Project, and finally, NTT's Atsugi Laboratory. The following are highlights of our discussions with their project managers.

MITI's New Semiconductor Functions Elements Project

Shigeru Fukuda, project manager, pointed out that the project is organized as shown in Figure 1. A committee of university professors is advising MITI's Agency for Industrial Science and Technology (AIST) on basic research. There are approximately 300 corporate researchers assigned to the project, equally divided among the three areas. Major results of the project to date include:

- MBE for AlGaAs/GaAs--Fujitsu has increased crystal perfection, and decreased alloy clusters (117,000 square cm/v sec at 77 degrees Kelvin)

- MBE for InGaAs/GaSb--Sumitomo has achieved 7,200 square cm/v sec at room temperature

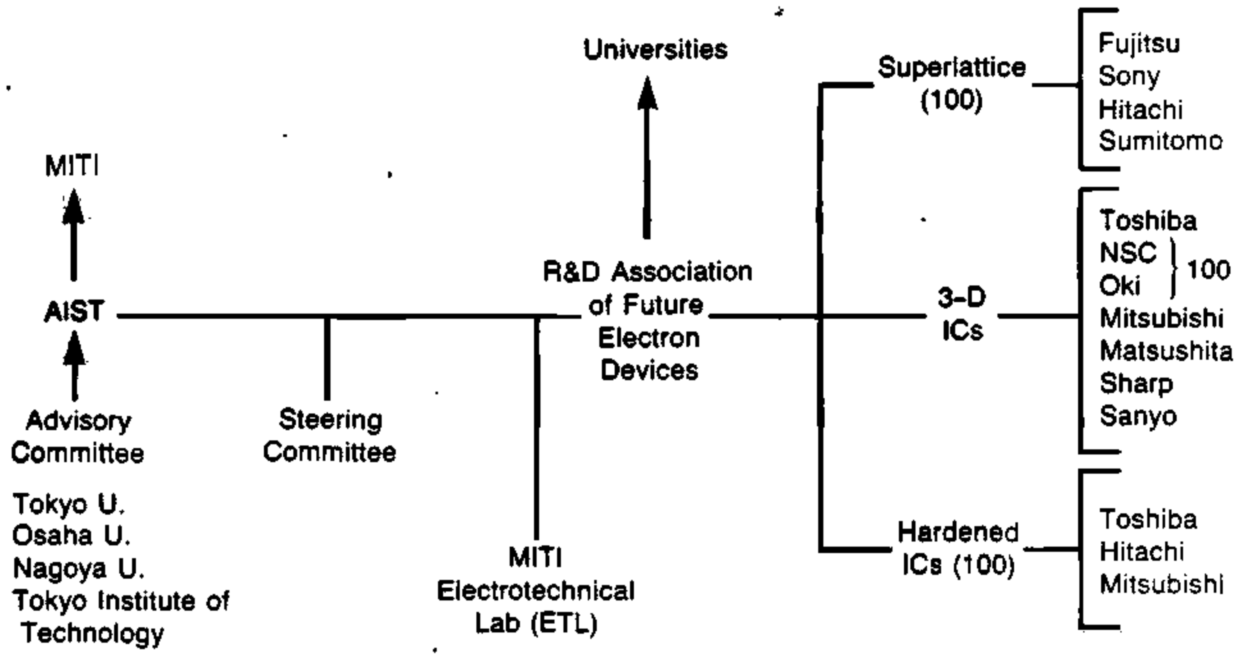
- MBE for silicon--Hitachi has developed a formation of p-n doping superlattice structures and silicon-nickel electrodes.

- MOCVD for AlGaAs/GaAs--Sony has investigated heterostructure abruptness (32-46 angstroms) and developed an impurity high doping technique that permits high-speed growth.

DATAQUEST believes that the New Functions Project is MITI's VLSI Project for the 1980s. The next major breakthroughs in semiconductor technology will come in the areas of 3-dimensional ICs (e.g., Mitsubishi's 1Mb DRAM with 3-dimensional stacked capacitor cells and Hitachi's 4-bit, 16-level cell storage for the file memory) and III-V compound superlattice devices. We will update you on the latest developments after the project's annual symposium in July.

Figure 1

MITI's NEW FUNCTIONS ELEMENT PROJECT



Source: DATAQUEST
MITI New Functions
Element Project

MITI Supercomputer Project

Kazuo Miyazawa, managing director, was unable to provide much information because of the project's confidentiality. He believes that Fujitsu, Hitachi, and NEC will introduce GaAs-based supercomputers in the near future. Participating companies were given the following assignments for fiscal 1984:

- System architecture--Fujitsu
- Large capacity high-speed storage unit--NEC
- Parallel processor for distributed processing--Oki, Mitsubishi, Toshiba
- Software--Hitachi

- Josephson junction--Fujitsu, Hitachi, NEC
- High electron mobility transistors (HEMT)--Fujitsu, Oki
- GaAs--Mitsubishi, NEC, Toshiba

For results of these projects, see the Technology Development and New Product Announcements sections of this and previous JSIS Technology Trends newsletters (April 5, 1984; August 17, 1984; October 26, 1984; January 23, 1985).

MITI Light Reactive Material Project

In January, MITI organized a $40 million project to develop high-performance photochromic materials and other materials that alter magnetic or light refraction when exposed to light. The goal is to develop materials for voice, image, and computer storage systems. Hitachi, Mitsubishi Electric, and Toshiba are likely candidates among the 5 to 10 firms that will be selected. Other candidates include Mitsubishi Chemical Research Centers.

NTT Atsugi Lab

Dr. Sudoh, semiconductor research manager, explained that the Atsugi Lab has the latest experimental semiconductor equipment from Japanese equipment makers. NTT is pursuing four processes: plasma x-ray using the synchrotron at the Tsukuba High Physics Lab; 0.1-micron level electron beam; submicron stepping; and plans for excimer lasers. NTT is interested in long-term joint research with foreign companies (e.g., Eaton for ion implant equipment and Energy Conversion Devices for memory). Companies interested in joint research should contact NTT New York City or Los Altos, California (Silicon Valley). NTT is also pursuing wafer scale integration at the Musashino Lab for memory-level application, but not at the logic level.

CORPORATE R&D

In January, Japanese companies highlighted their research achievements in 1984 and goals for 1985. As shown in Table 1, the major companies are pursuing basic research in 1985.

Table 1

JAPANESE SEMICONDUCTOR ACHIEVEMENTS AND GOALS

Company	1984 Achievements	1985 Goals
Hitachi	Handwriting and voice recognition (commercialization in five years) CMOS and bipolar gate arrays	SiC ceramic substrates 1.3-micron gate arrays
NEC	Silicon-doped GaAs and non-doped AlAs structure Biosensors Multilayer LSI process VLSI wiring design system High-rel semiconductor lasers	0.1-micron VLSI technology MPU development support tools
Toshiba	1Mb DRAM Folded capacitor cell (4Mb) Mask pattern use CAD 1,000-gate GaAs gate array Excimer laser	4Mb to 16Mb DRAM process 4,000-gate, 4K-16K GaAs gate array 1.3- to 1.5-micron lasers Read-write optical disk
Fujitsu	0.9ns, 1KK GaAs SRAM (HEMT) 400 Mb/sec. optical transmission	GaAs and HEMT 1.5 Gb/sec. transmission
Mitsubishi	1Mb DRAM basic development Inference machine (ICOT)	4Mb DRAM process 30-GHz GaAs IC
Matsushita	16-bit CMOS MPU (MN1617) 40-GHz semiconductor laser	Read-write optical disk Optoelectronic ICs

Source: DATAQUEST
Nikkei Electronics

Corporate R&D Centers

Toshiba will build a new $77 million electronics technology center in Kawasaki, Kanagawa Prefecture, to develop custom LSIs. The center will be completed by December 1986 and linked to Toshiba's plants and gate array design centers throughout the world through leased lines and communications satellites. It will have a staff of 2,300 employees (This development was announced in February.)

NEW INDUSTRY ASSOCIATIONS

In March, 350 Japanese companies formed the Japanese Semiconductor Equipment and Materials Association. The association has as its director Mr. Yoshida, director of Nikon and a speaker at our April 14-15 conference in Hakone.

TECHNOLOGY DEVELOPMENTS

With the rapid decline in 256K DRAM prices, the megabit DRAM era is in full swing. Five Japanese companies introduced 1Mb DRAM papers at ISSCC 1985 (Fujitsu, Hitachi, Mitsubishi, NEC, and Toshiba), in addition to AT&T, IBM, and Mostek. (See our JSIS newsletter, "Japan Takes Center Stage at ISSCC 1985," dated March 18, 1985.) Fujitsu, Hitachi, and Toshiba announced that they will begin sampling 1Mb DRAMs from mid-1985.

Memory

- Hitachi--A multilevel memory cell that quadruples the storage capacity of memory cells in DRAMs; input signals split into 16 sections and stored with information; access time slowed to 70 microseconds due to additional amplifier circuit (preamp) required to restore voltage; future use as file memory for portable computers and image data files (announced in February)

- Matsushita Electric--An 8K-bit content addressable memory for data-flow and next-generation computers; 2-micron design rule; 30 x 36 micron cell size; 4.8 x 7.1mm chip size; instantaneous data retrieval system ten times faster than conventional systems; 100ns execution cycle time; 12 functions for managing internal data, including re-entrant operation mode that automatically enters fresh data into an address after eliminating old data (announced in February); plans to mass produce 4Mb DRAMs and sample 16Mb DRAMs, and to sample 1Mb SRAMs by 1987 and 4Mb SRAMs by 1990 (announced March 12)

  Toshiba--A "flash" EEPROM prototype developed using triple-layer polysilicon and hot electron method for writing in data; one transistor and erasing, controlling, and floating gates; number of transistors reduced by one-third; 12.5 volt required; plastic packaging feasible; plans for commercial introduction of 64K flash EEPROM in 1986 (announced in January)

- Seiko Denshi--A 256-bit nonvolatile RAM with a simplified design and 5V for writing in data, developed using perpendicular accelerated-channel injection MOS; seven transistors per bit; memory retention capacity of 10 years and 10,000 data-write cycles; sample 256-bit parts by spring 1986 and 16K NVRAMs by late 1986 (announced in January)

Microprocessors/Microcontrollers

- Hitachi--Basic agreement with Sophia Systems to jointly develop software and support system for Hitachi original MPUs, commercialize software development tool (in-III) and program emulator (HSP/HD61810) by second half of 1985, and develop software to support Hitachi 40/8-bit MPUs (H685DS) and 16-bit (H6805D200); 1,000 units of software systems and 3,000 units of SA-Series emulator to be developed (announced January 18)

- Mitsubishi--A proprietary 16-bit MPU under development; to be compatible with Mitsubishi Electric's Processor Series (MELPS) 740 series original 8-bit MPU parts (announced in January)

- NEC--Five-year second-source agreement with Sony for 16-bit V-20 and 32-bit V-30 series; similar agreement with Zilog in April 1984; NEC to sample 32-bit MPUs by late 1985; CMOS parts with 600,000 to 700,000 elements (announced in January)

Application-Specific Integrated Circuits (ASICs)

Japanese semiconductor makers are rapidly moving into ASICs because of the soft memory and MPU markets. Dempa Shimbun estimates total Japanese gate array sales were $320 million in 1984 (compared to DATAQUEST's forecast of $295 million), with Fujitsu ($200 million), NEC ($40 million), and Toshiba ($40 million) leading the pack. Hitachi, NEC, and Toshiba plan to double their sales to about $80 million each. Mitsubishi Electric began taking orders in April. Matsushita Electronics and Sharp plan to double production by 1986. Other active gate array makers include Asahi Microsystems, Fairchild Japan, Motorola Japan, Nihon LSI Logic, Oki, Ricoh, Rohm, Suwa Seikosha, and TI Japan.

- Oki Electric--A GaAs gate array with 390ps computing speed; 3.7 x 3.9mm GaAs substrate integrating 1,000 transistors; 8 x 8-bit multiplier fabricated using Super Buffer FET Logic (SBFL); twice the speed of conventional Direct Coupled FET Logic (DCFL) (announced in March)

- Ricoh--A new standard cell method for designing custom single-chip MCUs around Rockwell's 8-bit CMOS MCU; design-to-delivery time one-third that of conventional custom chips and production costs one-half that of cell library of standard logic, ROMs, RAMs, I/O ports, timers/counters, DMA controllers and real-time clocks (announced in January)

- Sharp--Opening a custom LSI design center in Chiba to strengthen sales of CMOS gate arrays and standard cells in the Tokyo region (announced March 28)

- Matsushita Electronics--Fiber optic network to link its Nagaoka plant with Kyoto University R&D center, Matsushita Semiconductor Research Center, and design center in Tokyo; users to increase gate array backlogs; current monthly production of 1 million units; marketing of standard cells since March; production goal of ¥10 million ($40 million) in 1985 (announced March 26)

Standard Logic

- Kumamoto University--A semicustom, inference logic that calculates expressions in marginal differences and arithmetic sums, not linear digital computations; called "fuzzy logic ICs" due to result-by-hunch approach; 12 patent applications filed to create master-slice, p-channel, metal-oxide semiconductor; standard CMOS processes used (announced in January)

- NTT Atsugi Lab--A high-speed floating-point arithmetic LSI with 0.18 microsecond multiplication speed; addition speed of 0.36 microseconds and subtraction speed of 0.6 microseconds; 50,000 logic gates, 15K ROM, multiplier, and register fabricated on 10 square mm chip using 1.2-micron design rule and CMOS process; IEEE standard 80-bit input signals; 1 watt power dissipation (announced in March)

- A prototype macro cell array with computing speed of 78ps; 756 macro cells, each with 8 transistors and 8 resistors; equivalent of 2,500 gate arrays; fabricated using Super Self-Aligned Technology, which requires fewer photomasks; 16 x 16-bit multiplier achieved 7.5ns speed (announced in March)

Bipolar Digital

- Hitachi--A 500-MHz D/A conversion LSI; for future high-performance displays with up to 2,000 scanning lines; data multiplex method that divides image data into two input channels, halving the data transfer speed to 250 MHz per channel; 1.2 x 1.2mm chip size (announced in February)

- NTT Atsugi Lab--A macro cell array with 78ps computing speed; 756 macro cells, each with 8 bipolar transistors and 8 resistors; prototype equivalent to 2,500 gate array; fabricated using super self-aligned (SST) technology requiring fewer photomasks; 7.5ns operating speed for 16 x 16-bit multiplier using this technology (announced in March)

- Toshiba--A hybrid MOSFET module; sample shipments of 500V 25A, pressure-tight model since March; 1.0 to 1.2-microsecond switching speed; four-layer thyristor structure with P-layer substrate (announced in January)

Linear/Analog

No major announcements.

Discretes

- Hitachi--An ion beam MOSFET featuring an arsenic-doped layer impregnated with boron ions; between the source and drain; 30 percent faster than conventional EMOS transistors; produced using a micro beam system for injecting ions directly into wafers; patterns 0.1- to 1.0-microns wide possible without a mask; potential use for 4Mb and 16Mb DRAMs (announced in January)

Optoelectronics

- NTT Atsugi--An optical semiconductor capable of receiving optical signals, converting them to electrical signals, then amplifying them fourfold from the input level; indium phosphate substrate on which indium gallium arsenide grown by liquid phase growth method; 130 4mm square columns around 80 micrometer light-receiving PIN; light electricity conversion efficiency of 0.7; for use in optical communication receivers (announced in January)

- KDD--A 1.55-micron laser diode capable of doubling communication distance due to low transmission loss through single mode fibers; new structure using a defraction grid that creates windows with low reflection ratios at both ends of the diode; 100km without repeater stations in underwater cables; to use in No. 3 Pan-Pacific Underwater Cable System by 1988 (announced in January)

- NEC--A 671-nanometer laser diode using vapor-phase epitaxy and a mesa stripe structure to develop a double heterojunction indium-gallium phosphide; sensitivity about 2,000 times that of 780nm lasers; to be used for laser printers, optical disk memory, and other optical information processing (announced in March)

- Sharp--An interference visible semiconductor (VSIS) laser with a 780-nanometer wavelength that provides stable oscillation axis over a broad temperature range at low noise; an internal reflection region formed by a double resonance structure (IRI-VSIS); stable, single-axis mode oscillation possible at 10ns (announced in January)

  A GaAlAs semiconductor laser with a short wavelength; sample price of ¥20,000 ($80); 10,000 units monthly production from April (announced on March 27)

- Sumitomo Electric--A high-performance PIN-photo diode capable of receiving signals at 200 million bits per second (MBS); designed to receive light signals at 1.3-micron wavelength; capacity to transmit and receive image and other large volume data at real time; converts 1-watt light into 0.8 amperes of electrical current; monthly production of 100 units for in-house long distance (7-km) optical communication system and high-speed optical data links for computers (announced in March)

- Tohoku University--A 2-dimensional coaxial transverse junction LED for future ultra-high-speed printers and optocomputers; 40,000 cylindrical spikes (each 21 microns wide and 19 microns high) integrated onto 1 square cm GaAs substrate; fabricated by vapor deposition of argon-arsenide compound over GaAs substrate and etching with silicon oxide mask that has spike pattern; 10 to 100 times faster and clearer than conventional printers; plans to develop optical parallel digital logic arithmetic device for optocomputer (announced in March)

Image Sensors

- Fuji Photo Film--A high-definition MOS-type image sensor that can be used as 8mm video camera "eyes"; 10.1 x 8.7mm chip integrating 380,640 photo diodes in 488 vertical and 780 horizontal arrangement; commercialization within two years (announced in March)

- Hitachi--An optoelectronic IC (OEIC) for complex information processing tasks; 40 milliampere threshold current; 0.19 milliwatt per ma slope efficiency; integration of a laser diode, 12 FETs, and 3 resistors on a single chip; 120 to 130ps response from a 200ps signal input; process input signals as low as 0.8 to 1.0 volts; next-generation IC for optical computer system (announced in January)

Gallium Arsenide

- NEC--A 12 x 12-bit extended parallel multiplier with 1,813 logic gates of 3,646 transistors, 1,136 diodes, and 45 resistors; 2.5 watt power consumption (1.7mW per gate); 4ns maximum operation time and 170ps delay per gate; depression field-effect transistor and buffer FET logic gate circuit that increases driving capacity of the load and the source-coupled FET logic (SCFL); uses sidewall-assist, self-align technology; developed as part of MITI's Supercomputer Project (announced in January)

- Matsushita Electronics--A microwave monolithic integrated circuit (MMIC) for ultra-high frequency signal conversion for direct broadcast (DBS-TV); noise ratio of 1.6dB in 12 GHz, with 8dB high gain and 6V breakdown voltage; plans for 1- to 12-GHz devices and 3-stage amplifier ICs integrating 10 FETs in a DBS-TV satellite head amplifier (announced in January)

- Mitsubishi--A 28-GHz GaAs FET amplifier with 1-watt output and 7.5dB gain; potential to halve the cost of 28-GHz transmitters for satellite communication earth stations; unique technology that synthesizes electric power within the chip; two chips to produce 1 watt; measures 3 x 4.2 x 7cm in size; commercialization by 1986 (announced in January)

- Oki Electric--A GaAs gate array with 390ps computing speed at load conditions, twice that of direct coupled FET logic (DCFL) multiplier; 1,000 transistors integrated on a 3.7 x 3.9mm GaAs substrate; 8 x 8 multiplier fabricated using Super Buffered FET Logic (SBFL) (announced in March)

  A GaAs metal semiconductor FET (MESFET) with processing speed of 14.7ps; gate electrode length of 0.5 microns and 22.4mW power dissipation; speed increased inversely with length of electrode; shallow channel used to overcome current leakage caused by short gate length (announced in March)

- Furukawa Electric--Production of epitaxial GaAs wafers for high-value uses such as supercomputers; shipments by mid-1985 (announced March 25)

- Showa Denko--GaAs wafer with dislocation density of 200 to 300 per square centimeter, using an indium annexing method with crystal GaAs; sample shipments in April; mass production at Chichibu plant since September (announced March 27)

Josephson Junction

- NEC--A Josephson junction circuit with 80ps speed in 4 x 4 multiplication; 249 gates integrated on 2.7 x 2.7mm chip; 862 Josephson junctions; fabricated using NEC's resistor-coupled JJ logic and dual-rail logic that sends multiplication instructions without requiring a separate "not" step; use of single, two-thirds majority decision gate instead of three AND gates and an OR gate; step toward development of an ultra-high-speed Josephson computer (announced in March)

New Semiconductor Functions

- Mitsubishi Electric--Prototype of world's first 3-layer, 3-dimensional circuit produced using a selective laser recrystallizing method to form a single crystal silicon layer over an insulation film; temperature distribution of laser controlled to form optimum single crystal; a 256-bit SRAM developed integrating a photo sensor, signal processing, 10-bit linear image sensor, and peripheral circuits; CAD technology proposed to commercialize 3-dimensional LSIs (announced March 14)

- NEC--A single-chip biosensor capable of measuring urea, glucose, and potassium in blood samples; one-month life span three times existing devices; sensor designed on 2 x 6mm sapphire substrate incorporating four ion sensitive FETs and four MOS FETs arranged in pairs; urease, glucose oxidase, and barinomycin built into the IC device; commercial device capable of detecting 20 substances expected within one year; to be used as medical diagnostic tool for new-born infants and seriously ill patients (announced in March)

Manufacturing Processes

- NEC--A laminate process that bonds to conventional chips face-to-face under 300 to 400 degree centigrade heat to form a double-layered, 3-dimensional device; combinations of 50,000 chips of 5 square mm joined at each connection in 10-micron area; commercialization of multifunction compound ICs, optoelectronic ICs, and high-speed hybrid ICs combining ICs and wafer-scale MPUs possible within two years (announced in January)

  A laser CVD method that corrects tiny white defects much as pinholes and poor connections on photomasks within 10 seconds; production use within one to two years (announced March 17)

- Rohm--Practical use of molecular beam epitaxy (MBE) for crystal growth to produce semiconductor lasers for compact digital audio disk players; capable of producing wafers up to 75mm in diameter, yielding 88,000 chips each (announced in January)

- Mitsubishi--Trial production of 1,100-gate CMOS array using laser recrystallization technology to develop silicon on insulator (SOI) construction; 3-micron design rule; 2.5ns delay time; operating speed 20 percent greater than general CMOS LSIs; SOI substrate ideal for CMOS LSIs due to its high density and high speed, absence of latch-up effect, and negligible parasitic capacitance; only six masks due to elimination of well processing step; commercialization within three years (announced March 30)

Manufacturing Equipment

No major announcements.

Test Equipment

- Matsushita Electric--A water-soluble photopolymer resist for producing very, very large scale ICs (VVLSIs); jointly developed with Hayashibara Biochemical Laboratories, Inc. of Okayama; new photoresist for making submicron circuit patterns (0.5 micron) using ultraviolet rays and other beams; compound of polysaccharide compound and photo-bleaching reagents; light-scattering problem reduced; highly heat resistant and easily washed away during production (announced in March)

- Mitsubishi--A molybdenum silicide photomask material for fabrication of 4Mb DRAMs; greater compatibility with quartz substrates required for 1Mb to 4Mb DRAMs; excellent adhesive qualities and faster etching; low electrical resistance of 100 ohms; prototype circuit patterns of 0.5 microns wide (announced in February)

Packaging

No major announcements.

CAD Systems

- Fujitsu--Artificial intelligence CAD systems ("automatic logic circuit composition system") capable of designing logic circuits and complex wiring design; high-level knowledge of specialists input into system; practical use in near future (announced March 30)

- NEC--A standard cell library and CAD software; introduced at Custom Circuits Conference in Portland, Oregon (announced in May).

MAJOR PRODUCT ANNOUNCEMENTS

Memory

- Fujitsu--A 16-bit MOS one-time, sequentially programmable ROM with an address counter (MB8541); clock input and 1-bit serial output; one-transistor stack gate cell with CMOS peripheral circuits; 32 bits of test cell space for user write verification: 5.21V to write and 3V to read (announced in February)

- Hitachi--Six 256K DRAM types; page mode (HM50256CP) at sampling price of ¥3,000 ($12); nibble mode (HM50257CP) at ¥4,000 ($16); 256K x 1 organization; 120/150/200ns; PLCC packaging with 30 percent smaller package size and 40 percent height reduction; 350mW operating power and 20mW standby; 80-pin with 1.27mm lead pitch; 13.51 x 8.31mm chip size; 3.56mm height (announced January 22)

A 256K static column CMOS DRAM (HM51258P); 2-micron design rule; 100/120/150ns in normal mode; 45/55/70ns in static column mode; 256K x 2-bit organization; 16-pin 300 mil plastic DIP; power dissipation of 250mW during operation and 20mW at standby; sample prices ¥4,900 to ¥6,700 ($19.60 to $26.80); monthly production of 100,000 since July (announced in January)

A 1Mb CMOS mask ROM with 250ns access time (HN62301AP); power dissipation of 75mW during operation and 2.5mW at standby; 128K x 8-bit organization; 6 bits of check bits for 32 bits of data for error correction circuit (announced in January)

- Fujitsu--A one-time programmable 256K CMOS ROM with address counter (MB8541); power dissipation of 10 milliamperes during operation and 20 microamps at standby; 5 and 21 volts for writing; 3 to 8V for readout; maximum 5ns access time; priced at ¥280 ($1.12) in lots of 10,000 (announced in January)

A 224K memory designed for video digital signal processing (uPD41221C); large-capacity high-speed serial access monolithic memory; 500,000 elements on a single chip; 320 x 700 memory cell; used for NTSC and PAL TV receiver broadcasting systems (announced in January)

Two CMOS 256K SRAMs; RAM controlled by chip selection signal and output control signal (MuPD43256C); RAM controlled with two chip select signals (MuPD43257C); both 32K x 8-bit organization; titanium silicide gates featuring gate interconnect resistance of one-tenth that of conventional polysilicon gate interconnections; 5.09 x 8.0mm chip sizes; 100/120/150ns access times; 385mW power dissipation at 100ns operation and 550mW at standby (announced in February)

Two 256K video RAMs for high-performance graphic displays (uPD41264C); 120ns and 150ns parts; 64K x 4-bit NMOS organization and 256 x 4-bit serial data register; 1.3-micron design rule; 4.9 x 11mm chip; dual port design for simultaneous random memory access and serial readout (announced in March)

- Oki--A 128K stacked DRAM using two 64K DRAM chips (model MSM37S64A); 131K x 1-bit organization; 120/150/100ns access times; 128 refresh cycles at 2 milliseconds, noncritical clock timing requirements; TTL-compatible I/Os, standard 16-pin DIL plastic package; single +5V power supply; ¥1,750 ($7.00) for 200ns chip and ¥1,940 ($7.75) for 150ns chip in orders of 100,000 (announced in March)

- Sony--16K and 64K SRAMs using NMOS for memory cells and CMOS for peripheral circuits; 8K x 8-bit types (CXK5864P) with 100/120/150ns access times and 50 microamperes power dissipation; 2K x 8-bit types (CXK5816P series) with 100/120/150ns access times; 50-microampere and 1 milliampere power dissipation (announced in February)

- Toshiba--A 64K CMOS SRAM (TC5561P) with NMOS memory cell structure and CMOS peripherals; 3.86 x 6.99mm chip; 22-pin, plastic DIL package; 55ns access time; 64K x 1-bit architecture; 550mW power consumption in operation and 5.5mW at standby to be used in supercomputer main memories and microcomputer cache; monthly production of 50,000 units (announced in January)

- Suwa Seikosha--Entering EPROM market with sample shipments of 64K and 128K EPROMs; production of 64K SRAMs begun and 256K SRAMs under development (announced March 26)

Microprocessors/Microcontrollers

- Fujitsu--Four single-chip 4-bit NMOS and CMOS MCUs; available in piggyback configuration; quantity prices of MB88401H/411H/421H/501H will be $2.65/$2.95/$3.85/$3.25 for orders of 500; 42-pin MDIP and 84-pin MFPT packages (announced March 14)

- Tokyo Sanyo--A single-chip NMOS 8-bit MPU with Sanyo bus interface (LM8854); 4K ROM and 256-bit RAM; can be directly hooked to bus of an 8088, 8085 or Z-80 host CPU; housed in 64-pin DIP; ¥700 ($2.80) in lots of 50,000 (announced in February)

Application-Specific ICs (ASICs)

- Suwa Seikosha--A new CMOS gate array series (SLA6000) offering 800/1400/1700/2700/3300/4300/6200 gates; STTL-compatible; 2.0-micron design rules; 2-layer metal, 2ns gate delay speed, plastic DIP; up to 150 I/O; 8 to 12 week turnaround (announced January 18)

- Fujitsu--A 2,300-gate array incorporating 1K SRAM (model MB60VM000 Series) with 2.2ns delay per gate; organized at 256K x 4-bit, 128K x 8-bit, 64K x 16-bit, or 32K x 32-bit; 33ns standard access for 32K x 32-bit SRAM; samples from June at ¥3,000 ($11.50) (announced in March)

- Ricoh--A library of 130 new cells used for designing gate arrays and standard cells; 2.0- and 2.5-micron layer thicknesses using silicon gate CMOS processing; to be used for 512K and 1Mb NMOS devices and 64K, 128K, and 256K mask ROMs; orders for 5,500 to 8,000 gate devices starting in March (announced in January)

- Oki--A 10,000-gate CMOS array (MSM78H000) designed for use in 32-bit systems where large amount of random logic circuitry and controllers for memory, 1 logic, bus, and system bus required; fabricated using 2-micron dual-layer silicon gate CMOS process; programmed as a system-on-a-chip unit cell consisting of two pairs of transistors (PMOS and NMOS transistors per pair); 2.3ns propagation delay; 68 to 176-pin packages; CMOS- and TTL-compatible I/Os, 3 to 6 voltage range; 40-MHz operating frequency and operating temperature range of -40 degrees C to +85C; unit price of ¥25,000 ($100) in 84-pin plastic LCC; 16 to 18 week delivery time (announced in March)

<u>Application-Specific Standard Circuits (ASSCs)</u>

- Fujitsu--Two semiconductor disk subsystems using 256K DRAMs (FACOM 6630A/B); 0.3-millisecond access time, or one-eightieth that of conventional disk systems (announced in February)

- Oki--A 10,000 gate CMOS array (MSM78H000) designed for 32-bit systems with large random logic circuitry and controllers for memory, logic, bus, and system bus; 2-micron dual-layer silicon gate CMOS, unit cells consisting of two pairs of PMOS and NMOS transistors; 68- to 176-pin package; 2.3ns propagation delay; CMOS- and TTL-compatible I/Os, 3- to 6-voltage supply; 40-MHz operating frequency; priced at ¥25,000 ($100) in 84-pin PLCC; 16- to 18-week delivery time from data input (announced in March)

- Toshiba--Two driver ICs and three display control ICs for liquid crystal displays up to 200 x 640 dots; 26-volt capability; driver for 64 channel rows priced at ¥1,100 ($4.40); driver for 80 channel columns ¥1,150 ($4.60); LSIs for character, graphics, and character/graphics display control (announced in February)

  A realtime clock LSI (TC8250P) incorporating a circuit that distinguishes between 3V and 5V power supply; memory protection circuit and recharge control circuit; 50 percent space reduction; ¥500 ($2.00) sample price; a CRT control LSI (TC8505P) for programming characters, scanning lines, and display positions; paging and scrolling with light pen; sample price of ¥1,150 ($4.60) for 40-pin DIP unit (announced in March)

<u>Standard Logic</u>

- Fujitsu--Full-scale production of three CMOS logic series (MB74HC): HC series with CMOS input and I/O buffer, HCT devices with TTL input and I/O buffer, and unbuffered HCU series (announced in February)

- Nippon Precision--A 16 x 16-bit high-speed multiplier-accumulator integrated on a single-chip CMOS molybdenum gate LSI (SM5810); pin-compatible with the TD C1010 industry standard; 80ns speed; 30 miliampere power dissipation at 12.5 MHz, 5 volts; 2-micron rule; 0.55ns per gate propagation delay time; sample price ¥45,000 ($180) (announced in January)

Bipolar Digital

- Hitachi--Four models of high-frequency, low-noise, bipolar transistors; 6 GHz cut-off frequency, 11dB power gain, and 1.5dB noise factor (2SC3511); and 7.5 GHz cut-off frequency, 12.5dB power gain and 1.2dB noise factor (announced in January)

- Matsushita Electronics--A hybrid IC 16-bit A/D and D/A converter having full-scale output temperature range and conversion rate; sample shipments from May; initial production of 10,000 units monthly (announced March 29)

Linear Analog

- Sony--Two automatic audio processors with universal demodulation IC that will be compatible with AM broadcasting systems in the United States and Canada; PLL and malfunction-preventing circuits for stereo reception that introduce no co-channel interference (CX20177); universal demodulation IC with an envelope detector, PLL synchronous AM detector, PLL orthosynchronous detector, dividing inverse modulator, mute circuit, and FM detector (announced in January)

- Mitsubishi--Three models of Bi-FET operational amplifiers; 73dB at 13V/microsecond, 8-pin SIL (M523BL) priced at ¥200 ($0.80); 73db device in DIL package priced at ¥200 ($0.80); 82dB at 40V/micro- second, 16-pin DIL, (M5240P) priced at ¥400 ($1.60); initial shipment of 1.3 million units per month since April, rising to 20 million units (announced February 7)

- Full-scale sales of video amplifiers for high-resolution display terminals; incorporates bipolar processed IC; priced at ¥900 ($3.60) (announced March 21)

- Toshiba--Five types of FM car radio ICs having functions of FM medium frequency amplification detection and noiseless stereo demodulation; sample price of ¥1,200 ($4.80) for kit; monthly production of 300,000 units since March (announced March 27)

- Matsushita Electronics--Six ICs for long distance telephone transmission: one for communication; three ringer ICs to detect calling signals from telephone offices (multifunctional AN6171 priced at ¥300 ($1.20), standard AN6170 and AN6172 at ¥160 ($0.64), and two ringer ICs to convert telephone numbers into pulse or DTMF for transmission to telephone office (MN6114 priced at ¥1,000 ($4) and MN6112 at ¥500 ($2) (announced March 28)

Optoelectronics

- Sharp--A laser beam printer semiconductor laser (LT026MD) using a VSIS structure; 5mW maximum output and 780 nanometer visible light wavelength; 10-micron point separation; totally automated epitaxial process; 5nW optical output; sample price ¥7,000 ($28); initial monthly production of 10,000 (announced January 25)

  Three series of nine large-diameter LEDs; LT9507D series of 7.5mm diameter red and green LEDs at 150 mCda output, and yellow at 80 mCda output; LT9512D series at 10mm (using a parabolic lens) of 70 mCda red, 100 mCda green, and 30 mCda yellow LEDs; LT9526D series of red LEDs at 200 mCda output, green at 250 mCda, and yellow at 80 mCda (announced in February)

  A 750-nanometer laser diode with eight times the brightness of 780nm laser diodes; 50,000 hour life at 25 degrees centigrade and 3mW; proprietary VSIS structure and 50-micron thick cap layer used to reduce aluminum content without creating internal distortions; sampling at ¥20,000 ($80); monthly production of 10,000 units (announced in March)

- Sony--Two aluminum gallium arsenide (AlGaAs) high-output laser diodes fabricated using metal organic chemical vapor deposition (MOCVD); suitable for optical disk systems and high-speed laser printers; sampling price for 30mW model ¥200,000 ($800) and 40mW ¥300,250 ($1,200) (announced in April)

- Matsushita Electronics--A series of small, high-output LEDs and reflection sensors; LNO-1201C red LED with 1.5 mCda output at 15mA; LNO-1301C green LED with 10 mCda output at 20mA; LNO-1401C yellow LED with 5 mCda output at 20mA; LNO-2102C68 red LED at 3 mCda and green LED at 1.5 mCda at 10mA; single-LED packages measure 3.0 x 2.2 x 1.5mm, two-color devices 3.4 x 2.7 x 1.5mm (announced in February)

- Toshiba--A high-output semiconductor laser for optical disk filing equipment (TOLD500); 30mW output at peak 810-nanometer wavelength; beam concentration of 1 micron; very thin film developed with MOCVD; sample price of ¥150,000 ($600) (announced in February)

Image Sensors

No major announcements.

Gallium Arsenide

- Mitsubishi Electric--A field-effect transistor for microwave receivers (MGF1405); noise level of 0.5dB at 4 GHz and 1.4dB at 12 GHz; drain current of 70mA with allowable loss of 200mW; minimum power gain noise of 15dB at 4 GHz and 10.5dB at 12 GHz; packaged in a 1.8 x 1.8 x 1.1mm microceramic package with a soldered metal cap; priced at ¥68,200 ($272); four GaAs FETs also offered for satellite broadcast applications and microwave communications (announced in January)

- Toshiba--Three types of GaAs Hall sensors; designed to convert magnetic force into electrical force; 30 percent more sensitive than existing products; SIP type (TH106A) priced at ¥45 ($0.18); supermini (THS107A) with 1.7 x 1.5 x 0.6mm size and THS108A both priced at ¥60 ($0.24); monthly production of 70,000 planned (announced January 29)

Josephson Junction

No major announcements.

New Semiconductor Functions

No major announcements.

Manufacturing Processes

No major announcements.

Manufacturing Equipment

No major announcements.

Test Equipment

- NJS Corporation--A fully automatic defect detection for photomasks (7MD62) capable of handling 1Mb DRAMs; priced at ¥98 million ($392,000); shipments since June; sales goal of 20 units in first year (announced April 4)

Chemicals and Materials

No major announcements.

Packaging

- Fujitsu--Plastic lead chip carriers (PLCCs) for LSI being shipped; leads bent inward to absorb the application heat to reduce spreading during automatic mounting on PC boards; DIP standard 0.50mm lead pitch; 24.2 x 24.2 x 4.3mm carriers for 68-pin packages for gate arrays with 1,275/2,000/2,640/3,900 gates; material cost one-tenth that of conventional PLCCs (announced in January)

Sheridan Tatsuno

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: JSIA Newsletters

JAPANESE MARKET UPDATE--CURRENT OUTLOOK

SUMMARY

While the U.S. semiconductor market is currently in a depression marked by three consecutive quarters of declining consumption, the Japanese semiconductor market is in a recession, marked by only two consecutive quarters of declining consumption. The Japanese market will not decline as much as the rest of the world because of two major large markets: the INS (Information Network System) of telecommunications, and the large and expanding market in China (PRC) for made-in-Japan televisions.

DATAQUEST ANALYSIS AND FORECAST

Japan in a Global Perspective

We expect the Japanese semiconductor market to grow faster than the worldwide market over the long term from 1985 to 1995. Table 1 shows year-to-year growth rates of the four major geographic regions from 1984 to 1990, and the compound annual growth rates (CAGRs) from 1990 to 1995.

We also believe that Japan will grow as a percent of the worldwide market, gaining 4 percentage points from 1984 to 1995--more than any other region--to stand at 33 percent of the world market. By comparison, we predict that the U.S. market will lose 6 percentage points, dropping from 47 percent of the market in 1984 to 41 percent of the worldwide market in 1995 (see Table 2).

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Table 1

ESTIMATED WORLDWIDE SEMICONDUCTOR REGIONAL
CONSUMPTION GROWTH, YEAR-TO-YEAR
(Percent of Dollars)

	1984	1985	1986	1987	1988	1989	1990	CAGR 1990-1995
Total World	50%	(11%)	18%	31%	25%	2%	20%	21%
Japan	50%	(3%)	17%	29%	26%	3%	21%	22%
United States	53%	(20%)	20%	34%	25%	1%	19%	20%
Europe	43%	2%	16%	26%	24%	3%	19%	21%
ROW	42%	(12%)	19%	34%	26%	4%	18%	22%

Table 2

ESTIMATED WORLDWIDE SEMICONDUCTOR MARKET--
GEOGRAPHIC REGIONS AS A PERCENT OF THE TOTAL MARKET
(Percent of Dollars)

	1984	1985	1986	1987	1988	1989	1990	1995
Total World	100%	100%	100%	100%	100%	100%	100%	100%
Japan	29%	32%	31%	31%	31%	31%	32%	33%
United States	47%	42%	43%	44%	44%	43%	43%	41%
Europe	17%	19%	19%	18%	18%	18%	18%	18%
ROW	7%	7%	7%	7%	7%	8%	7%	8%

Source: DATAQUEST

Capital Spending

Most of the major Japanese semiconductor manufacturers have recently announced plans either to cut capital spending in 1985 or to hold it at 1984 levels. Only two companies, Sharp and Tokyo Sanyo, plan to increase capital spending; however, the increases will be substantially lower than in 1984. Table 3 compares 1984 and planned 1985 capital spending by the top nine Japanese suppliers. These planned expenditures are subject to revision as market conditions change, as are U.S. capital spending plans. For example, in January, many of these same companies announced that they would increase capital spending in 1985.

Table 3

TOP NINE JAPANESE SEMICONDUCTOR MANUFACTURERS
1985 CAPITAL SPENDING PLANS
(Billions of Yen)

	Fiscal 1985 Plan	Percent Change 1985/1984	Fiscal 1984 Actual	Percent Change 1984/1983
NEC	140.0	0%	140.0	109.0%
Hitachi	130.0	0%	130.0	85.7%
Toshiba	120.0	(18.9%)	148.0	52.6%
Fujitsu	100.0	(20.0%)	125.0	111.9%
Matsushita	100.0	(9.1%)	110.0	378.3%
Mitsubishi	70.0	0%	70.0	97.2%
Sharp	40.0	14.3%	35.0	75.0%
Tokyo Sanyo	46.0	46.0%	31.5	162.5%
Oki	32.0	(12.1%)	36.4	152.8%
Total	778.0	(5.8%)	825.9	107.6%

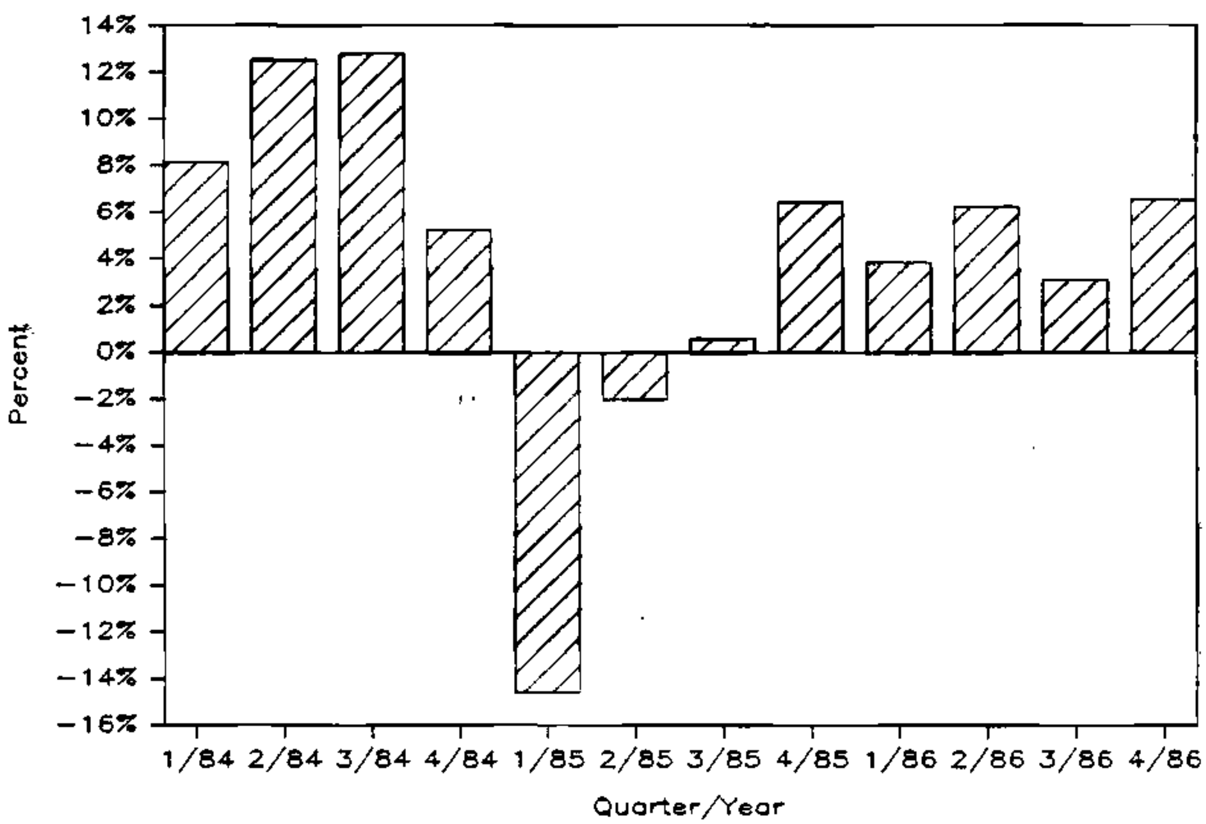
Source: DATAQUEST

Quarterly Forecast

We believe that the Japanese semiconductor market will show two quarters of decline in the first and second quarters of 1985, picking up very slightly in the third quarter and finally pulling out of the slump in the fourth quarter of 1985. Growth is expected to resume a more normal course in 1986. The quarterly growth pattern is shown in Figure 1. We have lowered our forecast since the March 29, 1985, newsletter because of continued price softness and the continued slump in the systems market. (See the JSIA newsletter for that date entitled, "Semiconductor Consumption in Japan Explodes in 1984.")

Figure 1

ESTIMATED JAPANESE SEMICONDUCTOR CONSUMPTION, 1984 TO 1986
(Quarter-to-Quarter Percent Change)



Source: DATAQUEST

Table 4 shows our growth forecast for the Japanese market quarterly through 1986. We believe that ICs, particularly MOS memory and bipolar digital logic, will take the hardest blows in 1985. We believe that discretes and optoelectronics will actually show some growth in 1985. In 1986, we expect strong recovery in all MOS products, especially in the memory area.

Table 5 shows actual market values in yen for the same period as the previous table.

Rates of Change

One of the forecasting tools we use is the 12/12 rate of change graph. This is a graph of the percentage change of a moving 12-month total from the total for the same 12 months one year earlier. The resulting graph shows a smooth picture of the rate of change for a given product line.

Figure 2 shows historical and forecast rates of change for total semiconductor consumption. This point at which the line crosses the Y axis in December of each year is the yearly growth rate for that year. In December 1985 we estimate that this point will be -3.2 percent. By December of 1986, however, the rate of change is expected to reach 17.3 percent.

Figure 3 shows historical and forecast rates of change for MOS memory, MOS micro devices, and MOS logic. As shown, the growth rate for MOS memory is falling precipitously from 91.1 percent in December 1984 to an anticipated -10.7 percent in December 1985. We believe that the turn in rate of change will occur in the second quarter of 1986.

Ten-Year Forecast

Table 6 gives DATAQUEST's forecast for the Japanese semiconductor market for 1985 to 1990, plus 1995. For the ten years from 1985 to 1995, we forecast a CAGR of 20.3 percent. The 6-year CAGR from 1984 to 1990 is forecast at only 14.8 percent due to the unprecedented market decline in 1985.

Table 4

JAPANESE SEMICONDUCTOR CONSUMPTION FORECAST PERCENT GROWTH (Year-to-Year and Quarter-to-Quarter) (Percent of Yen)

		1984					1985					1986			
	1984	Q1	Q2	Q3	Q4	1985	Q1	Q2	Q3	Q4	1986	Q1	Q2	Q3	Q4
Total Semiconductor	51.4%	8.2%	12.5%	12.8%	5.2%	-3.2%	-14.6%	-2.0%	0.6%	6.4%	17.3%	3.8%	6.2%	3.1%	6.5%
Total Integrated Circuit	57.3%	8.5%	13.3%	15.9%	5.9%	-4.9%	-14.8%	-6.1%	0.3%	6.2%	21.8%	7.2%	8.2%	3.8%	7.3%
Bipolar Digital	51.4%	7.8%	18.1%	8.5%	8.0%	-12.0%	-13.1%	-15.2%	-3.6%	7.8%	18.3%	5.8%	11.3%	4.0%	6.6%
Bipolar Digital Memory	70.8%	37.8%	9.3%	0.0%	7.2%	-3.1%	5.9%	-14.9%	-12.3%	8.0%	3.9%	1.9%	5.5%	3.4%	6.7%
Bipolar Digital Logic	49.4%	4.7%	19.3%	9.5%	8.1%	-13.1%	-15.2%	-15.3%	-2.4%	7.7%	20.2%	6.3%	12.0%	4.1%	6.6%
MOS	71.4%	11.2%	11.2%	25.2%	6.5%	-5.6%	-21.0%	-2.5%	2.3%	5.4%	31.1%	11.3%	10.2%	4.1%	9.9%
MOS Memory	81.1%	9.4%	14.9%	45.8%	13.3%	-10.7%	-28.3%	-9.0%	1.2%	0.8%	36.3%	13.4%	18.9%	6.4%	11.4%
MOS Micro Device	39.5%	1.2%	8.4%	7.9%	-1.3%	3.9%	-14.2%	14.2%	4.0%	8.8%	28.8%	9.7%	2.1%	1.7%	9.6%
MOS Logic	75.4%	27.4%	8.1%	8.6%	-1.0%	-4.8%	-9.2%	-5.3%	2.3%	10.0%	23.9%	9.5%	3.8%	1.8%	7.1%
Linear	40.6%	4.9%	14.2%	5.4%	3.0%	-0.4%	-3.6%	-7.3%	-1.2%	6.8%	8.7%	1.2%	3.3%	3.2%	2.5%
Total Discrete	36.7%	7.6%	11.3%	2.9%	1.5%	0.5%	-11.4%	8.9%	-1.0%	6.2%	4.2%	-2.6%	0.5%	0.5%	0.2%
Transistor	36.1%	5.0%	8.9%	3.9%	0.1%	4.6%	-12.4%	16.1%	2.1%	5.0%	-3.8%	-5.1%	-5.2%	-3.6%	-4.0%
Diode	36.7%	10.1%	15.8%	2.2%	-0.8%	-4.8%	-8.1%	-0.3%	-3.2%	5.8%	14.4%	0.6%	7.4%	7.7%	4.4%
Other	40.5%	14.4%	11.3%	2.9%	1.5%	-2.6%	-8.5%	4.4%	-11.6%	16.7%	15.2%	2.0%	9.0%	-3.7%	4.8%
Total Optoelectronic	38.1%	11.6%	8.5%	10.1%	8.8%	5.5%	-21.7%	14.5%	8.6%	9.4%	8.3%	-10.7%	0.6%	2.7%	15.9%

Table 5

JAPANESE SEMICONDUCTOR CONSUMPTION FORECAST QUARTERLY, 1984 TO 1986 (Billions of Yen)

		1984					1985					1986			
	1984	Q1	Q2	Q3	Q4	1985	Q1	Q2	Q3	Q4	1986	Q1	Q2	Q3	Q4
Total Semiconductor	1,980.1	418.6	471.1	531.3	559.1	1,917.2	477.6	468.0	470.7	500.9	2,248.0	520.0	552.2	569.4	606.4
Total Integrated Circuit	1,460.3	302.0	342.1	396.4	419.8	1,388.6	357.8	336.0	337.0	357.8	1,691.0	383.6	415.1	430.9	462.2
Bipolar Digital	222.0	45.8	54.1	58.7	63.4	195.3	55.1	46.7	45.0	48.5	231.1	51.3	57.1	59.4	63.3
Bipolar Digital Memory	23.5	5.4	5.9	5.9	6.3	22.8	6.7	5.7	5.0	5.4	23.7	5.5	5.8	6.0	6.4
Bipolar Digital Logic	198.5	40.4	48.2	52.8	57.1	172.5	48.4	41.0	40.0	43.1	207.4	45.8	51.3	53.4	56.9
MOS	773.2	155.1	172.4	215.9	229.8	730.2	181.5	177.0	181.0	190.7	957.5	212.3	234.0	243.5	267.7
MOS Memory	388.4	67.9	78.0	113.7	128.8	347.0	92.3	84.0	85.0	85.7	472.8	97.2	115.6	123.0	137.0
MOS Micro Device	194.8	44.2	47.9	51.7	51.0	202.4	43.8	50.0	52.0	56.6	260.7	62.1	63.4	64.5	70.7
MOS Logic	190.0	43.0	46.5	50.5	50.0	180.8	45.4	43.0	44.0	48.4	224.0	53.0	55.0	56.0	60.0
Linear	465.1	101.4	115.8	122.1	125.8	463.1	121.2	112.3	111.0	118.6	503.2	120.0	124.0	128.0	131.2
Total Discrete	396.0	89.6	99.7	102.6	104.2	398.0	92.3	100.5	99.5	105.7	414.7	103.0	103.5	104.0	104.2
Transistor	215.4	49.5	53.9	56.0	56.0	225.4	49.1	57.0	58.2	61.1	216.9	58.0	55.0	53.0	50.9
Diode	142.7	31.6	36.6	37.4	37.1	135.8	34.1	34.0	32.9	34.8	155.4	35.0	37.6	40.5	42.3
Other	37.8	8.5	9.5	9.8	9.9	36.8	9.1	9.5	8.4	9.8	42.4	10.0	10.9	10.5	11.0
Total Optoelectronic	123.8	27.0	29.3	32.3	35.1	130.6	27.5	31.5	34.2	37.4	141.5	33.4	33.6	34.5	40.0
Exchange Rate (Yen/US$)	237					237					237				

Source: DATAQUEST

Figure 2

ESTIMATED 12/12 RATE OF CHANGE--TOTAL SEMICONDUCTOR--1978 TO 1986

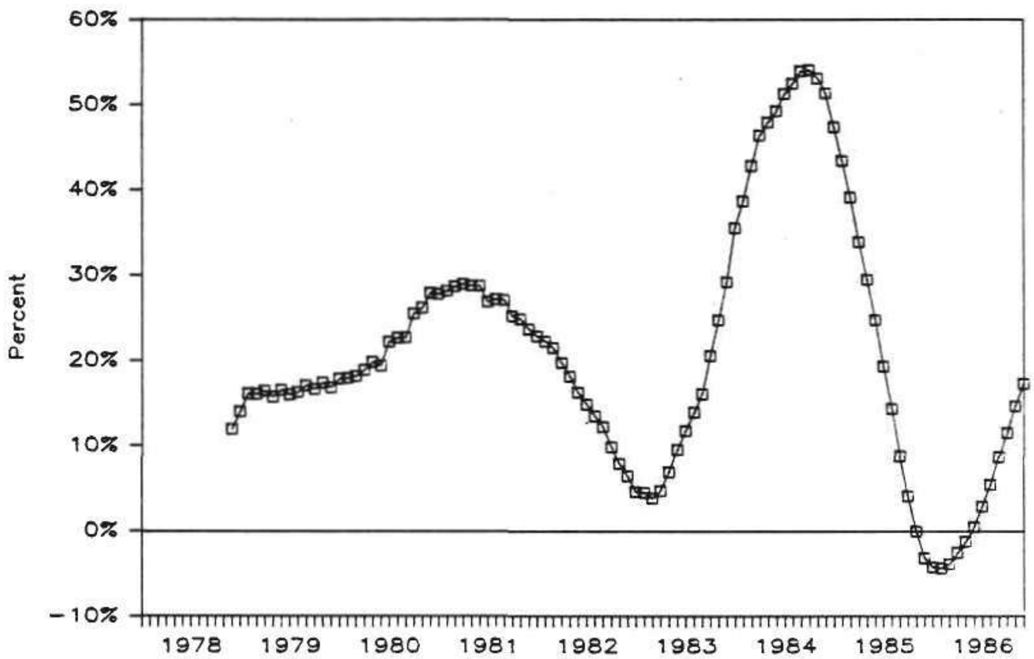
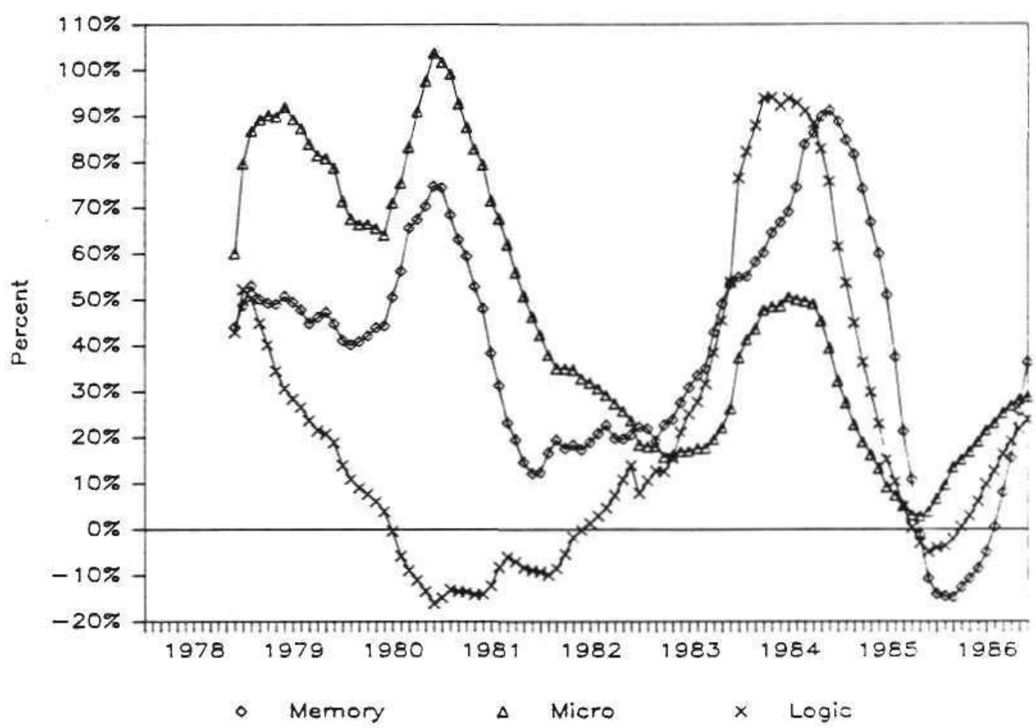


Figure 3

ESTIMATED 12/12 RATE OF CHANGE--MOS--1978 TO 1986



Source: DATAQUEST

Table 6

JAPANESE SEMICONDUCTOR CONSUMPTION FORECAST
YEARLY, 1983 TO 1990, PLUS 1995
(Billions of Yen)

	1983	1984	1985	1986	1987	1988	1989	1990	CAGR (1984-90)	1995	CAGR (1990-95)
Total Semiconductor	1,307.9	1,980.1	1,917.2	2,248.0	2,891.8	3,631.6	3,751.5	4,537.5	14.8%	12,173.8	21.8%
Total Integrated Circuit	928.6	1,460.3	1,388.6	1,691.8	2,304.5	2,979.1	3,093.2	3,809.2	17.3%	10,803.0	23.2%
Bipolar Digital (Technology)	146.6	222.0	195.3	231.1	301.2	374.9	384.6	443.6	12.2%	1,231.0	22.6%
TTL	65.6	104.4	89.8	104.0	130.1	157.8	156.9	169.9	8.5%	369.2	16.8%
DTL	10.0	24.2	18.5	19.4	24.2	27.0	25.8	23.5	-0.5%	12.3	-12.1%
ECL	58.9	77.9	73.2	91.5	125.8	163.8	174.9	219.2	18.8%	763.1	28.3%
Other Bipolar Digital	12.1	15.5	13.8	16.2	21.1	26.3	27.0	31.0	12.2%	86.4	22.8%
Bipolar Digital (Function)	146.6	222.0	195.3	231.1	301.2	374.9	384.6	443.6	12.2%	1,231.0	22.6%
Bipolar Digital Memory	13.8	23.5	22.8	23.7	31.3	37.4	36.0	41.2	9.8%	74.4	12.5%
Bipolar Digital Logic	132.8	198.5	172.5	207.4	269.9	337.5	348.6	402.4	12.5%	1,156.6	23.5%
MOS (Technology)	451.2	773.2	730.2	957.5	1,384.3	1,876.8	1,968.7	2,544.2	22.0%	7,997.6	25.7%
NMOS	303.4	498.7	460.0	543.9	707.4	816.5	706.7	722.6	6.4%	1,311.6	12.7%
PMOS	13.5	14.4	12.3	11.4	12.6	11.4	7.8	7.6	-10.1%	8.1	1.3%
CMOS	134.3	260.2	257.9	402.2	664.3	1,048.9	1,254.2	1,814.0	38.2%	6,677.9	29.8%
MOS (Function)	451.2	773.2	730.2	957.5	1,384.3	1,876.8	1,968.7	2,544.2	22.0%	7,997.6	25.7%
MOS Memory	203.2	388.4	347.0	472.8	706.5	994.9	939.7	1,183.1	20.4%	3,985.2	27.5%
MOS Micro Device	139.7	194.8	202.4	260.7	384.4	518.1	614.5	834.2	27.4%	2,330.4	22.8%
MOS Logic	108.3	190.0	180.8	224.0	293.4	363.8	414.5	526.9	18.5%	1,682.0	26.1%
Linear	330.8	465.1	463.1	503.2	619.0	727.4	739.9	821.4	9.9%	1,574.4	13.9%
Total Discrete	289.6	396.0	398.0	414.7	428.1	467.4	465.6	511.4	4.4%	834.2	10.3%
Transistor	158.3	215.4	225.4	216.9	228.9	253.6	260.9	287.7	4.9%	530.6	13.0%
Small Signal Transistor	78.4	96.0	99.8	99.8	101.9	107.6	110.9	123.5	4.3%	260.9	16.1%
Power Transistor	79.9	119.4	125.6	117.1	127.0	146.0	150.0	164.2	5.5%	269.7	10.4%
Diode	104.4	142.7	135.8	155.4	155.2	164.5	156.8	170.9	3.0%	225.6	5.7%
Small Signal Diode	42.4	57.2	47.6	54.0	53.1	56.9	52.1	58.3	0.3%	73.7	4.8%
Power Diode	53.2	73.7	76.3	87.7	88.4	91.7	89.1	97.4	4.8%	129.9	5.9%
Zener Diode	8.8	11.7	11.9	13.7	13.7	15.9	15.6	15.2	4.4%	22.0	7.7%
Thyristor	11.7	16.4	15.2	17.3	17.5	19.2	17.1	16.8	0.4%	17.3	0.6%
Other Discrete	15.2	21.4	21.6	25.1	26.5	30.1	30.8	36.0	9.1%	60.7	11.0%
Total Optoelectronic	89.7	123.8	130.6	141.5	159.2	185.1	192.7	216.9	9.8%	536.6	19.9%
LED Lamps	25.2	26.9	27.3	28.4	30.3	33.7	33.9	40.1	6.9%	105.9	21.4%
LED Displays	34.5	45.4	46.2	48.6	58.5	66.0	66.4	73.9	8.4%	183.0	19.9%
Optical Couplers	7.9	11.5	11.1	12.8	15.9	18.7	20.6	23.7	12.9%	70.2	24.3%
Other Optoelectronics	22.1	40.0	46.0	51.7	54.5	66.1	71.8	79.2	12.0%	177.5	17.5%
Exchange Rate (Yen/US$)	235	237	237	237	237	237	237	237		237	

Source: DATAQUEST

CONCLUSION

We believe that the Japanese semiconductor market will continue, over the long term, to grow faster than the worldwide average. Furthermore, we expect the Japanese market to continue to grow larger as a percent of the worldwide market, fueled by:

- Large government-sponsored and government-encouraged programs, such as the INS and the Super Computer Project, which require large amounts of semiconductors

- Continuing demand at home and abroad for Japanese-made consumer products, especially audio and visual goods

- Increased automotive production spurred by the lifting of voluntary restraints on cars imported into the United States

Note: Appendix A--Market Estimates, found in the JSIA volume of the Japanese Semiconductor Industry Service, contains a series of tables on Japanese shipments, imports, exports, and consumption. All values are given in both yen and dollars. Please contact your company's JSIS notebook holder if you wish to see these tables.

Patricia S. Cox

Nielsen Dataquest

RESEARCH BULLETIN

JSIA Code: Newsletters

THE SEMICONDUCTOR START-UP BOOM CONTINUES

Despite the industry downturn, semiconductor start-ups are alive and well. As shown in Table 1, DATAQUEST's Japanese Semiconductor Industry Service has recorded 47 semiconductor start-ups since late 1983--a record for the industry. This figure tops the 29 start-up companies recorded for the same period covered by our last newsletter on this subject, "Asian Ties with U.S. Semiconductor Start-Ups," January 18, 1984. Twenty-eight of the start-ups are located in Silicon Valley. DATAQUEST believes that there are at least 10 more start-up companies that have not yet been publicly announced. We believe that the continuing boom in semiconductor start-ups reflects the emergence of new market niches in application-specific ICs (ASICs), CMOS memory and logic, gallium arsenide (GaAs), linear, digital signal processing (DSP), and silicon compilers.

A major development is the growing number of ties between Asian electronics companies and U.S. semiconductor start-ups. Some of the more notable alliances are as follows:

- Barvon Research--Licensing agreement with Ricoh
- China Micro--British-Chinese joint venture
- Ixys Corporation--Ricoh wafers
- Modular Semiconductor--Licensing of CMOS 256K DRAM and 16K SRAM to Ricoh
- Mosel--First round Taiwan investors
- NMB Semiconductor--Subsidiary of Minebea Co. (Tokyo ball bearing maker)
- Panatech Semiconductor--Sales and Marketing agreement with Ricoh
- Quasel--Joint venture with Taiwanese investors
- SID Microelectronica S.A.--Sales of Sharp products

- Unicorn Microelectronics--Funding from United Microelectronics of Taiwan

- Vitelic--Wafer fab contract with Taiwan's ERSO and ties with Sony and Kyocera

Sheridan Tatsuno

Table 1

SEMICONDUCTOR START-UPS
(1983-1985)

Company	Location	Product
Anadigics	Morristown, NJ	GaAs A/D converters
Array Logic	Melbourne, England	CMOS and bipolar ASICs
Barvon Research	Milpitas, CA	ASICs
Calmos	Kanata, Ontario	ASICs
Calogic	Fremont, CA	ASICs
Celeritek	San Jose, CA	GaAs FETs
China Micro	China	MOS ICs
Chips and Technologies	Milpitas, CA	ASICs
Cirrus Logic	Milpitas, CA	Silicon compiler
Crystal Semiconductor	Austin, TX	Telecom ICs
Custom Silicon	Lowell, MA	ASICs
Dallas Semiconductor	Dallas, TX	CMOS memories
Electronic Technology	Cedar Rapids, IA	ASICs
Inova Microelectronics	Campbell, CA	SRAMs
Integrated Logic Systems	Colorado Springs, CO	ASICs
Integrated Power Semiconductor	Santa Clara, CA; Livingston, Scotland	Linear
Isocom	Campbell, CA	GaAs coupler
Ixys Corporation	Santa Clara, CA	Power monolithics
Logic Devices	Sunnyvale, CA	CMOS multipliers
Micro MOS	Santa Clara, CA	EEPROMs
Microwave Technology	Fremont, CA	GaAs amplifiers
Modular Semiconductor	Santa Clara, CA	CMOS memories
Mosel	Sunnyvale, CA	EPROMs, SRAMs
NMB Semiconductor	Tokyo, Japan	CMOS memories
Pacific Monolithics	Sunnyvale, CA	GaAs Monolithic ICs
Panatech Semiconductor	Santa Clara, CA	CMOS memories
Performance Semiconductor	Sunnyvale, CA	CMOS SRAMs, MPUs
Pivot III-V Corp.	Unknown	GaAs digital ICs
Quasel	Santa Clara, CA	CMOS memories
Seattle Silicon	Bellevue, WA	Silicon compiler
Sensym	Sunnyvale, CA	Pressure sensors
SID Microelectronica S.A.	Sao Paulo, Brazil	MOS ICs
Sierra Semiconductor	Sunnyvale, CA	Reconfigurable MPUs
Silicon Design Labs	Liberty Corner, NJ	Silicon compiler
Silicon Macrosystems	Santa Clara, CA	Static ROMs
Teledyne Microwave	Mountain View, CA	DMOS discretes
Topaz Semiconductor	Santa Clara, CA	DMOS discretes
Triquint Semiconductor	Beaverton, OR	GaAs analog and digital
Unicorn Microelectronics	San Jose, CA	ASICs
Vatic Systems	Mesa, AZ	ASICs
VTC, Inc.	Eagan, MN	CMOS logic
VISIC	San Jose, CA	CMOS RAMs
Vitelic	San Jose, CA	CMOS memories
Vitesse Electronics	Camarillo, CA	GaAs digital ICs
Xilinx	San Jose, CA	CMOS logic arrays
Xtar Electronics	Elk Grove, IL	Graphics chips
Zoran	Sunnyvale, CA	DSP

Source: DATAQUEST

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

VENTURING INTO JAPAN: HOW LSI LOGIC OPENED ITS DOORS IN TOKYO

SUMMARY

At a recent luncheon on Japanese venture capital sponsored by the Japan Society of Northern California, William J. O'Meara, Marketing Vice President of LSI Logic, described how Nihon LSI Logic was formed. His detailed account provides useful insights for semiconductor companies seeking to expand their presence in Japan. Unlike other companies, LSI Logic is pursuing a unique "venture business" approach to finance and staff its Tokyo offices.

DATAQUEST believes that Japanese gate array consumption will reach $794 million in 1989, growing at an annual rate of 32.9 percent, as shown in Table 1. Nihon LSI Logic's goal is to capture 10 percent of this rapidly growing Japanese gate array market.

Table 1

JAPANESE GATE ARRAY CONSUMPTION FORECAST
(Millions of Dollars)

	1985	1986	1987	1988	1989	CAGR
MOS	$173.3	$253.8	$309.2	$406.4	$530.7	32.3%
Bipolar	81.5	126.7	157.0	205.7	263.7	34.1%
Total	$254.8	$380.6	$466.2	$612.1	$794.4	32.9%

Source: DATAQUEST

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TAPPING INTO JAPAN'S VENTURE CAPITAL MARKET

Several years ago, Wilfred J. Corrigan, Chairman and Founder of LSI Logic, concluded that to dominate the worldwide ASIC market, a successful venture in Japan was imperative in order to tap into lower lending rates and to be accepted by Japanese customers. But he wanted to avoid the traditional methods used by U.S. companies--joint ventures, wholly owned subsidiaries, and Japanese trading companies--which are often plagued with communications problems and culturally based management differences. Instead, LSI Logic decided to form a totally Japanese-run and Japanese-financed company to establish its credibility in Japan. Mr. Corrigan observed that the Japanese save a large percentage of their income, which is held by large pension, insurance, and banks that have few investment avenues except the stock market or treasury notes. (See our newsletter of May 29, 1984, "Japan's Second Venture Capital Boom".) Moreover, given Japan's immature venture capital market and few start-up companies, he reasoned that a large pool of funds could be tapped with the right management approach. Thus, he decided to form a new company--Nihon LSI Logic--which would have the following features:

- U.S. ownership (70 percent) and minority stock share (30 percent)
- All-Japanese management
- Self financing
- Design centers and a manufacturing plant in Japan
- Stock sales within two to three years of founding
- Licensing of LSI Logic technology

LSI Logic would act as an investor in the Japanese company, not as a multinational conglomerate issuing orders to a subsidiary. All operating decisions would be made in Japan. The new company would license LSI Logic's technology, and both companies would eventually exchange technology.

In late 1983, Mick Bohn, co-founder and Vice President of Finance at LSI Logic, visited Japan four times to present the plan to Japanese pension funds, banks, and insurance companies. Initially, the Japanese were wary, but gradually warmed to the idea due to growing interest in the ASIC market and venture businesses. However, to succeed in Japan, LSI Logic learned that it had to reverse its start-up formula. In Silicon Valley, entrepreneurs put together a strong management team, then seek venture capital financing. In Japan, top executives cannot be lured from lifetime jobs unless financing is solid. Thus, LSI Logic pursued financing first. It made a 35mm slide presentation of its plan to investors in Japanese, using simultaneous translators to permit free discussion. Meanwhile, it hired a large law firm, Nagashima & Ohno, to make Japanese investment advisors and government officials comfortable with LSI Logic's concept, and to ensure that LSI Logic met all of the Ministry of Finance's requirements.

The plan worked. In late 1983, Nomura Securities agreed to act as agent to sell minority shares in Nihon LSI Logic. In April 1984, 30 percent of the stock was sold to 28 private and large institutional investors, raising ¥4.5 billion ($20 million). Nihon LSI Logic was valued at $60 million--six times the original valuation of LSI Logic. (When LSI Logic was formed in 1981, venture capitalists paid $6 million for 60 percent ownership.) Eventually, Nihon LSI Logic plans to sell up to 50 percent of its stock to investors.

AMAKUDARI AMERICAN-STYLE

With its financing secured, Wilf Corrigan pulled off a major coup by hiring Keisuke Yawata of NEC America to head up Nihon LSI Logic. A spokesman for Japanese industry during his years in Silicon Valley, Mr. Yawata was slotted for a top management position in NEC upon his return to Japan. Over a period of a year, Mr. Corrigan met with Mr. Yawata regularly to discuss the new company. Both men even approached NEC's top management, but were initially refused. Thus, Mr. Yawata's move is an American version of what Japanese call "amakudari" ("descent from heaven", usually from a top ministry post to a private company), since the ability to attract top level managers reflects favorably on the recipient company.

NIHON LSI LOGIC'S PLANS

Under Mr. Yawata's leadership, Nihon LSI Logic has hired 20 Japanese in Tokyo, and plans to have 200 employees by 1986. All employees will be promoted on the basis of merit, not seniority, and will receive stock options. The company is opening its second design center in Japan and reviewing final sites for a $100 million manufacturing plant to be totally Japanese-financed. Initially, the plant will offer 1.5-micron CMOS technology, then sub-micron designs. Nihon LSI Logic's goal is to reach $100 million in sales by 1992, or 10 percent of the Japanese ASIC market.

LSI Logic is following the advice of Kenichi Ohmae, president of McKinsey & Company, who advocates in his book, Triad Power, that to compete internationally companies must establish a presence in Japan, Europe, and the United States. In October 1984, LSI Logic opened a $40 million plant in Fremont, California. In early 1985, it raised £20 million in London to build a plant in West Germany by selling 20 percent stock share. Nihon LSI Logic is part of this global strategy.

ENTERING THE JAPANESE MARKET

DATAQUEST believes that the only way to compete internationally with Japanese semiconductor companies is to establish a major presence in Japan. Companies such as Fairchild, Motorola, and Texas Instruments have successfully penetrated the bipolar market because of their local manufacturing capabilities. Recently, AMI, Nihon LSI Logic, and Thomson CSF have opened local design centers in Japan to enter the highly competitive ASIC market.

To finance and staff these operations, we believe that several routes are available to non-Japanese companies:

- Local financing:
  - Japan Development Bank (JDB) loans--7.3 percent for research centers and plant facilities in any of the 15 Technopolis zones (such as Materials Research Corporation's Oita plant)
  - Regional bank financing--Secured with the assistance of local prefecture industry and government leaders
  - Venture capital financing (Nihon LSI Logic)
  - Local government tax incentives and special land writeoffs (Fairchild's Nagasaki plant, Monsanto's Utsunomiya plant)
  - Joint ventures with cash-rich conglomerates seeking new markets (AMI and Asahi Chemical)
- Staffing:
  - Hire internationally minded Japanese executives with overseas experience (Nihon LSI Logic's Mr. Yawata, Motorola's Dr. Iriye, DATAQUEST's Mr. Morishita)
  - Hire mid-level managers and professionals (IBM, DATAQUEST)
  - Establish joint technology development with a Japanese company (Thomson CSF and Oki)

Sheridan Tatsuno

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DATAQUEST'S JAPANESE CONFERENCE DEBUT-- FAR EAST INDUSTRY: ACHIEVEMENTS AND CHALLENGES

SUMMARY

DATAQUEST's Japanese Semiconductor Industry Service (JSIS) held its first annual conference April 14-16 at the Hakone Prince Hotel, Hakone, Japan (south of Tokyo). The conference was completely sold out. The 210 attendees heard 21 industry leaders, government officials, and DATAQUEST analysts speak at this first-ever, full-length DATAQUEST Japanese conference. Speakers and attendees represented U.S., European, Japanese, Korean, and Taiwanese companies and government agencies. It is particularly noteworthy that more than half of the attendees were Japanese, and about the same percentage were top-level executives. Keynote speakers were Dr. Atsuyoshi Ouchi, Vice Chairman of NEC Corporation, and Mr. W. J. Sanders III, Chairman, President, and CEO of Advanced Micro Devices, Inc.

The conference theme, "Far East Industry: Achievements and Challenges," was particularly timely because of the great achievements made by the Japanese semiconductor industry in the last five years, the emergence of Taiwan and Korea as fast-growing participants in the semiconductor industry, and the highly publicized challenge being posed to U.S. and European suppliers in their attempts to penetrate Japanese industry.

This newsletter will cover the major topics addressed at the conference in the areas of market trends and strategies, trade and technology issues, equipment and materials, and product trends. Conference notebooks were distributed to all conference attendees and will be mailed to subscribers who did not attend the conference. Readers who wish to read specific speeches should contact their companies' JSIS notebook holder or conference attendee.

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MARKET TRENDS AND STRATEGIES

Overview

DATAQUEST's Fred Zieber, Senior Vice President and Semiconductor Division Manager, kicked off the conference with an updated world semiconductor outlook. Predicting that the worldwide semiconductor market will grow only 2 percent in 1985, he blamed the disastrous first quarter of 1985 on a confluence of tremendous change in expectations, overbookings, a weak PC market, and very high prices in early- and mid-1984, which fell like a rock. He cited a growing U.S. economy and growth in real semiconductor usage as reasons for continued long-term growth of the industry. Mr. Zieber also pointed out the increasing ratio of materials cost to manufacturing, and projected a steadily decreasing trend for return on capital invested.

Sheridan Tatsuno, JSIS Research Analyst and author of an upcoming book entitled "Technology: Japan's HiTech Strategy for the 21st Century," noted a high correlation between the growth of Japanese-based companies' share of the world IC market, the Japanese share of the U.S. IC market, and the steadily increasing Japanese companies' share of papers presented at the International Solid State Circuits Conference. This correlation suggests that Japan is moving ahead quickly in both sales and technological expertise. He pointed to the dramatic increase in joint ventures and licensing between Japanese and other firms as signaling a change from the "we vs. them" philosophy to a new philosophy of sharing and working together. Mr. Tatsuno presented DATAQUEST's forecast of 7 percent growth for the Japanese market in 1985, with a caution that this figure is at the upper end of our current range of 0 to 7 percent.

Japanese Viewpoint

Tomihiro Matsumura, Senior Vice President of NEC, spoke on "Japanese Semiconductor Industry--The Coming New Age." (Mr. Matsumura received a special award from Japan's Ministry of Science and Technology on the day he spoke at the DATAQUEST Conference, for his work in developing NEC's V-Series of originally developed microprocessors.

He noted that only two Japanese semiconductor companies were in the top ten worldwide in 1975, while in 1984, five were in the top ten. He believes that this is due to:

- Creating new markets (i.e., not just waiting for the economy to turn up)
- Emphasizing mass production rather than R&D
- Having available a much larger pool of engineering graduates to draw from than either the United States or Europe

Regarding export sales, Mr. Matsumura suggested that to ease trade friction, 50 percent of overseas sales should be produced in the country in which they will be sold.

Tsuyoshi Kawanishi, Director and Group Executive of Toshiba, spoke on the topic "Concentrated or Well-Balanced Products Strategy?" He believes that in general, U.S. semiconductor companies tend to concentrate on specific products, while Japanese companies tend to have more balanced product lines including heavy emphasis on discrete devices. While the concentrated strategy offers capital investment concentration, clear strategy, a strong corporate image in the areas of concentration, and phases of extremely high growth, it also leads to decreased stability during downturns and an inability to provide customers with a full line of products. On the other hand, the well-balanced strategy offers technology growth due to interrelationships of products, stability, and ability to service all the customers' needs. Drawbacks include a weak corporate image, unclear strategy, and inability to concentrate capital investment.

Korea and Taiwan

Irving T. Ho, President of Taiwan's Institute of Information Industry and the holder of 36 patents in computer hardware and subsystems, spoke on "The Recent Development of the Information Industry in Taiwan." In 1979, Taiwan instituted a strategic policy of developing a domestic information industry. The results of this policy are dramatic. In 1983, for the first time, Taiwan's electrical and electronic exports exceeded textile exports. Information product exports, especially computers, have experienced the highest growth of any electronics products. Dr. Ho provided information on the major electronics producers and exporters in Taiwan, and discussed major products and companies. He revealed the heavy investment plans of IC producers in Taiwan over the next three to five years. All IC manufacturers in Taiwan cooperate extensively with ERSO, the semi-governmental IC technology company. ERSO now has 2-micron Si-gate CMOS technology with single poly and double metal.

P. June Min, Senior Managing Director of Goldstar Semiconductor, Ltd., spoke on "The Emerging Korean Semiconductor Industry." Dr. Min presented many tables detailing semiconductor production and consumption in Korea, for which he sees very high growth in the next several years. The Korean electronics industry began with Korean companies manufacturing for others on an OEM basis. Today, Korean name brand goods are sold worldwide. As in Japan, Korean semiconductor companies are parts of large, vertically integrated organizations. Also similarly to the Japanese, Korean companies are obtaining much of their design technology through licensing agreements with U.S. and European firms, although their processing technology is domestically developed. Dr. Min expects Korean semiconductor sales to triple by 1988.

A U.S. Look at Japan

Eugene J. Flath, Vice President and Assistant General Manager of Intel International, spoke on "A Fresh Look at Japan and Asia," a topic for which he is well qualified, having recently moved to Japan and become responsible for expanding Intel's presence in Japan and the Pacific Basin. Mr. Flath outlined the history of the U.S. semiconductor industry, which began with vertically integrated companies and now consists of many small- to mid-size companies specializing in semiconductors. This current state contrasts with the Japanese industry, which is dominated by vertically integrated manufacturers. He believes that due to the continually escalating cost of materials, most new capacity expansion will be in the Pacific Basin. He also believes that in order to support the Japanese market in a major way, foreign companies must build manufacturing facilities in Japan. This represents a radical change of view on Intel's part.

TRADE AND TECHNOLOGY

The areas of international trade and cooperation and government policy were very timely, since the conference was held during the height of tension in the trade negotiations between the United States and Japan.

Keynote Speakers

The conference keynote speakers, Atsuyoshi Ouchi of NEC and W. J. Sanders III of AMD, both spoke on these issues at dinner.

Dr. Ouchi struck a conciliatory tone regarding international trade relations. He believes that if the captive portion of the U.S. semiconductor market is accounted for, then Japanese companies actually have a smaller portion of the U.S. semiconductor market than the U.S. companies have of the Japanese semiconductor market. He also reminded Mr. Sanders that NEC is a major purchaser of AMD's ICs. Dr. Ouchi compared the completely open semiconductor market, which he thinks should exist, with contract bridge. He said that in a properly operating market, as in contract bridge, partners give each other signals that can be seen and understood by all partners, and all players follow the same rules. The perception now is that too much of the game is being played behind closed doors.

Mr. Sanders spoke pointedly on the U.S.-Japan trade imbalance and the difficult barriers U.S. companies face in the Japanese marketplace. While supporting the need for free international trade as vital to the free world's economic security, he termed the current imbalance "intolerable," and called for the United States to act unilaterally to provide incentive--in the form of U.S. trade barriers--to promote more openness in Japanese markets. Mr. Sanders supported his statement that barriers do exist in the Japanese semiconductor market by demonstrating that U.S. firms outperform their Japanese counterparts in the neutral markets of Europe and Rest of World. He called for "affirmative action" on the part of Japanese companies and consumers to buy more U.S. goods.

Government View

Clyde Prestowitz, Counselor on Japan to the U.S. Secretary of Commerce, spoke on "Government Involvement: Help or Hindrance." He noted that the U.S. government has both helped and hindered the U.S. semiconductor industry. While aiding the industry through military procurement, the Department of Defense (DoD) also hinders its ability to exploit overseas markets because the DoD makes it difficult to obtain the necessary export licenses. On the other hand, the Japanese government's efforts have been more focused and more continuous in aiding the Japanese semiconductor industry. He believes that in the matter of trade, there has been a lot of talk but little communication. He also cited several examples of instances in which, because of the bureaucratic Japanese system, U.S. companies were discriminated against, even though discrimination may not have been intended. Mr. Prestowitz noted that the Japanese still view themselves as a very small, developing country. He has been told, during the course of his trade negotiations, that "little baby companies" such as NEC and Hitachi cannot compete with "great sumo wrestler companies" like IBM and AT&T on a global basis.

Presenting the Japanese government's perspective was Shoichi Ito, a technical official from the Ministry of International Trade and Industry (MITI). Mr. Ito stood in for Hiroshi Shima, who was called at the last minute to testify in the Diet on the proposed Japanese chip protection act. Mr. Ito's topic was, "Status Quo and Tomorrow, Japanese Semiconductor Industry." He stated MITI's position that Japan and the United States "should strive for even freer semiconductor trade, and work to avoid regulative actions while eliminating any existing trade barriers." He believes that much progress has been made in Japan with U.S. electronics trade talks, and that they have resulted in concrete benefits. According to MITI's statistics, U.S. companies' individual growth rates in Japan in the last two years have been between 40 and 100 percent. Mr. Ito concluded by calling for further deepening of mutual understanding between Japan and the United States through such organizations as the U.S.-Japan Work Group on High-Technology Industries.

Industry View

William G. Howard, Jr., Corporate Director of R&D for Motorola, Inc., spoke on "Technology Futures." Dr. Howard described a report on international competitiveness published by the British government about the United States in 1855. The report described the mass production technology developed in the United States, and cited application of the principles of diligent management, creative ideas, and hard work as the factors that made U.S. industry far more efficient and internationally competitive than British industry. He believes that there are parallels between this British history and the United States today. To support his belief that the focus of the electronics industry is shifting from the Atlantic to the Pacific Basin, he cited three facts:

- Since 1979, international market share has fallen for all but one U.S. electronics company.

- The United States had an overall electronics trade deficit of $6.8 billion in 1984.

- The number of U.S.-origin patents has been decreasing since its 1971 peak, while the number of Japanese-origin patents has steadily climbed.

EQUIPMENT AND MATERIALS

Three industry leaders who are directors of their respective companies, Jon D. Tompkins of Varian Associates, Kihachi Tamura of Shin-Etsu Handotai Co., Ltd. (SEH), and Shoichiro Yoshida of Nippon Kogaku K.K. (Nikon), spoke on equipment and materials issues.

Mr. Tompkins spoke on "Challenges and Opportunities Facing U.S. Equipment Suppliers in Japan." He believes that the Japanese market can be very good for U.S. suppliers because it is the largest world market for capital equipment and offers a ready market for leading-edge manufacturing tools. He perceives that Japanese companies are becoming more willing to share technology with U.S. equipment companies in order to ensure the availability of manufacturing equipment for DRAMs of 1Mb and beyond. He stressed the importance of maintaining U.S. manufacturing and service organizations in Japan for customer support. He expressed his belief that Japanese companies will not adopt the SECS II communications protocol standard adopted by SEMI, and warned that if this happens, U.S. companies will find it much more difficult to compete in the Japanese marketplace for automated manufacturing.

Mr. Tamura focused his presentation on his estimates of the world's silicon markets. He believes that Japanese silicon consumption has been somewhat overestimated in the past while U.S. silicon consumption has been understated, primarily due to captive U.S. consumption, which has not been included. He believes that total U.S. silicon consumption is higher than Japanese silicon consumption, and that Japanese 6-inch wafer consumption is higher proportionally than U.S. 6-inch wafer consumption. He expects the percentage to be twice as high as the U.S. percentage in 1985, as more 6-inch lines come onstream in Japan. He noted that high oxygen content in wafers is very popular in the United States. SEH will begin experimental production of 8-inch wafers this year, but he would not reveal plans for 10- and 12-inch wafers.

Mr. Yoshida spoke on "Lithography Technology: Today and Tomorrow." His speech focused on lithography trends for increasing semiconductor device integration. Citing the fact that chip density tends to increase by four times every three years, he stated his belief that stepper technology can be used through the 4Mb DRAM. For 16Mb DRAMs and beyond, he believes that the lithographic method must be x-ray or e-beam. Mr. Yoshida has been named Secretary-General of the newly formed Semiconductor Equipment Association of Japan. He expects 1985 capital expenditures to be down from 1984.

PRODUCT TRENDS

Sutezo Hata, Executive Managing Director of Hitachi, and Lane Mason, Senior Industry Analyst in DATAQUEST's Semiconductor Industry Service, both spoke on MOS memory.

Mr. Hata believes that MOS memory is "the propulsion power of the IC industry." He cited the high volume of the market, high historical growth, and the fact that MOS memory technology is a catalyst for the development of other IC technologies. Hitachi is intensively promoting CMOS technology, due to its low power consumption. Mr. Hata outlined the history of MOS memory development and the diverse types of MOS memory that are now available, such as OTP PROMs and pseudo SRAMs. He pointed to the pervasiveness of MOS memory in the form of built-in memories in a system and dedicated memory chips. He also described how increasing integration has led to decreasing line widths, and predicted that 16Mb DRAMs will require line widths of 0.5 micron.

Mr. Mason spoke on "MOS Memory Strategies: Face to Face With the New Market Realities." He discussed the rapidly changing complexion of the market, with prices and profits rising in 1983 and 1984, only to come crashing down in the second half of 1984. He believes that 1985 and 1986 will be awash in red ink for MOS memory suppliers that have ill-defined strategic plans or poor manufacturing efficiency. He stated that in the MOS memory market, a cost-driven strategy will beat out a technology-driven strategy. He recommended that to succeed in the market, companies should commit themselves to the long haul and possibly find emerging niche markets in order to differentiate their products, although the mainstream market of standard, commodity products will continue to be the primary revenue growth vehicle for the foreseeable future.

Richard L. Sanquini, Vice President and General Manager, Microprocessor Group, of National Semiconductor Corporation, spoke on "Fundamental Forces Driving the 32-Bit MPU Market." Mr. Sanquini believes that the 32-bit market will be much larger than many believe. The 32-bit MPUs offer more performance per price per unit area than 8- or 16-bit machines. They allow more tasks to be performed in parallel, thus reducing nonproductive periods. Today's applications for 32-bit MPUs include desktop and engineering workstations, robotics, file servers, satellite processors, communication networks, and data links. In the future, he sees artificial intelligence becoming an important 32-bit application. He believes that by 1990, 32-bit "computing clusters"--each consisting of 32-bit CPU, MMU, FPU, and ICU--will account for a $900 million market, and that 32-bit MPUs will be an integral part of most systems, with 8- and 16-bit MPUs taking secondary roles.

D. A. DiLeo, I.C. Product Marketing Manager for AT&T Technology Systems, focused on custom MOS ICs in his presentation. He noted the increasing pervasiveness of semiconductors in AT&T's telecommunications equipment, which is forecast to grow by a factor of three from 1979 to 1989. He gave an example of a system in which cost was reduced by four times and parts were reduced by ten times, by replacing eight boards with one board containing ten custom chips. The average AT&T custom IC design rule is now 1.5 microns, and by 1987 this will have decreased to 1.0 micron. As design rule has decreased, so has gate delay time. Average gate delay time is now 0.7 ns. AT&T's goal is to integrate CODECs, protocol controllers, signal processing, and ISDN basic access into one custom integrated system on a chip.

PANEL DISCUSSION

The conference ended with a stimulating panel discussion. Questions solicited from the attendees during the course of the conference were presented to a panel consisting of David Laws of AMD, Mr. Flath, Rick Younts of Motorola, Dr. Min, Mr. Hata, and Mr. Kawanishi. Hard-hitting questions were handled very well by the panel members.

1986 JSIS CONFERENCE

The 1986 JSIS conference will be held April 13-15 at a location in Japan to be announced soon. We believe that the focus of this conference will be on the emerging applications for VLSI, such as telecommunications, artificial intelligence computers, new consumer media, and manufacturing automation.

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U.S.-JAPAN TRADE: EAST LEADS WEST

INTRODUCTION

U.S.-Japan trade is an issue of great concern in both industrial and government circles. Over the last ten years, the total U.S. trade deficit with Japan has increased twentyfold. Particularly hard-hit have been the high-tech industries. We sense a severe agitation on the part of both U.S. industry and government officials.

U.S. trade with Japan hit record levels in 1984, with total trade increasing 28 percent to $80,710 million. The overall U.S. trade deficit with Japan grew 74 percent, from negative $19,289 million to negative $33,560 million. Table 1 shows U.S.-Japan trade statistics for all merchandise, beginning in 1975. As this table shows, while U.S. exports of all merchandise to Japan grew at a compound annual growth rate (CAGR) of 11 percent from 1975 to 1984, U.S. imports from Japan grew at a CAGR of 20 percent during the same period.

Trade in electronic equipment and semiconductors also showed dramatic growth in 1984. In 1984, electronic equipment imports from Japan represented 32 percent of all U.S. imports from Japan; in 1975, it had been only 17 percent.

U.S.-JAPAN TRADE IN ELECTRONIC EQUIPMENT

As shown in Table 2, U.S. imports of electronic equipment from Japan experienced a CAGR of 35 percent from 1981 to 1984. Growth has been particularly dramatic in computers, which increased in sales by an order of magnitude over the four-year period. Consumer electronic product imports grew 52 percent in 1984 alone.

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Table 3 shows the U.S. trade deficit with Japan in electronic equipment. From 1975 to 1984, U.S. imports from Japan increased at a CAGR of 28 percent, 4 percent higher than U.S. exports to Japan. The huge amount of electronic equipment imported from Japan to the United States in 1984--$18,122 million--resulted in a U.S. deficit of $15,448 million, 72 percent higher than in 1983. This large deficit in electronic equipment is almost half of the entire U.S. trade deficit with Japan.

Figure 1 graphically depicts U.S.-Japan trade in electronic equipment from 1975 to 1984.

U.S.-JAPAN TRADE IN SEMICONDUCTORS

U.S.-Japan semiconductor trade, as measured by the U.S. Department of Commerce, grew to a total of $1,876 million in 1984. Tables 4 and 5 show U.S. semiconductor exports to Japan, U.S. semiconductor imports from Japan, and the U.S. semiconductor trade balance with Japan. These numbers are stated at import and export valuation.

DATAQUEST's estimates of total semiconductor sales (stated at actual market value and inclusive of locally manufactured product) are shown in Tables 6 and 7. Table 6 presents DATAQUEST's estimates of U.S. sales of semiconductors in Japan and Japanese sales of semiconductors in the United States. Table 7 presents DATAQUEST's estimate of the U.S.-Japan account balance in semiconductors. Figure 2 shows the U.S.-Japan semiconductor balance graphically.

From 1982 to 1984, U.S. semiconductor sales in Japan grew at a CAGR of 49 percent, from $446 million to $992 million. Strong areas for the United States include bipolar digital ICs and industrial linear ICs. Over the same period, Japanese semiconductor sales in the United States grew at a CAGR of 63 percent, from $787 million in 1982 to $2,100 million in 1984. By far the strongest products for the Japanese are MOS memory and logic devices. Sales of MOS memory by Japanese companies in the United States reached an estimated $1,409 million in 1984. DATAQUEST estimates the U.S. deficit with Japan in this area to be negative $1,252 million, resulting in a U.S. total semiconductor deficit of $1,108 with Japan in 1984. This U.S. deficit grew at a CAGR of 80 percent from 1982 to 1984.

The U.S. MOS market is clearly of paramount importance to Japanese suppliers. In 1984, 32 percent of all Japanese MOS sales were in the United States, as shown in Figure 3. In contrast, only 6 percent of U.S. MOS sales were in Japan, as shown in Figure 4.

The Japanese share of the U.S. semiconductor market, which stood at 12.0 percent in 1982, reached 17.4 percent in 1984, as shown in Table 8. Of this, Japanese companies held 44.0 percent of the U.S. MOS memory market, and 10.7 percent of the U.S. MOS logic market. From 1982 to

1984, U.S. companies gained only nine-tenths of a percentage point in their share of the Japanese semiconductor market, which was 11.9 percent in 1984. The largest U.S. share is in bipolar digital ICs, of which U.S. companies hold 34.2 percent of the market.

CONCLUSION

DATAQUEST believes that the U.S. semiconductor market is clearly the most strategically important marketplace for the Japanese semiconductor industry, accounting for 19 percent of all Japanese company worldwide sales. We expect Japanese companies to maintain U.S. market share during 1985 in a falling U.S. market, and poise themselves to increase market share in 1986 when the U.S. market picks up again.

At the same time, we believe that U.S. companies will continue to establish more sales, design, and perhaps manufacturing facilities in Japan, in order to form the local relationships necessary to successfully sell into the Japanese market.

The U.S. government is taking an increasingly aggressive stance toward perceived trade barriers in the Japanese market. We believe that in 1985, considerably more pressure than heretofore will be put on the Japanese government to reduce trade barriers and redress the U.S.-Japan trade imbalance, particularly in automobiles and electronics.

Patricia S. Cox

Table 1

ESTIMATED TRADE BALANCE FOR ALL MERCHANDISE UNITED STATES VS. JAPAN (Millions of Dollars)

Year	U.S. Exports to Japan	U.S. Imports from Japan	U.S. Trade Balance
1975	$9,567	$11,257	($1,690)
1980	$20,806	$31,217	($10,411)
1981	$21,796	$37,598	($15,802)
1982	$20,966	$37,744	($16,778)
1983	$21,894	$41,183	($19,289)
1984*	$23,575	$57,135	($33,560)
CAGR 1975–1984	11%	20%	39%

*Preliminary

Table 2

ESTIMATED U.S. IMPORTS OF ELECTRONIC EQUIPMENT FROM JAPAN (Millions of Dollars)

	1981	1982	1983	1984*	CAGR 1981–84
Communications	$961	$1,109	$1,391	$2,077	29%
Components (including semiconductors)	$962	$1,233	$1,741	$3,450	53%
Computers	$387	$822	$1,762	$3,200	102%
Consumer electronics	$3,646	$3,410	$3,985	$6,040	18%
Instrumentation	$592	$566	$701	$985	18%
Office Products	$1,338	$1,379	$1,602	$2,370	21%
Total	$7,886	$8,519	$11,182	$18,122	32%

*Preliminary

Source: U.S. Dept. of Commerce
DATAQUEST

Table 3

ESTIMATED ELECTRONIC EQUIPMENT TRADE BALANCE
UNITED STATES AND JAPAN
(Millions of Dollars)

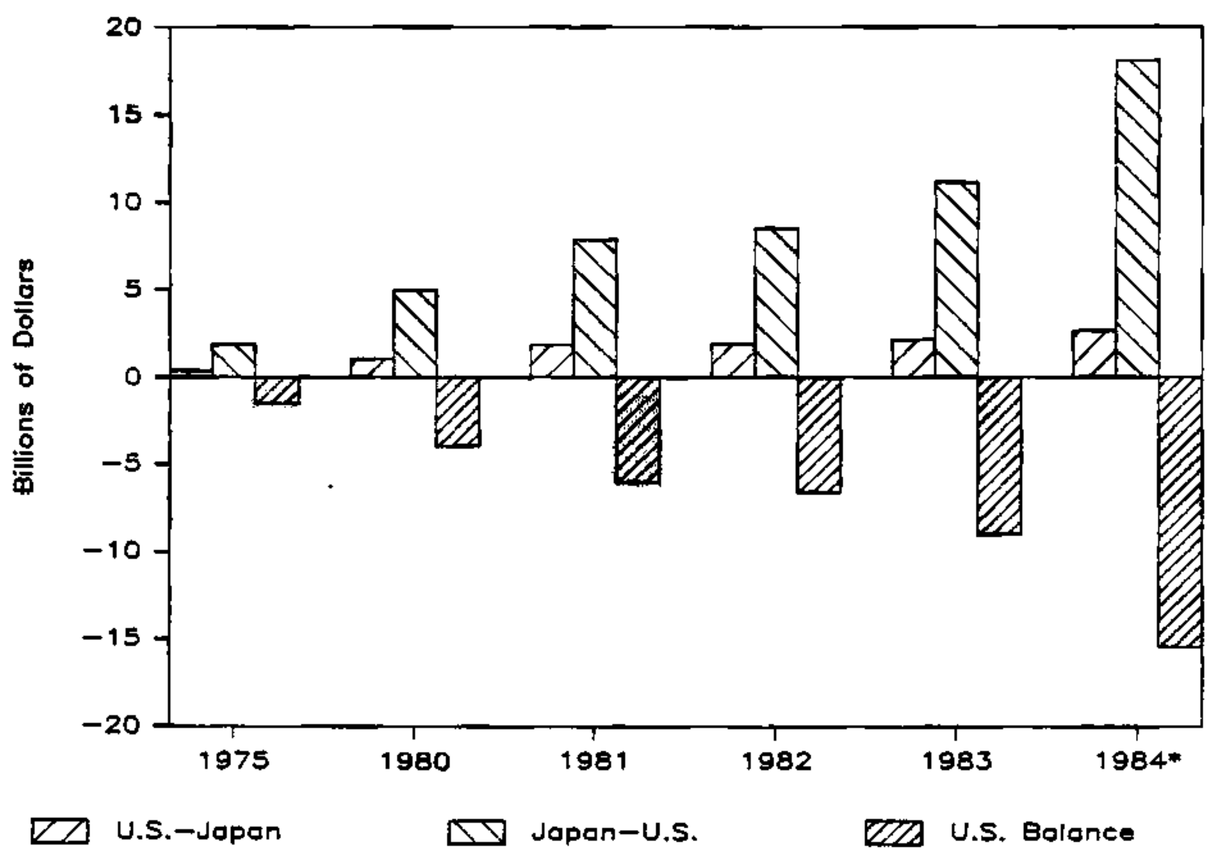
Year	U.S. Exports to Japan	U.S. Imports from Japan	U.S. Trade Balance
1975	$397	$1,903	($1,506)
1980	$1,058	$5,012	($3,954)
1981	$1,857	$7,886	($6,029)
1982	$1,941	$8,519	($6,578)
1983	$2,187	$11,182	($8,995)
1984*	$2,674	$18,122	($15,448)
CAGR 1975-1984	24%	28%	30%

*Preliminary

Source: U.S. Dept. of Commerce
DATAQUEST

Figure 1

U.S.-JAPAN TRADE IN ELECTRONICS



Source: DATAQUEST

Table 4

U.S. SEMICONDUCTOR TRADE WITH JAPAN*
(Millions of Dollars)

	Exports to Japan			Imports from Japan			Export CAGR	Import CAGR
	1982	1983	1984	1982	1983	1984	1982-84	1982-84
Total Semiconductor	$132	$183	$250	$495	$729	$1,626	38%	81%
Total IC	$120	$170	$234	$435	$666	$1,521	40%	87%
Bipolar Digital	$26	$34	$48	$72	$74	$133	36%	36%
MOS Memory	$36	$34	$43	$295	$464	$1,009	9%	85%
MOS Logic	$40	$53	$58	$45	$100	$309	20%	162%
Linear	$18	$49	$85	$23	$28	$69	117%	74%
Total Discrete	$12	$13	$16	$60	$63	$105	15%	32%

*Stated at import and export values

Table 5

U.S. SEMICONDUCTOR TRADE BALANCE WITH JAPAN*
(Millions of Dollars)

	1982	1983	1984	CAGR 1982-84
Total Semiconductor	($363)	($546)	($1,376)	95%
Total IC	($315)	($496)	($1,287)	102%
Bipolar Digital	($46)	($40)	($85)	36%
MOS Memory	($259)	($430)	($966)	93%
MOS Logic	($5)	($47)	($251)	609%
Linear	($5)	$21	$16	-
Total Discrete	($48)	($50)	($89)	36%

*Stated at import and export values

Source: U.S. Dept. of Commerce
DATAQUEST

Table 6

ESTIMATED U.S. SALES OF SEMICONDUCTORS IN JAPAN VS.
ESTIMATED JAPANESE SALES OF SEMICONDUCTORS IN THE UNITED STATES*
(Millions of Dollars)

	U.S. Sales in Japan			Japanese Sales in U.S.			U.S.–Japan CAGR	Japan–U.S. CAGR
	1982	1983	1984	1982	1983	1984	1982–84	1982–84
Total Semiconductor	$446	$600	$992	$787	$1,149	$2,100	49%	63%
Total IC	$389	$539	$917	$711	$1,071	$1,987	54%	67%
Bipolar Digital	$154	$190	$326	$90	$93	$144	45%	26%
MOS Memory	$47	$62	$157	$535	$818	$1,409	83%	62%
MOS Logic	$75	$135	$212	$57	$125	$359	68%	151%
Linear	$113	$152	$222	$29	$35	$75	40%	61%
Total Discrete	$57	$61	$75	$76	$78	$113	15%	22%

*Estimated sales by U.S. and Japanese companies

Table 7

ESTIMATED U.S. SEMICONDUCTOR ACCOUNT BALANCE WITH JAPAN*
(Millions of Dollars)

	1982	1983	1984	CAGR 1982–84
Total Semiconductor	($341)	($549)	($1,108)	80%
Total IC	($322)	($532)	($1,070)	82%
Bipolar Digital	$64	$97	$182	69%
MOS Memory	($488)	($756)	($1,252)	60%
MOS Logic	$18	$10	($147)	–
Linear	$84	$117	$147	32%
Total Discrete	($19)	($17)	($38)	41%

*Estimated sales by U.S. and Japanese companies

Source: DATAQUEST

Figure 2

U.S.-JAPAN TRADE IN SEMICONDUCTORS

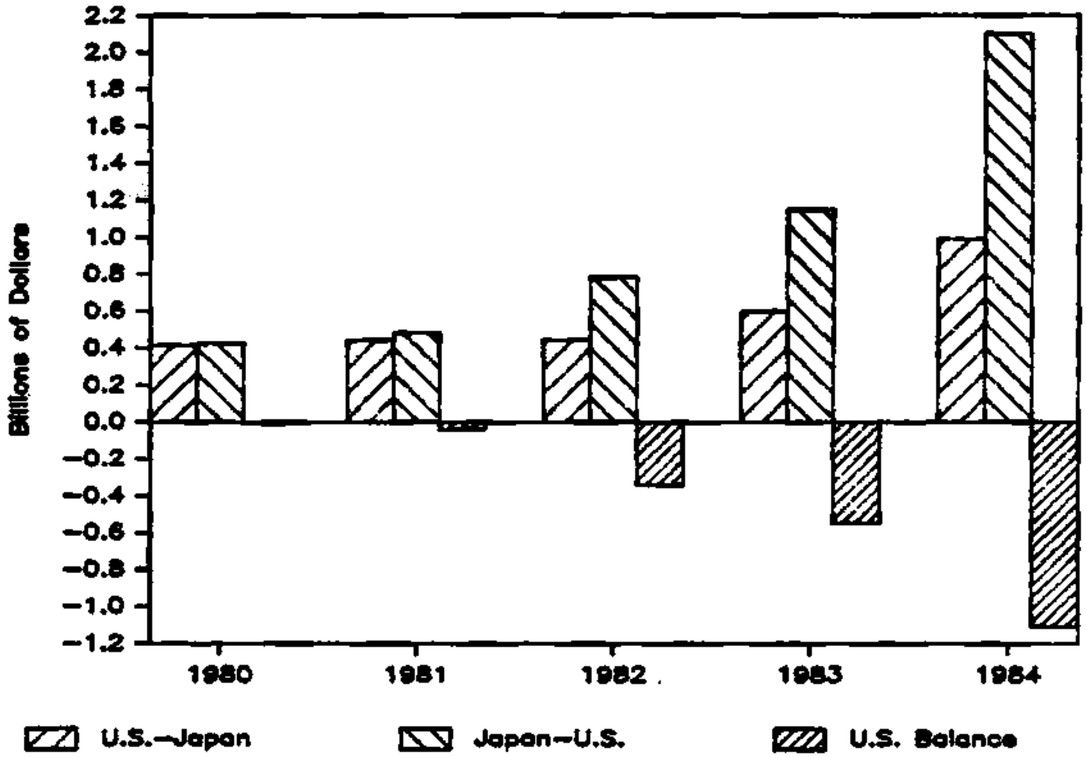
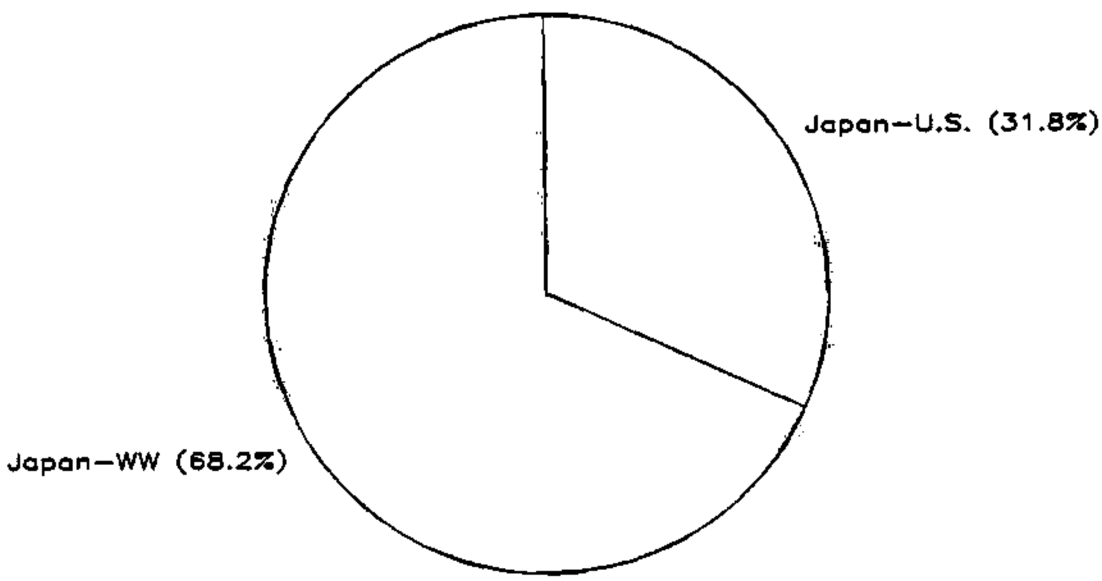


Figure 3

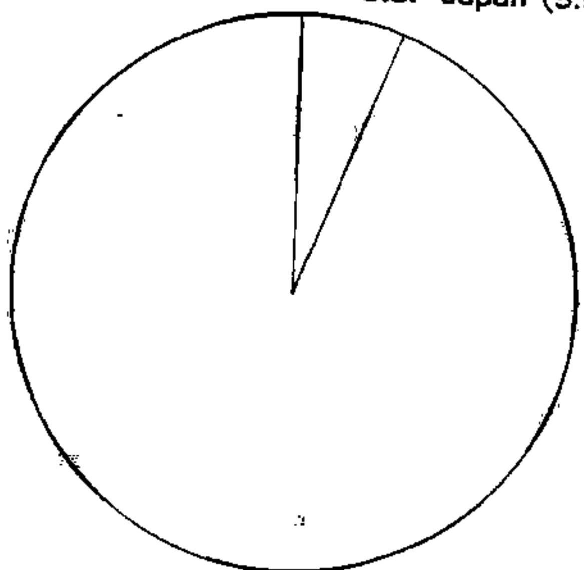
JAPANESE MOS SALES IN THE UNITED STATES AND WORLDWIDE
1984



Source: DATAQUEST

Figure 4

U.S. MOS SALES IN JAPAN AND WORLDWIDE
1984



Source: DATAQUEST

Table 8

ESTIMATED U.S. SHARE OF THE JAPANESE MARKET AND
ESTIMATED JAPANESE SHARE OF THE U.S. MARKET
(Percent)

	U.S. Share of the Japanese Market			Japanese Share of the U.S. Market		
	1982	1983	1984	1982	1983	1984
Total Semiconductor	11.0%	10.8%	11.9%	12.0%	13.7%	17.4%
Total IC	13.6%	13.6%	14.9%	13.5%	15.3%	19.3%
Bipolar Digital	29.5%	28.9%	34.2%	6.7%	5.4%	6.0%
MOS Memory	8.0%	6.4%	7.6%	35.7%	40.3%	44.0%
MOS Logic	11.5%	13.9%	15.8%	3.6%	5.8%	10.7%
Linear	10.3%	11.2%	12.2%	3.4%	3.2%	5.5%
Total Discrete	4.7%	3.8%	3.4%	5.9%	5.7%	6.5%

Source: DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

SEMICONDUCTOR CONSUMPTION IN JAPAN EXPLODES IN 1984

SUMMARY

If you weren't in Japan in 1984, you missed a great opportunity. Not since 1976, the year of the CB radio boom, has the Japanese semiconductor industry grown at such a pace. Fueled by the boom in personal computers, telecommunications, office automation, and factory automation products, the industry grew an estimated 51.8 percent, reaching $8.3 billion. This figure compares with a U.S. market of $12.1 billion.

JAPANESE SEMICONDUCTOR CONSUMPTION

Although it still ranks number two after the United States, the Japanese market has grown from 54.5 percent of the U.S. market in 1980 to 69.4 percent in 1984, as shown in Figure 1. In the hotly contested integrated circuit market it is even more dramatic. In 1980 it was 45 percent of the U.S. market; in 1984 it was 61 percent.

One should also note that in 1983, Japanese consumption of discretes surpassed that of the United States. We believe that this is due to the voracious appetite of VTRs for these devices. Table 1 shows our analysis of the semiconductor composition of a typical medium-range VTR. If one multiplies these devices by the total 1984 Japanese VTR production of 28 million units, it is easy to see why the Japanese discrete market has grown to surpass that of the United States.

Table 2 shows DATAQUEST's semiconductor consumption analysis. It shows that consumption of ICs grew 57.5 percent in 1984. Price firmness, which can be attributed to a shortage of supply of the dominant products such as 64K DRAMs, 8-bit MCUs, and TTL Schottky MSI devices, caused some of the high growth, but we believe that strong demand for office automation products was the principal culprit.

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Audio equipment and the rapid growth of compact disk (CD) players caused additional pressure on the semiconductor suppliers. However, as the U.S. market began slowing at the end of 1984, so did the Japanese market. The U.S. book-to-bill ratio, as measured by the World Semiconductor Trade Statistics Program, plummeted from 1.53 in January to 0.58 in December. We believe that as the United States began an inventory correction that will last through first quarter 1985, there has been a concurrent softness in Japan's personal computer market, causing semiconductor consumption to flatten out. As a result, we believe that fourth quarter 1984 domestic shipments grew only 5.0 percent over the third quarter, as shown in Table 2. This flattening can also be attributed to an inventory of VTRs both in the United States and Japan.

MARKET SHARE EXPLOSION IN THE UNITED STATES

Japanese manufacturers have quietly been gaining market share in the United States over the last several years. In 1984 they made the largest gain of the last five years, with the Japanese share of the U.S. market growing 3.5 percentage points to reach 17.4 percent (see Figure 2). In integrated circuits, we believe that the Japanese share of the U.S. market in 1984 was 19.4 percent, an increase of 4 percentage points over 1983. Even though the Japanese domestic market was experiencing a semiconductor shortage similar to that in the United States, we believe that for six to eight months, the Japanese continued to support large U.S. users of 64K DRAMs, and in many cases enjoyed a $1.00 premium per device over the same product sold in Japan. Furthermore, we believe that Japan's 1984 share of the U.S. MOS memory market grew 3.7 percentage points, and that the Japanese can now claim 44 percent of the U.S. MOS memory market.

REVISED OUTLOOK FOR 1985

We now believe that 1985 will be somewhat slower than it appeared in our September outlook. We have adjusted our predictions due to the following factors:

- Economic activity is moderating and we believe that 1984's real GNP growth rate of 5.3 percent will slow to a projected growth of 4.5 percent (based on the Japanese government's recently released economic forecast of December 1984).

- The inventory of VTRs has risen for two quarters.

- There is a glut of PCs in both the United States and Asia.

- Capital expenditures of the Japanese and U.S. semiconductor manufacturers rose to $6.2 billion during 1984, which has precipitated an overcapacity for the current level of demand, especially for MOS memories.

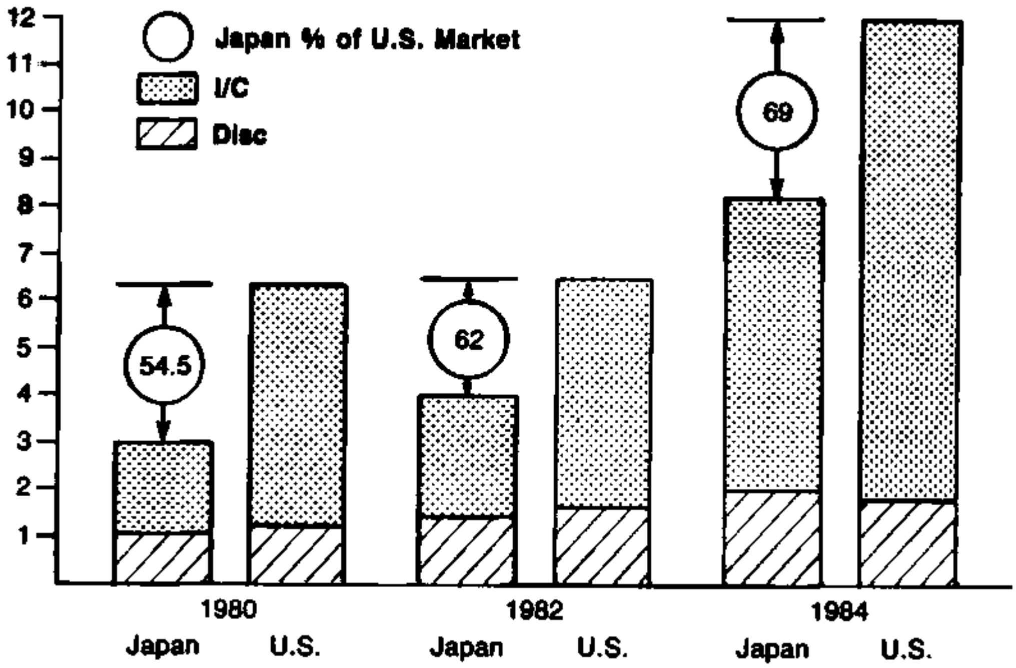
We expect this overcapacity to result in pricing below the learning curve through 1985. Incidentally, MOS memory represented about 30 percent of the total U.S. market for semiconductors and 20 percent of the Japanese semiconductor market.

Our forecasted growth rate for 1985 for total consumption is 7.0 percent, with discretes decreasing 2.6 percent and ICs growing 10.4 percent. The sectors of the Japanese electronics industry that we expect to be the most healthy will be telecommunications, new consumer media such as Videotex, high-resolution TV monitors, CAD/CAM, minifax for home use, and compact disc players. DATAQUEST believes that CDs will be the next high-volume consumer product. We estimate that 1.2 million units will be produced in 1985, up from 740,000 in 1984. From a quarterly pattern perspective, we believe that first quarter 1985 semiconductor consumption will be down relative to fourth quarter 1984 by 11 percent. Quarterly consumption changes are shown in Figure 3. Severe pricing pressures in memories and a general inventory adjustment are causing consumption to drop in value. New orders are not anticipated to increase until mid-second quarter. Because of the March fiscal year end date used by most Japanese companies, end users are currently adjusting their inventories as they prepare for the start of the new fiscal year.

Gene Norrett
Patricia S. Cox

Figure 1

JAPANESE SEMICONDUCTOR CONSUMPTION COMPARED TO
U.S. SEMICONDUCTOR CONSUMPTION



Source: DATAQUEST

Table 1

ESTIMATED SEMICONDUCTOR CONSUMPTION OF JAPANESE VTRs

20	Optoelectronic devices
170	Diodes
120	Transistors
30	MSI ICs (linear and digital)
3	Microcontrollers

Source: DATAQUEST

Table 2

ESTIMATED JAPANESE SEMICONDUCTOR CONSUMPTION
(Billions of Yen)

	Q1	Q2	Q3	Q4	Total Year
1983					
Discrete	74.1	91.1	103.7	105.8	374.7
IC*	188.8	218.5	248.8	272.5	928.6
Total	262.9	309.6	352.5	378.3	1,303.3
Percent Change from Previous Quarter	2.5%	17.8%	13.9%	7.3%	
Percent Change from Previous Year	5.9%	29.4%	33.1%	47.5%	29.2%
1984					
Discrete	116.6	129.0	134.9	135.3	515.8
IC*	302.0	342.1	396.4	422.3	1,462.8
Total	418.6	471.1	531.3	557.6	1,978.6
Percent Change from Previous Quarter	10.7%	12.5%	12.8%	5.0%	
Percent Change from Previous Year	59.2%	52.2%	50.7%	47.4%	51.8%
1985					
Discrete	117.6	119.8	127.1	138.1	502.6
IC*	377.6	384.7	408.0	444.3	1,614.6
Total	495 2	504.5	535.1	582.4	2,117.2
Percent Change from Previous Quarter	-11.2%	1.9%	6.1%	8.8%	
Percent Change from Previous Year	18.3%	7.1%	0.7%	4.4%	7.0%

*Includes hybrids

Source: DATAQUEST

Ex Rate 2[illegible]7

Figure 2

JAPANESE MANUFACTURERS' SHARE OF U.S. MARKET
(Percent)

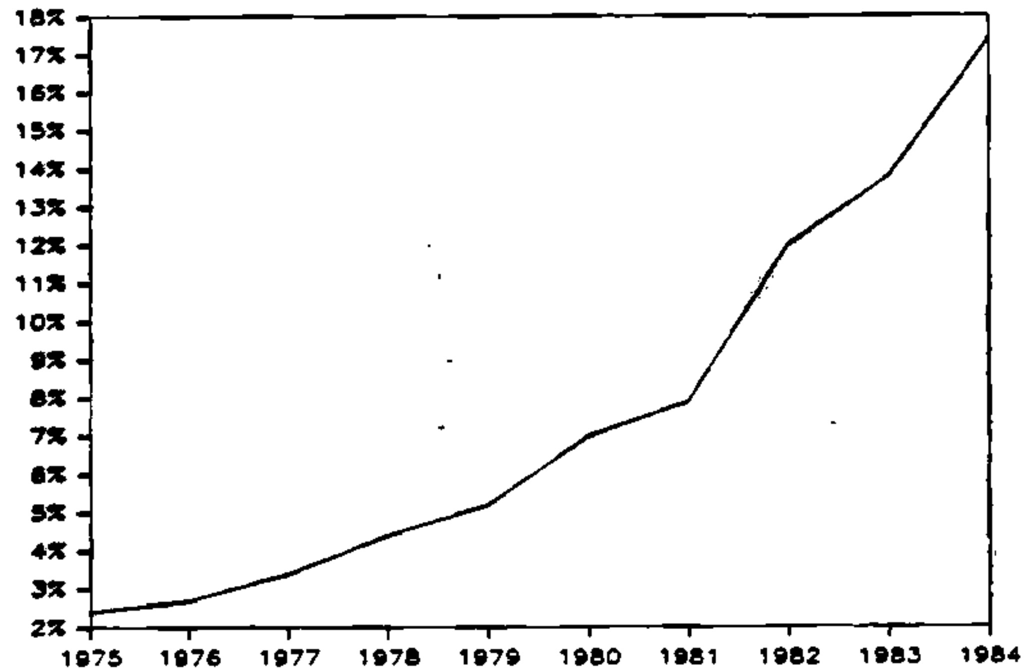
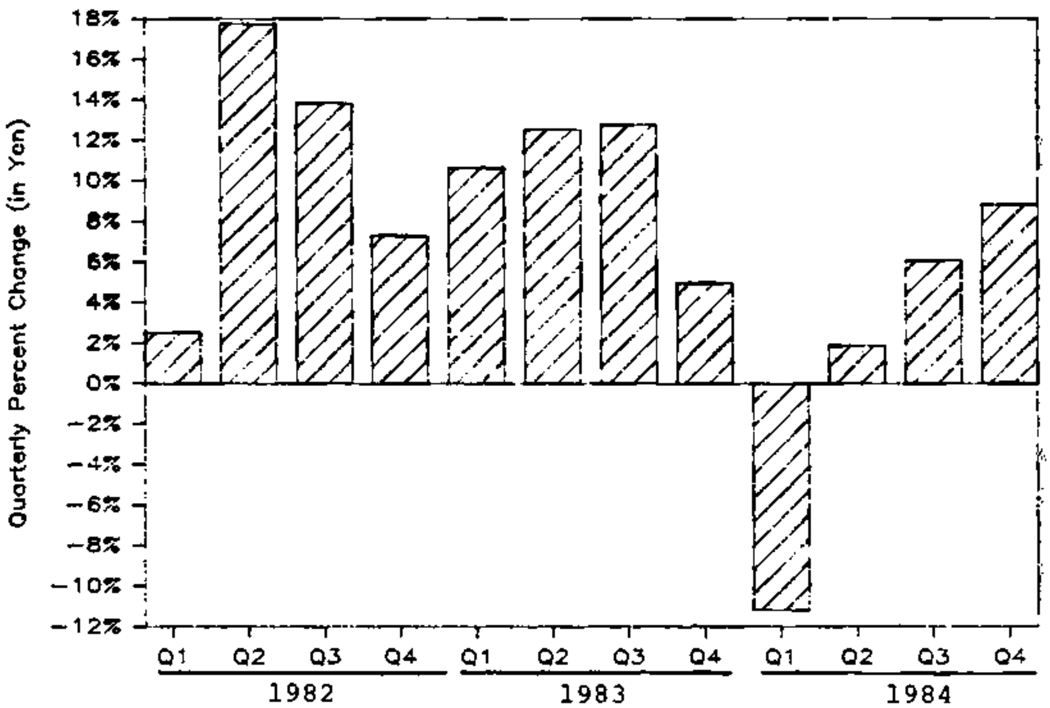


Figure 3

ESTIMATED JAPANESE SEMICONDUCTOR CONSUMPTION,
PERCENT CHANGE FROM PREVIOUS QUARTER



Source: DATAQUEST

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

SUCCESSFUL INTELLIGENCE GATHERING: DATAQUEST'S RECIPE

Gene Norrett, Vice President and Director of Dataquest's Japanese Semiconductor Industry Service, addressed Southcon '85 on market research and intelligence gathering techniques. The text of the speech is reprinted here.

Gene Norrett

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Good afternoon, ladies and gentlemen.

First, I want to thank the leader of this session and a good friend, Betty Prince from Motorola, for giving me this opportunity to address you today. I also want to thank the directors of Southcon 1985 for providing the forum to make this presentation.

I want to address the topic of Successful Intelligence Gathering from a high-technology market research perspective. This viewpoint is a natural one for both you and me because of our common interest in the world electronics market. Further, I will address this topic in the context of providing you, the worldwide marketing managers, with an insight into marketing your electronic products abroad, in accordance with the theme of this session. (Slide 1).

My analysis will cover four major points: the What, Why, Where, and finally, the How to, of intelligence acquisition.

In preparing this speech, I was reminded of some statements made by the great Silicon Valley prophet, James R. Riley. In case some of you don't know Jim, he started the Dataquest Semiconductor Industry Service in 1974 and directed its growth for many years. Before that, Jim was president of Signetics and then Intersil. Jim has many one-liners that very often help to crystallize ethereal concepts. For example,

> What's a good tax shelter? Jim's answer: "Make a lot of money."
>
> What is the best overall method of making a decision? Jim quickly responds "Listen to what your gut is telling you."
>
> "Why use Dataquest or other market research companies for decision support? Jim's answer is, "Are you good at explaining an Edsel to your stockholders?"

I believe that what Jim is saying here is that information or intelligence is critical for success. The most important thing for business and professional people to have, and the most difficult thing to find, is intelligence.

Now let's look at each of the major points in detail: (Slide 2).

The first point is "What Is Intelligence?". Webster defines intelligence as

> First: The ability to learn or understand or deal with new or trying situations
>
> Second: The ability to apply knowledge in order to manipulate one's environment

Therefore, to paraphrase Webster, I would say that intelligence is both the acquisition of hard facts on a given topic and the cogent use of these facts for successful decision making.

The fundamental knowledge that is needed to market your products abroad, especially in Japan, is:

1. What is the market potential for your product (i.e., total available market, past and future)?

2. Who are your potential customers?

3. Who are your competitors, what are their relative sizes, and what are their strengths and weaknesses?

4. What are the price trends of competing products?

5. What is the best method of distribution: (a) direct sales, (b) agents or reps, (c) trading or distributing company?

6. What are the major trade journals for promotion?

7. What cultural differences are important and are there any language barriers?

There are, of course, many more considerations, but once the answers to these questions are answered, then you, as world marketing managers, can make decisions that will lead to successful penetration of international markets. (Slide 3)

"Why Use Intelligence?" is the second major question. Obviously, one answer would be to minimize failures and maximize success. Jim Riley's answer would be "How good are you at explaining the Edsel to your stockholders?" Unfortunately, I believe that today there are only a very limited number of decision makers who have come to the conclusion that "In the Valley of the Blind, the one-eyed man is King." To support this opinion, I cite a study published in the prestigious Harvard Business Review. It revealed that only about 8 percent of the businesses represented by 1,200 survey participants had a department with employees trained to gather and analyze information about competitors.

In explaining the purpose of intelligence to my clients, I tell them that information should be considered as valuable a resource as capital and labor. Information has been historically underpriced, underutilized, and its contribution underrated. The question of why we use intelligence seems basic to me, but again, this is my business. But for many American executives, "seat of the pants" decision making is a way of life. The Japanese executives are much different. Furthermore I believe that there is a strong relationship between the amount of information that the Japanese gather on western technology and the trade balance between Japan and the West. (Slide 4)

When I was starting the Japanese Semiconductor Industry Service, I came across two very interesting statistics relating to the unbalanced level of information trade. The first one is that from a translation perspective, for every page of Japanese translated into English, there are 100 pages of English translated into Japanese. I don't know the breakdown of the text contents, but I would guess that for electronics the ratio is significantly larger. The second statistic relating to information trade is that the largest users of the National Technical Information Service (NTIS) are the Japanese. In fact, one official of the NTIS told me that the Japanese keep it solvent. The NTIS contains more than 500,000 publicly available reports on research projects sponsored by federal agencies and some state and local governments.

I can further cite another very specific example of how the Japanese value information. When I was working for Motorola as Manager of Market Research and Business Analysis, I served as Motorola's rep to the SIA. As chairman of the Statistics Committee, which met twice per year to prepare a consensus three-year forecast of the industry, I visited the Electronic Industry Association of Japan. In my discussions with this group, they told me that they had a similar committee to the committee that I was chairman of. They advised me that their committee meets monthly to discuss the status of the Japanese industry, and in some cases might meet more frequently than monthly. Certainly you can see that this level of information on the status of their industry is significantly higher than that of the SIA.

At Dataquest, as reporters and analyzers of market competition, we frequently compare this competition to a game of cards. Due to the extensive information advantage of the Japanese, they generally know 50 of the 52 playing cards whereas western competitors know only 2 of the 52, a significant disadvantage, I believe.

Anyone who has done research projects knows that libraries are a fundamental source of information. They contain journals, surveys, and annual reports. Other sources are colleagues and, of course, research companies. Dataquest is relatively new at decision support but its parent companies, A.C. Nielsen Company and Dun and Bradstreet, have been educating leaders of industry on the importance of sound information and have been delivering this information to an ever-increasing population for many years. This delivery is supplemented with application related material because we know that today's executives need interpretation of information even more than the data itself.

Today, A.C. Nielsen, Dataquest's direct parent, is operating in 28 countries, employs more than 22,000 people worldwide, and serves 17,000 clients. Its 1983 sales were more than $680 million and its revenues have grown over the last ten years at a rate of 17.8 percent. Moreover, Dun and Bradstreet, which purchased A.C. Nielsen in September 1984, is a $1.5 billion information company. D&B has 28,000 employees and is the largest provider of business services and information in the private sector. (Slides 5 and 6)

As this slide shows, Dun and Bradstreet's business spans business information services, publishing, and marketing services. These businesses are designed to support many of the fastest growing sectors of the world's economies. The specific areas of marketing, market research, and product development are the most significantly supported by Dun and Bradstreet. (Slide 7)

Furthermore, Dataquest, like A.C. Nielsen and Dun and Bradstreet, is also an information company. Dataquest was started in 1972 and has grown into a company with 300 employees and more than 2,000 clients. We specialize in the high-technology industries of semiconductors, computers and computer peripherals, telecommunications, and design and manufacturing automation. Based in Silicon Valley we are dedicated to providing a unique consulting service to our clients, founded upon intelligence gathering and analysis. (Slide 8)

I believe the answer to the question, "where to find information" is on the surface an obvious one. We, at Dataquest, use the information sources mentioned in slide 9 as our principal sources of published information. However, to be able to get specific detail on the industries, products, companies, technologies, etc. we, at Dataquest, have developed a collection of the most important information sources and in some cases sources of sources on the industries that we follow. (Slide 9)

From companies' annual reports and Securities and Exchange Commission Files we are able sometimes to gather not only fundamental information on companies but also very valuable intelligence on the market in which these companies participate. I want to call your attention to Electronic Association reports. In many cases the associations in the United States, Europe, Japan, and Asia have statistical committees that are chartered to provide their members with very high quality data and analyses. We thoroughly know and utilize these data bases. (Slide 10)

We also find that utilizing other research companies' published reports is a valuable help in our analyses. These companies include, of course, those on Wall Street.

Further we are making increasing use of on-line data bases and I recommend you become familiar with the data bases that pertain to your industry. One major data bank vendor is CompuServe. The second is Dialog.

Finally, in our library we have the proceedings from the major trade shows and also our analysts' trip reports, which summarize the major happenings at these shows.

The last question, namely how to gather information is the most difficult one. (Slide 11)

In order to develop this point, I'll share with you the recipe of the Japanese Semiconductor Industry Service (JSIS), which I direct.

In setting up the service, we were faced with the challenge of providing a comprehensive data base on the Japanese market, technologies, and companies, including their strategies, capacities, patent applications, equipment/materials that they use, and finally their products. (Slide 12)

To do this, I set up two offices to gather information, conduct analyses, and interact with the clients.

I believe that in order to be in the international intelligence business, one must gather information locally by locals. As such, JSIS has staff in both Tokyo and in San Jose, the two centers of the competing semiconductor industries. We also maintain very good relationships with companies on the "Silicon Plain" in Texas and in the "Silicon Desert" in Phoenix. (Slide 13)

Our analysts gather both published and unpublished data and incorporate them into a total data base.

I have already shown you the published data sources. The unpublished information comes from our network of industry and government contacts that have been established over the years. When a contact is made by an analyst, manager, V.P., or President at Dataquest, a contact report is generated and sent to our central library for processing. (Slide 14)

The library receives the contact report and it is computerized and filed by subject, key word, and company. Through electronic mail, members of the Dataquest staff can see this information immediately for action and follow-up.

Direct interaction with our computerized data base is available to clients of our service. The clients can also interact with analysts through the inquiry privilege that is included in the services. These inquiry privileges allow clients to interrogate the analysts on subjects pertinent to the data base; response time is generally within one day. The need for immediate response to these unique questions drives us to do a great deal of in-depth analysis. (Slide 15)

The Japanese Semiconductor Industry Service data base is tied into other regional semiconductor data bases, and Dataquest is in the process of linking all its services into a macro data base. This linking will enable the analysts to do significantly more research and provide much better service to the clients. Our world semiconductor data base is supported by 50 people around the world, which constitutes the world's largest group of experts that continuously monitor this very rapidly changing industry. (Slide 16)

Dataquest's Japanese Semiconductor Industry Service monitors technology trends in materials, components, and semiconductor manufacturing equipment. We have the most extensive data base on Japanese factories so that statements can be made on capacity levels and changes in capacity. We also report on patent trends through this data base. Patent information is available by company, by technology, and by product. We do market share and product portfolio analyses from our company profile data, and finally, the data base contains the Japanese market dissected by end-user market by product by company. A very ambitious project.

To summarize, I have addressed the what, where, why, and the how to of successful intelligence gathering for the purpose of marketing products abroad. The most critical thought to remember is that the progress of information gathering should not be passive, but interactive with experts. We at Dataquest believe that it is not only data that is needed, but a unique perspective that will enable you, as decision makers, to test the validity of your assumptions. We want you to succeed and we believe that our research and analysis will help to provide this success.

Thank you.

Slide 1

INTELLIGENCE GATHERING

- WHAT
- WHY
- WHERE
- HOW

Slide 2

WHAT IS INTELLIGENCE?

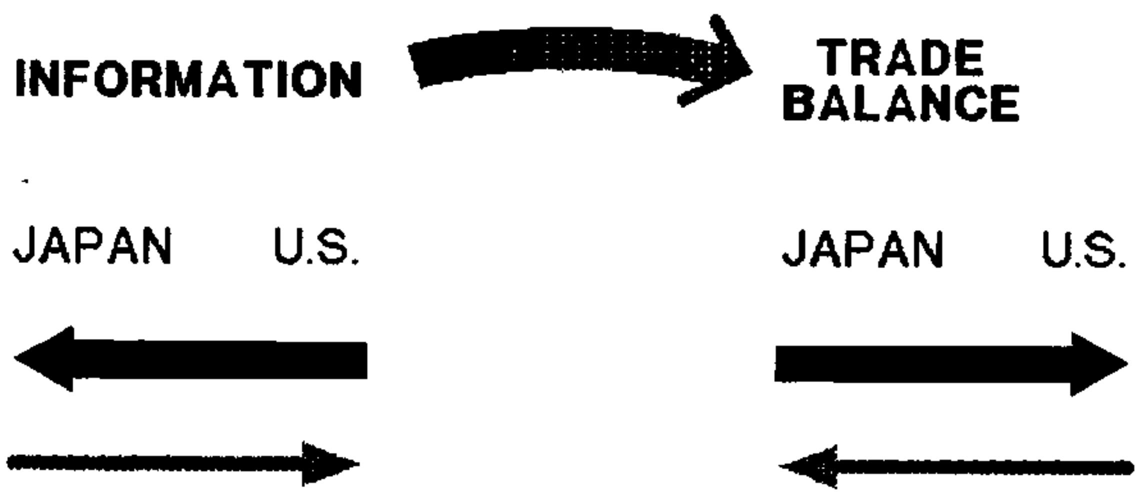
- LEARNING OR UNDERSTANDING THE SITUATION
- APPLICATION OF THE KNOWLEDGE LEARNED IN THE MOST BENEFICIAL MANNER

Slide 3

WHY USE INTELLIGENCE?

- MINIMIZE FAILURES
- MAXIMIZE SUCCESSES

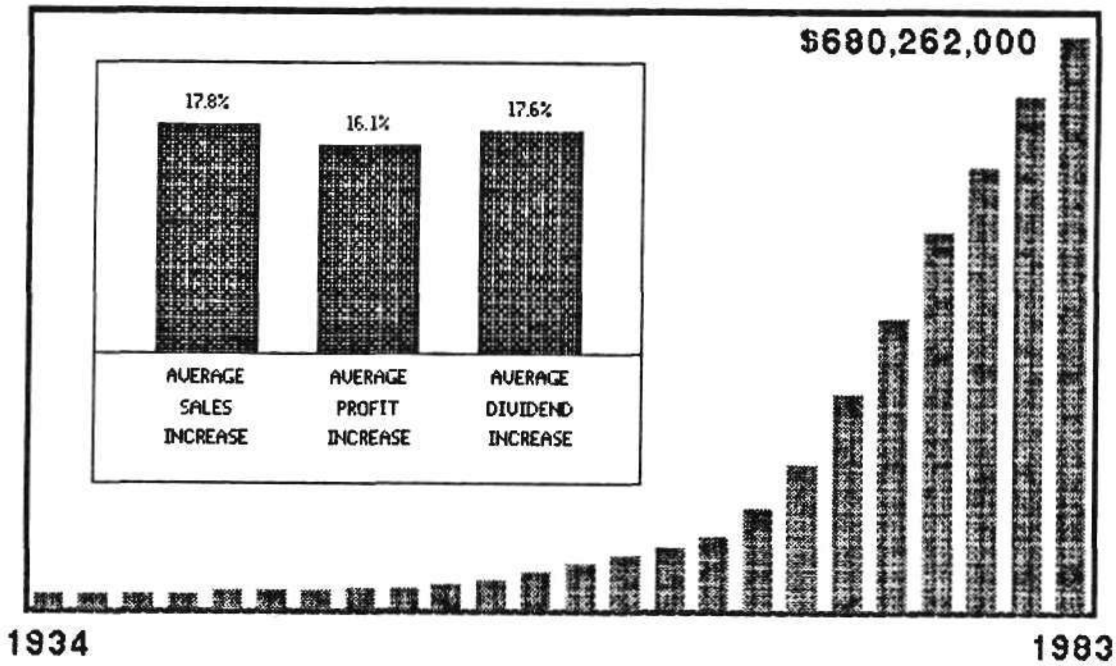
Slide 4



Slide 5

A.C. NIELSEN COMPANY REVENUES

(Fiscal Years Ended August 31st)



Slide 6

DUN & BRADSTREET

	1982	1983	1984 (Forecast)
REVENUES	1,361	1,510	1,700
INCOME	147	167	185
NET INCOME PER SHARE	2.53	2.97	3.20

Slide 7

Products and Services

	Strategic Planning	Sales and Sales Management	Reference Material for Schools and Libraries	Marketing, Market Research and Product Development	Manufacturing, Distribution and Purchasing	Human Resources Management	Economic and Financial Analysis and Investment Planning	Computer Services, Software Programs and Applications	Commercial Credit Information and Collection Services	Banking and Insurance	Airline and Travel Information and Planning	Advertising, Direct Mail and Telemarketing
Business Information Services												
Dun & Bradstreet Credit Services	●		●	●	●		●		●	●		●
Dun & Bradstreet International *(Credit Services and Commercial Collections)*	●	●	●	●	●	●	●		●	●		●
D&B Computing Services	●	●		●	●		●	●		●		●
Dun & Bradstreet Plan Services				●	●		●			●		
Dun & Bradstreet Commercial Collections					●				●	●		
DunsPlus	●	●		●		●	●	●	●		●	●
McCormack & Dodge	●	●			●	●	●	●	●	●		
TSI International	●			●			●	●				
Zytron								●		●		
Publishing												
Reuben H. Donnelley		●		●	●					●		●
Moody's Investors Service	●		●	●	●		●		●	●		
Official Airline Guides	●		●	●							●	●
Technical Publishing		●	●	●	●	●	●	●				●
Dun & Bradstreet Business Education Services		●		●	●	●	●	●	●	●		
Technical Data Resources	●	●		●	●						●	●
Marketing Services												
Donnelley Marketing				●	●					●		●
Dun's Marketing Services	●	●	●	●	●	●	●			●		●
Dun & Bradstreet International *(Marketing)*		●	●	●								●
Donnelley Marketing Information Services	●	●	●	●						●		●
Financial Services Industry Group	●			●			●			●		
Salesnet		●		●						●		●

Some of the many fields of economic activity served by The Dun & Bradstreet Corporation:

- Advertising, Direct Mail and Telemarketing
- Airline and Travel Information and Planning
- Banking and Insurance
- Commercial Credit Information and Collection Services
- Computer Services, Software Programs and Applications
- Economic and Financial Analysis and Investment Planning
- Human Resources Management *(including personnel education and training)*
- Manufacturing, Distribution and Purchasing
- Marketing, Market Research and Product Development
- Reference Material for Schools and Libraries
- Sales and Sales Management
- Strategic Planning

Slide 8

DATAQUEST

- STARTED IN 1971
- 2000 CLIENTS
- REVENUE GROWTH OF 20% PER YEAR
- SPECIALIZING IN HIGH TECHNOLOGY MARKET RESEARCH

Slide 9

SOURCES OF ELECTRONICS INFORMATION

- ANNUAL REPORTS AND SEC FILINGS BY COMPANIES
- WORLD GOVERNMENT REPORTS AND STATISTICS
- DATAQUEST NOTEBOOKS AND NEWSLETTERS
- TRADE MAGAZINES
- WORLDWIDE PATENT RECORDS
- ELECTRONIC ASSOCIATION'S DATA AND REPORTS

Slide 10

SOURCES OF ELECTRONICS INFORMATION (Continued)

- INFORMATION COMPANIES
- SECURITY ANALYST
- MAJOR DATA BANK VENDORS
- SOURCE OF SOURCES
- INTERNATIONAL INFORMATION SOURCES
- MAJOR TRADE SHOWS

Slide 11

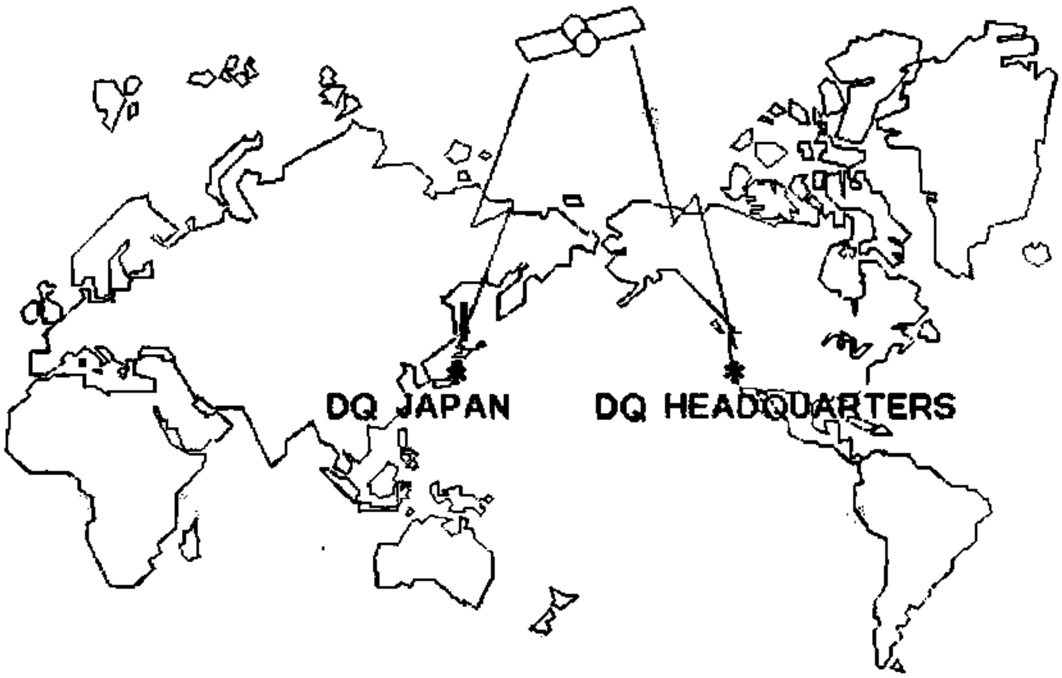
HOW TO GATHER INFORMATION

**DATAQUEST'S
JAPANESE SEMICONDUCTOR
INDUSTRY SERVICE**

RECIPE

Slide 12

JSIS INFORMATION LINK

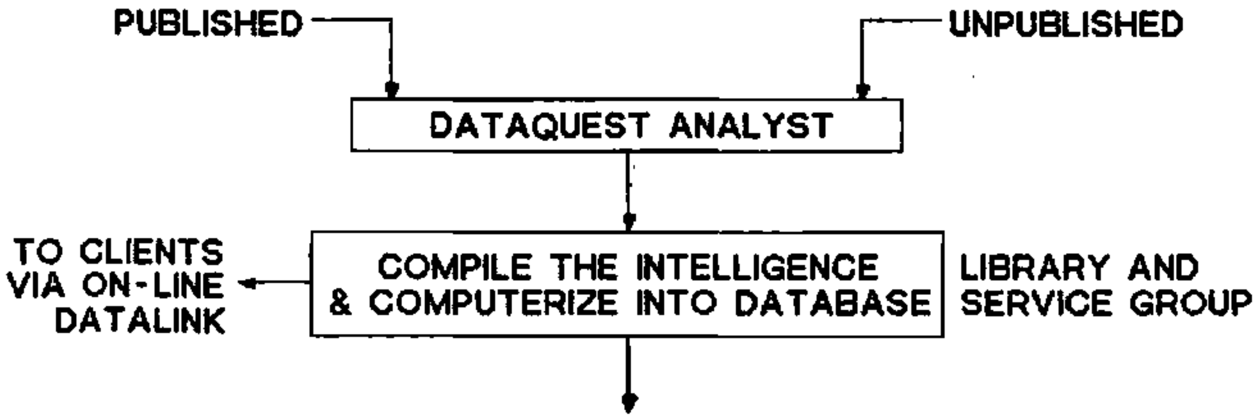


Slide 13

THE JSIS RECIPE

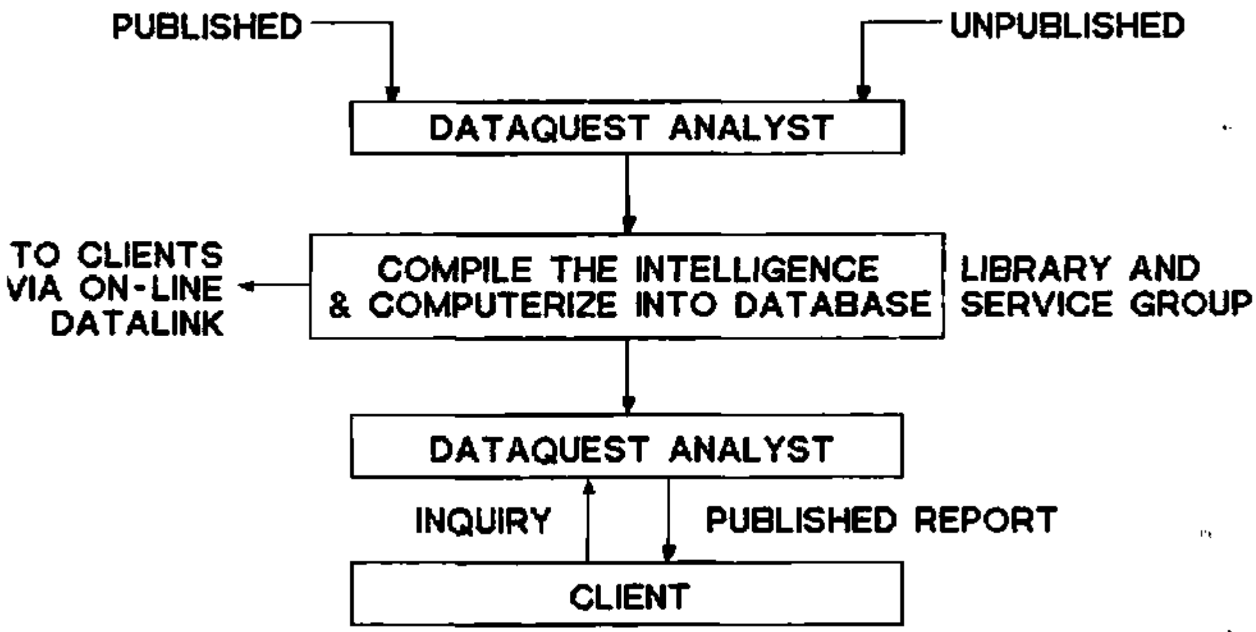
Slide 14

THE JSIS RECIPE



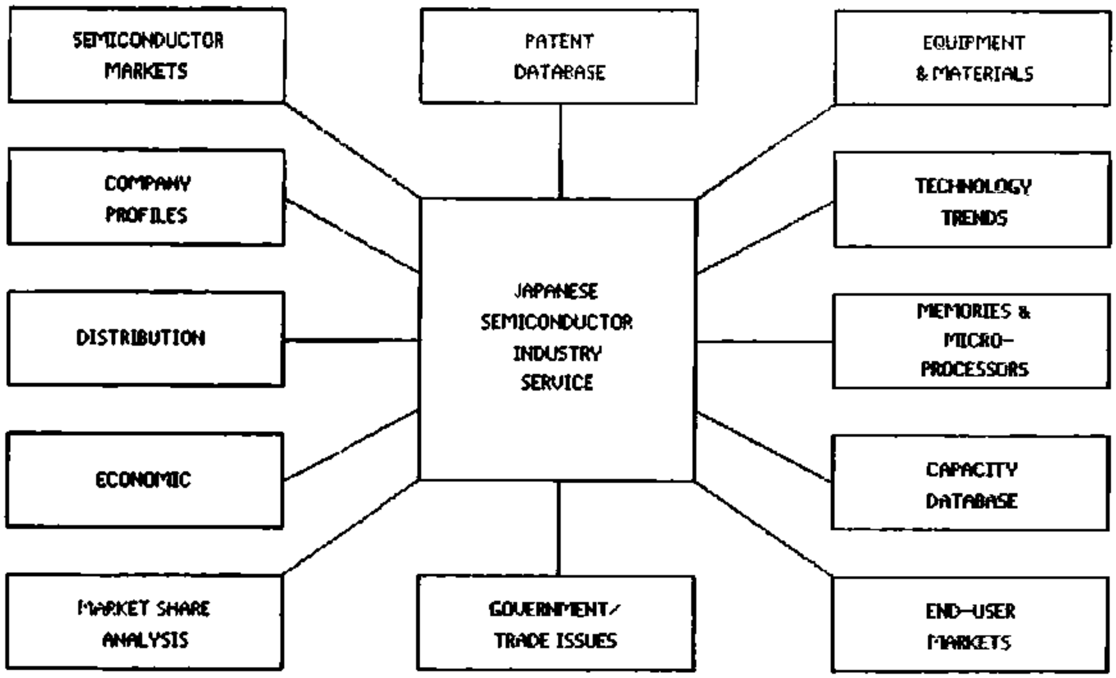
Slide 15

THE JSIS RECIPE



Slide 16

"THE SOLUTION"



Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

NEW TRENDS IN JAPANESE SEMICONDUCTOR DISTRIBUTION

INTRODUCTION

The Japanese semiconductor distribution market, thought to be the most complex of all the major world markets, has undergone significant change over the last five years. DATAQUEST believes that many of the leading semiconductor manufacturers are increasing their use of distribution as a major means of market penetration. For example, semiconductor resales by Hitachi's top five distributors have grown at a compound annual growth rate (CAGR) of 68.6 percent over the last five years.

DATAQUEST's Japanese Semiconductor Industry Service (JSIS) has developed a comprehensive data base on semiconductor distribution and consumption in Japan. We have analyzed the market by major semiconductor distributors' total resales and by the major distributors' sales for the top six semiconductor manufacturers in Japan. We have also compared Japanese methods of distribution with those of the United States.

DISTRIBUTOR RESALES

Table 1 lists resales for the top 50 semiconductor distributors in Japan, from 1979 through 1984.

The following points can be observed from this table:

- The number one distributor, Ryosan, lost market share from 1982 to 1984, with 10.6 percent of total distributor resales in 1982 decreasing to 8.9 percent in 1984; however, Ryosan experienced an overall CAGR of 21.9 percent.

- The market share of the top ten distributors decreased from 49.4 percent of total resales in 1982 to 47.9 percent in 1984.

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- The smaller distributors are growing significantly faster than the large distributors. While most of the top ten grew at CAGRs less than the average 29.4 percent, many of the smaller distributors grew much faster. Prime examples of this are O.S. Seiki, number 11, at 45.9 percent, and Koshida Shokoh, number 38, at 43.1 percent.

- Four of the top five distributors handle NEC parts.

- Only two of the top ten distributors, Marubun and Tokyo Electron, handle U.S. semiconductor manufacturers' lines

An interesting observation of Table 2 is that from 1979 to 1984, distribution resales as a percentage of total Japanese semiconductor consumption averaged about 43 percent. DATAQUEST believes that in the United States, distribution resales average about 30 percent of total semiconductor consumption.

A second major point that can be seen from this table is that distribution is increasing in importance as a method of going to market. Hitachi is a case in point. Hitachi's major distribution resales grew a whopping 68.6 percent CAGR from 1979 to 1984. This overall trend is a reflection of the increasing pervasiveness of semiconductors in Japan as well as the world. It is also due to the fact that Japanese distributors have recently become more aggressive in exporting VLSIs to the United States and Europe.

Table 3 lists resales by the top five distributors for each of the six major suppliers in the Japanese market.

This table illustrates the following:

- Total distributor sales for these six companies grew close to overall distributor resales growth, at a CAGR of 28.6 percent from 1979 to 1984.

- Hitachi experienced skyrocketing growth, with its distributor sales increasing at a CAGR of 68.6 percent. We believe that Hitachi has made a major strategic change in its path to market, with a heavy emphasis on distribution.

- The top six suppliers' percentage of total distribution resales declined from 1979 to 1984. We believe that smaller suppliers are increasing their use of distribution as a means of getting to market and therefore their distribution sales are growing faster than those of the top six suppliers.

Distribution Methods

Table 4 compares distribution in the United States and Japan. (Europe is intentionally excluded from this comparison because of the lack of homogeneity in the European marketplace. We believe that Europe must be examined on a country-by-country basis.) Table 4 makes many comparisons between the two competing marketplaces; however, the most important difference is the fact that in Japan, an exclusive distributor handles only one major semiconductor manufacturer because these distributors have very close financial relationships with the semiconductor manufacturers. There are independent distributors in Japan that represent competing manufacturers, but their intent is to represent manufacturers whose products are more complementary than competitive.

We believe that in Japan, a distributor's average order size per device type is almost twice that in the United States. In the United States, a distributor with 150,000 end customers and an average order size of $500 is not uncommon. In Japan there are less than 60,000 end customers and the average order size is $1,200 ([280,000).

In the United States, the major U.S. semiconductor manufacturers sell an average 25 to 35 percent of their domestic business through distributors, and some large manufacturers such as National Semiconductor and AMD use distribution as their primary sales channel. We believe that these companies sell more than twice the average through distribution. In Japan, on the other hand, the top two manufacturers, NEC and Hitachi, sell 95 percent and 60 percent, respectively, of their noncaptive domestic business through distribution.

There are other striking differences in the general methods of doing business through distribution. Japanese equipment manufacturers tend to use the semiconductor distributors as inventory staging locations in order to carry significantly lower inventories. The Japanese semiconductor manufacturers also use the distributors in the same way in order to provide a very high level of service and very quick turnaround on delivery. And in many cases, a Japanese end user will negotiate with a distributor for a fixed price for a given quantity regardless of the unit quantity on an order. This is much different from the United States where prices are most always quoted strictly on a given unit quantity per device or a total unit quantity per order.

Although there are comparatively fewer end customers in Japan, there is a significantly larger (ten times) number of second- and third-tier distributors. This is due to the difference in the makeup of the two electronics industries. In the United States, semiconductor manufacturers tend to grant distributor franchises on a regional or a national basis. However, they do not always give their distributors franchises for all locations, because they want to limit the number of distributors in each territory. In Japan, the granting of franchises is very complex. They may be granted on an area basis or on a given customer basis. There could be a situation where a specific distributor has one major customer with many ship-to locations in a region and only a very limited geographic region to cover because of the importance of this one major customer to the semiconductor manufacturer. In the United States, the largest distribution markets are in the west (principally California) and the mid-Atlantic regions. In Japan, the largest regions are Kanto (Tokyo and Yokohama) and Kinki (Osaka, Kyoto, and Nara).

The average annual sales budget for a typical outside salesperson in a U.S. distributorship is estimated to be $2.5 million. This includes all products that the distributor sells; i.e., semiconductors, passive components, and systems. His counterpart in Japan is responsible for an estimated $4.8 million, almost twice as much. However, the Japanese distributor generally has more factory support for this higher sales burden. On average, there is one applications engineer per five or six salespersons in Japan, compared to one for every ten in the United States. Today, because of excess inventory and overcapacity, many Japanese semiconductor manufacturers are sending applications and marketing personnel from the factory to work with the distributors temporarily to support an intensive sales campaign. Once supply/demand balance is achieved, the factory employees will return to their former positions.

Sales margins are generally lower for Japanese distributors than for U.S. distributors. Japanese distributors typically have margins of 5 to 25 percent, while their U.S. counterparts have margins of 25 to 30 percent. However, representatives have lower margins (5 to 7 percent) in the United States. Japanese distributors of imported devices, however, typically have rather high margins of 15 to 30 percent.

Billings and payments are handled differently in Japan and the United States. In Japan, distributor invoices are generated on the customer's paperwork, while in the United States, distributors generate their own invoices. Payment both by the distributors to suppliers and by customers to distributors, can be as long as 120 days in Japan, while U.S. payment terms are generally 30 days.

REGIONAL SEMICONDUCTOR CONSUMPTION

DATAQUEST maintains a data base on regional semiconductor consumption within Japan, by prefecture and by end use. We believe that it is important to provide this information to both distributors and manufacturers.

Tables 5 and 6 list average monthly semiconductor consumption and total available market (TAM) by region and by prefecture. Table 7 lists monthly semiconductor consumption and TAM by prefecture for VCRs. Table 8 lists the same information for computers and terminals. TAM represents the total market available to merchant suppliers and distributors exclusive of captive consumption.

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Table 1

ESTIMATED SEMICONDUCTOR RESALES OF TOP 50 JAPANESE SEMICONDUCTOR DISTRIBUTORS*
(Billions of Yen)

	Distributor	1979	1980	1981	1982	1983	1984	1979-84 CAGR%	Semiconductor Firm Represented
1.	Ryosan	¥ 27.2	¥ 39.5	¥ 46.8	¥ 49.5	¥ 54.9	¥ 73.3	21.93%	NEC
2.	Sanshin Electric	25.7	28.6	31.9	32.6	41.5	55.2	16.52%	NEC
3.	Ryoyo Electric	16.0	17.0	21.0	28.8	37.5	46.7	23.89%	Mitsubishi
4.	Shinkoh	14.2	20.0	20.9	23.6	30.5	39.8	22.89%	NEC
5.	Satori Electric	12.1	14.6	17.7	19.7	28.3	41.6	28.02%	NEC
6.	Nissei Denshi	6.2	6.7	12.1	17.3	23.4	32.7	39.45%	Hitachi
7.	Nissei Sangyo	8.9	11.7	15.4	17.6	22.2	33.5	30.36%	Hitachi
8.	Marubun	8.9	10.7	11.6	13.4	17.9	24.7	22.65%	TI, Motorola
9.	Easton Electronics	4.7	5.9	11.2	14.4	17.3	23.9	38.44%	Hitachi
10.	Tokyo Electron	6.6	7.4	10.1	13.2	16.6	22.8	28.14%	Intel, AMD
	Top 10 Subtotal	¥130.5	¥162.1	¥198.7	¥230.1	¥290.1	¥394.2	**	
11.	Toshiba Electron Device	¥ 3.4	¥ 3.9	¥ 7.1	¥ 10.7	¥ 14.6	¥ 19.7	42.10%	Toshiba
12.	O.S. Seiki	2.3	4.3	5.5	12.0	14.2	21.8	45.88%	Tokyo Sanyo
13.	Mikasa	5.2	6.0	7.5	9.7	12.4	16.9	26.58%	NEC
14.	Ryoden Shoji	4.5	5.8	7.6	10.2	12.3	16.8	30.14%	Mitsubishi
15.	Kyoei Industry	3.1	4.5	7.0	8.8	11.8	15.9	38.68%	Mitsubishi
16.	Midoriya Electric	6.0	6.2	8.5	9.4	11.7	15.0	20.11%	Toshiba
17.	Tokyo Denshi Kagaku Kizai	3.0	4.5	5.6	9.0	11.3	15.1	38.16%	Motorola
18.	Nichiwa Shoko	N/A	N/A	2.8	5.9	11.0	15.3	N/A	Hitachi
19.	Chemicon Semi. (CSS)	N/A	1.5	3.0	6.0	10.0	13.5	N/A	Hitachi
20.	Omron Tateishi Electric	N/A	3.8	5.6	7.2	9.2	13.1	N/A	Motorola
	2nd 10 Subtotal	¥ 28.5	¥ 40.5	¥ 60.2	¥ 88.9	¥118.5	¥163.1	**	
21.	Kanematsu Electric Com.	N/A	N/A	¥ 3.5	¥ 5.6	¥ 9.0	¥ 10.2	N/A	AMD, Oki
22.	Fujitsu Electronics	3.3	4.0	4.8	5.3	8.6	12.0	29.46%	Motorola, TI
23.	Asahi Glass	2.9	3.8	4.5	5.7	8.5	12.0	32.85%	NS, Oki
24.	Sumitomo Elec. & Mac.	4.3	4.6	5.6	6.7	8.4	10.2	18.86%	TI
25.	Kaga Electronics	3.3	3.9	5.1	5.6	7.0	9.4	23.29%	Mitsubishi, Oki
26.	Hoei Electric	2.3	3.0	4.0	5.1	6.8	8.0	28.31%	Fujitsu
27.	Ohkura Shoko	N/A	N/A	N/A	3.3	6.7	9.4	N/A	Hitachi
28.	Nihon Denso Kogyo	2.1	2.5	3.4	4.3	6.7	9.1	34.08%	Oki
29.	Yashima Electric	N/A	N/A	1.9	3.2	6.7	9.3	N/A	Hitachi
30.	Dainichi Denshi	1.8	2.0	3.0	3.2	6.2	8.4	36.08%	NJRC, FCI, AMD
	3rd 10 Subtotal	¥ 20.0	¥ 23.8	¥ 35.8	¥ 48.0	¥ 74.6	¥ 98.0	**	

Note: TI=Texas Instruments, AMD=Advanced Micro Devices, GI=General Instrument, FCI=Fairchild
*Revenue includes export, captive, or other internal trade.
**CAGR is omitted for subtotals because of unavailable data.
N/A = Not Available

(Continued)

Table 1 (Continued)

ESTIMATED SEMICONDUCTOR RESALES OF TOP 50 JAPANESE SEMICONDUCTOR DISTRIBUTORS*
(Billions of Yen)

	Distributor	1979	1980	1981	1982	1983	1984	1979-84 CAGR%	Semiconductor Firm Represented
31.	Fujitsu Buhin Shoji	¥ 1.5	¥ 1.9	¥ 2.4	¥ 2.9	¥ 5.9	¥ 7.4	37.60%	Fujitsu
32.	Kantoh Denshi	1.6	1.8	2.9	4.0	5.8	8.4	39.33%	Fujitsu, Matsushita
33.	Tohman Electronics	2.2	2.6	3.5	4.2	5.6	8.9	32.25%	Mostek
34.	T.V. Shokai	1.5	2.3	3.6	5.0	5.5	5.0	27.23%	Hitachi
35.	Ashitate Electric	3.1	3.7	4.7	5.0	5.2	7.2	18.36%	Oki, TI, GI
36.	Hitachi Electric Components	N/A	N/A	1.4	3.0	5.0	11.0	N/A	Hitachi
37.	Kanematsu Semiconductor Sales	1.8	2.3	2.9	3.6	4.7	6.1	27.65%	FCI, GI
38.	Koshida Shokoh	1.0	1.2	1.9	3.0	4.3	6.0	43.10%	Mitsubishi
39.	Japan Macnics	1.1	1.4	1.9	2.3	4.2	4.7	33.70%	Oki, Harris
40.	Dainichi Seigyo	1.8	2.2	2.6	3.0	4.2	5.6	25.48%	AMD
	4th 10 Subtotal	¥ 15.6	¥ 19.4	¥ 27.8	¥ 36.0	¥ 50.4	¥ 70.3	**	
41.	Internix	¥ 2.6	¥ 2.9	¥ 3.1	¥ 3.8	¥ 4.2	¥ 7.1	22.25%	Intersil
42.	Tokyo Shuna	2.1	2.6	3.2	3.5	4.1	5.5	21.24%	Toshiba
43.	Kenden Kogyo	1.8	2.2	2.8	3.1	4.1	5.4	24.57%	Toshiba
44.	Mitsui Co, Ltd.	3.4	3.8	6.5	4.8	4.0	4.3	4.81%	TI
45.	Nideco	1.6	2.2	2.7	3.1	3.7	4.0	20.11%	Sharp
46.	O.K. Denki	1.8	2.2	2.7	3.3	3.7	5.0	22.67%	Sharp
47.	Tachibana Shokai (Osaka)	1.7	2.3	3.0	3.4	3.6	5.0	24.08%	Mitsubishi
48.	Chiyoda Denshi Kiki	1.5	1.9	2.4	2.7	3.4	4.5	24.57%	Matsushita
49.	Sankoh Electric	0.8	1.2	1.5	2.0	3.1	4.4	40.63%	Toshiba, Signetics
50.	Numata Donyokusha Shoji	1.3	1.7	2.1	2.4	3.0	4.0	25.21%	NEC
	5th 10 Subtotal	¥ 18.6	¥ 23.0	¥ 30.0	¥ 32.1	¥ 36.9	¥ 49.2	**	
	Top 50 Subtotal	¥213.2	¥268.8	¥352.5	¥435.1	¥570.5	¥774.8		
	Other	¥ 13.7	¥ 18.4	¥ 25.9	¥ 31.3	¥ 44.0	¥ 48.3		
	Total Distributor Sales	¥226.9	¥287.2	¥378.4	¥466.4	¥614.5	¥823.1	29.40%	

Note: TI=Texas Instruments, AMD=Advanced Micro Devices, GI=General Instrument, FCI=Fairchild
*Revenue includes export, captive, or other internal trade.
**CAGR is omitted for subtotals because of unavailable data.
N/A = Not Available

Source: DATAQUEST

Table 2

ESTIMATED JAPANESE SEMICONDUCTOR
SHIPMENTS, CONSUMPTION, AND SALES
THROUGH DISTRIBUTION
(Billions of Yen)

	1979	1980	1981	1982	1983	1984	CAGR% 1979-84
Consumption	¥582.8	¥750.7	¥938.1	¥1,009.9	¥1,308.4	¥1,979.8	27.71%
Distributor Sales	¥226.9	¥285.4	¥378.4	¥ 466.4	¥ 614.5	¥ 823.1	29.40%
OEM Sales	¥355.9	¥465.3	¥559.7	¥ 543.5	¥ 693.9	¥1,156.7	26.58%
OEM %	61%	62%	60%	54%	53%	58%	

Table 3

MAJOR SEMICONDUCTOR MANUFACTURERS' RESALES BY TOP FIVE DISTRIBUTORS
(Billions of Yen)

	1979	1980	1981	1982	1983	1984	CAGR 1979-84
Fujitsu	¥ 4.6	¥ 5.9	¥ 5.3	¥ 7.2	¥ 13.8	¥ 18.9	32.7%
Hitachi	6.1	9.9	24.0	35.9	55.2	83.0	68.6%
Mitsubishi	24.6	29.6	42.7	61.0	73.6	94.4	30.9%
NEC	76.8	100.7	117.5	136.3	170.2	226.6	24.2%
TI	16.9	19.8	13.4	28.7	36.8	44.1	21.2%
Toshiba	10.8	11.9	16.0	17.9	23.0	25.2	18.5%
Subtotal	¥139.8	¥177.8	¥218.9	¥287.0	¥372.6	¥492.2	28.6%
Percent of Total	62%	62%	58%	62%	61%	60%	
Total Distributor Sales	¥226.9	¥285.4	¥378.4	¥466.4	¥614.5	¥823.1	29.4%

Source: DATAQUEST

Table 4

COMPARISON OF SEMICONDUCTOR DISTRIBUTORS IN JAPAN AND IN THE UNITED STATES

I. Sales	Japan	United States
Number of semiconductor manufacturers represented by a given distributor	Exclusive distributors of major manufacturers: 1 Independent distributors: 5-10 Distributors of imported devices: 2-10	Independent distributors: 5-10* Representatives: Complementary semiconductor product lines
Typical distribution order	5,000 to 10,000 units	2,000 to 4,000 units
Percent of sales made through distributors	Varies; e.g., NEC 65%; Hitachi 60%; Matsushita 5%	25 to 35% (average) for top five manufacturers
Inventory--staging and planned	Exclusive distributors of major manufacturers: 1/2 to 1 month Independent distributors: 0.6-2 months Distributors of imported devices: 0.6-2 months	Independent distributors: 2-3 months Most reps carry very low inventory.
Number of second-tier/third-tier distributors	2,000 to 4,000	Less than 200**
Exports/imports by major distributors	Significant--20% of total sales	Import insignificant; export 10 to 15%
Territories	Complex, sometimes divided by area or major customer	Nationwide and regional
Annual budget per outside salesman	¥1.2 billion ($4.8 million)	$2.5 million
Technical staff	1 technical staff member per 5 or 6 salesmen	1 technical staff member per 10 salesmen
Technical support from factory	Frequent	Frequent
III. Management		
Sales margin	Exclusive distributors: 5-15% Independent distributors: 5-25% Distributors of imported devices: 15-30%	Independent distributors: 25-30% Representatives: 5 to 7%
Invoicing	Invoices generated on customers' paperwork	Invoices generated by distributors using their own paperwork
Payment terms for customers	30-120 days with promissory note	Cash payment within 30 days following delivery
Payment terms to suppliers (semiconductor manufacturers)	Cash payment by the end of the month following delivery; generally 30-120 days with promissory note	Cash payment within 30 days following delivery. 2% discount within 10 days
Typical distributor structure	Salesmen sell both passive and active components; components is one division of the company.	Salesmen may sell both passive and active components. Board level products are generally handled by a separate sales organization.

*Can be as many as 20.
**Excludes repair shops selling to hobbyists.

Source: DATAQUEST

Table 5

ESTIMATED AVERAGE MONTHLY SEMICONDUCTOR CONSUMPTION BY REGION
1983 AND 1984
(Billions of Yen)

Rank	Region	1983 Consumption	1983 TAM*	1984 Consumption	1984 TAM*
1	Kanto	¥ 58.6	¥41.3	¥ 85.3	¥ 66.9
2	Kinki	15.8	11.4	24.7	21.0
3	Tokai	14.6	11.1	19.9	16.8
4	Shinetsu	7.9	4.5	13.6	9.6
5	Shikoku	3.8	3.1	4.5	3.7
6	Tohoku	3.4	2.5	8.1	6.6
7	Chugoku	2.7	1.9	4.6	3.4
	Others	2.2	1.0	4.3	2.3
	Total	¥109.0	¥76.8	¥165.0	¥130.3

Note: Others include Hokkaido, Hokuriku, and Kyushu.
*Total Available Market excluding captive consumption

Source: DATAQUEST

Table 6

ESTIMATED AVERAGE MONTHLY SEMICONDUCTOR CONSUMPTION BY PREFECTURE
1983 AND 1984
(Billions of Yen)

		1983		1984	
Rank	Region	Consumption	TAM*	Consumption	TAM*
1	Kanagawa	¥ 23.2	¥17.7	¥ 34.6	¥ 25.9
2	Tokyo	13.6	8.9	21.9	14.4
3	Osaka	7.0	5.0	10.3	8.0
4	Tochigi	6.5	3.8	11.0	6.7
5	Aichi	6.0	4.6	9.1	6.5
6	Nagano	5.7	3.4	10.6	7.1
7	Ibaraki	5.4	4.5	7.4	6.3
8	Shizuoka	5.3	4.0	8.7	6.9
9	Saitama	4.7	3.7	8.3	6.7
10	Ehime	3.4	2.9	4.0	3.3
	Top 10	80.8	58.5	125.9	91.8
	Others	28.2	18.3	39.1	38.5
	Total	¥109.0	¥76.8	¥165.0	¥130.3

*Total Available Market excluding captive consumption

Source: DATAQUEST

Table 7

ESTIMATED AVERAGE MONTHLY SEMICONDUCTOR
CONSUMPTION AND TAM FOR VCRS
1983 AND 1984
(Billions of Yen)

		1983		1984	
Rank	Region	Consumption	TAM*	Consumption	TAM*
1	Kanagawa	¥ 3.1	¥ 3.0	¥ 3.9	¥ 3.8
2	Ibaragi	1.8	1.5	1.9	1.5
3	Ehime	1.8	1.6	1.8	1.5
4	Osaka	1.8	1.7	2.0	1.8
5	Tochigi	1.6	1.0	2.3	0.9
6	Aichi	1.5	1.3	1.8	1.6
7	Okayama	0.9	0.8	1.3	1.1
8	Gumma	0.8	0.6	1.5	1.2
9	Chiba	0.4	0.3	0.4	0.4
10	Kyoto	0.3	0.3	0.8	0.7
	Top 10	14.0	12.1	17.7	14.6
	Others	1.2	0.7	3.6	3.6
	Total	¥15.2	¥12.8	¥21.3	¥18.2

*Total Available Market excluding captive consumption

Source: DATAQUEST

Table 8

ESTIMATED AVERAGE MONTHLY SEMICONDUCTOR
CONSUMPTION FOR COMPUTERS AND TERMINALS
1983 AND 1984
(Billions of Yen)

		1983		1984	
Rank	Region	Consumption	TAM*	Consumption	TAM*
1	Tokyo	¥ 4.6	¥ 2.7	¥ 7.3	¥ 4.5
2	Kanagawa	2.6	2.0	5.1	3.2
3	Nagano	2.1	1.0	3.7	2.1
4	Nara	1.6	1.4	2.0	1.7
5	Yamanashi	1.2	1.1	1.3	1.2
	Top 5	12.1	8.2	19.4	12.7
	Others	6.3	3.7	11.8	7.7
	Total	¥18.4	¥11.9	¥31.2	¥20.4

*Total Available Market excluding captive consumption

Source: DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPAN TAKES CENTER STAGE AT ISSCC 1985

SUMMARY

Japan's "take-lead" strategy in semiconductor research is beginning to pay off. Of the 108 technical papers introduced at the 1985 International Solid State Circuits Conference (ISSCC), Japanese research teams presented 49 papers, or 44 percent, in contrast with 41 papers for the United States, 13 for Europe, and 5 for Canada. As shown in Figure 1, the number of Japanese papers presented at the conference has doubled since 1980, reflecting the heavy R&D investment made by Japanese companies. Hitachi was the leader, with 14 papers, followed by Toshiba and NEC, as shown in Table 1. Japanese research closely mirrors the commercial market: 40 percent of all the Japanese papers concentrated on memory technology, 26 percent on video consumer applications, and 16 percent on gate arrays. Clearly, the highlight of the 1985 ISSCC was the profusion of 1Mb DRAMs, 256K CMOS SRAMs, and nonvolatile memories. But DATAQUEST observes that Japanese makers are also dominant players in CMOS and GaAs gate arrays and image-sensing technology.

HIGHLIGHTS OF THE ISSCC

1Mb DRAMs

East-West competition is heating up in 1Mb DRAMs, an area dominated by the Japanese in 1984. AT&T and Mostek presented CMOS devices using 1.2- to 1.3-micron geometries, while IBM offered a fast-page-operation NMOS device with 1.5-micron line widths. As shown in Table 2, Japanese 1Mb DRAMs generally use finer geometries (1.0 to 1.2 microns), smaller cell sizes (20 to 35 μ^2), and smaller die sizes (43 to 65 mm^2). Three Japanese companies offer NMOS designs (Mitsubishi, NEC, and Toshiba); two companies offer CMOS prototypes (Hitachi and Toshiba). Many of the devices use planar, double-poly, one-transistor cells.

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The 1Mb DRAMs offer a variety of new features. NEC's quasi 4-bit-wide test circuit and Mitsubishi's multibit test mode reduce testing time. Toshiba's device features a folded capacitor cell structure using its buried oxide (BOX) isolation technology. Toshiba and IBM both offer fast-page-operation modes. Hitachi's CMOS device has an address transition detection feature to reduce power dissipation at long cycle times and a back bias generator to reduce standby power dissipation.

New memory cell structures that may be used in 4Mb DRAMs also made their appearance. Hitachi introduced a 4b (16-level) cell storage for use in a semiconductor file memory. The 4Kb test circuit can read and write a multilevel signal in a cell without using complicated precision circuits. Fujitsu introduced a 1Mb DRAM with three-dimensional stacked capacitor cells (word line, storage node, and cell plate). These technologies are the early results of MITI's New Semiconductor Function Elements Project, which is investigating three-dimensional ICs.

Nonvolatile Memories

Japanese companies are focusing heavily on EPROM technology because of its ease of programming and low process costs. Hitachi's 1Mb CMOS EPROM offers fast-page-mode programming comparable to the time required to program a 256K EPROM. Toshiba's asynchronous 1Mb CMOS EPROM offers an address transistor detector, a mid-word-line buffer, and sensing to achieve an 80ns access time. Hitachi also presented a 256K CMOS EPROM that avoids latch-up problems by using polysilicon PMOS FETs in the programming control circuit. Toshiba's 256K flash EEPROM overcomes the problems of conventional UV-EPROMs and EEPROMs by rejecting failed devices with a burn-in test after plastic packaging. DATAQUEST notes that in 1986 Toshiba plans to commercialize 64K flash EEPROMS for which it has developed low-cost production techniques.

SRAMs

Japanese makers dominated this session with their 256K CMOS SRAMs. Hitachi's 32Kx8b device features variable impedance loads and a pulsed word-line technique to attain fast access times and low power dissipation during the write cycle (see Table 3). NEC uses a buried isolation structure and three-layer configuration to achieve a small die size. Its 256K CMOS SRAM consumes only 10mW standby power because doping of the polysilicon layer has been optimized. Mitsubishi's device offers a tri-level word line to minimize the peak current and a data equalizing technique to achieve high-speed operation.

Other papers introduced included Toshiba's paper on a 64K CMOS SRAM with a Schmitt trigger sense amplifier, Motorola's paper on a 16K SRAM, and NEC's paper on a CML-compatible GaAs 4K SRAM (see Table 4).

Flexible Gate Arrays

Despite predictions of their imminent decline, gate arrays are still popular among Japanese manufacturers because of their shorter fab cycle, fewer masks, and improved CAD systems. In addition, new array architectures offer more flexibility. Toshiba's 24,000-gate CMOS array offers triple-level wiring and a hierarchical layout that allows tighter designs. Fujitsu's 240,000-transistor CMOS masterslice features a flexible allocation of memory and channels to increase the memory area. Mitsubishi Electric presented a CMOS gate array with configurable 1,024b ROM and 256b RAM using a 1.5-micron design rule. Hitachi's 4,000-gate CMOS array has automatically generated test circuits to reduce testing time, a process that is becoming increasingly time consuming with larger arrays.

High-Speed Gate Arrays

Besides flexible gate arrays, Japanese makers are focusing on high-speed gate arrays using bipolar, GaAs, and CMOS technologies. Nippon Telegraph and Telephone (NTT) presented an 80ps 2,500-gate bipolar macrocell array with ECL compatibility, using a 1.0-micron rule super self-aligned process technology (SST), to make a 26b parallel multiplier. Oki's 390ps 1,000-gate array uses GaAs MESFET superbuffer FET logic and offers high load drivability and low power dissipation. Toshiba's 42ps 2,000-gate GaAs gate array offers a small gate delay and low power consumption, making it an attractive alternative to ECL gate arrays. DATAQUEST observes that Japanese manufacturers are seeking faster development times because of shortening product life cycles in Japan's competitive market.

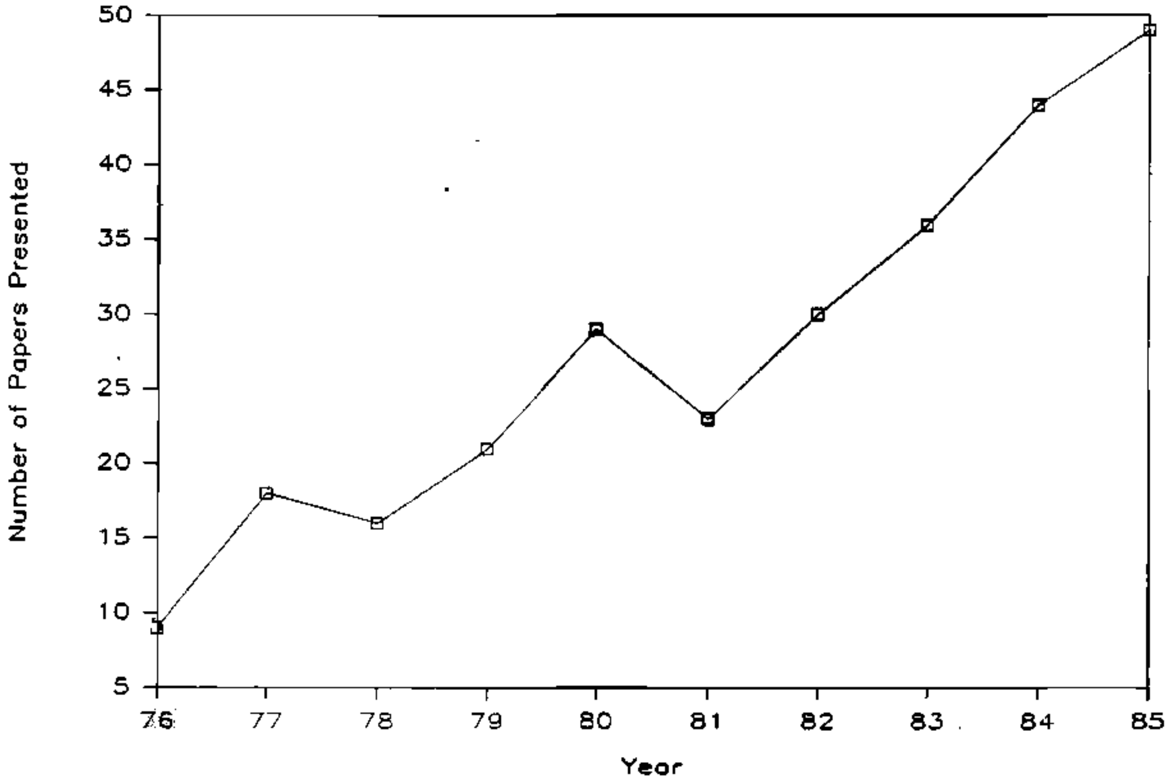
Image Sensors

Japan's video camera market is also pushing development of charge-coupled device (CCD) image sensors. Matsushita introduced two papers, one covering a 490 x 490-element super-8 format CCD color imager using a vertical overflow drain for blooming supression and wider dynamic range, and one about a collinear contact-type three-chip CCD image sensor containing a plane structure of photosites. Sharp presented a 580 x 500-element interline-transfer CCD imager for the 2/3-inch format that offers a high-aperture ratio and a low smear level. Mitsubishi's 480 x 400-element CCD imager features a charge sweep device that allows narrower vertical channel widths without a decline of the charge-handling capacity.

Sheridan Tatsuno

Figure 1

NUMBER OF JAPANESE PAPERS PRESENTED
AT THE ISSCC--1976-1985



Source: DATAQUEST

Table 1

NUMBER OF JAPANESE PAPERS PRESENTED AT THE ISSCC BY ORGANIZATION--1976-1985

Private Firms	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total
NEC	1	3	4	4	5	4	6	7	6	8	48
Hitachi	1	1	3	5	6	6	4	3	8	14	51
Toshiba	4	3	1	1	3	2	5	4	11	9	43
Fujitsu	1	2	1	-	4	2	3	11	4	4	32
Sharp	-	-	1	-	-	1	1	1	-	1	5
Matsushita	2	-	-	2	3	-	1	2	4	3	17
Mitsubishi	-	1	1	1	1	1	2	3	1	4	15
Sanyo	-	-	1	-	-	-	-	-	-	-	1
Oki	-	-	-	1	-	1	-	-	2	1	5
Sony	-	-	1	-	1	4	1	2	3	2	14
TI Japan	-	-	-	-	-	-	-	-	1	-	1
	9	10	13	14	23	21	23	33	40	46	232
Government Agencies											
Nippon Telegraph & Telephone (NTT)	-	3	3	6	4	2	7	3	4	2	34
VLSI Development Laboratory	-	1	-	1	1	-	-	-	-	-	3
MITI Electronic Technology Laboratory	-	1	-	-	-	-	-	-	-	-	1
Control Research Laboratory	-	2	-	-	-	-	-	-	-	-	2
Tohuku University	-	1	-	-	1	-	-	-	-	1	3
	0	8	3	7	6	2	7	3	4	3	43
Total	9	18	16	21	29	23	30	36	44	49	275

Source: DATAQUEST

Table 2

SPECIFICATIONS OF 1Mb DRAMs

Company	Die Size (mm^2)	Cell Size (μm^2)	Design (μm)	Process	Access Time (ns)	Functions Available
NEC	4.6 x 9.4 (43.24)	3.4 x 6.0 (20.40)	1.5	NMOS	85	Quasi 4-bit-wide testing
Mitsubishi	5.0 x 13.0 (65.00)	3.8 x 9.4 (35.72)	1.2	NMOS	90	Multibit test mode Shared sensing
Toshiba	4.78 x 13.23 (63.24)	5.0 x 6.4 (32.00)	1.2	NMOS	70	Folded capacitor cell structure Buried oxide (BOX) isolation
Fujitsu	4.45 x 12.3 (54.74)	3.15 x 8.4 (26.46)	1.4	NMOS	90	Three-dimensional stacked capacitor cells
Toshiba	5.0 x 12.5 (62.50)	3.8 x 9.0 (34.20)	1.2	CMOS	56	Fast page and static column modes Substrate bias generator Laser redundancy
Hitachi	4.68 x 10.1 (47.27)	3.35 x 7.2 (24.12)	1.5	CMOS	74	Address transition detection Back bias generator
AT&T	4.8 x 14.5 (69.60)	3.5 x 10.5 (36.75)	1.3	CMOS	80	On-chip substrate bias generator
Mostek	6.0 x 11.4 (68.4)	4.0 x 9.0 (36.00)	1.2	CMOS	N/A	Divided bit-line matrix architecture
IBM	5.5 x 10.5 (57.75)	4.1 x 8.8 (36.08)	1.5	NMOS	80	Fast page operation

N/A = Not Available

Table 3

SPECIFICATIONS OF JAPANESE 256K CMOS SRAMs

Company	Die Size (mm^2)	Cell Size (μm^2)	Design (μm)	Process	Access Time (ns)	Functions Available
Hitachi	4.98 x 9.16 (45.62)	N/A (94.72)	1.2	Hi-CMOS	45	Variable impedance loads Pulsed word-line Address transition detection
NEC	5.09 x 8.00 (40.72)	7.4 x 12.1 (89.54)	1.2	CMOS	55	10uW standby power Buried isolation Ti polycide gate
Matsushita	5.41 x 9.18 (49.66)	8.0 x 14.5 (116.0)	1.3	CMOS	45	Trilevel word line Address transition activated circuit

N/A = Not Available

Source: ISSCC Proceedings
DATAQUEST

Table 4

TOPICS OF JAPANESE PAPERS PRESENTED AT THE 1985 ISSCC

Company	Title of Paper
1Mb DRAMs	
NEC	85ns 1Mb DRAM in a 300-mil Plastic DIP with Quasi 4-bit-Wide Testing and Double Level Polycide
Mitsubishi	90ns NMOS 1Mb DRAM with Multi-bit Test Mode and Shared Sensing Scheme
Toshiba	1Mb NMOS DRAM with a Folded Capacitor Cell Structure, Using Buried Oxide (BOX) Isolation and Two-Level Aluminum Metal
Hitachi	16-Levels/Cell Storage, Single Transistor DRAM for Use in Semiconductor File Memory
Fujitsu	1Mb DRAM with 3-Dimensional Stacked Capacitor Cells and 55fG Capacitance
Toshiba	1Mb CMOS DRAM with 24ns Column and 56ns Row Access Times, Using Bit-Line Precharge with Complementary Capacitor Coupled Dummy Cell and Bit-Line Level Generator
Hitachi	20ns Static Column 1Mb CMOS DRAM, Using Back Bias Generator and Corrugated Capacitor Cell (CCC)
Nonvolatile Memory	
Hitachi	95ns 256K CMOS EPROM, Using Polysilicon PMOS FETs in the Programming Control Circuit
Toshiba	256K Flash EEPROM Using Triple Polysilicon and 2.0 Micron Design Rule
Hitachi	1Mb CMOS EPROM with Fast Page Mode Programming, Using High-Voltage MOS Structure with Lightly Doped Drain, Double Poly N-Well CMOS, and 1.0 Micron Minimum Gate Length
Toshiba	Programmable 80ns 1Mb CMOS EPROM with Address Transition Detector and Mid-Word-Line Buffer, Using Selective Diffused Self-Alignment (DSA)

(Continued)

Table 4 (Continued)

TOPICS OF JAPANESE PAPERS PRESENTED AT THE 1985 ISSCC

Company	Title of Paper
SRAMs	
Hitachi	256K CMOS SRAM with Variable Impedance Loads and Pulsed Word-Line Technique
NEC	10mW Standby Power 55ns 256K CMOS SRAM Using 1.2 Micron P-Well CMOS, Ti Polycide Gate and Buried Isolation
Mitsubishi	45ns 256K CMOS SRAM with Tri-Level Word Line Using Double Poly Single Aluminum CMOS
Toshiba	17ns 64K CMOS SRAM with a Schmitt Trigger Sense Amplifier, Using Two-Level Aluminum Metal and Twin-Well CMOS Process
NEC	CML GaAs 4K SRAM with Source Coupled FET Logic for Peripheral Circuits and Conventional E/D-DCFL Circuitry for the Memory Cell
Special-Application Memories	
NEC	256K Dual Port Memory
Matsushita	8K Content-Addressable and Reentrant Memory, Using a Small Associative Memory Cell and PLA
Fujitsu	64K ECL RAM with Two-Array Redundancy, Using 1.2-Micron Lithography and Isolation by Oxide and Polysilicon
Gate Arrays	
Toshiba	24,000 Gate CMOS Array Using Triple-Level Wiring and Hierarchical Layout
Fujitsu	240K Transistor CMOS Array with Flexible Allocation of Memory Channels
Mitsubishi	1.5-Micron CMOS Gate Array (16-bit MPU) with 1,024b ROM and 256b RAM
Hitachi	4K CMOS Gate Array with Automatically Generated Test Circuits

(Continued)

Table 4 (Continued)

TOPICS OF JAPANESE PAPERS PRESENTED AT THE 1985 ISSCC

Company	Title of Paper
High-Speed Arrays	
Fujitsu	1ns 20K CMOS Gate Array Series with Configurable 15ns 12K Memory
NTT	80ps 2,500-Gate Bipolar Macrocell Array
Oki	390ps 1,000-Gate Array Using GaAs Super-Buffer FET Logic
Toshiba	42ps 2,000-Gate GaAs Gate Array
Microprocessors	
Hitachi	CMOS MPU with Instruction-Controlled Register File and ROM
NTT	Single-Chip 80b Floating Point Processor
Signal Processors	
Hitachi	CMOS Facsimile Video Signal Processor
NEC	Single Chip Signal Processor for CCITT Standard ADPCM Codec
Tohoku U.	NMOS Pipelined Image Processor Using Quaternary Logic
Image Sensors	
Matsushita	490 x 404 Element Imager for Single-Chip Color Camera
Sharp	580 x 500 Element CCD Imager with Shallow Flat P Well
Mitsubishi	480 x 400 Element Image Sensor with Charge Sweep Device
Matsushita	Collinear 3-Chip Image Sensor
Toshiba	1/2-inch Format Two-Level CCD Imager with 492 x 800 Pixels

(Continued)

Table 4 (Continued)

TOPICS OF JAPANESE PAPERS PRESENTED AT THE 1985 ISSCC

Company	Title of Paper
High-Speed Technology	
Hitachi	Low Temperature CMOS 8 x 8b Multipliers with Sub 10ns Speeds
Hitachi	6GHz ECL Frequency Divider Using Sidewall Base Contact Structure
NEC	Silicon Bipolar 6.2GHz 300 mW Frequency Dividers
NEC	280ps Josephson 4b x 4b Parallel Multiplier Consisting of 249 Gates with 862 Josephson Junctions
Modeling and Technology	
Toshiba	Hot-Carrier Supressed VLSI with Submicron Geometry
Consumer ICs	
NEC	700MHz Monolithic Phased-Locked Demodulator
Sony	1.2GHz Single-Chip NMOS PLL
Sony	470MHz 5V CATV Tuner
Hitachi	VCR Servo IC with Self-Calibrating Adaptive Speed Control
Hitachi	CMOS 8b 25MHz Flash ADC
Data Converters	
Hitachi	500MHz 8b DAC
Monolithic Analog Filters	
Hitachi	CMOS Video Filters Using Switched Capacitor 14MHz Circuits

Source: ISSCC Proceedings
DATAQUEST

Nielsen Dataquest

JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPANESE SEMICONDUCTOR ACTIVITY IN THE UNITED STATES--1984 UPDATE

SUMMARY

Japanese semiconductors are becoming an increasingly pervasive part of the U.S. semiconductor market. The 1984 events contributing to this include the following:

- Imports of Japanese semiconductors into the United States continued at record high levels. Finished goods imports were up 123 percent in 1984 over 1983.
- Total 1984 Japanese company semiconductor sales grew much faster than those of U.S. companies.
- A seventh Japanese firm established manufacturing facilities in the United States.
- U.S. semiconductor sales by Japanese companies grew 83 percent from 1983 to 1984.
- The Japanese share of the U.S. semiconductor market jumped from 13.9 percent to 17.4 percent in 1984.

U.S.-JAPAN SEMICONDUCTOR TRADE

Table 1 shows U.S.-Japan semiconductor trade from January through September of 1984 compared with the same period in 1983. The numbers in this table represent DATAQUEST estimates of the total market value of imports plus locally manufactured product (e.g., devices assembled by Fujitsu in the United States for sale in the United States). While sales by Japanese companies increased more than 120 percent January through September year-to-date, growth was most dramatic in MOS logic. This is due in part to a huge influx of microprocessor products imported from Japan to the United States.

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PRELIMINARY 1984 MARKET SHARE DATA

Preliminary 1984 market share data show that on the average, total semiconductor sales of major U.S. companies grew approximately 46 percent over 1983, exhibiting an average compound annual growth rate (CAGR) of 15 percent from 1980 to 1984. Total semiconductor sales of major Japanese companies grew an average of 58 percent in 1984, with an average CAGR of 34 percent from 1980 to 1984. This is shown in Table 2. For the purposes of this analysis, we define "major company" as any company for which DATAQUEST has published market share estimates for a given year. According to this definition, in 1980 there were 45 major U.S. companies and 7 major Japanese companies. In 1984, there were 55 major U.S. companies and 9 major Japanese companies.

Clearly, overall Japanese growth has been much higher than overall U.S. growth. The Japanese companies have fueled their growth with sustained capacity expansion, high levels of automation, a highly captive market for consumer and industrial electronic products, and a much-publicized export boom. The Japanese government-sponsored VLSI program, which ended in 1979 and led to Japanese development of the 64K DRAM, can be thought of as the catalyst for the dramatic growth in Japanese sales that has since occurred.

JAPANESE PRODUCTION FACILITIES IN THE UNITED STATES

With the addition of two more Japanese companies to the U.S. manufacturing base in 1984, the number of Japanese companies that manufacture semiconductors in the United States now stands at seven.

Oki Semiconductor opened its Sunnyvale, California, test facility in December 1984; assembly capability will be added in the summer of 1985. Mitsubishi Semiconductor America's Research Triangle Park, North Carolina, assembly and test plant is scheduled to open early in 1985. Hitachi is currently building a second assembly facility in Irving, Texas, which will also perform final metallization of gate arrays.

Toshiba Semiconductor USA (TSUSA) recently announced a plan to shut down its Sunnyvale plants due to the outmoded lines in place there; the company plans to build a new factory in the United States in 1987.

Fujitsu has announced plans to build a wafer fab in Oregon, to be completed in 1986. The major product will be 256K DRAMs.

Sharp and RCA recently announced a joint venture for designing, developing, and manufacturing CMOS VLSIs. Expectations are that this 49 percent Sharp-owned venture will build a factory in the United States in 1986.

NEC no longer fabricates wafers at the former Electronic Arrays plant in Mountain View, California. This facility is now used for assembly only.

It should be noted that the presence of manufacturing facilities in the United States is a very effective way for Japanese companies to penetrate the U.S. market while at the same time soothing trade friction. U.S. plants are overseen, in general, by Japanese personnel, but most management personnel and staff are Americans. Products that are completely manufactured and sold in the United States are not included in import/export figures.

Most of the Japanese production in the United States is in MOS memories and logic; however, Matsushita assembles hybrid ICs. DATAQUEST estimates that the sales value of Japanese products fabricated and/or assembled in the United States was $350 million in 1984.

Table 3 shows Japanese manufacturing capability in the United States.

JAPANESE SALES IN THE UNITED STATES

Table 4 gives DATAQUEST estimates of 1982, 1983, and 1984 total semiconductor sales in the United States by the nine major Japanese companies. We believe that sales by Japanese companies in the United States grew 83 percent to $2.1 billion in 1984. This represents 17.4 percent of the total 1984 U.S. semiconductor market. Hitachi is by far the leader with U.S. sales of $595 million, or 28.3 percent of total Japanese sales in the United States.

DATAQUEST believes that sales of Japanese company-manufactured semiconductors in the United States were up only 83 percent, while imports of finished goods increased 123 percent due to the following reasons:

- Imports of raw wafers to be assembled and sold in the United States increased only 74 percent.

- Between 10 percent and 15 percent of imported goods were not sold in 1984, and are currently in inventory.

Table 5 shows DATAQUEST estimates of the Japanese share of the U.S. semiconductor market from 1980 to 1984. Over that period, Japanese share gained 10.4 percentage points, to stand at 17.4 percent of the U.S. market in 1984. The largest part of this is in MOS ICs; the Japanese share of that market is now 27.2 percent. Figure 1 graphically illustrates the sharp rise in Japanese share of the U.S. market.

Patricia S. Cox

Table 1

JAPANESE SEMICONDUCTOR SALES IN THE UNITED STATES VS. U.S. SEMICONDUCTOR SALES IN JAPAN-- JANUARY-SEPTEMBER 1983 VS. JANUARY-SEPTEMBER 1984 (Millions of Dollars)

	January-September 1983			January-September 1984			% Change 1983-1984	
	Japan to U.S.	U.S. to Japan	U.S. Trade Balance	Japan to U.S.	U.S. to Japan	U.S. Trade Balance	Japan to U.S.	U.S. to Japan
Total Semiconductor	$801	$392	($409)	$1,767	$640	($1,127)	120.6%	63.2%
Total Integrated Circuit	$744	$342	($402)	$1,661	$572	($1,089)	123.3%	67.3%
Bipolar Digital	$67	$127	$60	$125	$200	$75	86.6%	57.6%
MOS Memory	$572	$39	($533)	$1,205	$84	($1,121)	110.7%	115.9%
MOS Logic	$80	$84	$4	$271	$147	($124)	238.2%	74.8%
Linear	$25	$92	$67	$61	$141	$80	143.6%	53.2%
Total Discrete	$57	$50	($7)	$106	$68	($38)	85.1%	36.0%

Source: Japanese Ministry of Finance
U.S. Department of Commerce
SIA
DATAQUEST

Table 2

ESTIMATED WORLDWIDE SALES OF MAJOR U.S. SEMICONDUCTOR MANUFACTURERS VS. ESTIMATED WORLDWIDE SALES OF MAJOR JAPANESE SEMICONDUCTOR MANUFACTURERS--TOTAL SEMICONDUCTOR (Millions of Dollars)

Country	1980	1981	1982	1983	1984	Percent Growth 1983-1984	CAGR 1980-1984
Japan	$3,078	$4,239	$4,475	$6,249	$ 9,886	58%	34%
United States	$8,090	$7,597	$7,821	$9,723	$14,239	46%	15%

Source: DATAQUEST

Table 3

JAPANESE-OWNED SEMICONDUCTOR MANUFACTURING CAPABILITY IN THE UNITED STATES

Company	U.S. Company/Location	Function	Products
Fujitsu	Fujitsu, Ltd. San Diego, CA	Assembly	16K, 64K DRAM 16K SRAM 32K, 64K EPROM
Hitachi	Hitachi Semiconductor America Irving, TX	Assembly	16K, 64K DRAM 16K SRAM 32K, 64K EPROM
Hitachi	Hitachi Semiconductor America Irving, TX	Assembly and test	MOS memory and logic
Matsushita	Matsushita Electronic Components Company* Santa Clara, CA	Assembly	Custom hybrid ICs
Mitsubishi	Mitsubishi Semiconductor America** Research Triangle Park, NC	Assembly and test	64K DRAM
NEC	NEC Electronics USA# Mountain View, CA	Assembly	128K, 256K ROM 64K DRAM 32K, 64K EPROM
NEC	NEC Electronics USA Roseville, CA	Fab and assembly	ROM, custom, gate arrays
Oki	Oki Semiconductor Group Sunnyvale, CA	Assembly and test	MOS memory and logic
Toshiba	Toshiba Semiconductor USA## Sunnyvale, CA	Assembly	16K SRAM, ROM
Toshiba	Toshiba Semiconductor USA## Sunnyvale, CA	Fab	4K SRAM, ROM 16K DRAM

*Formerly Microelectronics Technology Corporation; now a division of Matsushita Electric Corporation of America.

**Phase I of Mitsubishi's plant will include assembly and test only. Completion is due early in 1985. Later plans call for fully integrated production of 64K and 256K DRAMs.

#Formerly Electronic Arrays, these operations were purchased by NEC in 1978 for an estimated $8.9 million.

##Toshiba purchased Maruman in 1980 for an estimated $2.7 million and subsequently renamed it Toshiba Semiconductor USA (TSUSA). These facilities are currently being phased out.

Source: DATAQUEST

Table 4

ESTIMATED U.S. SALES OF MAJOR JAPANESE SEMICONDUCTOR MANUFACTURERS
TOTAL SEMICONDUCTOR
(Millions of Dollars)

Company	1982	Percent Growth 1982-1983	1983	Percent Growth 1983-1984	1984
Fujitsu	$108	34%	$ 145	106%	$ 298
Hitachi	224	41%	315	89%	595
Matsushita	28	43%	40	88%	75
Mitsubishi	35	117%	76	97%	150
NEC	170	47%	250	72%	430
Oki	42	100%	84	73%	145
Sanyo	10	40%	14	43%	20
Sharp	6	67%	10	130%	23
Toshiba	124	40%	173	73%	300
Others	40	5%	42	52%	64
Total	$787	46%	$1,149	83%	$2,100

Table 5

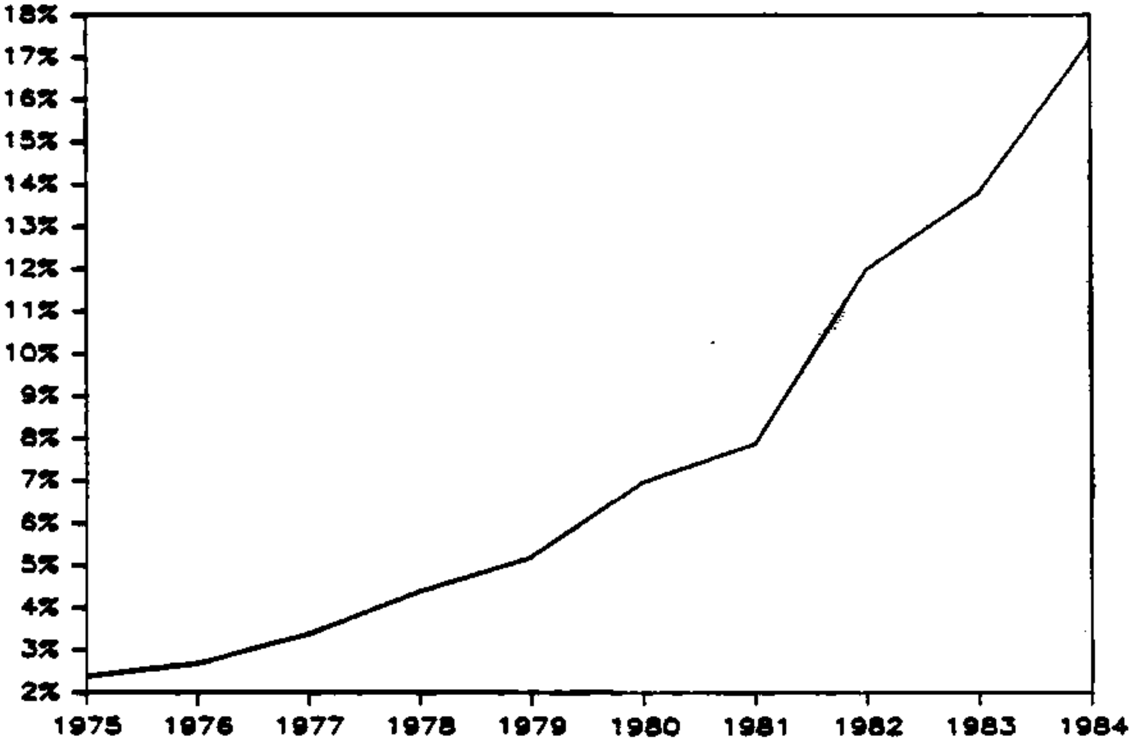
JAPANESE SHARE OF THE U.S. SEMICONDUCTOR MARKET
(Percent)

	1980	1981	1982	1983	1984
Total Semiconductor	7.0%	7.9%	12.0%	13.9%	17.4%
Total Integrated Circuit	7.9%	8.8%	13.5%	15.5%	19.4%
Bipolar Digital	3.7%	6.2%	6.7%	5.4%	6.3%
MOS	11.5%	12.1%	19.2%	23.1%	27.2%
Linear	3.2%	2.7%	3.4%	3.2%	5.2%
Total Discrete	3.9%	5.1%	5.9%	5.7%	6.6%

Source: DATAQUEST

Figure 1

JAPANESE SHARE OF THE U.S. SEMICONDUCTOR MARKET



Source: DATAQUEST

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JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

JAPANESE SEMICONDUCTOR TECHNOLOGY REVIEW
FOURTH QUARTER 1984

SUMMARY

Japanese semiconductor makers finished 1984 with a profusion of new products and technologies, most of which were targeted for the Japan Electronics Show in October. During the fourth quarter, DATAQUEST recorded 112 major announcements--more than twice the 54 announcements made during the third quarter. The year was highlighted by the introduction of 1Mb DRAM and 256K SRAM prototypes, Nippon Telegraph and Telephone's 16K GaAs SRAM, and Hitachi's experimental 32-bit CMOS MPU. As shown in Figure 1, memory products and technologies led the way, but DATAQUEST also observes the following trends:

- New MPU/MCU product announcements exceeded those for advanced developments as top makers have kept quiet about their 16-bit and 32-bit MPU development activities.

- Japanese vendors are developing 15,000- to 20,000-gate arrays and standard cells, which are being used primarily in-house.

- The explosion of advanced research on optoelectronics and gallium arsenide (GaAs) is being driven by the introduction of laser-based compact disks, optical memory files, and optical communications.

- Linear/analog products are primarily driven by the VTR and telecommunication markets.

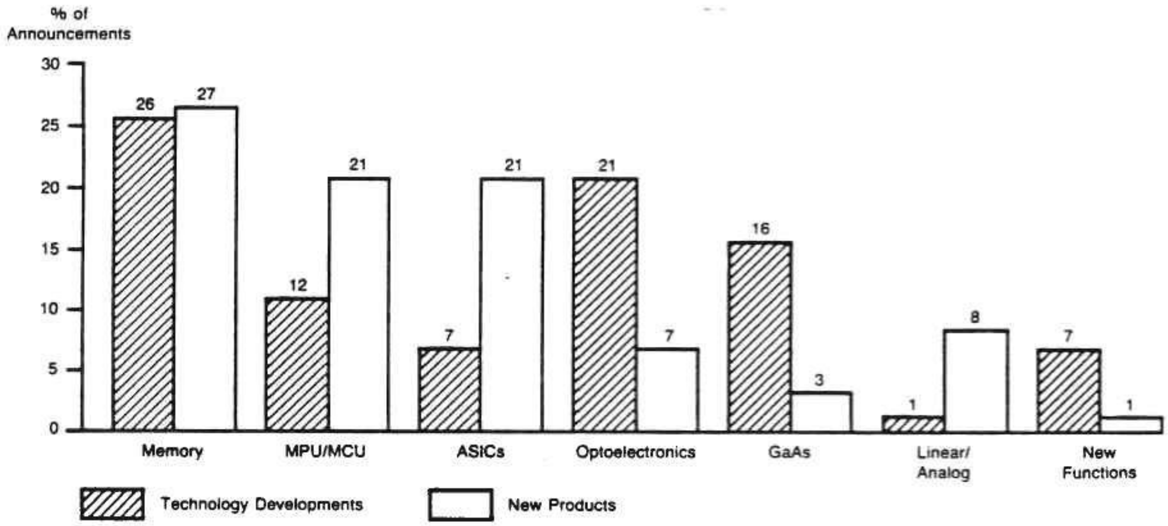
- Research on new semiconductor function ICs, including bio-sensors, 3-dimensional ICs, and superlattices, is being conducted at corporate and government labs.

Device technologies are being supported by a rush of new semiconductor equipment, which DATAQUEST believes is a result of the VLSI Project (1976-1980). Major semiconductor makers such as Hitachi, NEC, and Toshiba are developing advanced equipment for next-generation

semiconductors, including megabit DRAMs and 3-dimensional ICs. A new development is Hitachi's 3-dimensional CAD system that runs on Hitachi's supercomputer. DATAQUEST believes that supercomputers using GaAs digital ICs will play a central role in the development of ultra-VLSI technologies.

Figure 1

TOP 1984 SEMICONDUCTOR TECHNOLOGIES



Source: DATAQUEST

Table 1 provides a summary of major Japanese semiconductor technology announcements, by device category, in 1984.

Table 1

MAJOR SEMICONDUCTOR TECHNOLOGY ANNOUNCEMENTS IN 1984

	Technology Developments		New Products		Total	
	Announced	Percent	Announced	Percent	Announced	Percent
Memory	36	26%	57	26%	93	26%
MPU/MCU	16	12	45	21	61	17
Digital Signal Processing	1	1	14	7	15	4
ASICs	10	7	45	21	55	16
CMOS Standard Logic	3	2	5	2	8	2
Bipolar Digital	1	1	5	2	8	2
Linear/Analog	1	1	18	8	19	5
Optoelectronics	29	21	15	7	44	13
Discretes	7	5	3	2	8	2
Gallium Arsenide	23	16	7	3	30	9
New Functions	9	7	1	1	10	3
Josephson Junction	2	1	0	0	2	1
	138	100%	215	100%	353	100%

Source: DATAQUEST

1984 JAPANESE ELECTRONICS SHOW

The 1984 Japan Electronics Show was held in Tokyo in October with the theme of "Growing New Media and State-of-the-Art Technology." Sponsored by the Electronic Industry Association of Japan (EIAJ), the show offered 2,065 exhibit booths displayed by 675 companies from 18 countries. DATAQUEST observed the following trends at the show:

- Japanese semiconductor makers expect strong demand from Nippon Telegraph and Telephone's (NTT) Character and Pattern Telephone Access Information Network System (CAPTAIN)
- Prototypes of 1Mb DRAMs and 256K SRAMs
- Gallium arsenide memories with 1K and 4K densities
- High-output semiconductor lasers (more than 25 milliwatts)
- Wide acceptance of gate array products
- Promotion of industrial parks by Japanese prefectures as part of MITI's Technopolis program and by South Korea

Semiconductor highlights included Mitsubishi Electric's 1Mb DRAM prototype, and 256K SRAM prototypes by Mitsubishi and Toshiba. Hitachi displayed a photograph of its 1Mb DRAM. DATAQUEST believes that 1.3 micron geometries will be used for mass production of 1Mb DRAMs and 256K SRAMs within two to three years.

In the area of microprocessors, Japanese makers displayed 4-bit and 8-bit CMOS MPUs, while NEC and Mitsubishi displayed their original MPU series. The major manufacturers are presently developing 32-bit MPUs.

The main logic products exhibited were high-speed CMOS standard logic and high-speed TTL, due to the expected surge in demand. Table 2 lists the major products introduced at the show.

Table 2

MAJOR PRODUCTS SHOWN AT 1984 JAPAN ELECTRONICS SHOW

Company	Products	Specifications
Fujitsu	1Mb mask ROM	Not Available
	CMOS 4-bit MPU	4K/8K ROM, 256 RAM x 4-bit
	NMOS/CMOS 8-bit MPU	+5 V (+-5%) power supply
	NMOS 16-bit MPU	-
	Bipolar gate arrays	240-1100-gate; 2000-gates
	CMOS gate arrays	440-3900 gates; 2640-8000 gates
Hitachi	1Mb DRAM	4.67 x 9.86mm chip; 3 x 7mm cell
	CMOS 64K SRAM	55/70ns access time
	MNOS 64K EEPROM	25/300/450ns access time
	256K pseudo SRAM	200/250ns access time
	16-bit MPU (HD68000)	32-bit counter; 16-bit status register and 72-bit register
	Hi-BiCMOS gate array	3,000 gates
Matsushita	CMOS/NMOS 16-bit MCU	Not Available
	1Mb mask ROM	-
	256K DRAM	-
Mitsubishi	1Mb DRAM	Prototype
	256K SRAM	Prototype
	64K DRAM	ZIL-packaged
	GaAs 1K SRAM	-
	CMOS 8-bit MCU	ROM 3-8K x 8-bit; RAM 96-256K x 8-bit
NEC	V20 Series MPU	8-bit external/16-bit internal bus
	V30 Series MPU	16-/16-bit data buses
	CMOS gate array	400-11,000 gates
	TTL gate array	250-2,000 gates
	ECL gate array	300-3,000 gates
	Other	16 x 16 image pipelined processor
Oki	NMOS 64K DRAM	150/200ns access time
	NMOS 4K DRAM	200/300/450ns access time
	NMOS 16K SRAM	120/150/200ns access time
	CMOS 4K SRAM	200/300/450ns access time
	CMOS 16M SRAM	150/200ns access time
	NMOS 64K EPROM	200/250/300ns access time
	CMOS 8-bit MCU	-
	CMOS 16-bit MCU	-
	CMOS gate array	10,000 gates
	CMOS/NMOS 16-bit MCU	-
	1Mb mask ROM	-
	256K DRAM	-

(Continued)

Table 2 (Continued)

MAJOR PRODUCTS SHOWN AT 1984 JAPAN ELECTRONICS SHOW

Company	Products	Specifications
Rohm	General-purpose IC	Audio equipment, VTRs
Sharp	CMOS 16K SRAM	150/200ns access time
	NMOS 64K DRAM	150/200/250; 120/150/200ns access
	CMOS/NMOS mask ROM	-
	P/N/CMOS 4-bit MCU	-
	CMOS 8-bit MCU	Single chip
	CMOS 8-bit MPU	Z80 Family
	CMOS 16-bit MPU	Z8000 Family
	CMOS gate array	300-2,200 gates; 3000/5000 gates
	CMOS logic ICS	LR74HC Series; LR40H Series
Sanyo	Si PIN photodiode	200 ten-second response time
	GaAs FET	1.0/3.0/1.8dB minimum noise
Seiko Instrument	CMOS NVRAM	-
	CMOS LSI	Industrial and consumer uses
	CMOS IC	Analog quartz watch
Sony	NMOS 4-bit MCU	2K/4K ROM; 128/256 RAM x 4-bit
	NMOS NVRAM	-
	General ICs	Audios, TV, camera, VTR
Suwa Seikosha	CMOS 4-bit MCU	Single chip
	CMOS 8-bit MPU	-
	CMOS 4K SRAM	-
	CMOS 16K SRAM	-
	CMOS 64K SRAM	200/250ns access time
	CMOS 64K mask ROM	-
	CMOS 128K mask ROM	-
	CMOS 256K mask ROM	-
	CMOS gate arrays	413-3,082 gates; 820-4,342 gates
Toshiba	CMOS 256K SRAM	Not available
	CMOS 256K DRAM	Not available
	CMOS 64K DRAM	Not available
	NMOS 64K SRAM	100/120/150ns access time
	CMOS 64K SRAM	120/150ns access time
	CMOS 256K EPROM	200/250ns access time
	CMOS 256K mask ROM	200ns access time
	CMOS 1Mb mask ROM	200ns access time

Source: DATAQUEST

GOVERNMENT R&D PROJECTS

Fifth-Generation Computer

The Institute for New Generation Computer Technology (ICOT) held an international conference in Tokyo in November, which attracted more than 1,000 attendees. Kazukiyo Kawanobe of ICOT reported that the ICOT Research Center had developed the following:

- Personal sequential interference (PSI) machine
- Knowledge-based subsystem
  - Parallel-type relational data base machine
  - Specifications for inference machine interface
- Basic software system
  - Parallel-type logic programming language
  - Basic specifications for a knowledge programming language
  - Large-scale relational data base management program
  - Japanese proofreader system
  - Advanced syntactic analysis program
  - Experimental semantic analysis program
  - Modular programming system
- Pilot software development models
  - Sequential logic programming languages
  - Sequential inference machine software

Non-Von Neumann Computer

On November 5, the Ministry of International Trade and Industry (MITI) announced that it had developed an experimental non-Von Neumann computer with an operating speed of 3 million floating point operations per second (megaflops), which will form the basic unit for a large supercomputer. According to MITI's Electrotechnical Laboratory, this basic unit will permit development of supercomputers with 50 times the operational speed of existing models.

Optical Communication

On November 14, MITI announced that it plans to launch a feasibility study on international cooperation between Japan and Europe for integrated optical information transmission control technology. A study group of five to ten representatives from government offices, universities, NEC, Fujitsu, and Mitsubishi Electric were sent in November to visit the United Kingdom, France, West Germany, and the Netherlands to exchange opinions.

Supercomputers

Supercomputer technology is rapidly entering the commercial market. In October, Hitachi introduced a 3-dimensional CAD system for developing megabit DRAMs, high-function MPUs, and superlattice devices, which runs on its supercomputer (see DATAQUEST newsletter entitled "Hitachi Announces CAD System for 3-Dimensional Analysis," October 29, 1984). In a separate move, Amdahl announced that it would begin selling Fujitsu's VP100 and VP200 supercomputers in the United States in 1985. Hitachi and NEC are expected to follow Fujitsu's lead. In Japan, there is growing interest in using GaAs digital ICs in next-generation supercomputers. Since FY1981, the Science and Technology Agency (STA) has run the Perfect Crystal Project under the leadership of Junichi Nishizawa of Tohoku University to develop defect-free GaAs single crystals for digital ICs. Currently, about 22 to 23 tons of gallium is used in Japan. A serious shortage of GaAs is expected because of the strong demand for GaAs in LEDs and semiconductor lasers for compact disks and optical communication.

NEW RESEARCH LABS

Konishiroku Photo plans to establish the Konica High Technology Laboratories in southern California by June 1986. The new research facility will be operated in cooperation with four local universities, including the University of Southern California (USC). According to President Megumi Ide, ¥1 billion ($4.2 million) will be invested in the facility annually (announced December 18).

Mitsubishi Electric is investing ¥18 billion ($75 million) in a new research building at its LSI Research Center in Itami, Hyogo Prefecture, to develop next-generation VLSI, including 4Mb DRAMs (announced December 14).

Nippon Telegraph and Telephone (NTT) plans to invest ¥7 billion ($28.6 million) in a synchrotron at its Atsugi Laboratory to conduct R&D in super VLSIs, such as 64Mb DRAMs. Construction will begin in 1985, with operation scheduled for 1988 (announced November 6).

Tokyo Electron Ltd. (TEL) is investing ¥2.0 billion ($8.3 million) in a research laboratory at its Nirasaki Works in Yamanashi Prefecture to conduct technical research on ultra-LSI manufacturing equipment. The current staff of 50 researchers will be expanded to 100 within three years (announced November 21).

Toshiba is building a design center in Kawasaki, Kanagawa Prefecture, for the Toshiba Microcomputer Engineering Corporation (TMEC). Scheduled for completion in April 1985, the center will have the latest CAD systems to design logic ICs and LSIs and to develop microcomputer software. TMEC expects to raise ¥3000 million ($1.25 million) in capital (announced October 24).

TECHNOLOGY DEVELOPMENTS

The megabit era is approaching. Fujitsu, Hitachi, Mitsubishi Electric, NEC, Oki Electric, and Toshiba have begun mass production of 256K DRAMs and have already manufactured experimental 1Mb DRAMs. Hitachi and NTT announced their 1Mb DRAMs at ISSCC 1984, while NEC, Mitsubishi, and Toshiba will announce 1Mb DRAMs at ISSCC 1985. Research in 256K SRAMs is proceeding rapidly, with Hitachi, NEC, and Toshiba planning to present papers at ISSCC 1985.

Memory

The following memory developments were announced during the fourth quarter of 1984:

Hitachi--A 45ns, 256K CMOS SRAM with variable impedance loads; 32K x 8-bit organization; 200mW at 10-MHz active power dissipation; polycide Vss-line used in a 95-micron-square memory cell (to be presented at ISSCC 1985)

A 95ns, 256K CMOS EPROM with 12mW power dissipation at 1-MHz cycle time; 0.5ms/byte average programming time with voltage range of 11-14 volts; 12mW active operating power (to be presented at ISSCC 1985)

Matsushita--An 8K content-addressable and re-entrant memory using 20 micro CMOS; 100ns cycle time; 30 x 36 micron memory cell (to be presented at ISSCC 1985)

Mitsubishi--A 1Mb DRAM with 2.5 million transistors and 1.0 micron design rule and 256K SRAM; both displayed at Electronic Show '84 (announced October 1984)

A 90ns, 1Mb DRAM with multibit test mode using half Vcc biased memory cell and a reduced electric field; shared sense amplifier design and continuous nibble mode; 65mm-square die (to be presented at ISSCC 1985)

A 45ns, 256K CMOS SRAM; peak current of 45mA by using an address transition activated circuit with a tri-level wordline circuit (to be presented at ISSCC 1985)

NEC--A 55ns, 256K CMOS SRAM using optimized poly load resistors, buried isolation and Ti polycide to achieve 10mW standby power in a 40.7mm square die (to be presented at ISSCC 1985)

A 64K x 4 DRAM and a 256 x 4 serial readout memory with 35ns access time; for graphic data pickup from any location (to be presented at ISSCC 1985)

An NMOS 85ns, 1Mb DRAM; trench capacitors and extra polycide interconnect layer to develop 43.2mm-square circuit in a 300-mil plastic DIP (to be announced at ISSCC 1985)

A 4K (16-level) cell storage, single transistor DRAM with 4 x density storage (to be announced at ISSCC 1985)

Seiko Instrument & Electronics--An experimental nonvolatile random access memory (NVRAM) that combines RAM and EEPROM; developed using a perpendicular accelerated channel injection MOS (PACMOS) method; writing voltage for memory storage less than 5 volts; 7 transistors per bit; sampling from 1985 with plans to mass produce 16K NVRAMs by 1986 (announced December 3)

Toshiba--An NMOS 1Mb DRAM with 70ns access, using 1.2-micron design rule and Toshiba's Buried Oxide Isolation technology; two-level metal; 300-mil, 18-pin standard DIL; 4.78 x 13.23mm chip with 2,250,000 transistors and capacitators; 5.0 x 6.4 micron memory cell size; NMOS process and double-layer metal; 270mW operating power consumption and 15mW at standby (announced November 1)

A new memory cell (folded capacitor cell) that features a groove etched in the isolation field of two neighboring devices and oxide film buried in the groove; permits an increase in the capacitor area while reducing the memory cell size; marks a major step toward development of ultra-LSI devices greater than 4Mb (announced November 19)

A 17ns, 64K CMOS SRAM using a four-transistor cross-coupled flip-flop memory cell with high resistivity load composed of the second polysilicon; 12.5 x 21.5 micron cell; 3.86 x 6.99mm die in 300-mil-wide 22-pin plastic DIP (to be presented at ISSCC 1985)

A 256K flash EEPROM with a single transistor cell; 5.7 x 5.8mm square chip size achieved using 2.0-micron design rule and triple polysilicon technology (to be presented at ISSCC 1985)

Microprocessors/Microcontrollers

Hitachi--An experimental 32-bit CMOS MPU capable of processing 5 MIPS; 50ns execution cycle time in standard operations; 1.3-micron design rule; two-layer aluminum interconnect method; 300,000 units integrated on a 6.5 x 9.0mm chip; 20-MHz speed; 400 to 500-mmW power consumption in test model and 1 watt in commercial model; sampling from 1987 (announced November 15)

An 8-bit CMOS MPU with instruction controlled register file and ROM, using 2-micron rule (to be presented at ISSCC 1985)

NEC--joint ventures with Yokogawa Hewlett-Packard, Sophia Systems, Tektronix, and Digital Research for joint development of V Series MPU support systems (announced in May and November)

An agreement with Corvus Systems to jointly develop a CMOS single-chip controller with a 1.6-micron rule and 100,000 transistors for use in Corvus' Omninet local area network (LAN) that will offer 4Mb/sec transmission speed (announced November 15)

NTT Atsugi--A single chip, 5.6-MFLOP, 80-bit floating-point processor using 1.2-micron N-well CMOS technology; 50K gates and 15K memory; developed by hierarchical design automation system (to be presented at ISSCC 1985)

Digital Signal Processing

Tohoku University--A 2-MHz pipelined image-processing chip designed with a 5-micron NMOS process; multiple ion implant quaternary logic resulting in a four-fold reduction in complexity (to be presented at ISSCC 1985)

Application-Specific ICs (ASICs)

Fujitsu--A 240K transistor CMOS masterslice array with flexible memory and channel allocation (to be presented at ISSCC 1985)

A 1ns CMOS gate array series with configurable 15ns 12K memory and 20K logic gates; 1.5-micron twin well process (to be presented at ISSCC 1985)

Hitachi--A bipolar/CMOS 1,300-gate array with the high-speed features of an ECL and low power consumption of CMOS; 0.15mW power dissipation; 0.8ns delay; complete merging of CMOS and bipolar at basic cell level; Hi-BiCMOS 1,000 to 3,000-gate products to be introduced within one year (announced October 9)

A 4K CMOS gate array with automatically generated test circuits; 2-micron process on a 7.2 x 7.0mm square chip; 98 to 100 percent dc fault testing with logic design restrictions in a chip area of 5 percent (to be presented at ISSCC 1985)

Mitsubishi--A 1.5-micron CMOS gate array with configurable ROM and RAM; 8,000-gate array with double word line memory addressing on a 9.9 x 9.8mm chip (to be presented at ISSCC 1985)

Nippon Telegraph and Telephone--A high-density bipolar gate array with 0.32ns processing speed and 5,000 gates; processing time three to four times conventional arrays; 1cm-square silicon substrate; to be used as logic for supercomputers and telecommunications equipment (announced October 19)

An 80ps 2,500-gate bipolar microcell array using 1-micron rule; 7.5ns, 16-bit multiplier achieved (to be presented at ISSCC 1985)

Toshiba--A triple-level, wired, 24K-gate CMOS array using 2-micron design rule on a 12.8mm-square chip (to be presented at ISSCC 1985)

CMOS Standard Logic

Hitachi--A low-temperature CMOS 8 x 8-bit multiplier with sub 10ns speeds; 5mW and 460mW power dissipation (to be presented at ISSCC 1985)

A 6GHz ECL frequency divider using sidewall base contact structure; 45mW and 9mW dissipation (to be presented at ISSCC 1985)

Bipolar Digital

No major announcements.

Linear/Analog

Hitachi--A CMOS video filter using switched capacitator 14-MHz circuits; 2-micron design rule (to be presented at ISSCC 1985)

Optoelectronics

Asahi Chemical--A new organic semiconductor that is highly sensitive to a wide wavelength area ranging from infrared to visible light; used to produce a photoconductor drum for commercial LED printers, liquid crystal printers, laser printers, and intelligent copy machines (announced November 26)

Kokusai Denshin Denwa (KDD)--A hetero-structured avalanche photo diode (HAPD) for next-generation long-distance underwater optical cable systems; 50 percent reduction in transmission loss using 1.55-micron wavelength; high sensitivity and response (announced in October)

Matsushita Electric--World's first optical integrated device with semiconductor laser and transistor functions; for next-generation optical memories and inverters; enables large increase in optically transmitted information (announced October 30)

NEC--A long-wavelength semiconductor laser with 140 mmW of continuous operating power; consists of indium, GaAs, and phosphorous, and emits 1.3-micron wavelength laser; to be used for remote sensing and long-distance optical communication (announced November 29)

Rohm--A compact disc semiconductor laser (RLD-78A) produced using molecular beam epitaxy (MBE); technical breakthrough made possible by producing most suitable characteristics during a single photomask process; vacuum used for laser fabrication process; equal growth layers and 88,000 laser chips possible from a 75mm wafer; one hour for wafer growth (announced November 29)

Sharp--An interference-type laser with an 780-nanometer oscillation wavelength, using Sharp's original twin resonator structure (IRI-VSIS); stable oscillation axis mode (announced December 14)

Toshiba--Quantity production technology for optical communication LEDs using metal organic chemical vapor deposition (MOCVD); productivity increased 15 times over conventional liquid phase epitaxial (LPE) methods; sample shipments of MOCVD-produced LEDs from mid-1985; ¥5,000 ($20.40) quantity price (announced November 14)

Image Sensors

Fuji Photo Film--Solid state image pick-up devices for 8mm VTR and electron still camera; test manufactured CCD with 400,000 picture elements; experimental CCD with 800,000 picture elements (announced October 29)

Japan Research Development Corporation--A semiconductor image pickup device (electrostatic induction-type photo sensor) capable of photographing in starlight; sensitivity claimed to be 1,000 times higher than conventional image pickup devices (announced November 21)

Matsushita Electronics--Small, low-noise, charge-coupled devices (CCD) using two types of technologies (heat process and IG process) to produce epitaxial wafer; 40 percent space reduction possible using new technologies (announced December 11)

A 490 x 404 element CCD imager for a single-chip color camera; 5.86 x 7.13mm; S/N ratio of 55dB under scene illumination of 200 lx (to be presented at ISSCC 1985)

A multichip, constant-type CCD linear image sensor that can read A4-size document with 16 lines/mm resolution and S/N ratio of 48dB (to be presented at ISSCC 1985)

Mitsubishi--A 480 x 400-element image sensor with charge sweep device; 10 x 16-micron-square pixel size (to be presented at ISSCC 1985)

Sharp--A 580 x 500 element interline-transfer CCD imager with a shallow flat P well that incorporates CCD shift registers and photodiodes; N-type substrate for blooming suppression; 32 percent aperture ratio (to be presented at ISSCC 1985)

Discrete

NEC--A silicon bipolar 6.2-GHz, 300mW frequency divider for local oscillators in a microwave communication system; self-aligned bipolar transistors with 1.25-micron lithography (to be presented at ISSCC 1985)

Sony--An ultra-thin-film transistor (MOS FET) only 0.02 microns thick; operating speed two to three times faster than conventional thin-film transistors; practical use in flat plane liquid crystal TVs, facsimiles, and two-story SRAMs in the future (announced October 15)

Toshiba--Bipolar-type MOS FET featuring high response of MOS FETs and large current capability of bipolar transistors; 500- and 1,000-volt prototypes; 1.0 to 1.2-microsecond switching speed; on resistance of 0.1-0.2 ohm; 3-micron rule; used as power modules for motor control systems (announced in October)

Gallium Arsenide

Hitachi/Optoelectronics Joint Research Laboratory--A GaAs single-crystal wafer with inequality in transistor threshold voltage that is one-third that of conventional devices; initial step toward development of GaAs LSIs (announced November 9)

Matsushita Electronic--A GaAs self-aligned FET that will enable production of MMICs (microwave monolithic ICs); noise frequency at 12 GHz is 1.6dB; 6-volt breakdown voltage (announced December 7)

NEC--An ultra-high-speed GaAs logic IC; a 12-bit x 12-bit extended-type parallel multiplier consisting of 1,083 logic gates, 3,546 transistors, 1,136 diodes, and 45 resistors; 4ns maximum operating speed; 170ps delay time per gate; 2.5W power consumption (1.7 mmW per gate); commercialization within two years (announced December 10)

A GaAs 4K SRAM for high-speed computer cache memory, 2.4ns address access time with 1.1W power dissipation; 1K by 4 bit (to be presented at ISSCC 1985)

Nippon Telegraph and Telephone--A GaAs monolithic IC for microwave band switching and milliwave band amplication for multibeam, large-capacity communications satellites; eight switches integrated on a 4.5 x 4.0mm chip; power consumption of 10 watts; designed for 1-GHz band and capable of up to 30 GHz (announced in October)

Oki--A 390ps 1,000-gate GaAs gate array using super-buffered FET logic (to be presented at ISSCC 1985)

Optoelectronics Joint Research Laboratory--A dislocation-free, GaAs 2-inch single crystal with no surface defects; suitable for lasers and LEDs, but not for ICs (announced December 14)

Toshiba--A high-performance transistor (selectively-doped transistor) using structure similar to Fujitsu's high-electron mobility transistor (HEMT); 1.0-micron layers of GaAs and GaAlAs on a GaAs substrate; 30 percent noise reduction and 50 percent increased amplification over conventional GaAs FETs in 12- to 30-gigahertz microwave range (announced November 13)

Josephson Junction

Hitachi--World's first ultra-conductive transistor using Josephson junction device for control terminal; source and drain placed 0.2 micron apart to form channel; potential for 20ps switching speed and 5mW power consumption; 200mm-thick Pb superconducting terminal; 300nm-thick P-type silicon crystal; 40nm-thick silicon oxidized film; plans for a ring oscillator within one year to confirm device performance (announced November 10)

NEC--A 350ps Josephson 4 x 4-bit parallel multiplier and 1mW dissipation; built with 249 resistor-coupled Josephson logic gates; Pb-alloy process with 5-micro minimum line widths and junction diameters (to be presented at ISSCC 1985)

New Semiconductor Functions

NEC--A diamond thin-film over silicon for 3-dimensional ICs; direct current flow electrical discharge method used to form the diamond layer in a vacuum chamber by saturating the silicon layer with methane and hydrogen gases; one-micron thick film over 2cm-square area produced (announced in October)

Tokyo Industrial University--A one-chip biosensor capable of detecting sugar and urea in blood and urine samples; 2.5 x 0.4mm sapphire-coated silicon substrate on which two transistors bearing enzymes are designed; potential use as a home health diagnostic system (announced in October)

Toshiba--Improved 3-dimensional IC production technology; development of an experimental 0.5mm-square single-crystal silicon substrate; 1.3-micron-thick isolation layer of tungsten coated on bottom IC layer before growing second IC layer; even temperature distribution allowed by tungsten coating; test manufacturing of a 2-layered, 3-D IC scheduled for January (announced November 21)

CAD Systems

Hitachi--World's first CAD system for 3-dimensional analysis for developing 1Mb to 64Mb DRAMs, PMUs, superlattice devices, 3-D ICs, and bipolar devices; runs on Hitachi supercomputer at one-hundredth current processing times; displays electrical and physical characteristics of CMOS and bipolar devices (announced on October 19)

Manufacturing Processes

Dai Nippon--A new photomask capable of producing ultra-high-frequency FETs with 0.3-micron line widths; resolution achieved by using electron beam lithography and highly-automated clean room line; 8Mb memories possible with 0.3-micron design rule (announced in October)

Hitachi--A highly sensitive photoresist that permits 0.8-micron geometries using an organic silicon solution that reacts to ultraviolet rays with extremely short wavelengths; 4Mb devices possible by eliminating the pre-etching process (announced in October)

Electron beam equipment capable of positioning circuits within 0.05 micron and automatically measuring the pattern at high speed and an accuracy of 0.01 micron; automatically measures 100 to 200 positions per hour on a single wafer; to be used for 16Mb DRAM development; titanium-doped tungsten used as electrical field emission electron source and a new optical system 1,000 times brighter than conventional beams (announced in October)

NEC--A multi-layer processing technology called ELVIC (elements level vertically integrated circuit) that doubles LSI densities and allows fabrication of composite LSIs using different materials and functions; PMOS and NMOS transistors used to form 31-stage CMOS ring oscillator; 30 patent applications submitted and plans to commercialize LSIs using technology within two years (announced December 4)

Research on VLSI manufacturing and analysis of material structures by using the synchrotron orbital radiation generator at the National Laboratory for High Energy Physics in the Tsukuba Science City; NEC equipment to be established in the laboratory to develop VLSIs larger than 1Mb (announced December 12)

Manufacturing Equipment

On November 28, 15 major semiconductor equipment makers, including Canon, Nippon Kogaku, Takeda Riken, and Anelva, agreed to establish a Semiconductor Manufacturing Equipment Council in January. The council will conduct joint research and information exchange on product technology and distribution, product standardization, negotiations with government agencies, and compilation of statistics. The group will work with MITI's Industrial Machinery Division.

Hitachi--World's first dust counter capable of detecting 0.05-micron dust particles; reflective power ten time stronger than conventional models by using helium cadmium laser instead of helium neon laser; permits development of 16Mb DRAM (announced November 8)

IC measuring technology that uses electron beams; wiring pattern of 100 to 200 points per hour on a wafer automatically measured to 0.01-micron accuracy; permits development of megabit VLSIs (announced November 8)

Kuwano Electric--High-speed burn-in equipment (BS-1000) for 64K and 256K DRAMs; capable of handling 9,600 units; being used at Oki Electric; sales to start in 1985 (announced November 19)

Nissin Electric--An ion implantation machine (NH-2DSD) capable of processing 450 wafers per hour; shipments beginning spring 1985 at ¥200 million ($833,000) per unit (announced December 4)

NTT/Eaton--An agreement to jointly develop high-current oxygen ion implantation equipment for next-generation VLSI production; NTT to provide SIMOX technology that involves injecting films; Eaton system to have 100 milliamperes of ion beam current and 200 electron KV acceleration voltage; first model to be shipped to NTT in late 1985 and world sales in 1986 (announced December 1)

Osaka University/JEOL Limited--An electron-beam nanometer lithography system capable of 10-nanometer line widths; to be used for next-generation gigabit memories in late 1990s; employs a field emission-type electron gun and a conical-shaped tungsten tip (0.5-micro radius) in the emitter (announced in October)

Test Equipment

Sony--Wafer defect inspection equipment being developed at Kokubu Semiconductor plant in Kagoshima prefecture; designed for wafers used in high-resolution CCDs and 64K SRAMs (announced October 29)

Chemicals and Materials

Noritake--A ceramic substrate for thin-film ICs; glazed and non-glazed alumina; 0.7-micron thin film possible, but 0.25-micron process being developed (announced November 16)

NTT Ibaraki Lab--A new resist material for VLSI memories greater than 1Mb; 0.2-micron 2-level structure over 1-micron polymer resist; 0.7-micron circuit patterns possible (announced November 8)

Packaging

Fujitsu--A plastic chip carrier featuring inward curving of leads projected in four directions, 50 mils between leads, and small size suitable for mounting to ICs with large pin counts; this new package to be used for gate arrays (announced December 5)

Nippon Telegraph and Telephone--Plastic IC packaging to be introduced in telecommunications LSIs used in the Information Network System (INS) to lower costs (announced December 11)

Toshiba--A carbon dioxide gas laser engraver to mark IC packages (announced October 13)

MAJOR PRODUCT ANNOUNCEMENTS

Memory

Ricoh--Five mask ROM models; two models with 250/300ns access time (NMOS 512K and 1Mb) and three models with 200/250ns access time (CMOS 64K, 12K, and 256K); CMOS types compatible with Intel and TI's EPROMs (announced December 17)

Toshiba--64K SRAM (64K x 1) with 55ns access time; 1.5-micron design rule; 3.86 x 6.99mm chip; smallest chip size made by Japanese industry; 500mW power dissipation during operation and 5.5mW at standby; 22-pin 300-mil plastic DIP; sample price ¥12,000 ($49); monthly production of 50,000 units from January (announced November 27)

Microprocessors

Hitachi--Two plastic-package 16-bit MPU models for HD68000 series; a 900-mil unit, pin-compatible with 64-pin DIL ceramic type (model P) and a 64-pin DIL in a shrunken package; sampling price of ¥6,500 ($27) and mass production price of ¥4,500 ($19); monthly production to be increased to 75,000 units in 1985 (announced December 5)

Sony--A series of 4-bit MCUs (SPC500 Series) featuring CPU core architecture that allows the user to add peripheral functions without making alterations (announced in October)

Four models of CMOS 4-bit single-chip MPUs (SPC5000 Series) with 4K ROMs; two types available; high-speed type (1.9 microseconds) priced at ¥1,800 and ¥2,000 ($7.35 and $8.16) and general type (3.8 microseconds) at ¥2,000 and ¥2,000 ($8.16 and $8.98); piggy-back type ¥20,000 ($81.60) (announced on October 4)

Tokyo Sanyo--A 4-bit CMOS MCU with a 950ns cycle time; for use as a control signal processor for printers, floppy drives, VTRs, and tape decks; priced at ¥450 ($1.80) (announced in October)

Toshiba--Two CMOS single-chip LSIs for interface control; Model TC8577P for serial interface; Model TC8578P for parallel type; sample price ¥1,000 ($4.10); monthly production of 50,000 units starting in February 1985 (announced October 19).

Two NMOS 16-bit MPUs of Z8000 line; 6 MHz and 48-pin DIP for TMPZ8003-6 and 6 MHz and 40-pin DIP for TMPZ8004C-6; sample prices ¥5,500 ($22.45) and ¥5,000 ($20.40) respectively; monthly production of 10,000 units starting in 1985 (announced November 10)

Digital Signal Processing

NEC--A single-chip LSI for adaptive differential pulse-code modulation (PCM) operation necessary for voice mail system and voice answering equipment; compression and expansion of voice digital signal; sample price ¥10,000 ($40.80) (announced October 5)

Application-Specific ICs (ASICs)

Mitsubishi--Nine models of CMOS gate arrays, ranging from 238 to 8,096 gates; initial production at 200,000 units per month (announced October 26)

Ricoh--CMOS gate array series of 500, 1,000, 1,500, 2,500, and 3,800 gates to existing 400 to 1,500 gate array series (announced December 14)

Sharp--A personal workstation (LZ9D100) for gate array development; equipped with conversation type high-speed logic simulator so that logic circuit operations can be checked while talking to workstation; priced at ¥5.5 million ($22,450) beginning in March 1985 (announced October 2)

Toshiba--Two CMOS gate array models with 1.5ns gate delay; 6,000-gate model (TC17GM61) with 1K SRAM built in and 540-gate model (TC17G005); available in April (announced November 21)

A large, full-custom LSI (super integration) with Z80 as core and various peripheral circuits; shipments starting in 1985 (announced December 17)

CMOS Standard Logic

Sanyo Electric--A CMOS logic device (VLC8930) to scramble voice signals transmitted by cordless phones and wireless equipment; voice signals compressed and expanded using a variable delay circuit; 3.6mW power consumption; priced at ¥1,500 ($6.12); to be exported in cordless phone next spring (announced in October)

Tokyo Sanyo--A high-speed CMOS standard logic line (LC74HC series) featuring an 8.0ns delay time; includes logic gates, inverters, and flip-flop devices (announced in October)

Bipolar Digital

No major announcements.

Linear/Analog

Pioneer Electronic--A surface wave device that converts 668- to 674-MHz cable TV signals to 50-MHz TV signals; to be used in Pioneer's CATV equipment and sold as components; monthly production 100,000 units (announced October 13)

Sanyo Electric--World's first ICs for secret communication and two noise-proof LSIs for remote control; secret communication IC priced at ¥1,500 ($6.10), remote control and central control equipment IC at ¥3,000 ($12.25), and remote control and peripherals at ¥2,000 ($8.16) announced October 4)

Toshiba--Two telephone ICs (TA31024N/TA31025N) on a single chip that contains all the functions for putting voice signals on telephone circuits; 15V line voltage; 150-mmA line current; 500-mmW power consumption; sampling at ¥1,500 ($6.12); monthly production of 100,000 units starting in spring 1985 (announced October 2)

Optoelectronics

Sony--Two visible optical semiconductor lasers produced using metal organic chemical vapor deposition (MOCVD); SLD101U1 for video disk priced at ¥7,000 ($28.60); SLD101U for compact disks at ¥5,000 ($20.40); 780-nanometer wavelength; 5-mmW output; 100,000-hour life at room temperature; monthly production of 150,000 units starting in 1985 (announced November 14)

Suwa Seikosha--Two MOS solid-state image pickup devices; 59,536 and 186,725 picture elements; to be applied to VTR cameras and robot visual systems; Suwa Seikosha to enter video processing equipment market (announced November 2)

Toshiba--A high-power semiconductor laser for optical disk filing equipment (TOLD500); capable of narrowing laser beam diameter to 1 micron at 30 mmW; peak wavelength of 810 nanometers (announced December 19)

Discretes

Hitachi--Four super-low-noise bipolar transistors; three models with 6-GHz cut-off frequency, 11dB voltage gain, and 1.5dB noise, and one model with 7.5-GHz frequency, 12.5dB voltage gain and 1.2dB noise index; quantity production at ¥45 ($0.18) per unit for 10,000 unit orders (announced November 30)

Toshiba--Two bipolar MOSFETs; sample shipment of electric power module for motor controls planned in 1985; 500V model in March and 1000V model in autumn (announced October 30)

Gallium Arsenide

Mitsubishi Electric--Five low-noise GaAs FET models for telecommunication receivers; MGF1405 (0.5dB at 4 GHz, 1.4dB at 12 GHz); MGF1302 (below 1.4dB at 4 GHz); MGF1303 (below 1dB at 4 GHz, 2dB at 12 GHz) MGF1304 (below 0.7db at 4 GHz, 1.7dB at 12 GHz), MGF1305 (below 0.6dB at 4 GHZ, 1.6dB at 12 GHz); one FET model for consumer use (announced December 18)

Nippon Telegraph and Telephone--Two GaAs MMICs for future telecommunications satellite transponders; a monolithic single-chip switch IC with either switches integrated on a 4.5 x 4.0mm chip (one hundredth the size of conventional hybrid types) and a monolithic amplifier IC on a 2.0 x 2.0mm chip (announced October 18)

New Semiconductor Functions

No major announcements.

Josephson Junction

No major announcements.

CAD Software

Prime Computer Japan--A 3-dimensional CAD system (Prime Medusa); presently used at Japan Radio Corp. and Sony Tektronix (announced December 5)

Manufacturing Processes

No major announcements.

Manufacturing Equipment

Anelva--Deposition equipment using an ECR ion source; can be used for thin-film formation ranging from submicron-class VLSIs to chemical compound semiconductors; priced at ¥41 million ($167,350); processing capacity of 8 to 10 4-inch wafers per hour (announced October 17)

Komatsu--A commercial excimer laser with 12-watt average output and emission rate of 60 pulses per second; plans for 30-watt device in 1986; used as light source for ultra-VLSI lithography; mixture of krypton and fluorine gases used; 1.2kW power supply and 280-millijoule maximum pulse energy; priced at ¥10 million ($40,800) (announced in November)

Nippon Seiko--A multiple-use exposure machine (TZ-800) capable of processing pattern exposure, including mask production, stepping, and wafer direct exposure; developed at Semiconductor Research Institute of Tohoku University in Sendai; sales from summer 1985 (announced November 7)

Toshiba/Tokuda Works--Plasma CVD equipment with nearly 100 percent automatic microcomputer control; 70 types of sensors for handling variety and increased production of thin-film semiconductors used for liquid crystal and solar cells; price ¥120 million ($490,000) production beginning in April 1985 (announced October 24).

A single-wafer reactive ion etching (RIE) machine to handle 6-inch wafers for 4Mb memories; 80 HIRRIE-100 units to be produced and marketed by Tokuda from December; price ¥68 million ($277,550) (announced November 29)

__Test Equipment__

Matsushita Communication--A linear IC tester capable of processing 1200 ICs per hour; built around Z80 and employing ACTION high-level language for controlling measurement tasks; priced at ¥5 to ¥15 (R20,000-$61,000) (announced November 28)

Mitsui/Anritsu Electric--A laser prober system designed to locate defects in LSI logic chips; technology originally developed by Data Probe of Santa Clara which granted exclusive rights to Mitsui; shorter development time and no chip scratches possible; priced at ¥32 million ($131,000) (announced in October)

Takeda Riken--A logic LSI testing system (T3126) with throughput double that of existing model; test rate of 10 MHz; simultaneous testing of 4 IC units possible using two units of 48-pin test heads; price ¥45-65 million ($183,670 to 265,300) (announced November 27)

A 4Mb memory testing system (T3332) capable of handling 16 units at a time; 30-MHz test speed; potential for lowering test costs by 50 to 60 percent; priced at ¥70 million ($285,700); an auto-handler that handles eight units at a time (T3778) (announced in November)

__Chemicals and Materials__

No major announcements.

__Packaging__

No major announcements.

Sheridan Tatsuno
Nagayoshi Nakano

Nielsen Dataquest
JAPANESE RESEARCH NEWSLETTER

JSIA Code: Newsletters

PRELIMINARY 1984 MARKET SHARE ESTIMATES

SUMMARY

DATAQUEST's preliminary market share estimates show that the semiconductor revenues of the top nine Japanese semiconductor manufacturers grew 59 percent in dollars in 1984. Several major ranking changes also occurred. Most notably, NEC now ranks as the second largest merchant semiconductor manufacturer in the world, with 1984 revenues of $2,270 million, usurping Motorola's long hold on the number two spot.

JAPANESE COMPANY REVENUES

Table 1 lists 1983 and 1984 total semiconductor revenues for the top nine Japanese semiconductor manufacturers. No changes in ranking occurred. While overall growth for these companies was 59 percent, several grew at significantly higher rates, including Fujitsu at 73 percent and Mitsubishi at 67 percent. The three revenue leaders, NEC, Hitachi, and Toshiba, grew 61 percent, 55 percent, and 59 percent, respectively. Sanyo and Sharp, ranked seventh and eighth, grew the slowest at 47 percent.

Table 2 analyzes the relative changes in market share experienced by the top nine Japanese manufacturers in 1984. This analysis measures the change in each company's percentage of total top nine revenues for each product line. NEC lost 4.5 percent of its market share in bipolar digital ICs, while Fujitsu gained 3.9 percent. In MOS, NEC, Fujitsu, and Mitsubishi gained the market share that the other six companies lost. Toshiba picked up 2.4 percentage points in linear ICs and lost 4.8 percentage points in optoelectronics. Sharp was the big winner in optoelectronics, maintaining its position as world leader and gaining 3 percent in market share from its Japanese competitors.

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Table 1

ESTIMATED WORLDWIDE REVENUES
OF TOP NINE JAPANESE COMPANIES--1983-1984
TOTAL SEMICONDUCTOR
(Millions of Dollars)

Company	1983	1984	Percent Growth
NEC	1,413	2,270	61%
Hitachi	1,277	1,977	55%
Toshiba	983	1,561	59%
Fujitsu	673	1,165	73%
Matsushita	600	944	57%
Mitsubishi	443	742	67%
Sanyo	352	516	47%
Sharp	279	410	47%
Oki	229	361	58%
Exchange Rate (Yen per US$)	235	237	

Table 2

ESTIMATED CHANGES IN MARKET SHARES
OF TOP NINE JAPANESE COMPANIES—1983-1984
(Percent)

Company	Total	Bipolar Digital	MOS	Linear	Discrete	Opto
NEC	0.2%	-4.5%	1.0%	-0.2%	-1.3%	-0.4%
Hitachi	-0.6%	0.2%	-0.4%	-0.7%	-2.3%	0.9%
Toshiba	.0%	0.6%	-0.5%	2.4%	1.7%	-4.8%
Fujitsu	0.9%	3.9%	0.5%	.0%	-0.3%	0.6%
Matsushita	-0.1%	0.2%	-0.2%	0.7%	1.5%	1.2%
Mitsubishi	0.4%	-0.2%	1.0%	-1.8%	0.1%	0.5%
Sanyo	-0.4%	-0.1%	-0.1%	.0%	0.4%	-1.1%
Sharp	-0.3%	0.0%	-0.7%	-0.4%	0.0%	3.0%
Oki	.0%	-0.1%	-0.6%	.0%	.0%	0.2%

Source: DATAQUEST

WORLDWIDE COMPANY REVENUES

Table 3 shows the rankings and revenues of the top ten worldwide semiconductor suppliers in 1983 and 1984. Texas Instruments retained its position as the number one merchant semiconductor manufacturer in 1984 with estimated revenues of $2,408 million and growth of 47 percent. NEC surpassed Motorola for the first time to take the number two slot with revenues of $2,270 million and high growth of 61 percent.

Table 3

ESTIMATED RANKING AND REVENUES OF TOP TEN
WORLDWIDE SEMICONDUCTOR SUPPLIERS--1983 and 1984
TOTAL SEMICONDUCTOR
(Millions of Dollars)

	Ranking		Revenue		Percent Growth
Company	1983	1984	1983	1984	1983-84
Texas Instruments	1	1	1,638	2,408	47%
NEC	3	2	1,413	2,270	61%
Motorola	2	3	1,547	2,097	36%
Hitachi	4	4	1,277	1,977	55%
Toshiba	5	5	983	1,561	59%
National Semiconductor	6	6	914	1,263	38%
Intel	7	7	775	1,253	62%
Fujitsu	8	8	673	1,165	73%
AMD	10	9	505	950	88%
Matsushita	9	10	600	944	57%

Source: DATAQUEST

Five of the top ten manufacturers are Japanese--NEC, Hitachi, Toshiba, Fujitsu, and Matsushita. One other change in ranking occurred. AMD surged forward, growing at 88 percent--the fastest growth of any top ten company--to displace Matsushita as the ninth largest manufacturer. Matsushita is now number ten.

MOS memory was the fastest-growing product family among the top nine Japanese manufacturers in 1984, increasing 88 percent in dollars. DATAQUEST believes that this was due primarily to the strong push by the Japanese in 64K DRAMs, of which 860 million units were shipped during the year.

A ranking change occurred among the top ten worldwide MOS suppliers. National Semiconductor, number nine in 1983, slipped out of the top ten to eleventh place. Mitsubishi, formerly number twelve, became the tenth largest MOS supplier worldwide in 1984, with revenue growth of 100 percent. Table 4 shows 1983 to 1984 growth rates of the top ten worldwide MOS suppliers. Table 5 shows 1984 MOS revenues by family for these companies.

NEC's MOS memory sales grew 118 percent to $749 million. Hitachi, number one worldwide in MOS memory with sales of $897 million, grew more slowly, at 79 percent, while Mitsubishi, with MOS memory sales of $127 million, grew 119 percent. AMD showed dramatic growth in sales of MOS microprocessors, at 245 percent. In MOS logic, Fujitsu and AMD were the growth leaders at 144 percent and 300 percent, respectively.

Table 4

ESTIMATED GROWTH OF TOP TEN WORLDWIDE MOS SUPPLIERS--1983-1984
(Percent)

Company	MOS Memory	MOS MPU	MOS Logic	Total MOS
NEC	118%	64%	41%	81%
Intel	26%	104%	0%	60%
Hitachi	79%	41%	43%	71%
Texas Instruments	76%	-19%	53%	51%
Motorola	31%	34%	33%	32%
Toshiba	79%	56%	58%	68%
Fujitsu	84%	39%	144%	81%
AMD	61%	245%	300%	114%
Mostek	63%	31%	7%	48%
Mitsubishi	119%	64%	89%	100%

Source: DATAQUEST

Table 5

ESTIMATED REVENUES OF TOP TEN WORLDWIDE MOS SUPPLIERS--1984
(Millions of Dollars)

Company	MOS Memory	MOS MPU	MOS Logic	Total MOS
NEC	749	388	290	1,427
Intel	390	688	75	1,153
Hitachi	897	120	76	1,093
Texas Instruments	654	110	101	865
Motorola	305	254	244	803
Toshiba	396	70	304	770
Fujitsu	512	118	105	735
AMD	260	200	20	480
Mostek	350	55	62	467
Mitsubishi	278	97	68	443

Source: DATAQUEST

DATAQUEST OBSERVATIONS

The very high 1984 growth rates of the Japanese manufacturers can be attributed, in part, to their very high levels of capital investment in 1983 and 1984 and to their dominant market share in the fastest-growing and largest single market, MOS memories.

On the American side, AMD can be congratulated for its outstanding growth rate of 88 percent. Available capacity and a portfolio dominated by proprietary products has enabled AMD to move into the number nine position in the world.

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