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1977-1979

SEMICONDUCTOR INDUSTRY SERVICE

1979

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*Out of Print

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters December 29, 1978

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of some of the current issues having an impact on the U.S. semiconductor industry. Some of these issues have been reported upon before in earlier DATAQUEST newsletters, and we will be following all of them in the coming months.

- The International Trade Commission, at the request of Senators Abraham Ribicoff and Adlai Stevenson, will conduct a study of the competitive position of the U.S. semiconductor and computer industries.

- The House Ways and Means Committee will schedule hearings in early January in an attempt to determine what should constitute a National Export Policy.

- Congress will be looking seriously at a value added tax system as well as tax incentives for private sector R&D when it reconvenes in January. In the meantime, the Treasury is preparing regulations that could severely limit foreign tax credits.

Trade Commission to Investigate Semiconductor, Computer Industries

The International Trade Commission will begin an investigation of the trends in international trade in computers and integrated circuits shortly after January 1, 1979. The Commission's investigation was prompted by a request from Senator Abraham Ribicoff, Chairman of the Subcommittee on International Trade of the Senate Finance Committee, and Senator Adlai Stevenson, Chairman of the Subcommittee on International Finance of the Senate Banking Committee.

At their request to Joseph Parker, Chairman of the International Trade Commission, Senators Stevenson and Ribicoff indicated that the Commission's study should focus on factors affecting the present and future international competitive position of U.S. producers. In particular, the Senators are interested in obtaining data about an analysis of foreign producers and of any disincentives confronting U.S. manufacturers' entry into foreign markets. The Commission was also asked to compare such policies with U.S. policies affecting the computer and integrated circuit industries.

The Commission's study will be conducted pursuant to Section 332 of the Tariff Act of 1930 and is to be completed by no later than September 30, 1979. A Section 332 investigation carries no obligation for action on the part of the government once it is completed, but the findings of the study will undoubtedly be used on Capitol Hill during the 1979 Congressional debate on the trade bill.

Actually, the staff of the International Trade Commission has been interested in conducting a study of the semiconductor industry for some time. A Commission staff outline of what such a study might encompass is available from DATAQUEST upon request.

Ways and Means Committee to Reschedule Trade Policy Hearings

The Trade Subcommittee of the House Ways and Means Committee will hold two or three days of hearings in early January on the question of what should constitute a National Export Policy.

The hearings in January are an offshoot of a more informal session that the Subcommittee had scheduled for December 7, 1978. Those discussions were canceled due to the untimely death of Rep. William Steiger (R-Wis.), the ranking Republican member of the Subcommittee.

Participation in the December 7 hearings was by invitation only. Some 37 chief executives were asked to meet with the Subcommittee to discuss informally how best to stimulate U.S. export performance. The Subcommittee's interest in hearing from the high technology electronics industries was demonstrated by the number of executives who received special invitations to participate in the informal briefings. Companies invited included Control Data, Hewlett-Packard, IBM, Intel, National Semiconductor, Tektronix, Texas Instruments, and TRW.

The January hearings will not be limited as was the case for the December sessions. However, witnesses can be expected to be asked to respond to some of the same questions such as:

- On balance, are current government export promotion activities cost effective?

- What changes should be made in these programs to relate them more directly to increasing the competitive position of U.S. producers in foreign markets?

- To what extent are specific laws and government regulations impeding exports to particular countries?

- Under the current government organization, is an effective program to give priority consideration to improving the export performance of U.S. producers possible?

- Does the incidence of the U.S. tax system in relation to the tax systems of other countries disadvantage U.S. producers in competing in world markets?

- If U.S. producers competing in foreign markets face a disadvantage stemming from differences in tax systems, what approach should the U.S. government take to eliminate such disadvantages?

- Should the U.S. amend its antitrust laws or regulations to improve the competitive posture of the U.S. producers competing in foreign markets?

- Can the trading company concept be adapted to U.S. business operations as a means of improving the ability of U.S. producers to compete abroad?

The scheduling of these hearings for early January, and the types of questions being asked, reflects a general consensus on Capitol Hill that the Administration's export promotion program announced earlier this year will yield only modest results, and that Congressional intervention will be necessary to develop a more effective export promotion program.

Tax Changes May Be in the Offing

It appears likely that two major changes in U.S. tax law will be given serious consideration when the Congress reconvenes in January. At the same time, shortly after the first of the year, the Department of the Treasury is expected to publish proposed regulations that may severely restrict foreign tax credits.

In Congress, both House Ways and Means Committee Chairman Al Ullman and Senate Finance Committee Chairman Russell Long have again been talking about adopting a value added tax system, to fund social security and health care programs and to stimulate U.S. exports. While it is unlikely that Congress will move very far in this direction next year, the Ways and Means Committee is expected to hold mid-year hearings on the issue. On the Senate side, there are some who are more activist, and there is talk about amending a value added tax bill into some House-passed legislation in 1979.

There is also growing support in both the House and the Senate for stimulating private sector research and development through some form of tax incentive. An indication of how seriously the Congress will take this proposal should come early in the next Congress, when Representative Charles Vanick (D-Ohio) is expected to introduce a bill on this subject. Vanick, a member of the Ways and Means Committee and Chairman of that Committee's Subcommittee on International Trade, reportedly had language on this subject drafted last year, but chose not to introduce it as an amendment to the Tax Reform Bill.

In the meantime, the Treasury Department is currently working on draft guidelines that would establish criteria as to what foreign taxes would be creditable against U.S. taxes under Sections 901 and 903 of the Internal Revenue Code. At the present time, questions as to what constitutes an "income tax" for the purpose of determinig U.S. tax liability are handled by the IRS on a case-by-case basis. Recently, the IRS published several rulings that severely restrict previous interpretations. Concern is mounting that the new Treasury regulations, expected to be published for comment in January, will follow the strict and restrictive policies of recent IRS rulings.

James F. Riley
Frederick L. Zieber
Daniel L. Klesken

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.04 Intel Corporation December 20, 1978

UPDATE ON INTEL CORPORATION

Summary

Intel's revenues in the third quarter of 1978 rose to $106.9 million. Profits for the quarter were $11.4 million (or $0.82 per share), indicating an after-tax profit margin of 10.6 percent. DATAQUEST estimates Intel's total 1978 revenues will be approximately $395 million, up 40 percent from 1977. DATAQUEST also estimates that 1979 corporate revenues could approach $540 million, or an increase of 37 percent. We see little indication of a major change in profit margins for the Company.

Intel has had a good year in 1978. The following corporate developments are noteworthy:

- Bookings remain strong with growth currently limited by production. Inability to meet demand is one of the Company's significant problems.
- Intel remains the only company in production on reduced dimension (HMOS) devices. Its significant lead should give it a cost and product advantage for the next few years.
- The Company's ability to put linear functions on NMOS digital chips gives it an additional technology lead. This technology is being applied successfully to telecommunication products and will be further used for other products nearing introduction.
- The introduction of the 8086 and associated products has placed Intel in a significant lead in the high-performance 16-bit microprocessor market. In the third quarter, Intel acquired MRI Inc. of Austin, Texas, a supplier of software products for data base management. We believe this presages future movements into proprietary system products.
- Intel acquired a large ($25 million) order from IBM for memory boards scheduled for 1979 delivery. We understand that qualification is proceeding satisfactorily.
- Intel has begun the physical decentralization of the corporation following the organizational decentralization in 1977. This is a critical step in corporate growth.

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- Corporate expansion has proceeded at a rapid pace. We expect capital expenditures, primarily for capacity expansion, to approach $100 million in 1978. Estimated expenditures for 1979 are also in the range of $100 million.

- A consequence of the high expenditures is the likelihood that Intel may need more outside financing in 1979.

Estimated Revenues

Estimated revenues by division for Intel are shown in Table 1. DATAQUEST estimates total sales for 1978 to be about $395 million, with excellent growth in all divisions. This growth is expected to continue, with revenues reaching $540 million in 1979. Significantly, the faster growth of the noncomponent areas—Commercial Systems and Microcomputer Systems—should increase their share of total corporate revenues from an estimated 33 percent in 1978 to about 40 percent in 1979. At current operating rates, no division is more than double the size of any other.

The largest part of Intel is the Memory Components Group. A breakdown of its estimated 1977 revenues by major product category is shown in Table 2. Estimated revenues for 1978 are shown in Table 3.

Margin Analysis

During 1978, Intel has been able to maintain its historically high profit margins, as forecast by DATAQUEST in its previous update on Intel (March 7, 1978). We expect those margins to continue through 1979, even though slower industry growth is forecast. Intel has undoubtedly had some benefit because of heavy product demand in 1978. This has allowed slightly firmer prices, some ability to allocate wafer starts according to profitability, and limited competitive inroads. At the same time, however, the Company's very high growth rate has entailed substantial costs, as well as consequent deleterious effects on yield. In a year of slightly slower quarter-to-quarter growth rates, these benefits and drawbacks should be self-canceling. We perceive that in 1978 Intel has incurred tremendous costs due to product and market development. Examples include the very large ($20 million) start-up costs for the 8086 microprocessor product family, and high product and marketing costs, such as those to enter the telecommunications market. We feel these high costs could be foregone in future periods if necessary.

The Company also enters 1979 with a strong product position. Several product areas provide excellent margins with some protection from the competitive environment:

- High-speed static RAMs (2147, 2141)
- 8086 microprocessor family
- Microcomputer board products

- Microcomputer development systems
- Telecommunications products
- EPROMs
- Some older products (such as the 1101 and 1103 dynamic RAMs)

Intel still has major market advantages through its breadth in microprocessors and memory and its position as the low-cost manufacturer of NMOS. Combined with the products mentioned, these factors should ensure excellent margins throughout the following year. We believe that the Company should be able to maintain a 20 to 22 percent pretax profit margin in 1979.

Organization and Geographical Dispersion

In 1977, Intel made major organizational changes—decentralizing its decision-making process to five operating divisions. In 1978, and continuing in 1979, the Company's growth is forcing a geographical dispersion of these groups. The Memory Components Division has completed its move of headquarters and manufacturing to Aloha, Oregon. Part of Microcomputer Systems is scheduled to follow in 1979. MRI Inc., in Austin, Texas, has been acquired. The European office has increased nine-fold, to about 300 persons, over the last three years. In 1979, an increase is planned for the Portland area (Hillsborough and Aloha) facilities and the Chandler, Arizona, facility is expected to be occupied. Intel's ability to maintain control under these conditions remains to be tested. At any rate, such moves are costly but necessary due to the labor unavailability in the San Francisco Bay Area.

Intel is no longer relying solely on its technology to develop markets. With large, complicated chips, knowledge of markets must precede product development. Intel continues to strengthen its marketing organization, which was almost nonexistent two years ago. This has become a large and, so far, effective group. Thus, Intel has substantially boosted capability in many areas (there are 21 specific groups) including microprocessors, automotive, memory, and telecommunications. Furthermore, geographical marketing areas have been expanded; in addition to the previously noted European expansion, marketing in Japan has increased. More recently, a marketing group has been formed in Canada.

In sales, Intel has planned a computerized real time inventory, order, and backlog status system for 1979 that will enable field sales managers to instantly query the product inventory status of this multinational, geographically dispersed company. This system should have some positive marketing and sales advantages, as well as being a substantial management planning and profit forecasting tool, using current yields and booking average selling price (ASPs) to provide gross margin projections. One feature of the EDP system is advance notification of delivery delinquencies.

Corporate Analysis

Overall, Intel is in a good position. Orders have been excellent through November, exceeding billings for all of the recent months. Intel currently has a considerable backlog in all areas and enjoys an excellent competitive position. It has excellent breadth in its product lines, superb technology, and strong market position. Because of the volatility of the semiconductor industry, however, Intel's success cannot be assured. Problems could come from several areas that need to be closely watched, including:

- Problems arising from too-rapid growth, including inability to meet demand (and the resultant strengthening of competitors) and organizational stresses.

- The possibility of an economic slowdown or recession, and the resultant price pressure on semiconductors, which could be further complicated by Japanese semiconductor manufacturers.

- The possibility of not maintaining state-of-the-art products in semiconductor memory. Intel's current business intensity makes research and development difficult to allocate. In 1979, the Company must join its competitors in introductions of 16K static devices and 64K dynamic RAMs to remain competitive.

- The increasing costs of capital expansion (common to the industry). Interest costs are a threat to margins.

Each division is analyzed in greater detail in the following sections of this newsletter. In addition, three major areas where we feel Intel currently has a technical and market advantage are discussed. These areas—HMOS, the 8086 microprocessor, and linear NMOS—are keystones of the Company's long-term strength.

HMOS

Intel's HMOS process was initially introduced with the 2147 4K RAM and is applied to all new Intel products, including the 8086 microprocessor. That process is still unequaled among world semiconductor manufacturers. It has enabled Intel to remain a single source on the highly profitable 2147, and to get a product advantage for its newer devices. DATAQUEST believes that this process currently obtains excellent yield. The HMOS process is the first process to bring minimum manufacturing dimensions to under 5 microns, providing smaller chips and faster speeds. This goal is being actively sought by all major worldwide manufacturers. Significantly, Intel now has an 18-month lead time in experience in HMOS. The advent of competition will be signaled by effective competition for the fast 4K static RAM. We believe that Intel's current lead in this basic processing technology will give it a cost and/or performance advantage for the next few years.

Linear NMOS

Intel has developed the capacity to put linear functions on NMOS chips, no minor accomplishment as it includes the development of excellent NMOS voltage references, operational amplifiers, and capacitive ladder networks. While the NMOS A/D converters and other functions currently used are not startling in their technical performance, their major benefit lies in the ability to produce a chip that combines linear and digital functions of high density and low manufacturing cost. Products include the 2910 and 2911 Codecs, the 2912 digital filter, and the 8022 microcomputer. Additional products are being planned, including further telecommunication products to be announced at the ISSCC, and other microcomputer/microprocessor-related products. The Company's lead times on these products should help it enjoy significant sales and profits for the next few years.

16-Bit Microprocessors

DATAQUEST estimates that Intel had shipped 10,000 8086 chip sets by the end of the third quarter 1978, following introduction in the second quarter. The Company is in quantity production of the 8086 and offers:

- A full complement of peripheral devices (37 at this time)
- The ICE-86 In-Circuit Emulator
- The Intellec Microcomputer Development System with an upgraded ISIS-II operating system
- Full software support systems, including the higher level PL/M 86 language
- The PL/M 86 compiler and ASM-86 assembler
- The iSBC-86/12 single-board microcomputer utilizing the 8086 microprocessor.

This total availability of software service and support is evidence of unequaled technical investment and makes arguments concerning the 8086's technical capabilities academic.

In the arena of high-performance 16-bit microprocessors, the 8086 now has a very significant lead time. This should enhance its acceptance. Manufacturers at this time have no other choice of microprocessor if they wish to use a high-speed 16-bit chip. The Z-8000 of Zilog and 68000 of Motorola have yet to be introduced in quantity. The quantity of 8086s shipped to date indicates the wide acceptance of this product, since it is too early for any manufacturer to be using production volumes. It is clear at this time that Intel has established a commanding lead in this part of the 16-bit microprocessor market. In terms of board products, DEC is still the leader with its LSI-11. However, in terms of units, the 8086 has pulled within parity of the LSI-11 in less than six months.

Software support includes introduction of PL/M 86, the new structured, high-level programming language designed specifically for software development for the 8086 microprocessors. Significantly, this programming language will operate on the Intellec MOS Microcomputer Development systems, thus permitting software to be developed for the 8086 without significant hardware reinvestment and retraining on the part of past 8080 and 8085 users. Since Intel is estimated to have sold over 12,000 microcomputer development systems, this convertibility should speed market development and provide a significant competitive advantage in maintaining and upgrading users of the 8080 8-bit microprocessors. While this advantage may often be overstated, it is nevertheless quite significant.

The arrangement on the 8086 recently concluded with Mostek sets up a strong second source. This, in our opinion, should be viewed favorably by the users and is a significant market advantage. Furthermore, the arrangement tends to exclude other suppliers from the market. Although not detailed in the agreement, we believe Intel has consented to provide masks (or tapes, so that Mostek can convert to its process) to Mostek for the 8086 in return for some development aid.

Memory Components Group

The Memory Components Group includes the Memory Components Division under Ron Whittier and the Special Products Division under George Schneer. Estimated sales for these divisions, as well as a product breakdown, are shown in Tables 2 and 3. Both divisions grew at about the same rate in 1978. Sales for the total group are expected to rise from about $220 million this year to about $258 million in 1979.

For the greater part of the year, Intel has been capacity limited in memory manufacture. This has led to severe allocation of production. Consequently, Intel has not been able to maintain market share in all areas, but has emphasized newer or more profitable products. During mid-1978, production was further complicated by the move of the Memory Components Division to Portland and some unfortunate experiments in work shift hours. This led to productivity losses, especially affecting the 16K dynamic RAM and the 16K EAROM.

The Memory Components Group has maintained Intel's position as the leader in semiconductor memory. New products in recent months include the 32K EAROM and the 2141 fast (lower power) 4K static RAM. We understand the fast 5 volt 16K dynamic RAM is being quietly sampled. The 2114 1K static RAM is being converted to HMOS.

Intel has a 64K dynamic RAM and a 16K static RAM under development, but deliveries of the former are not expected until the second quarter of 1979. Since these and other advanced products are being announced by Fujitsu, Mostek, Motorola, Texas Instruments, and others, Intel's current position is of some concern. We believe that when the Company enters the market, it will do so in quantity, but that it is holding back during the present strong market.

DATAQUEST expects Intel to introduce the 16K static RAM (the 2167) at the ISSCC in February, and also expects the devices to be available about the same time.

Intel is pulling back from the CCD memory market. Costs on these products, due to their low quantities, have never reached the level required to give them a significant advantage over RAMs. It is DATAQUEST's perception that the CCD market requires a substantial volume commitment in order to become cost competitive on a per bit basis. Intel was unwilling to make this commitment.

Microcomputer Components Division

The Microcomputer Components Division has introduced a wide range of products in 1978, including the 8086 family. Over 300 microcomputer-related products are now offered by Intel. The product line reflects Intel's desire to be a total microprocessor supplier with a full range and breadth of product. In 1979 the Company is expected to further round out its line of peripheral support products, but major family introductions are not expected. Although Intel is believed to be developing a 32-bit processor, introduction does not appear imminent. The current product line will provide excellent growth for this division for some time, with the 8048 family the fastest growing product line as users move into full production.

Telecommunication products are expected to provide revenue in excess of $10 million in 1979; total division sales are expected to reach $100 million.

Microcomputer Systems Division

The Microcomputer Systems Division under Dr. William Davidow has two major areas:

- Microcomputer Development Systems for microprocessors and microproccesor systems. This group is estimated to account for more than 60 percent of this division's 1978 revenues. DATAQUEST estimates that that percentage will drop slightly in the future.

- Board Computers. Small board computers account for most of the remainder of division revenues. Industrial applications are increasing, especially with the inclusion of the 8086 products—the iSBC 86/12 16-bit microcomputer.

Microprocessor testing, where the major product has been the μSCOPE systems, is not being further expanded by Intel.

This division is growing very rapidly. Sales are being boosted by the 8086 microprocessor products, the wide use of the 8048, and new applications in industry that are just beginning to enter the production phase. DATAQUEST estimates that this division could have sales of $125 million in 1979. Significant product development has been tied to the new microprocessor products, which should begin to impact revenue in 1979. New capacity has been added in the Portland area, with movement into the new 150,000 square foot facility planned for February 1979.

Commercial Systems Division

The Commercial Systems Division, formerly the Memory Systems Division, has obviously acquired an expanded charter with the acquisition of MRI Inc. MRI is a developer of data base management software systems and employs about 250 people. Intel regards MRI as an extension of its end-user (memory) systems business as well as an eventual extension of its microcomputer systems. DATAQUEST expects Intel to introduce an EDP product in 1979 to take advantage of MRI's data base management capability. MRI also adds considerable software expertise to Intel's growing talent pool. The ultimate strategy behind this acquisition, however, is not apparent. MRI's gross revenues should be about $8 million in 1978, and are expected to reach about $10 million in 1979.

The Commercial Systems Division was rejuvenated during 1978 under the direction of William McCallmont. This rejuvenation has been sparked by new product direction and product rationality. Intel memory systems include standard add-in/add-on memory systems (especially for microcomputers), custom memory systems, and IBM add-on memories. In the former two areas, some progress has been made in standardization of systems, with the resultant spreading of engineering and manufacturing development costs and manufacturing overhead.

Especially significant to this division has been the sale of 2147 board products to IBM. This may be the first time in IBM's history that it has put merchant semiconductor products into its mainframe computer product memories.

The IBM add-on systems have been simplified by the availability of the 2147 fast 4K RAM that gives Intel the capability of a universal system. The inability of IBM to meet its own memory needs, with the computer giant facing product transition and excessive demand, gives Intel's Commercial Systems Division an excellent opportunity for growth in 1979.

We believe that the Commercial Systems Division should increase sales in 1979 to $90 million from $55 million in 1978, making it the fastest growing division in the Company. Currently, about 50 percent of sales is believed to be IBM add-on memory, down from 65 percent in 1977.

Intel Magnetics

Intel Magnetics was formed in late 1977 as a subsidiary to perform research and development on magnetic bubbles. DATAQUEST expects first products to be announced in the first half of 1979, with limited revenue in that year.

Capacity

Intel has undergone an ambitious expansion program in 1978, with total capital expenditures of about $100 million. Land acquisitions include land in Santa Clara, California; Mission Park (34 acres near Great America in Sunnyvale, California); Hillsborough, Oregon; Deer Valley, Arizona (near Phoenix); and Chandler, Arizona. Buildings include Santa Clara 4, completed in January 1978; Santa Clara 5, completed in July 1978 (25,000 square feet); Aloha 3, completed in September 1978; Fab V, also in Aloha; Hillsborough 1, to be completed early in 1979; and Chandler, Arizona, with a completion planned for the first quarter of 1979. The Deer Valley (Phoenix) facility is planned for occupancy by the Commercial Systems Division in late 1979. Foreign facilities include buildings and equipment in Penang, Malaysia; in Barbados; and in Manila, Republic of the Philippines.

Intel names its facilities by location and number, such as Santa Clara 4, and its wafer fabrication facilities by Roman numeral. This leads to some confusion. Table 4 lists Intel's wafer fabrication facilities and new and planned divisional headquarters.

In 1979 Intel plans capital expenditures of about $100 million, mostly for equipment. For the first time in the Company's history it has begun to borrow money. Debt, now at about $14 million, is expected to continue increasing significantly through 1979 and could be one factor affecting Company margins. Intel could require up to $50 million in financing in 1979.

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Table 1

Intel Corporation

ESTIMATED REVENUES 1977-79
(Dollars in Millions)

	1977	1978	1979
Memory Components Division	$ 69	$ 97	$113
Special Products Division	93	123	145
Total Memory Components Group	$162	$220	$258
Microcomputer Components Division	$ 38	$ 75	$100
Microcomputer Systems Division	52	75	125
Commercial Systems Division[1]	37	55	90
Microma Division	17	0	0
Intel Magnetics	0	0	3
Intracompany	(23)	(30)	(36)
Total Company Revenues	$283	$395	$540

[1]Does not include MRI in 1977 or 1978

Source: DATAQUEST, Inc.
December 1978

Table 2

Intel Corporation

MEMORY COMPONENTS GROUP
ESTIMATED 1977 REVENUES

Memory Type	Major Product	Units (Millions)	Average Price	Estimated Revenues ($ in Millions)
MEMORY COMPONENTS DIVISION				
Dynamic RAMs				
1K	1103	6.5	$ 2.35	$ 15.3
4K	2107	10.4	3.50	36.4
16K	2116, 17	0.56	18.00	10.1
High Speed RAMs				
1K	2115	0.5	$ 5.00	$ 2.5
4K	2147	0.1	24.00	2.4
CCDs and Others	2416	0.25	10.00	2.5
Total Division				$ 69.2
SPECIAL PRODUCTS DIVISION				
Static RAMs				
1K	2101	10.0	$ 1.50	$ 15.0
4K	2114	0.89	12.00	10.7
EPROMs				
2K	1702	1.4	$ 6.00	$ 8.4
8K	2708	1.5	13.00	19.5
16K	2716	0.45	20.00	9.0
ROMs				9.0
Bipolar				15.0
CMOS, Memory, Peripheral, Other				6.0
Total Division				$ 92.6
TOTAL MEMORY COMPONENTS GROUP				$161.8

Source: DATAQUEST, Inc.
December 1978

Table 3

Intel Corporation

MEMORY COMPONENTS GROUP
ESTIMATED 1978 REVENUES

Memory Type	Major Product	Units (Millions)	Average Price	Estimated Revenues ($ in Millions)
MEMORY COMPONENTS DIVISION				
Dynamic RAMs				
1K	1103	3.9	$ 2.05	$ 8.0
4K	2107	11.6	2.20	25.5
16K	2116, 17	3.3	9.60	31.7
High Speed RAMs				
1K	2115	2.8	$ 2.45	$ 6.9
4K	2147	1.2	18.00	21.6
CCD Memory	2416	0.4	4.80	1.9
Other				1.7
Total Division				$ 97.3
SPECIAL PRODUCTS DIVISION				
Static RAMs				
1K	2101	9.6	$ 1.35	$ 13.0
4K	2114	2.6	5.50	14.3
EPROMs				
2K	1702	1.2	$ 3.50	$ 4.2
8K	2708	3.2	7.00	22.4
16K	2716	1.45	18.50	26.8
ROMs				17.0
Bipolar				17.0
COMS, Memory, Peripheral, Other				8.0
Total Division				$122.7
TOTAL MEMORY COMPONENTS GROUP				$220.0

Source: DATAQUEST, Inc.
December 1978

Table 4

INTEL FACILITIES[1]

Plant Location	Sq. Footage	Activity
Mountain View, CA	22K	Fab I
Santa Clara, CA No. 1	78K	Fab II
Livermore, CA	50K	Fab III
Aloha, OR No. 1	60K	Fab IV
Aloha, OR No. 2	80K	Fab V
Chandler, AZ (under construction)	100K	Fab VI
Santa Clara, CA No. 4	180K	Headquarters for Microcomputer Components Division, corporate offices
Hillsborough, OR No. 1 (under construction)		Future headquarters of the Microcomputer Systems Division
Deer Valley, AZ (planned)		Future headquarters of the Commercial Systems Division

[1] Not a complete list

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 27, 1978

MOS MICROPROCESSOR SHIPMENTS

Summary

Worldwide shipments of MOS microprocessors in the third quarter of 1978 were an estimated 7.5 million units, up about 37 percent over estimated second quarter shipments of 5.5 million units. Single-chip microcomputers represented about 72 percent of the total third quarter shipments. As a percent of the total third quarter unit shipments, the breakout was 4-bit=69 percent, 8-bit=30 percent, and 16-bit=1 percent. However, the dollars are not as heavily weighted toward the 4-bit microprocessors because of the higher selling prices and the amount of imput/output (I/O) and peripheral chips that traditionally go with 8-bit and 16-bit microprocessors.

Quarterly Microprocessor Shipments

Table 1 presents DATAQUEST's estimates of worldwide microprocessor CPU shipments for the first three quarters of 1978. The estimated shipments refer to the CPU chips and do not include a count of the I/O or peripheral chips. The number of product families offered continues to grow each quarter as witnessed by the fact that Table 1 lists 49 products and 21 suppliers, up from 30 products and 18 suppliers listed in our November 23, 1977, newsletter.

Third quarter shipments of standard MOS microprocessors were up about 37 percent over estimated second quarter shipments, whereas second quarter shipments were up only about 20 percent over estimated first quarter shipments. We believe that part of the large increase in third quarter shipments was due to the seasonality of many microprocessor applications, such as games, appliances, and automobiles.

This newsletter reports on standard MOS products. However, we must mention that there are a number of custom microprocessors that are tailored for a particular class of applications and are not advertised or generally available. For example, Rockwell has a custom 4-bit microprocessor whose quarterly shipments are estimated at about the same as the PPS-4 shipments. About one-half are used for calculator applications, and the rest for a variety of game, appliance, and other simple controller applications. Texas Instruments has a family of custom microprocessors for its calculator products; however, these chips are not available from TI. These are only two examples of the many custom microprocessors in existence. It is our understanding that most suppliers have one or more custom microprocessor programs

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serving a variety of applications, but information is difficult to obtain. Therefore we feel that reporting only on standard microprocessors accurately indexes both the growth of the industry and of its participants.

Table 2 presents our estimates of single-chip microcomputer shipments. Third quarter shipments of single-chip microcomputers were an estimated 5.4 million units, up about 56 percent over estimated second quarter shipments. Single-chip microcomputers are playing an increasingly important role, as they represented about 72 percent of the total units shipped in the third quarter, up from an estimated 63 percent of the total in the second quarter.

4-Bit Microprocessors

Table 3 indicates that worldwide shipments of 4-bit microprocessors continued to grow in the third quarter to an estimated 5.1 million units, up about 57 percent over an estimated 3.3 million units shipped in the second quarter.

The quarterly growth in estimated shipments of 4-bit microprocessors continues to exceed the quarterly growth of 8-bit and 16-bit microprocessor shipments. For example, the quarterly growth in estimated shipments of 4-bit microprocessors during the first three quarters of 1978 was 58, 35, and 57 percent respectively, as compared to 20, 2, and 6 percent for 8-bit microprocessors, and 13, 22, and 18 percent for 16-bit microprocessors. Of course, this growth is closely related to the low price and broad-based set of applications for 4-bit microprocessors. The single-chip TMS-1000, COPS, and PPS-4 microcomputers are currently shipping at $1.50-$3.00 in large quantities (100,000 to 300,000 units).

8-Bit Microprocessors

Worldwide shipments of 8-bit microprocessors in the third quarter of 1978 were an estimated 2.2 million units, up about 6 percent over estimated second quarter shipments. After a comparatively flat second quarter (only 2.1 percent increase over the first quarter), the 8-bit microprocessors had better growth in shipments in the third quarter. Growth in this product segment continues to come from mature products as well as the new product introductions of the past year.

Prices of 8-bit microprocessors and microcomptuers have not changed drastically in the past quarter. They are still in the $4.00-$8.00 range with a few large quantity shipments being made for as low as $3.50. Most of the 8-bit products are packaged in plastic, but some of the military and computer applications do require ceramic or cerdip packages; this adds $1.00 to $3.00 to the price.

Quarterly shipments of several major 8-bit microprocessor families are presented in Table 4. Three of the four mature 8-bit products continued to grow on a quarter-to-quarter basis. Much of the growth in the 8-bit products is coming from the new product introductions and the single-chip 8-bit microcomptuers. Data from Table 2 shows that single-chip 8-bit microcomputers comprised about 16 percent of all 8-bit microprocessor shipments in the third quarter of 1978, up from 13 percent in the second quarter of 1978.

16-Bit Microprocessors

Worldwide shipments of 16-bit microprocessors in the third quarter of 1978 were an estimated 98,000 units, up about 18 percent over estimated second quarter shipments. The entry of additional suppliers is adding to the strength of this segment of the market. We expect it to take on added importance over the next year as additional suppliers enter the market. Prices of 16-bit microprocessors are in the $10.00-$100.00 range. The TMS-9900 is currently being shipped for about $25.00 in quantities in excess of 1,000 units. While the TMS-9980, which is available in a 40-pin plastic package, is currently shipping for about $12.00. The 8086 is currently selling for about $100.00 at quantity 1,000.

The drag factor for 16-bit microprocessors is in the range of 7 to 12 depending upon the particular applications. This means that about $7.00-$12.00 of additional peripheral, I/O, and memory chips are sold for every $1.00 of microprocessor sales. The drag factor for 8-bit microprocessors is in the range of 4 to 8, again depending upon the particular application.

Daniel L. Klesken
James F. Riley
Frederick L. Zieber

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS
(Units in Thousands)

Company	MPU Products	Bits	MOS Process	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMD	8080A	8	N	165	90	105	115
	8085	8	N	0	0	0	S[1]
AMI	6800	8	N	89	35	30	50
	S2000	4	N	0	0	9	8
Fairchild	F8	8	N	655	110	130	190
	3870	8	N	0	3	5	5
	6800	8	N	15	55	45	80
GI	CP-1600	16	N	31	10	20	15
	PIC-1650	8	N	0	75	95	105
Harris	6100	12	C	13	5	5	5
Hitachi	HMCS-40	4	P&C	140	85	95	110
	6800	8	N	25	10	15	20
Hughes	1802	8	N	10	5	8	10
Intel	4004	4	P	215	42	42	40
	8008	8	P	124	28	28	25
	8080A	8	N	510	165	170	180
	8048/8021	8	N	95	60	100	150
	8085	8	N	55	50	80	95
	8086	16	N	0	0	1	10
Intersil	6100	12	C	16	8	10	10
MOS Technology	6500	8	N	280	50	55	60
Mostek	F8	8	N	90	50	30	35
	Z80	8	N	85	70	50	55
	3870	8	N	20	20	50	75
Motorola	141000	4	C	0	0	5	50
	6800	8	N	435	160	190	230
	6802	8	N	0	0	S	5
	3870	8	N	0	10	20	20
National	COPS	4	N	N/A[2]	300	500	675
	4004	4	P	110	30	35	35
	IMP	4	P	55	20	20	20
	8080A	8	N	145	85	90	100
	SC/MP	8	P	189	65	70	100
	PACE	16	P	47	18	18	25
NEC	COM-4	4	N	225	150	225	525
	8080A	8	N	162	70	85	90
	8085	8	N	0	0	0	2
	Z80	8	N	0	0	0	5
RCA	1802	8	C	222	75	75	85
Rockwell	PPS-4	4	P	575	400	550	675
	6500	8	N	225	260	200	75
Sescosem	6800	8	N	20	5	6	7
Signetics	2650	8	N	39	12	20	22
	8048	8	N	0	0	0	S
Synertek	6500	8	N	250	325	225	60
TI	TMS 1000	4	P&C	2,825	1,400	1,800	3,000
	TMS 8080A	8	N	100	30	30	40
	TMS 9900	16	N	95	40	44	48
Zilog	Z80	8	N	95	90	100	150
Total Microprocessors				8,447	4,571	5,486	7,492
Percent change from previous quarter					35.1%	20.0%	36.6%

[1]S = Sampling

[2]N/A = Not Available

Source: DATAQUEST, Inc.
November 27, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF SINGLE-CHIP MICROCOMPUTERS
(Units in Thousands)

Company	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMI	S2000	0	0	9	8
Fairchild	3870	0	3	5	5
GI	PIC-1650	0	75	95	105
Hitachi	HMCS-40	140	85	95	110
Intel	8048/8021	95	60	100	150
Mostek	3870	20	20	50	75
Motorola	3870	0	10	20	20
	141000	0	0	5	50
National	COPS	N/A[1]	300	500	675
NEC	COM-4	225	150	225	525
Rockwell	PPS-4	575	400	550	675
TI	TMS 1000	2,825	1,400	1,800	3,000
Total Single-Chip Microcomputers		3,880	2,503	3,454	5,387

[1]N/A = Not Available

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

4-Bit Products	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMI	S2000	0	0	9	8
Hitachi	HMCS-40	140	85	95	110
Intel	4004	215	42	42	40
Motorola	141000	0	0	5	50
National	COPS	N/A[1]	300	500	675
	4004	110	30	35	35
	IMP	55	20	20	20
NEC	COM-4	225	150	225	525
Rockwell	PPS-4	575	400	550	675
TI	TMS 1000	2,825	1,400	1,800	3,000
Total		4,145	2,427	3,281	5,138
Percent change from previous quarter			57.8%	35.2%	56.6%

[1]N/A = Not Available

Source: DATAQUEST, Inc.
November 27, 1978

(Continued on page 7)

Table 3 (Continued)

ESTIMATED WORLDWIDE SHIPMENTS OF MICROPROCESSORS BY BIT LENGTH

(Units in Thousands)

8-Bit Products	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMD	8080A	165	90	105	115[1]
	8085	0	0	0	5
AMI	6800	89	35	30	50
Fairchild	F8	655	110	130	190
	3870	0	3	5	5
	6800	15	55	45	80
GI	PIC-1650	0	75	95	105
Hitachi	6800	25	10	15	20
Hughes	1802	10	5	8	10
Intel	8008	124	28	28	25
	8080A	510	165	170	180
	8048/8021	95	60	100	150
	8085	55	50	80	95
MOS Technology	6500	280	50	55	60
Mostek	F8	90	50	30	35
	Z80	85	70	50	55
	3870	20	20	50	75
Motorola	6800	435	160	190	230
	6802	0	0	8	5
	3870	0	10	20	20
National	8080A	145	85	90	100
	SC/MP	189	65	70	100
NEC	8080A	162	70	85	90
	8085	0	0	0	2
	Z80	0	0	0	5
RCA	1802	222	75	75	85
Rockwell	6500	225	260	200	75
Sescosem	6800	20	5	6	7
Signetics	2650	39	12	20	22
	8048	0	0	0	8
Synertek	6500	250	325	225	60
TI	TMS 8080A	100	30	30	40
Zilog	Z80	95	90	100	150
Total		4,100	2,063	2,107	2,241
Percent change from previous quarter			20.1%	2.1%	6.4%
12-Bit Products					
Harris	6100	13	5	5	5
Intersil	6100	16	8	10	10
Total		29	13	15	15
Percent change from previous quarter			30.0%	15.4%	0%
16-Bit Products					
GI	CP-1600	31	10	20	15
Intel	8086	0	0	1	10
National	PACE	47	18	18	25
TI	TMS 9900	95	40	44	48
Total		173	68	83	98
Percent change from previous quarter			13.3%	22.1%	18.1%

Source: DATAQUEST, Inc.
November 27, 1978

Table 4

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]

(Units in Thousands)

Microprocessors	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
8080A	1,082	440	480	525
F8	745	160	160	225
6800	564	260	280	380
6500	755	635	480	195
Total	3,146	1,495	1,400	1,325

[1]Numbers in this table include all manufacturers of these types.

Source: DATAQUEST, Inc.
November 27, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 16, 1978

PRODUCING LSI WITHOUT A FACTORY

Introduction

For several years, a number of companies have been subcontracting some or all of the manufacture of large scale integrated (LSI) circuits an activity known in the industry as "no factory" production. Some of these firms produce for their own use, while others produce for sale on the open market. The rapid growth of farming out at least part of the manufacturing process suggests that it is cost competitive, at least in certain market segments. DATAQUEST believes this trend will continue.

This newsletter describes how the rapidly growing demand for custom LSI has helped create "no factory" production and discusses the impact of this semiconductor manufacturing approach on captive semiconductor manufacturers, merchant semiconductor manufacturers, and electronic equipment manufacturers. It also describes the types of subcontractors that provide "no factory" production services.

History

"No factory" semiconductor production is possible because there now exists a significant market for fabricated wafers—wafers processed using customer-supplied tooling. The fabricated wafer market developed about 10 years ago as semiconductor companies with excess capacity began to fabricate wafers for those with inadequate capacity. At this point, the LSI tooling, which defined the mask, was still under control of the semiconductor industry. During the recessions of 1970-71 and 1974-75, however, the semiconductor industry laid off many LSI designers.

Many of these engineers became consultants or went to work for electronic equipment manufacturers, taking with them their technical expertise in LSI. There were already many independent maskmaking companies, which made it possible for these engineers to develop LSI tooling even though they were no longer employed in the semiconductor industry. To obtain the wafer fabrication services needed to prove their designs, they took advantage of their previously established industry contacts.

Semiconductor firms provided these prototype wafer fabrication services to establish themselves as preferred suppliers for the follow-on production. Once the prototype phase was complete, these manufacturers typically would deliver packaged units and perform the functions of wafer fabrication, assembly, and test. Once LSI design and LSI manufacturing were performed by separate companies, it was not long before all LSI manufacturing functions became completely unbundled. It is now possible to obtain wafer fabrication, assembly, and test services from separate companies.

Continuing Demand for Custom LSI

Demand for custom LSI has grown rapidly; Table 1 gives estimated historical custom LSI design completions in the United States and Canada, exclusive of those designs manufactured by captive suppliers.

Table 1

ESTIMATED CUSTOM LSI DESIGN COMPLETIONS

	1973	1974	1975	1976	1977	1978
Design Completions	298	398	528	612	768	1014
Share of Completions:						
Semiconductor Manufacturers	92%	81%	75%	67%	60%	63%
Independent Design Firms	3%	6%	8%	11%	14%	14%
Captive Design Groups	5%	13%	17%	22%	26%	23%

Source: Anderson/Bogert 1978

The data in Table 1 include custom LSI designs that are manufactured by merchant semiconductor firms, but does not include semi-custom LSI designs. (Usually, only the metal mask is changed on a semi-custom LSI design.)

Though semiconductor companies complete only 60 percent of the custom LSI designs, they actually capture most of the production revenue because they typically provide wafer fabrication services for both independent design firms and captive design groups. Production revenue generated by these custom LSI circuits is substantial; each design usually generates $50,000 to $500,000 of production revenue annually for three years or more. DATAQUEST estimates that production revenue generated by these designs in 1978 was $250 million to $350 million. An advantage of custom LSI production is that during periods of recession revenue from this source tends to be more stable than the revenue from standard products. Although unit sales may shrink, unit prices usually do not decline. In fact, some contracts call for price increases at lower quantities. This phenomenon occurs because most custom LSI is effectively single sourced.

Semiconductor companies provide custom designs where standard designs do not yet exist, and often design such custom LSI circuits to gain knowledge that can later be used to develop new standard products. Many electronic equipment makers see custom LSI as a way to maintain their proprietary product features; it is harder to copy custom LSI than it is to copy a printed circuit board or microprocessor program.

When volume is high, many LSI requirements are best filled by custom designs that have only the circuitry required for that application. The money saved by eliminating the extra standard product circuitry pays for the custom LSI design. Often, the custom design is only a stripped-down standard product.

A final reason for the continuing custom LSI demand is that dollar savings can be effected when SSI or MSI is replaced by LSI. Various electronic equipment manufacturers estimate that these savings vary from $2 to $10 for each MSI or SSI eliminated from their product.

Impact

The availability of these services has an impact on captive semiconductor manufacturers, merchant semiconductor manufacturers, and electronic equipment manufacturers.

Many smaller companies with captive semiconductor manufacturing capabilities have high overhead costs because they operate well below capacity. DATAQUEST estimates that an equipment manufacturer would have to consume about $27 million worth of LSI devices (of one process technology) to fully utilize the capacity of today's typical semiconductor fabrication facility. The manufacturer would have to have equipment sales in excess of $540 million since LSI component costs are typically 5 percent, or less, of sales.

The penalty for operating below capacity is great. We estimate that wafer-fabrication costs are 130 percent of standard at one-half capacity, and 150 percent of standard at one-third capacity. A number of firms now supplying services to the wafer fabrication market are captive or formerly captive manufacturers. They are reducing this undercapacity cost penalty by selling the unused portions of their semiconductor manufacturing capabilities in the wafer fabrication market.

Semiconductor manufacturers can also use the wafer fabrication business to keep their plants at full capacity through swings in the business cycle. They do not have to maintain large facilities to handle peaks in production during prosperous times because they can supplement their plant capacity by purchasing that of another company. Consequently, cutbacks during lean times need not be so severe.

Electronic equipment manufacturers now have an alternative to becoming captive semiconductor manufacturers. They can buy outside wafer fabrication services rather than set up plants of their own.

"No Factory" Production Services

The industry services that support "no factory" production are custom LSI design, semi-custom LSI, maskmaking, wafer fabrication, assembly, and test.

Custom LSI design services are provided both by independent design firms and by semiconductor companies. Independent design firms, which do not have wafer fabrication capability, are generally willing to undertake designs of LSI circuits for production in small- to medium-sized quantities. These design firms may or may not manage the manufacturing. It is estimated that they will provide design and manufacturing services valued at approximately $15 million in 1978. There are at least 13 of these firms in the United States and Canada. The largest, Silicon Systems, is expected to have revenues of $5 million in 1978. Some other independent design firms are Alphatron, LSI Computer Systems, Micro-Innovators, and Pico Design.

Most semiconductor firms will take on custom LSI design projects if the incentive is sufficiently large. However, only a minority, some 14 firms, actively market their custom design services. Of these, the firms with the largest design capabilities are believed to be AMI, National Semiconductor, and Synertek.

Semi-custom LSI designs typically consist of an array of gates or components that can be custom interconnected by a customer-designed metal mask. However, some firms customize all layers by means of a "standard cell" approach, and others customize by using fusible links. There are at least 13 firms in the United States and Canada offering semi-custom capabilities, some of which have their own wafer fabrication capability.

Approximately 12 firms provide maskmaking services in the United States and Canada. Leading firms include Micro Mask, NBK, and Qualitron. Many of them provide digitizing services. Digitizing is a technique for translating the engineering drawing of an LSI circuit into computer-readable magnetic tape. These firms make master masks using computer-control equipment—typically a reticle generator and step-and-repeat camera—and will provide masks with chrome, iron oxide, or emulsion surfaces. These firms sell their masks to all segments of the semiconductor industry including merchant and captive suppliers, and independent designers. Today, even large semiconductor companies, such as AMD and Intel, are customers of these maskmaking firms because they do not have their own maskmaking capability.

Some 16 firms provide wafer fabrication services in the United States and Canada. They work with customer-provided tooling in the form of magnetic tapes or masks, and provide either fabricated wafers or packaged and tested units. All firms supply wafers during the prototype phase but some prefer to contract for packaged and tested units during the production phase. Most firms supply customers with a set of specifications called "design rules" for use as a guide in the design of LSI circuits. They guarantee that the wafer is correctly processed to these specifications, but do not guarantee that the wafer has good devices on it. Once customer design errors are eliminated and prototyping is complete, most firms are willing to make some guarantee concerning the number of good parts expected per wafer. These suppliers of wafer fabrication services offer processes that are technologically current. Double poly (used on the 16K RAM) is currently available; VMOS should soon be available from AMI; processes similar to Intel's HMOS should be available from other companies late this year.

Assembly services have been available for many years. The usual process is for assembly firms to take wafers, cut them into die, and assemble them into packages supplied by their customers. Normally, they do not supply electrical test services. Most of these firms are located in the Far East.

Test services are supplied by more than 10 independent testing companies in the United States and Canada. These firms provide overflow test capability for semiconductor manufacturers and incoming inspection services for component purchasers.

Further information on this subject is available in a new 240-page report by Anderson/Bogert, Vertical Disintegration--New Opportunities for Access to LSI Technology, Published by Electronic Trend Publications, 10050 North Wolfe Road, SW3, Suite 200, Cupertino, CA 95014 (408) 996-7401.

Howard Bogert
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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 10, 1978

MOS MEMORY—STATIC AND DYNAMIC RAM AND EPROM SHIPMENTS

Summary

Worldwide shipments of 16K dynamic MOS RAMs increased to an estimated 6.3 million units in the third quarter of 1978, up about 43.8 percent over an estimated 4.4 million units shipped in the second quarter of 1978.

Worldwide shipments of 4K dynamic MOS RAMs in the third quarter of 1978 reached an estimated 19.8 million units, up about 0.2 percent over the number of units shipped in the second quarter.

We estimate that about 5.1 million units of the 4K static MOS RAM were shipped in the third quarter of 1978, essentially flat with the second quarter shipments.

The third quarter shipments of 2708 8K EPROMs were an estimated 2.3 million units, and shipments of 2716 16K EPROMs were an estimated 0.5 million units.

Dynamic MOS RAMs

1K. Despite the strength of the 16K and 4K dynamic MOS RAM markets, the 1K dynamic MOS RAM market continues to be a good market for the remaining two suppliers, Intel and ITT. Prices remain firm in the $2.00 range.

4K. DATAQUEST's estimates of worldwide 4K dynamic MOS RAM shipments in the third quarter of 1978 are presented in Table 1. We estimate that about 19.8 million units were shipped in this third quarter of 1978, up about 0.2 percent over the number of units shipped in the second quarter of 1978.

Unit volumes continued to increase on a quarter-to-quarter basis. However, we believe that the end is about in sight as 4K unit volumes are expected to begin declining. Dollar revenues from 4K dynamics peaked several quarters ago. Prices for fourth quarter 1978 and first quarter 1979 deliveries are being quoted in the $1.50-$1.75 range. Lead times on the 22-pin 4K dynamic are still rather long—in the 18-24 week range. Most of the standard 16-pin 4K dynamic parts are more readily available, with lead times in the 14 week range.

16K. DATAQUEST's estimates of worldwide 16K MOS RAM shipments are presented in Table 2. We estimate that worldwide shipments in the third quarter of 1978 were about 6.3 million units. This is an increase of about 43.8 percent over an estimated 4.4 million units shipped in the second quarter of 1978.

Availability of 16K dynamic RAMs is generally good. Lead times are in the range of 8-14 weeks. Only the very high speed parts (sub-120 nanoseconds) are in short supply.

Prices of 16K dynamic RAMS for fourth quarter deliveries are in the $6.00-$7.00 range. These prices reflect large quantity purchases of plastic packages. Higher quality parts in cerdip or ceramic are generally priced $1.00-$2.00 higher.

Static MOS RAMs

1K. The supply of 2102-type 1K static MOS RAMs is now quite good with lead times of less than eight weeks and prices in the $1.00 range.

4K. Table 3 presents DATAQUEST's estimates of 4K static MOS RAMs in the third quarter of 1978. We estimate about 5.1 million units were shipped in the third quarter, up about 1.5 percent over the number of units shipped in the second quarter. Lead times for most 4K statics are in the 8-15 week range. Current prices on 4K statics are in the $4.25-$5.00 range.

Intel still remains the only supplier of the 2147-type high speed static MOS RAM. DATAQUEST believes that about 40 percent of Intel's 4K static shipments in the third quarter were of the 2147 type. A number of suppliers are actively working to be able to sample devices shortly but technical difficulties have slowed their progress.

EPROMs

8K. Table 4 presents DATAQUEST's estimates of worldwide shipments of 8K EPROMs. We estimate that worldwide shipments in the third quarter of 1978 were about 2.3 million units, down about 1.7 percent from the number shipped in the second quarter. Prices on 8K EPROMs are currently in the range of $4.50-$5.50.

16K. Table 5 presents our estimates of worldwide shipments of 16K EPROMs. We estimate that about 475,000 units were shipped in the third quarter. Current prices on the 2716 are in the $15.00 range.

32K. Texas Instruments continues to sample its 32K EPROM, but production deliveries have not yet begun.

Daniel L. Klesken
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James F. Riley

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
(Units in Thousands)

Company	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMD	2,340	1,100	1,500	1,800
Fairchild	2,080	600	600	200
Fujitsu	2,900	600	600	400
Hitachi	910	330	500	500
Intel	10,400	3,000	3,000	2,700
Intersil	900	240	200	240
ITT	300	200	300	300
Mostek	11,800	4,000	4,000	4,800
Motorola	2,740	1,000	1,300	1,500
National	3,675	1,200	1,200	1,500
NEC	6,100	1,600	1,600	1,600
Signetics	870	250	300	300
TI	12,400	4,200	4,700	4,000
Total	57,415	18,320	19,800	19,840
Percent Change From Previous Quarter		3.4%	8.1%	0.2%

Source: DATAQUEST, Inc.
November 14, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF
16K DYNAMIC MOS RAMS

(Units in Thousands)

Company	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
Fairchild	25	25	40	200
Fujitsu	260	250	350	500
Hitachi	S[1]	120	240	350
Intel	560	600	800	1,000
Intersil	0	S	S	S
ITT	S	3	25	75
Mostek	760	700	1,000	1,400
Motorola	50	200	500	550
National	S	12	50	75
NEC	310	650	800	1,100
Siemens	S	5	15	25
Signetics	0	S	30	30
TI	43	300	500	950
Toshiba	0	S	S	S
Zilog	S	10	15	15
Total	2,008	2,875	4,365	6,275
Percent Change From Previous Quarter		163.7%	51.8%	43.8%

[1]Indicates sampling

Source: DATAQUEST, Inc.
November 15, 1978

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS

(Units in Thousands)

Company	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMD	260	200	250	350
EMM	2,035	900	1,150	1,000
Fujitsu	20	50	75	100
Hitachi	85	90	130	200
Intel	890	800	1,050	800
Intersil	60	70	50	140
Mostek	95	120	250	200
Motorola	50	50	200	250
National	0	0	100	250
NEC	640	500	600	650
Synertek	205	160	280	350
TI	405	700	800	700
Zilog	40	60	120	140
Total	4,785	3,700	5,055	5,130
Percent Change From Previous Quarter		80.0%	36.6%	1.5%

Source: DATAQUEST, Inc.
November 15, 1978

Table 4

ESTIMATED WORLDWIDE 8K EPROM SHIPMENTS

(Units in Thousands)

Company	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
AMD	0	15	50	80
Electronic Arrays	150	30	50	60
Fairchild	5	40	60	60
Fujitsu	90	50	90	70
Intel	1,600	700	900	800
Motorola	70	100	220	400
National	150	150	300	300
Signetics	150	75	75	80
TI	700	350	550	400
Total	2,915	1,510	2,295	2,250

Source: DATAQUEST, Inc.
November 15, 1978

Table 5

ESTIMATED WORLDWIDE 16K EPROM SHIPMENTS

(Units in Thousands)

Company	1977 Total	1978 1st Qtr.	1978 2nd Qtr.	1978 3rd Qtr.
Intel	340	250	400	250
Mostek	0	S[1]	S	S
Motorola	0	S	S	25
National	0	S	S	S
TI	130	100	250	200
Total	470	350	650	475

[1]Indicates sampling

Source: DATAQUEST, Inc.
November 15, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 10, 1978

Avoid these

GENERAL INDUSTRY FORECAST

Summary

U.S. semiconductor consumption for 1978 is expected to be up approximately 19 percent over 1977. The strong growth in the first half of the year is believed to have slowed in the second half of this year. A situation of uncontrolled expansion, similar to 1973, has not developed. This slowdown—not a downturn—is expected to continue into the first half of 1979, with growth in semiconductor consumption increasing somewhat as 1979 progresses.

DATAQUEST forecasts a 12.3 percent growth in 1979 semiconductor consumption over 1978. Additionally, the combined effects on semiconductor demand from inflation, the dollar devaluation, and outside purchases by the major captive manufacturers, could make 1979 a very good year. We are extremely optimistic about the industry's prospects, but remain uncertain about the U.S. economy. Current maladjustments in the economy raise the probability of a downturn in 1979, and therefore should be watched very closely.

Recent Economic Trends

The U.S. economy remained strong during the third quarter of 1978, helped, in part, by stronger-than-expected consumer purchases. However, future growth is expected to slow, and there is some concern that a downturn in the economy may occur in 1979. We are seeing an economy that is entering its fourth year of recovery. It is to be expected that economic growth at this time should show some erratic behavior, with future direction clearly uncertain. If there is a consensus of economic opinion, it is that the economy can go in one of several directions. The following recent general economic developments are noteworthy:

- President Carter's dramatic actions to solve the world monetary crisis and strengthen the dollar had an immediate beneficial result.

- The Gross National Product (GNP) continued its healthy growth in the third quarter of 1978.

- Industrial production has continued to grow steadily, with growth of 0.5 percent in both August and September, following 0.7 percent rises in June and July.

NOTE DATE ≠ 15 or 30

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- The Index of Leading Indicators has continued its erratic but slow growth with a 0.9 percent advance in October. Due to the recent decline in the stock market, this index will likely show a decline in November.

- Money supply growth, accelerating recently, has been dampened by President Carter's actions.

- Retails sales continue sluggish.

- Recent economic growth in Japan, the United Kingdom, and Germany indicates that these key economies have overcome their low growth of 1976 and 1977. Other European economies have performed less well.

The actions of President Carter had immediate results, and helped stem a possible world monetary crisis. However, the long-term effects are more uncertain: the actions taken further increase future economic uncertainty. The benefits of a more stable dollar must be balanced against the index of tight money.

The continued sluggishness of retail sales indicates that inventories may be accumulating, and that industrial production will slow. Thus, economic growth next year should be moderate. Unless there is an actual downturn, capital spending growth should remain at about current levels, providing stimulus to sales of industrial electronic equipment.

Semiconductor Industry Forecast and Trends

Strong 1978 Demand: U.S. semiconductor demand in 1978 has been extremely strong. The semiconductor industry has been hard pressed to fill that demand, but it has responded. U.S. industry shipments in the third quarter of 1978 ran about 24 percent above the past year's figures for the same quarter. Included within that increase is a remarkable shift to newer MOS LSI devices. These areas show an increase currently of about 52 percent above this time last year.

The high rate of orders earlier in the year, particularly March, April, and May, has been met with higher production. While most companies are still striving to meet some unfulfilled demand, the majority of users are getting most of the semiconductor devices they want. Because of this, abnormal situations have not developed. Semiconductor industry production is still very near, or at, industry capacity, but has not been overstressed.

Selective Shortages: We see little real evidence of widespread shortages, although selected products are in high demand and are difficult to get. What has happened is that selective shortages—or excessive demand—began, particularly in the high-end NMOS memory area. As the industry progressed through late 1977 and early 1978, wafers and people began to be allocated more heavily in these areas. This, in turn, diffused the tight capacity situation throughout most semiconductor products, and the inability to meet demand spread to a wider range of products, including what some may look upon as more mundane areas. At this time, although some of the state-of-the-art products, such as 16K RAMs, are now readily available, there is still difficulty in obtaining other products. Those products now in short supply are those that either have experienced rapid price declines in the recent past, or show little future for market growth, products that companies have not had a strong incentive to overproduce. We understand that 1K static MOS RAMs, bipolar PROMs, and Schottky TTL devices, for example, are difficult to obtain. Nevertheless, despite some long lead times, there are not excessive shortages. With slower growth in demand in the third and fourth quarters of this year, that situation (and lead times) should ease further.

Bookings: Lack of excessive shortages is also reflected in a reduction in bookings. Although industry shipments in August, a vacation month, were equal to those in May, we believe book-to-bill ratios have dropped from about 1.25 to 1.1. Although excellent, the ratios do reflect a definite easing.

Prices: Despite the heavy recent demand for semiconductors, DATAQUEST has not perceived any unusual stiffening of prices. Industry prices have continued to decline at what we might characterize as normal rates. Prices for 16K RAMs, which have been in very heavy demand, have fallen by more than 50 percent since the beginning of the year. Even in less volatile areas, such as discrete devices, prices have continued to decline as the year has progressed. By and large, we feel that this has reflected a general industry consensus that demand would indeed slow down in the second half of the year. As a result, forward pricing, even in those months of very heavy bookings, reflected that belief. This has beneficial aspects. The industry, in our opinion, has not been setting itself up for a future situation of disastrous price reductions.

Profits: Increased profits have come despite the costly efforts of increasing production. The heavy demand to build production in the spring and summer has resulted in what we perceive as considerable inefficiencies throughout the industry. The cumulative effects of heavy demand, allocated wafer starts, inexperienced and/or untrained labor, and other factors, have tended to decrease productivity. In other words, yields have not increased at the rates that should be expected. If demand slows further, that situation will be corrected rapidly.

Inventories: On the users' side, inventories appear to be rising slightly, but not to dangerous levels. However, it is probable that inventory in terms of finished goods has been rising considerably. There is a general uneasiness throughout the business community about the state of the economy. The euphoria that existed in such years as 1969 and 1973 doesn't exist. That has manifested itself in one measure by closer controls of inventories, less double ordering, and quicker reaction to changes in final demand—all beneficial practices. In short, the industry is extremely busy, but has avoided experiencing the uncontrolled levels of 1973 and early 1974.

Labor Availability: In one area, there are some similarities to the past—the area of labor availability. This is particularly evident in Silicon Valley (Santa Clara County in the San Francisco Bay Area). That area has a plethora of semiconductor and other high technology companies. This industry has expanded rapidly since the last recession and has used up the available labor pool. During the same period, inflation has increased the cost of housing to the point where the incoming flow of people has essentially been stopped. This has caused considerable problems for local companies in meeting their labor needs.

Forecast: Table 1 gives our estimate for U.S. semiconductor consumption, in terms of millions of dollars. We believe future semiconductor consumption will increase at a moderate pace. In 1978, we expect an increase in worldwide semiconductor consumption of 19 percent over 1977. For 1979, we expect semiconductor consumption to increase by 12.3 percent over 1978. A part of that increase will come from the momentum of the industry built up through the last few quarters. While we see integrated circuits accounting for the majority of the increase, we also see considerable growth in the discrete device market.

Our current estimates for 1978 U.S. semiconductor consumption by calendar quarter are shown in Table 2. The slow growth in the first quarter is somewhat misleading. That quarter was not only affected by the winter freeze, but it was surrounded by exceptionally high shipments in the fourth quarter of 1977 and the second quarter of 1978. The real demand probably increased somewhat faster than these numbers might indicate. Growth in the third quarter is also somewhat misleading because of the normal summer slowdown.

In 1979, DATAQUEST forecasts somewhat sluggish growth for the semiconductor industry with an acceleration not occurring until the third and fourth quarters. Our econometric model tells us that industry growth will slow for a while, before picking up, but that there will not be a downturn in demand. Longer term, we feel the growth prospects are excellent. The demand for semiconductors appears to have an extremely strong base at this time, with old markets increasing their use of semiconductors, and new markets—such as telecommunications and automobiles—continuing to open up.

Extra Demand Factors: We feel there are some positive factors adding to semiconductor demand in 1979 that are not taken into account in our econometric forecast but could provide stimulus to the market next year:

- Outside purchases of semiconductor products by captive suppliers

- The resultant effects of the inflation that we have had over the past several years

- The delayed effects of the dollar devaluation

The three largest captive semiconductor manufacturers in the United States are General Motors, IBM, and Western Electric. They share some common problems:

1. They face heavy demands on their semiconductor capacity. At IBM, this derives from substantial computer sales. At General Motors and Western Electric, the demands are derived from the increasing pervasiveness of semiconductors in the telecommunications and automotive industries where semiconductors have not previously been used. For some time, and particularly in the high technology areas, these companies will face strains on their production capacity.

2. These companies face the same problems that the merchant market manufacturers have been facing in 1978—converting a significant percentage of their semiconductor production to NMOS. This change in process technology, including upgrading technology to higher levels of LSI from, in some cases, discrete devices and SSI, is a particularly difficult problem.

3. These companies—particularly IBM—face the necessity of a turnover in their product line.

These three problems exist in varying degrees among all captive manufacturers. The combination and severity of these problems indicate that their likelihood of being solved rapidly is slim. We expect these companies to be major purchasers of semiconductors in the merchant market for some time. Incremental purchases by these companies in 1979 could exceed $100 million or more, or an incremental stimulus to U.S. semiconductor consumption of around 3 percent. These figures are purely speculative at this time, however.

Inflation may also play a key role in semiconductor demand. Inflation is something fairly new that we are living with and it has been endemic to our economy for only a few years. It seems to us, on the basis of limited evidence, that this is currently providing strong market growth for the semiconductor industry. Overall capital expenditures are sluggish and are being far outpaced by electronic sales. The industry may be getting a stimulus to its market growth not only now in 1978, but in 1979 and for many years to come. How much this will add to industry growth is difficult to estimate, but we believe that it has positive overtones.

Costs of virtually everything except semiconductors—labor, capital, equipment—have been going up. We see increasing evidence that the lower cost of electronics and the higher costs of labor and capital are creating and maintaining very large markets for semiconductors. An example is the type of elasticity that IBM and the minicomputer companies have seen for their products, and in the type of rapid growth that other markets employing electronics have seen. People are using electronics to increase the productivity of their work force. The decision of cost-effective electronics replacing additional labor is occuring many times over. Calculators, watches, automobiles, telecommuniations, and process control equipment are all excellent examples of the cost performance of semiconductor electronics versus mechanical equipment.

Another factor affecting the U.S. semiconductor industry is the relationship of the dollar to other currencies. The dollar devaluation has been substantial, and it has important implications in the competitiveness of the U.S. semiconductor and electronics industries in Europe and Asia. This is having a very direct result in foreign bookings by U.S. semiconductor companies which have risen over 75 percent in the interval of less than a year. Some of that is artificial, due to slowness in adjusting local prices. Local market growth also accounts for some of this rise. But we think the evidence is conclusive that the dollar devaluation is having an effect.

Since devaluation has continued recently, we believe it is an increasingly bullish factor in semiconductor demand for U.S. companies. The stimulus shown in foreign bookings for components should also be a stimulus to the U.S. electronics industry in general. The same competitive advantage seen in components will accrue in time to end products. This, of course, will show up as increased domestic consumption of semiconductors. However, we see little evidence of this increase so far; it may require somewhat longer to take effect.

Frederick L. Zieber
Mary Ellen Hrouda
James F. Riley

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Table 1

ESTIMATED U.S. CONSUMPTION OF SEMICONDUCTORS
(Dollars in Millions)

	1977	1978	Percent 77-78	1979	Percent 78-79
Discrete Devices	$ 925	$1,027	11.0%	$1,097	6.8%
Integrated Circuits	1,787	2,198	23.0%	2,525	14.9%
Total	$2,712	$3,225	18.9%	$3,622	12.3%

Source: DATAQUEST, Inc.
November 1978

Table 2

ESTIMATED QUARTERLY U.S. SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1978				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$236	$258	$264	$269	$1,027
Integrated Circuits	497	554	563	584	2,198
Total	$733	$812	$827	$853	$3,225
Percent Change From Previous Quarter	0.7%	10.8%	1.8%	3.1%	

	1979				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$267	$271	$276	$283	$1,097
Integrated Circuits	594	617	638	676	2,525
Total	$861	$888	$914	$959	$3,622
Percent Change From Previous Quarter	0.9%	3.1%	2.9%	4.9%	

Source: DATAQUEST, Inc.
November 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 31, 1978

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of some current issues having an impact on the U.S. semiconductor industry. Some of these issues have been reported upon before in earlier DATAQUEST newsletters.

- President Carter went public with his National Export Policy and called for a reduction in U.S. barriers to exports, and an investigation of U.S. antitrust laws, among other things.

- Congressional and business reaction to the President's National Export Policy was skeptical, with key members of Congress calling it "weak" and "cosmetic."

- Leading members of the House of Representatives have organized an Export Task Force to resolve foreign trade problems. California Congressmen have organized an ad hoc committee to look at bureaucratic delays hindering exports.

- A Congressional Task Force continued critical of Japanese, U.S. Government, and business efforts to implement the Strauss-Ushiba Communique and recommended major changes in U.S. trade policies.

- President Carter has signed the Customs Procedural Reform Act of 1978, which includes a substantial reduction in Section 592 penalties.

- An Industrial Innovation Coordinating Committee has been established by the White House to find ways to increase significant industrial innovation in the United States.

- The Senate Commerce Committee has scheduled hearings on technology innovation for October 30 in San Francisco. The hearings will focus on the semiconductor and computer industries.

- The U.S. Commerce Department relaxed export controls over shipment of certain semiconductor devices to Eastern bloc destinations.

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- U.S. high technology firms can expect increasing problems as a result of the application of export controls for national security and foreign policy purposes.

- Congress could well tighten controls on sales of high technology items to Communist countries. It may also expand the application of controls to free-world countries in 1979.

Export Policy--President Carter's Proposals

President Carter's long awaited plan to increase U.S. exports has attracted some strong criticism, both on Capitol Hill and in the business community. Nevertheless, White House attempts to put a plan together have resulted in substantially increased attention to problems confronting U.S. companies attempting to compete in foreign markets.

Announced late last month, The President's National Export Policy comprises actions that the Administration intends to take in the following three general areas:

- Providing increased direct assistance to U.S. exporters

- Reducing domestic barriers to exports

- Reducing foreign barriers to U.S. exports and securing a fairer international trading system for all exporters

More specifically, in his September 26 statement, the President called for:

- Increased loan authorizations for the Export-Import Bank that will amount to $4.1 billion in fiscal year 1980

- Small Business Loan Guarantees to provide seed money to enable small businesses to enter foreign markets; a total of $100 million of the Small Business Administration's current authorization will be committed for this purpose

- An increased effort in the area of Export Development Programs; these efforts, estimated to cost $20 million annually, will be directed towards developing:

    1. A computerized system to provide exporters with prompt access to international marketing opportunities

    2. Risk-sharing programs to help associations and small companies meet initial export marketing costs

    3. Targeted assistance to firms and industries with high export potential and intensified short-term export campaigns in promoting markets

Regarding domestic barriers to exports, the President directed the heads of all Executive Departments and agencies to take into account and "weigh as a factor" the possible adverse effects on the U.S. trade balance of their major administrative actions that will have "significant export consequences." At the same time, the President directed the heads of Commerce, State, Defense, and Agriculture to take export consequences fully into account when considering the use of export controls for foreign policy purposes.

The President also called upon the Justice Department to clarify the scope of U.S. antitrust laws, especially as they might apply to one-time joint ventures created to help several U.S. companies participate in a single export-related activity. The President further instructed the Justice Department to expedite requests by business firms on all international antitrust issues.

On the controversial issue of environmental reviews, the President said he would shortly issue an Executive Order specifying the following:

- Environmental Impact Statements will not be required for federal export licenses, permits, approvals, and other related actions.
- Export licenses issued by the Commerce and Treasury departments will be exempt from any environmental reviews required by the Executive Order.
- Abbreviated environmental reviews will be required only with respect to nuclear reactors and products and facilities whose toxic effects create serious public health risks.

The Administration's Export Policy Statement singled out the importance of a strong U.S. posture in the current round of Trade Negotiations. As one of the Administration's major objectives during these negotiations, the Policy Statement specifically identified the establishment of an international code to restrict the use of government subsidies for exports.

The President's Message offered nothing new in the tax area. Mr. Carter has continued to call for the elimination of the Domestic International Sales Corporation (DISC) but has not offered any suggestions for an alternative to replace DISC if it is repealed.

<u>Export Policy--Congressional and Industry Reactions</u>

Just two days after President Carter's Export Policy Statement, key members of the Senate Commerce Committee and the Joint Economic Committee publicly suggested that the statement was "weak" and "cosmetic."

Senator Jacob Javits (R-NY), a member of the Joint Economic Committee noted that the Administration's plan had no provision for a national productivity drive and contained no major research and development component.

Senator Adlai Stevenson (D-IL), a member of the Senate Commerce Committee called the President's plan "weak" and specifically expressed concern over the Administration's recommendations relating to the Export-Import Bank.

Industry witnesses were no kinder to the Administration's proposals, citing as major deficiencies the President's continuing opposition to DISC and the lack of any strong policy advocate for international trade interests in the Executive Branch.

Most observers agree that the President's Message of September 26 represents only the starting point for next year's increased Administration and Congressional consideration of this basic issue. There is little question that Congress will play an increasingly important role as both branches of government struggle to develop a strong national export policy. The degree to which export expansion will prevail over protectionism in the new Congress remains uncertain.

Trade Policy

Even before President Carter announced his recommendations to strengthen and enhance the growth of U.S. exports, key members of the House of Representatives were meeting with members of the U.S. business community to examine what might be done to change U.S. export policies.

As a result of that meeting, Congressional leaders in the House agreed to form an Export Task Force "in order to provide a forum for all Members of the House to assemble regularly to share information, ideas and goals on how best to resolve foreign trade problems."

The initial meeting was called by Rep. William Alexander (D-AR), a member of the House Appropriations Committee and a longtime proponent of domestic trade promotion efforts. Other Congressional participants in the meeting included the chairmen of the Ways and Means, Banking, Agriculture, and International Relations Committees as well as several ranking members of the House Appropriations Committee.

With this level of participation, there is little question that the Task Force will have tremendous clout in Congress. There is also little question that the group will become more than a debating society as it finalizes its program of action and identifies its objectives for the coming year.

Rep. Alexander will chair the House Task Force. Rep. Barber Conable (R-NY) will be vice chairman and Rep. Stephen Neal (D-NC) will be secretary.

In a related development, an Ad Hoc Committee on Exports was recently formed by the California Delegation in the House of Representatives. In announcing the formation of the committee, its chairman, Rep. James Lloyd (D-CA), said that U.S. companies are losing business to foreign competitors because of "bureaucratic delays in both the Departments of State and Commerce." These barriers, together with better ways of promoting exports of nonmilitary products, will be the focus of the committee's attention.

The committee includes Democrats Don Edwards, Mark Hannaford, John Krebs, and Lionel Van Deerlen, and Republicans Robert Lagomarsino and Paul N. McCloskey.

<u>U.S.-Japan Trade Policy</u>

A Congressional study group, the Special Task Force on the United States-Japan Trade Agreement, organized by the House Ways and Means Committee under the Chairmanship of Rep. James Jones (D-OK), has continued critical of progress made toward implementing the Strauss-Ushiba Communique. Consequently, in its second report, the Task Force urged the President to consider two major policy proposals:

- Create a cabinet-level office to be led by an "Export Minister" who would coordinate, publicize, and expand government programs to increase export development.

- Develop a list for further study of special incentives to aid marketing expenses associated with the export of <u>any</u> new products into foreign markets.

Specific provisions of draft legislation in these areas have not yet been released, but it is significant that President Carter's National Export Policy Statement included reference to neither of these concepts. It is understood, however, that the Ways and Means Committee will be scheduling public hearings on the continuing U.S.-Japan trade situation later this year. Several members of the Committee seem anxious to expand the scope of the Committee's investigation into the development of a more active and aggressive U.S. trade policy.

The Ways and Means Committee Task Force on Japanese Trade raised a number of specific concerns with respect to the situation including:

- Serious concern over the lack of <u>any</u> progress in the Trade Facilitation Committee. The Task Force noted that since its creation in April 1978, not a single new case has been resolved by the Committee, and only three cases have been resolved in favor of a U.S. exporter since September 1977.

- A declaration that the Japanese have not come half way on Trade Facilitation cases and are not seeking grounds for accommodations to legitimate U.S. requests. The Task Force notes that typical Japanese response to such requests has been either to provide technical counterarguments of "questionable plausibility" or to claim that the problem is "not susceptible to a simple solution."

- Concern that implementation of other aspects of the Strauss-Ushiba Communique has "not proceeded past the talking stage." As an example, the Task Force cites statements by Japanese officials early this year that procurement practices of Nippon Telephone and Telegraph (NTT) would follow the January Cabinet Order opening government telecommunication to foreign competition. However, in a May 17 meeting between NTT President Akikusa and Prime Minister Fukuda, Japanese press reports quote Akikusa as saying that "NTT uses only domestically produced equipment--and wants to keep it that way."

- The observation that in the area of computer procurement, only two companies have received important contracts since January, according to the Task Force's investigation. The Japanese Government purchases 98 percent of its computers from Japanese suppliers.

In addition to these findings, the Task Force has asked its professional staff to investigate legislation creating reciprocal testing arrangements with foreign nations. This request was made because the group has found that the Japanese do not accept product testing results that are accepted by other nations around the world. Instead, according to the Task Force, the Japanese insist on retesting in Japan before approving products for distribution. This system provides a "convenient means" to delay and/or block introduction of competing products into the Japanese market.

While not as outspoken in its criticism of the U.S. Government and U.S. business, the Task Force also found fault with their efforts to increase trade with Japan. As an example, the Task Force reports that it has found numerous cases of rigidity in U.S. pricing, packaging, and timing policies that greatly reduce the ability of U.S. companies to sell in the Japanese market.

It is clear that the Task Force intends to keep pressure on the U.S. Government and the American business community as well as on the Japanese as it attempts to monitor the progress all three elements are making to reduce the trade imbalance between the two countries. To the extent that progress is not made, and to the extent that such lack of progress can be attributed to the Japanese, the Task Force is likely to recommend a wide range of retaliatory measures to an in-

increasingly sympathetic Congress. However, these proposals are likely to have diminished impact in the coming months proportionate to the fault that can be found with U.S. efforts.

Customs Reform

President Carter has signed H.R. 8149, called the Customs Procedural Reform Act of 1978.

A House-Senate Conference Committee approved the legislation on August 17 and in doing so resolved two significant differences between versions of the bills approved earlier by the House and Senate.

Regarding the calculating of monetary penalties under a substantially revised Section 592 of the Tariff Act of 1930, the Conference Committee agreed with the recommendation of the House that penalty calculations be based on the domestic value of the merchandise. The Senate had recommended that any penalties be based on the dutiable value of the merchandise, a method of calculation that would have benefited high technology companies using Items 806.30 and 807.00 of the U.S. Tariff Schedules.

More important to many semiconductor and other high technology companies, however, was the Conference Committee's decision regarding the effective date of the substantially reduced penalty provisions contained in H.R. 8149.

As agreed to by the Conference Committee and approved by the President, the provisions of Section 592 as they existed before the enactment of H.R. 8149 would apply to any alleged intentional violation involving television receivers produced by Japanese manufacturers that were the subject of antidumping proceedings, if such alleged violations (1) occurred before the date of enactment of H.R. 8149, and (2) were the subject of a U.S. Customs Service investigation before the date of enactment of H.R. 8149.

The earlier Senate version had employed language that would have applied the stiff penalty provisions of Section 592 existing before the enactment of H.R. 8149 to all intentional acts or omissions committed before the date of enactment--if such acts were the subject of a U.S. Customs investigation. Restricting this language to Japanese television sets eliminated most U.S. users of Items 806.30 and 807.00 from potential application of old and far more onerous Customs penalties.

Federal Policy on Industrial Innovation

President Carter has established an Industrial Innovation Coordinating Committee to develop policy options designed to increase significant industrial innovation in the United States. The objectives of these policy options, which are to be presented to the

President in late 1979, are to:

- Ameliorate any negative impacts that existing federal policies have upon private sector R&D and innovation in a way consistent with other national goals

- Stimulate greater and more effective industrial innovation through new policies, programs, and incentives

More specifically, the Committee has been asked to address the following questions:

- Are new or revised government policies needed to increase the effectiveness of the private sector in generating:

  - The industrial R&D needed to produce innovations consistent with the national goals?

  - The investment, entrepreneurial, informational, technological, or other capacities needed for the development and utilization of innovations?

- What is the optimal level and scope of direct federal participation in the innovation process?

- Are significant changes needed in current policies and procedures to minimize adverse impacts and maximize mutual support?

- Should mechanisms be introduced to assure that proposed legislation and regulations are assessed for their impact on innovation?

- What can and should the Government do to counter foreign initiatives that might cause U.S. industry to fall behind foreign firms in technology and world market competitiveness?

- What can and should the Government do to foster technological innovation and thus improve and expand the U.S. position in export markets?

Technology Innovation Hearings Scheduled

The Senate Commerce Committee has scheduled hearings in San Francisco for October 30 on the growth in the United States and internationally of competition in the semiconductor and computer industries.

According to the Committee's staff, these hearings will focus on such topics as:

- Factors contributing to the tremendous growth and success of these U.S. industries

- The nature of present and future foreign competition
- The situation with respect to the continued ability of small firms to successfully compete both at home and abroad

Witnesses will include Wilfred Corrigan of Fairchild Camera and Instrument and Gene Amdahl of Amdahl Corporation, as well as representatives from Texas Instruments and from the venture capital community.

Controls Over Semiconductors Relaxed

The Office of Export Administration in the U.S. Department of Commerce has determined that the export of certain transistors and diodes does not violate the Department's security guidelines in light of the fact that they would not contribute significantly to the development, production, or use of military equipment in the Communist bloc countries. At one time, a firm was required to submit an application to the Office of Export Administration to receive specific authorization before exporting these items to Communist markets. These devices may now be exported to Communist destinations under general license.

DATAQUEST has a list of the specific decontrolled products that we will be glad to furnish upon request. Questions regarding the list should be directed to Mr. Charles Swanson, Director, Operations Division, Office of Export Administration, U.S. Department of Commerce, Washington, D.C., 20230; (202) 377-4196.

Export Controls

The use of export controls by the U.S. Government to achieve both national security and foreign policy objectives has already created major problems for U.S. high technology companies doing business in international markets and threatens to become a major issue both within the Executive Branch and on Capitol Hill next year. The battle lines are already being drawn, and if the last decade's progress in reducing the level, complexity, and number of procedures involved in the export control process is reversed, U.S. companies could lose a significant amount of international business in both free world and Communist markets.

Traditionally, the United States has controlled exports to Communist countries for national security purposes. During the past several months, however, under pressure from certain elements in the White House and the State and Defense Departments, and with support from some members of Congress, these same controls are being applied to free-world countries to achieve U.S. foreign policy objectives. For example, validated export licenses are now required by the Commerce Department for the export of crime control and detection equipment to most free-world destinations.

Executive Branch movement in this direction has received considerable support on Capitol Hill. Only last month, the Senate passed legislation (S. 3075) that would have required a validated export license for the sale of any product to any country engaged in activities detrimental to important political or military interests of the United States. At the last minute, this language was deleted from the legislation, but only after representatives from both the House and Senate promised to look into the effect of this requirement and report back to their respective chambers next year.

Currently pending in the House are several bills, including H.R. 14140, the "Technology Transfer Ban Act of 1978." This bill, introduced by Rep. Richard Ichord (D-MO) and 24 cosponsors, would:

- Ban the transfer of goods and technology having any potential military, law enforcement, or intelligence gathering value to any Communist or other country to which exports are restricted for national security purposes

- Require the President to notify Congress of any proposed sale of products or technology to any Communist or other nation designated as a controlled country

- Mandate that the Secretary of Defense submit directly to the Congress a "military impact statement" on those proposed transactions, which the Defense Department normally reviews with the Export Control Office in the U.S. Department of Commerce, or within 21 days of a Congressional request submit a similar military impact statement on <u>any</u> license application

- Grant the Congress veto authority over any proposed transfer of technology or product sale to any Communist nation or other nation designated as a controlled country

This legislation has been referred to the Subcommittee of the International Economic Policy and Trade Committee of the International Relations Committee in the House which, during recent weeks, has shown the most sympathy for continuing industry pleas to reduce both the level and complexity of U.S. controls.

While H.R. 14140 is not expected to be seriously considered in the new Congress, several of its underlying objectives could well form the basis for legislation when the Export Administration Act comes up for renewal early next year. These include:

- Greater involvement by Congress in individual license applications as well as a greater say regarding what destinations in the free world will be subject to more stringent requirements

- Increased Defense Department and White House involvement in the export licensing process

- Less predictability in the level of controls and the nature of products to which such controls will be applied as well as equal uncertainty with respect to the export destinations that will be subjected to those controls

All of this portends serious consequences to U.S. high technology exporters who have consistently argued that the level of U.S. controls and the delays in the export licensing process have resulted in lost business in Communist markets. Now some U.S. firms are already experiencing similar difficulties with proposed exports to free-world destinations.

Industry representatives have not been silent on the issue. Earlier this month, in testimony before the Senate Banking Committee, Hewlett-Packard's Chairman, David Packard, recommended that any decision to use export controls for foreign policy purposes should be undertaken only:

- To support clearly defined foreign policy objectives
- When based on an adequate amount of factual information
- When the likelihood of such unilateral action will cause a desirable behavior change in the target country
- Where the commodities cannot be obtained readily from non-U.S. sources
- When the action is unlikely to adversely affect U.S. business in other countries
- After full consideration of the potential impact on various aspects of the U.S. economy, such as employment, inflation, management attitudes, and the balance of trade and payments

The computer industry has also expended considerable effort during the past several months developing a series of recommendations to counter the thrust of those proposing more stringent application of U.S. export controls. In testimony before a House subcommittee earlier this month, representatives from that industry, supported by the machine and tool industry, recommended the creation of a Government/Industry Business Advisory Committee whose principal functions would be to:

- Review and confer with key government officials as to the status of:
  - U.S. development and availability
  - International development and availability

- Determine the competitive levels of U.S. exporters and their resulting export forecasts, including trade balances

- Establish threshold levels for exports and evaluate the merits of license applications

The industry also requested the Defense Department to delegate more authority to the Commerce Department so that license applications could be processed more quickly.

Frederick L. Zieber
Daniel L. Klesken
James F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 30, 1978

SEMICONDUCTOR INDUSTRY
CAPITAL EXPENDITURES 1973-1979

Summary

After an extended recovery period following the 1974-75 downturn, 1978 capital expenditures this year by U.S. merchant semiconductor manufacturers should significantly surpass prerecession levels. Expenditures for 1978 are expected to exceed $650 million, an increase of 55 percent from the estimated $421 million spent in 1977.

Capital expenditures in 1978 are anticipated to be 13 percent of estimated semiconductor revenues, a higher percentage than any previous year, and almost twice as high as 1975's estimated 7 percent level. Proportional spending rates among captive producers could raise the total facilities and equipment bill for semiconductor plants to around $800 million in 1978.

Information available from several major manufacturers indicates that 1979 spending for facilities and equipment should remain at a level comparable to that of 1978. DATAQUEST believes that the increased capital-intensity of the industry will continue and the ratio of capital spending to revenues could trend upward over time. This may eventually strain the industry's financial resources.

Historical Capital Spending Levels

From 1973 to 1974, capital spending by U.S. merchant semiconductor manufacturers expanded slightly faster than industry revenues. The downturn in 1974-75, however, resulted in a reduction in capital expenditures by more than 50 percent. It was not until 1977 that capital spending levels were restored to their pre-1975 levels with estimated expenditures of $421 million.

DATAQUEST estimates that 1978 capital expenditures for merchant semiconductor manufacturing plant and equipment should total approximately $653 million, up substantially from an estimated $421 million spent during 1977.

Table 1 summarizes overall corporate capital expenditures by major U.S. merchant manufacturers for the period 1973 to 1978. Table 2 contains DATAQUEST's estimates of capital expenditures for semiconductor plant and equipment only.

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Yearly capital expenditures as a percentage of semiconductor revenues dropped significantly, from 12 percent in 1973-74 to 7 percent in 1975. After two years at the 10 percent level, capital expenditures in 1978 should be greater than 13 percent of projected semiconductor revenues. Table 3 breaks out capital expenditure-to-revenue ratios for nine major U.S. merchant semiconductor manufacturers on a yearly basis, and estimates the industry average, for the years 1973 through 1978. Table 4 provides the overall corporate revenues. Table 5 shows the semiconductor revenues from which the percentages in Table 3 were derived.

Future Prospects

While prospective capital spending plans can only be viewed as a tentative measure of industry well-being, there are a number of indications that can be viewed very positively with regard to spending levels in the near-term future:

- Intel originally estimated "likely" corporate spending of $60 million for 1978 but, in face of a quickening pace of sales, schedules were advanced where feasible. Intel is now expected to spend about $90 million in 1978 and about $100 million in 1979.

- National Semiconductor announced fiscal 1979 spending plans of $85 million compared with $42 million in fiscal 1978. They are expected to spend on the order of $60 million in fiscal 1980.

- Advanced Micro Devices indicated plans to spend $20 million in fiscal 1979, reportedly followed by $30 million in fiscal 1980.

- Fairchild had announced plans to spend $30 million corporate wide for facilities early in 1978, but it now appears that this amount will be exceeded by year end. The company has tentatively budgeted $50 million for 1979.

Plans for 1978 have already been exceeded or restated upwards, and no significant slackening is planned for 1979. Clearly, manufacturers seem to feel that to keep pace with continuing industry growth and changing technology in the immediate future, they must sustain the current high level of expenditure through the next two years.

Lane Mason
Frederick L. Zieber

Table 1

TOTAL CORPORATE CAPITAL EXPENDITURES[1]
(Calendar Years - Dollars in Millions)

	1973	1974	1975	1976	1977	1978E[2]	1979E
Texas Instruments	$125	$148	$ 66	$136	$199	$ 300	N/A[3]
Motorola	$ 85	$135	$ 71	$ 98	$124	$ 145	N/A
National	$ 21	$ 26	$ 19	$ 29	$ 41	$ 67	$ 71
Fairchild	$ 35	$ 41	$ 21	$ 36	$ 22	$ 32	$ 50
Intel	$ 9	$ 13	$ 11	$ 32	$ 45	$ 90	$ 100
Signetics	$ 22	$ 21	$ 4	$ 10	$ 19	$ 45	$ 60
AMD	$ 6	$ 5	$ 1	$ 5	$ 7	$ 17	$ 28
Mostek	$ 5	$ 10	$ 3	$ 10	$ 24	$ 21	$ 30
AMI	$ 9	$ 5	$ 2	$ 3	$ 4	$ 5	$ 6

[1] AMD and NSC fiscal years end March 31 and May 31 respectively. In all tables in this newsletter, fiscal year data have been calendarized by prorating expenditures and revenues from included calendar years; companies are listed in order of total corporate revenues shown in Table 4.

[2] E = Estimated

[3] N/A = Information not available

Source: Annual Reports
DATAQUEST, Inc.
October 1978

Table 2

ESTIMATED SEMICONDUCTOR CAPITAL EXPENDITURES

OF U.S. MERCHANT MANUFACTURERS

(Calendar Years - Dollars in Millions)

	1973	1974	1975	1976	1977	1978E[1]	1979E
Texas Instruments	$ 64	$ 68	$ 35	$ 62	$ 88	$ 120	N/A[2]
Motorola	41	71	21	33	~~43~~ 53	~~60~~ 72	N/A
National	21	20	17	26	31	57	$ 55
Fairchild	35	41	20	36	15	23	34
Intel	9	13	11	32	33	60	75
Signetics	22	21	4	10	19	45	60
AMD	6	5	1	5	7	17	28
Mostek	6	10	3	10	24	21	30
AMI	9	5	2	3	4	5	6
Subtotal	$213	$254	$116	$218	$265	$ 408	N/A
Others (Est.)	128	167	79	139	156	245	N/A
Industry Total	$341	$421	$195	$356	$421	$ 653	N/A

see p.30 Annl Rpt.

[1] E = Estimated

[2] N/A = Information not available

Source: Annual Reports
DATAQUEST, Inc.
October 1978

Table 3

ESTIMATED SEMICONDUCTOR CAPITAL EXPENDITURES AS A PERCENTAGE OF SEMICONDUCTOR REVENUES FOR U.S. MERCHANT MANUFACTURERS

(Calendar Years)

	1973	1974	1975	1976	1977	1978
Texas Instruments	10.6%	10.8%	6.7%	9.5%	11.8%	14.1%
Motorola	9.2%	14.8%	5.8%	7.1%	7.8%	8.5%
National	13.7%	9.5%	7.9%	9.9%	10.9%	15.0%
Fairchild	12.4%	12.7%	8.5%	11.7%	4.6%	6.5%
Intel	15.5%	11.3%	9.9%	21.8%	15.9%	20.7%
Signetics	20.4%	16.5%	4.9%	8.0%	10.3%	20.9%
AMD	28.6%	17.9%	6.3%	9.1%	8.5%	12.9%
Mostek	15.4%	20.8%	7.9%	17.9%	30.0%	18.2%
AMI	16.1%	6.7%	5.2%	6.0%	7.0%	6.8%
Industry Average	12.0%	12.5%	7.0%	10.2%	10.5%	13.1%

Source: Annual Reports
DATAQUEST, Inc.
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Table 4

TOTAL CORPORATE REVENUES

(Calendar Years - Dollars in Millions)

	1973	1974	1975	1976	1977	1978E[1]
Texas Instruments	$1,287	$1,572	$1,368	$1,659	$2,046	$2,510
Motorola	$1,213	$1,388	$1,337	$1,535	$1,848	$2,127
National	$ 156	$ 244	$ 269	$ 374	$ 426	$ 572
Fairchild	$ 362	$ 396	$ 300	$ 450	$ 470	$ 520
Intel	$ 66	$ 135	$ 137	$ 226	$ 283	$ 398
Signetics	$ 98	$ 121	$ 82	$ 125	$ 175	$ 215
AMD	$ 21	$ 28	$ 32	$ 55	$ 82	$ 132
Mostek	$ 42	$ 60	$ 47	$ 58	$ 86	$ 130
AMI	$ 58	$ 75	$ 66	$ 67	$ 71	$ 73

[1] E = Estimated

Source: Annual Reports
DATAQUEST, Inc.
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Table 5

ESTIMATED SEMICONDUCTOR REVENUES

(Calendar Years - Dollars in Millions)

	1973	1974	1975	1976	1977	1978E[1]
Texas Instruments	$604	$632	$520	$655	$745	$ ~~850~~ 920
Motorola	$445	$481	$362	$462	$548	$ 650
National	$153	$210	$215	$263	$288	$ 380
Fairchild	$283	$323	$236	$307	$325	$ 355
Intel	$ 58	$115	$111	$147	$207	$ 290
Signetics	$ 98	$121	$ 82	$125	$175	$ 225
AMD	$ 21	$ 28	$ 32	$ 55	$ 82	$ 130
Mostek	$ 39	$ 48	$ 38	$ 56	$ 80	$ 110
AMI	$ 56	$ 74	$ 58	$ 67	$ 71	$ 73

[1] E = Estimated

Source: Annual Reports
DATAQUEST, Inc.
October 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletter October 11, 1978

SEMICONDUCTOR INDUSTRY CAPACITY EXPANSION

Summary

Capital expenditures in the semiconductor industry are at record levels with estimated 1978 expenditures by U.S. companies approaching the $650 million level. These expenditures are resulting in additional wafer fabrication capacity in the industry, and fears have been expressed concerning future overcapacity, which DATAQUEST believes to be unjustified. We do not foresee a future problem with industry overcapacity, since several factors modify the effect of current capacity expansion.

- Industry growth
- Changing technology
- Increasing wafer fab requirements per revenue dollar
- Market purchase requirements of captive suppliers

A look at these factors indicates that not only is there a great need for increased capacity, but that many of the improvements appear merely to be filling changing industry requirements and not adding net wafer capacity. DATAQUEST believes an overcapacity situation is not developing. We presently forecast about 11 percent dollar growth in U.S. semiconductor consumption in 1979, and we believe that overcapacity will not be a factor in impacting industry profits. Since pricing pressure would come from weak demand, rather than over building, profits are not expected to be greatly affected unless dollar growth next year approaches zero. (Note: DATAQUEST is currently taking a census of worldwide wafer fabrication facilities that will be used as a basis for a more quantitative analysis. We are also researching industry capital expenditures as a seperate operation. Results will be reported in future newsletters.)

Industry Growth

At the present time, the semiconductor industry is clearly operating at capacity and many companies are operating facilities at above comfortable rates. Most companies are increasing their output to meet demand. Worldwide, the semiconductor industry is growing at a rate of over $1 billion per year. U. S. semiconductor companies, excluding captive suppliers, grew about $500 million in output in 1977 and are expected to grow an additional $700-800 million in 1978. A new wafer fabrication module is generally designed to produce $30-50 million in semiconductor devices per year, which indicates that in the

United States alone, a net yearly increase of about 15 to 20 semiconductor fabrication modules is not excessive. Furthermore, U. S. companies must compensate for slow capacity growth following 1974. Companies must meet demand growth, make up for slow past expansion, and provide a cushion of excess capacity. In short, the industry is large (2.6 times its 1971 size) and getting larger. This growth requires extensive yearly capacity expansion to keep even.

Changing Technology

The rapid change of processing technology in the semiconductor industry is a critical factor in current capital expenditures. Generally, N-channel MOS can not be manufactured efficiently in older semiconductor manufacturing modules designed for bipolar or PMOS devices. Similarly, bipolar memory, Schottky, and other LSI devices need new manufacturing facilities. Considerable equipment upgrade is also required to manufacture HMOS, VLSI, or smaller dimension devices, and to upgrade to 4-inch silicon wafer manufacture. Thus, many new modules are required simply to remain competitive. It is not surprising that this tremendous need for new modules is often manifested in the retrofitting or upgrading of older fabrication areas. A large percentage of current capital expenditures for new modules are actually retrofits that do not add to net capacity.

Wafer Fabrication Requirements

A major turning point in semiconductor economics occurred in 1977. For the first time in the history of the industry, average selling prices for integrated circuits began increasing, which was of course an indication of the switch to LSI chips and the decline in market share of SSI devices. Even if industry revenues remained constant, this change would significantly increase wafer fabrication capacity requirements, because larger chips are more wafer fabrication intensive. More of the revenue dollar is in fab, and less in packaging costs. In a simple example, the average final revenue for a 3-inch wafer of SSI devices can be approximately $250. This is often around $150 for many LSI devices. Thus, to ship $1,500 worth of semiconductor devices, might require six wafers in the case of SSI and 10 wafers in the case of LSI—a 67 percent increase, which illustrates a hidden need for increased wafer fabrication capacity.

Captive Suppliers

The major U. S. captive manufacturers—General Motors, IBM, and Western Electric—have similar problems adjusting to new LSI technologies. These companies are faced with needs that they currently cannot meet with their own manufacturing capabilities. As a result, they are increasing outside purchases; this further swells the requirement for additional merchant manufacturing.

Wafer Fabrication Module Costs

DATAQUEST has previously estimated that wafer fabrication module costs have increased from about $2 million in the recent past to $8-10 million at present. This reflects costlier facilities and equipment requirements as well as inflation. Thus, capital expenditures are increasing for a given amount of capacity expansion. Annual revenue per dollar of capital expenditure has declined from about $10 in 1971 to $3 today. This decline is expected to continue, and poses a significant industry problem.

U. S. semiconductor companies increased output by about 10 percent in the second quarter of 1978 alone. The need for additional capacity, and some excess cushion, is apparent.

Expansion in bricks and mortar and equipment can be overstated. Capacity in the semiconductor industry can be measured in people as well as facilities. Furthermore, personnel are most often the limiting factor. For average semiconductor overall costs, labor (including sales, engineering, and administration) can account for nearly 70 percent, material for about 24 percent, and buildings and equipment for about 6 percent, of which buildings represent about 1 percent and equipment about 5 percent. Although that percentage is increasing, it seems clear that the most cost-effective short term method to affect capacity is to increase (or decrease) employment. But facilities are operating at full potential, companies have an upper limit to their output. This limit can hurt a company in the marketplace during strong business periods. With this knowledge, semiconductor companies are willing to risk excess unused facility capacity, with a minor cost penalty, against the potential cost of being unprepared for future expansion.

DATAQUEST believes that the current increase in capacity is not one for concern. That increase is needed and is being absorbed. Current expenditures are well justified.

Frederick L. Zieber
Daniel L. Klesken
James F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 11, 1978

LASER ANNEALING

Summary

A new process using lasers to anneal semiconductor wafers following ion implantation is currently being investigated by several research laboratories. The potential of this process is sufficient to merit industry attention. Laser annealing offers improved control over dopant implants, excellent defect annealing, and better dimensional tolerance control. Because of its newness, information on this process is necessarily incomplete.

Who?

Laser annealing was first proposed by scientists in the U.S.S.R. Major work is being done at Bell Laboratories, Stanford University, and other research institutions. We believe investigations are also taking place in several industrial laboratories such as those at Intel, IBM, Toshiba, and Xerox.

How?

Laser annealing uses a laser to produce a short duration, high concentration of energy on the surface of the semiconductor wafer. The beam must scan the wafer to cover the area required. Generally, energy densities for the laser range from 1 to 10 joules per square centimeter. Beam exposure times are in the millisecond range. Because the light hits the surface of the wafer for only a short period of time, only a very thin layer on the surface is heated. Since the wafer and the surrounding environment remain at a much lower temperature, cooling is also extremely rapid. Studies have shown that this rapid annealing accomplishes the same purpose as thermal annealing—activation of the implanted dopants (settling them in the crystal lattice) and returning the surface to a single crystal.

Why?

Laser annealing appears to have potential advantages over the thermal annealing currently in use.

1. The wafer is not submitted to a high temperature for an extended time. The advantage of a low-temperature process is fully realized.

2. The speed of laser annealing is such that there is essentially no thermal migration of the dopants. They remain in the profile

expected from the ion implantation. This profile in terms of concentration and depth is determined by the time and power of the implantation and is highly controllable. With laser annealing, this control is not then lost by further thermal migration but remains highly predictable and controllable.

3. Because there is no thermal migration, layers remain shallower and there is no horizontal diffusion by the dopants. The surface geometry will remain more or less the same as implanted—a major advantage as minimum dimensions become smaller.

4. Research indicates that laser annealing can cause excellent recrystallization at the surface of the wafer. Many surface crystalline defects appear to be annealed by this process. This may have some potential advantage for future VLSI devices, especially for dynamic RAMs.

Frederick L. Zieber
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James F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.08 National Semiconductor Corporation

October 6, 1978

NATIONAL SEMICONDUCTOR ANALYSTS' MEETING

The National Semiconductor Analysts' Meeting on September 14, 1978 was chaired by Charles Sporck, President and Chief Executive Officer who focused upon present and future developments in such areas as auto electronics, computer products, and Point of Sale products. Other directors and officers present included Robert Beshar, Floyd Kvamme, Pierre Lamond, Peter Sprague, Donald Weeden, and Harry Wetzel.

FINANCIAL HIGHLIGHTS

Expansion was the key word as National commented on capital expenditures and the outlook for 1979 as follows:

- Capital expenditures for the 1979 fiscal year will be about \$85 million; 1978 capital expenditures were \$42 million. The majority of this spending will be allocated to semiconductors for wafer fab and to the Computer Systems Group for land and buildings.
- New capacity being added at the Salt Lake facility is expected to be in production this year. This facility will be devoted largely to NMOS memory. Although the facility will initially handle 4-inch wafers, it will have the capability of conversion to 5-inch wafers.
- The April 1977 wafer fabrication fire in Scotland cost the Company approximately \$60 million in sales (Linear, NMOS Si gate, Bipolar Digital). Nonetheless, the facility was completely rebuilt in nine months. The MOS fabrication area is expected to be running this fall as well as the Bipolar Digital fabrication areas.
- R&D expenses in the 1978 fiscal year were reported to be 8.5 percent of sales, and the percentage is projected to go up in the 1979 fiscal year.
- Because of these additional depreciation and R&D expenditures National does not anticipate an improvement in 1979 profit margins.
- National bookings appear strong with semiconductor products having a book/bill ratio of well over 1. There was no summer slowdown; however, there was a spring peak.

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- National anticipates the market to remain strong through fall 1978 with a slackening in the spring of 1979. This prediction does not reflect the condition of the market at this time, however.

Automotive Electronics

- Model year 1981 will be the first year for across-the-board use of electronics in the automobile industry.
- National claims that in 1981 the auto industry will purchase about $500 million of semiconductor devices. Specifically, $39.50 per car will be expended for semiconductors; $30 of this will be required to meet legal engine control requirements.
- Due to this anticipated automotive electronics market, National plans to focus upon the following markets: engine maintenance, entertainment, instrumentation, body safety, sensors, and transducers.

Bipolar Digital

- National is working to strengthen its present position in the bipolar digital market, a market which is expected to be $3 billion by 1985.
- National claims to have been the first to introduct BI-FET technology. National's LM3914 and LM3915 circuits will be applied to auto instrumentation.

Linear

- National's 74C948, an 8 bit A/D converter (CMOS technology), will be used by auto manufacturers for engine control. However, National is designing a more specific A/D converter for this application.

CRT Controllers

- National's 8350 (I^2L technology) will reduce component count substantially.
- Microprocessors - National is playing catch-up here, and is working on a broader range of peripheral devices.
- National is also working on a new form of microcontrollers (COPS) that utilize n-channel Si gate technology.
- National's 8070 is an 8-bit single chip microcomputer that is bus oriented and able to directly execute a 16-bit memory.

Mainframes

- AS/5 computer shipments began in fiscal year 1978, and approximately 100 systems were shipped during the fiscal year.
- In May 1978 National announced its System 400, an IBM-compatible minicomputer. This product is still in development and the first shipment is expected in the first quarter of calendar year 1979.
- National shipped its first AS/3 (compatible with the IBM 370-138) in August.
- National is working on development systems (Starplex) for microcomputer systems and microcomputer board application.

POS Division

- Power Management Systems - Control of electric power consumption for stores was emphasized, with semiconductor sensors and transducers playing important roles.
- Bar Double X Scanner - This new scanner will be in large-scale production at the end of 1978, and National anticipates a strong market for scanners.

The question and answer period covered the following topics:

ITEL Status

- ITEL was originally a good customer for add-on memory and remains a valued customer as an exclusive agent for AS/4 and AS/5 computers.

Magnetic Bubble Device Densities

- National's planned 256K bit device occupies a 300 x 300 mil chip.
- A 1M bit device will be feasible on the same size chip in the future and eventually, a 4M bit device utilizing contiguous discs will be feasible on the same size chip.

Profit Margins

- National does not forecast a decrease in profit margins. However, there will be shifts among divisions, as the Consumer Division is expected to increase its margins.

Employment

- Worldwide employment level at end of fiscal year 1978 was reported to be 26,500.
  Employment outside U.S. - 15-16,000
  Employment inside U.S. - 10,000 (6,000 - Santa Clara
  4,000 - Salt Lake)

CCDs

- Two months ago, National dropped its 64K CCD program, since the program had a late entry.

- National is looking at a 256K CCD; however, it is not optimistic that CCDs will succeed.

1979/1974 Economic Comparison

- Lead times are up from a year ago, but National does not see a great amount of double ordering.

- National does not anticipate inventory problems as in 1974.

Mary Ellen Hrouda
Daniel L. Klesken

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 6, 1978

ESTIMATED WORLDWIDE MOS MEMORY CONSUMPTION

Summary

DATAQUEST estimates that worldwide consumption of MOS memory will grow from $555 million in 1977 to $820 million in 1978 and reach $1.8 billion in 1982, a 26 percent compound annual growth rate. We expect consumption of MOS memory bits to grow from 633 billion bits in 1977 to 1,494 billion bits in 1978 and reach 14.2 trillion bits in 1982, representing a compound annual growth rate of 86 percent.

Dynamic MOS RAMs are currently the largest segment of the MOS memory market and we believe they will maintain this dominant position over the next four years, growing from an estimated $352 million in 1978 to an estimated $685 million in 1982. Static MOS RAMs should grow from $170 million in 1978 to $329 million in 1982. We anticipate MOS EPROMs to experience dramatic growth from an estimated $117 million in 1978 to $311 million in 1982. MOS ROMs and CCDs are also growth markets, while shift registers are a declining market.

Total MOS Memory Consumption

DATAQUEST estimates of worldwide MOS memory consumption are presented in Table 1. We expect 1978 MOS memory consumption to be an estimated $820 million, up 48 percent over the estimated 1977 level of $555 million. Furthermore, we believe the market will grow another 27 percent in 1979 to over $1 billion. Dynamic and static RAMs share a major segment of the MOS memory market, but MOS EPROMs should experience major growth and represent a significant segment of the market by the early 1980s. The MOS mask-programmable ROM market is growing well but not at the rates of the dynamic and static RAMs.

Electrically Erasable PROM usage (EEPROM, which have previously been called Electrically Alterable Read Only Memories (EAROM)), will probably grow slowly unless technical advances enable these devices to become more cost effective than EPROMs. CCDs should begin their growth in the early 1980s, whereas shift registers continue to decline.

MOS Dynamic RAMs

Table 2 represents DATAQUEST's estimates of worldwide MOS dynamic RAM consumption. Estimates of units, average selling prices, and total dollars are presented. Note that the average selling price represents an average price for the entire year and can vary widely from the market prices, especially those at the beginning and end of the year. In 1978 the 4K dynamic RAM is expected to peak in units whereas it has already peaked in dollars. We believe consumption of 16K dynamic RAMs will grow to 20 million units this year and reach 45 million units next year. We expect the 64K dynamic RAM to get a reasonable start in 1979 with an estimated 1 million units. The 256K dynamic RAM, expected to be introduced in the early 1980s, should reach about 2.5 million units by 1982. We have also listed a hybrid category—the 32K dynamic RAM. At least one company introduced the product in 1978 and two others are working on a large IBM order for 32K dynamic RAMs which are hybrid devices because the package contains two 16K-bit chips. It is still too early to make a reliable statement about how 32K RAM market will develop.

MOS Static RAMs

Table 3 presents DATAQUEST's estimates of static MOS RAM consumption. The total market is expected to grow from $170 million in 1978 to $329 million in 1982. The 1K static MOS RAM has peaked in units and dollars but is still showing reasonable strength in 1978. Several suppliers have dropped out of this market so demand continues strong for the remaining suppliers. Consumption of 4K static RAMs is growing dramatically in 1978 and should nearly reach 20 million units. In 1978 we are seeing the first of the 8K and 16K static RAMs and expect to see the first of the 32K statics in 1979 and the 64K statics in 1980. User acceptance and supplier support for the 8K, 16K, 32K, and 64K static RAMs at this point is a matter of conjecture. Therefore, the total dollars could be distributed somewhat differently than we estimate here.

MOS ROMs

Table 4 presents DATAQUEST's estimates of worldwide MOS ROM consumption, which is expected to grow from $130 million in 1978 to $255 million in 1982. Currently, the dramatic growth is occurring at the 16K and 32K bit levels with the 64K bit devices following closely behind in the 1979 and 1980 time frame. Unit growth for MOS ROMs is accelerating as large quantities are being shipped for games, terminals, and other high-quantity production runs.

MOS EPROMs

Total worldwide consumption of MOS EPROMs in 1978 is estimated at $117 million, up 98 percent over the estimated 1977 levels of $59 million, and should grow to $311 million in 1982 as shown in Table 5. In 1978, consumption of the 16K EPROM is growing dramatically and will probably reach 3.5 million units, while consumption of the 8K EPROM should grow to 9.4 million units.

CCDs

Table 6 represents our estimates of worldwide CCD consumption. Currently, only two producers are delivering 64K CCDs. We do not think many suppliers will enter this market. Instead most suppliers will probably turn their attention to the 256K bit and 1M bit chips. The critical question on CCDs is timing as we feel this market will not develop rapidly unless companies can bring their products to market one generation ahead of competing dynamic RAMs. The CCD market was expected to emerge about two years ago but has been slow to develop because of technical difficulties and other priorities faced by the suppliers. Therefore, there is still some doubt about the rate at which this market will develop.

Bit Consumption

The rate at which MOS memory bits are being consumed is amazing. Table 7 presents our estimates of MOS memory consumption expressed in billions of bits. Memory bit consumption was an estimated 633 billion bits in 1977 growing to an estimated 1,494 billion bits in 1978. By 1982, worldwide consumption is expected to about 14.2 trillion bits. Growth in bits consumed is largest in CCDs and EPROMs which are starting from a lower base. However, even dynamic RAMs, static RAMs, and ROMs are experiencing compound annual growth rates of 78, 87, and 70 percent per year respectively.

Daniel L. Klesken
Frederick L. Zieber
James F. Riley

Table 1

ESTIMATED WORLDWIDE MOS MEMORY CONSUMPTION

(Dollars in Millions)

	1977	1978	1979	1980	1981	1982	COMPOUND ANNUAL GROWTH RATE 1977-1982
RAM	$351	$522	$ 651	$ 760	$ 878	$1,014	24%
Dynamic	254	352	422	502	588	685	22%
Static	97	170	229	258	290	329	28%
ROM	100	130	166	192	221	255	21%
EPROM	59	117	154	201	254	311	39%
EEPROM	4	11	19	28	36	44	62%
CCD	3	4	19	64	92	131	113%
Shift Register	38	36	32	28	26	24	(9%)
Total MOS Memory	$555	$820	$1,041	$1,273	$1,507	$1,779	26%
Percent Change From Previous Year		48%	27%	22%	18%	18%	

Source: DATAQUEST, Inc.
October 6, 1978

Table 2

ESTIMATED WORLDWIDE DYNAMIC MOS RAM CONSUMPTION

	1977	1978	1979	1980	1981	1982
Value ($ in Millions)						
1K	$ 20	$ 14	$ 10	$ 6	$ 2	$ 2
4K	200	160	123	75	44	28
16K	34	175	236	252	263	202
32K	0	2	18	39	50	52
64K	0	1	35	128	221	326
256K	0	0	0	2	8	75
	$ 254	$ 352	$ 422	$ 502	$ 588	$ 685
Percent Change From Previous Year		39%	20%	19%	17%	16%
Units (Millions)						
1K	8.0	6.5	5.0	3.0	1.0	1.0
4K	57.1	80.0	70.0	50.0	35.0	25.0
16K	2.0	20.0	45.0	60.0	75.0	65.0
32K	N.A.	0.05	1.5	5.0	8.0	10.0
64K	N.A.	.02	1.0	8.0	21.0	42.0
256K	N.A.	N.A.	N.A.	0.02	0.2	2.5
Average Selling Price						
1K	$ 2.50	$ 2.20	$ 2.00	$ 1.90	$ 1.80	$ 1.70
4K	$ 3.50	$ 2.00	$ 1.75	$ 1.50	$ 1.25	$ 1.10
16K	$17.00	$ 8.75	$ 5.25	$ 4.20	$ 3.50	$ 3.10
32K	N.A.	$32.00	$12.00	$ 7.75	$ 6.25	$ 5.20
64K	N.A.	$70.00	$35.00	$16.00	$10.50	$ 7.75
256K	N.A.	N.A.	N.A.	$80.00	$40.00	$30.00

N.A. - Product not available

Source: DATAQUEST, Inc.
October 6, 1978

Table 3

ESTIMATED WORLDWIDE STATIC MOS RAM CONSUMPTION

	1977	1978	1979	1980	1981	1982
Value ($ in Millions)						
1K (1Kx1 - 2102)	$ 22	$ 17	$ 11	$ 8	$ 6	$ 4
1K (256x4 - 2101)	19	13	10	7	3	1
1K (Fast - 2115)	6	7	13	8	4	2
4K (Slow)	39	99	108	104	53	33
4K (Fast - 2147)	11	32	64	54	53	40
8K	0	2	9	20	33	30
16K	0	0	10	32	52	63
32K	0	0	4	16	50	60
64K	0	0	0	9	36	96
Total	$ 97	$ 170	$ 229	$ 258	$ 290	$ 329
Percent Change From Previous Year		75%	35%	13%	12%	13%
Units (Millions)						
1K (1Kx1 - 2102)	17.0	15.0	12.0	10.0	8.0	5.0
1K (256x4 - 2101)	10.0	8.0	7.0	5.5	3.0	1.0
1K (Fast - 2115)	2.0	3.0	6.0	4.0	2.5	1.5
4K (Slow)	4.3	18.0	26.0	36.0	26.0	20.0
4K (Fast)	0.4	1.8	8.0	12.0	15.0	16.0
8K	N.A.	0.1	0.9	4.0	10.0	12.0
16K	N.A.	0.01	0.5	4.0	9.0	14.0
32K	N.A.	N.A.	0.1	0.8	4.0	7.0
64K	N.A.	N.A.	N.A.	0.2	1.5	6.0
Average Selling Price						
1K (1Kx1 - 2102)	$ 1.30	$ 1.10	$ 0.95	$ 0.80	$ 0.80	$ 0.80
1K (256x4 - 2101)	$ 1.85	$ 1.60	$ 1.40	$ 1.20	$ 1.10	$ 1.00
1K (Fast - 2115)	$ 2.80	$ 2.40	$ 2.15	$ 1.95	$ 1.70	$ 1.50
4K (Slow)	$ 9.00	$ 5.50	$ 4.15	$ 2.90	$ 2.05	$ 1.65
4K (Fast - 2147)	$28.00	$18.00	$ 8.00	$ 4.50	$ 3.50	$ 2.50
8K	N.A.	$15.00	$10.50	$ 5.00	$ 3.30	$ 2.50
16K	N.A.	$35.00	$20.00	$ 8.00	$ 5.75	$ 4.50
32K	N.A.	N.A.	$35.00	$20.00	$12.50	$ 8.50
64K	N.A.	N.A.	N.A.	$45.00	$24.00	$16.00

N.A. - Product not available

Source: DATAQUEST, Inc.
October 6, 1978

Table 4

ESTIMATED WORLDWIDE MOS ROM CONSUMPTION

	1977	1978	1979	1980	1981	1982
Value ($ in Millions)						
4K	$ 8	$ 2	$ 1	$ 0	$ 0	$ 0
8K	53	21	11	5	3	1
16K	33	88	84	50	14	4
32K	6	16	42	77	84	42
64K	0	3	24	40	60	81
128K	0	0	4	20	55	102
256K	0	0	0	0	5	25
Total	$ 100	$ 130	$ 166	$ 192	$ 221	$ 255
Percent Change From Previous Year		30%	28%	16%	15%	15%
Units (Millions)						
4K	3.0	1.0	0.5	0	0	0
8K	15.0	8.0	5.0	3.0	2.0	1
16K	6.0	25.0	30.0	22.0	8.0	3
32K	0.4	1.8	7.0	18.0	24.0	15
64K	N.A.	0.1	1.6	5.0	10.0	17
128K	N.A.	N.A.	0.1	1.0	5.0	12
256K	N.A.	N.A.	N.A.	N.A.	0.1	1
Average Selling Price						
4K	$ 2.75	$ 1.75	$ 1.40	N.A.	N.A.	N.A.
8K	$ 3.50	$ 2.65	$ 2.10	$ 1.65	$ 1.40	$ 1.25
16K	$ 5.50	$ 3.50	$ 2.80	$ 2.25	$ 1.75	$ 1.40
32K	$15.00	$ 9.00	$ 6.00	$ 4.25	$ 3.50	$ 2.80
64K	N.A.	$25.00	$15.00	$ 8.00	$ 6.00	$ 4.75
128K	N.A.	N.A.	$40.00	$20.00	$11.00	$ 8.50
256K	N.A.	N.A.	N.A.	N.A.	$50.00	$25.00

N.A. - Product not available

Source: DATAQUEST, Inc.
October 6, 1978

Table 5

ESTIMATED WORLDWIDE MOS EPROM CONSUMPTION

	1977	1978	1979	1980	1981	1982
Value ($ in Millions)						
2K	$ 15	$ 5	$ 3	$ 1	$ 1	$ 0
8K	35	66	32	15	6	3
16K	9	42	74	61	30	18
32K	0	4	40	70	88	48
64K	0	0	5	40	84	125
128K	0	0	0	14	45	117
Total	$ 59	$ 117	$ 154	$ 201	$ 254	$ 311
Percent Change From Previous Year		98%	32%	31%	26%	22%
Units (Millions)						
2K	3.0	1.4	1.0	0.5	0.3	0.2
8K	2.9	9.4	7.0	4.0	2.0	1.0
16K	0.5	3.5	9.0	11.0	7.0	5.0
32K	N.A.	0.1	2.2	7.0	11.0	8.0
64K	N.A.	N.A.	0.1	1.8	6.0	12.5
128K	N.A.	N.A.	N.A.	0.2	1.6	6.5
Average Selling Price						
2K	$ 5.00	$ 3.50	$ 3.00	$ 2.70	$ 2.40	$ 2.20
8K	$12.00	$ 7.00	$ 4.50	$ 3.75	$ 3.00	$ 2.50
16K	$18.00	$12.00	$ 8.25	$ 5.50	$ 4.25	$ 3.50
32K	N.A.	$40.00	$18.00	$10.00	$ 8.00	$ 6.00
64K	N.A.	N.A.	$50.00	$22.00	$14.00	$10.00
128K	N.A.	N.A.	N.A.	$70.00	$28.00	$18.00

N.A. - Product not available

Source: DATAQUEST, Inc.
October 6, 1978

Table 6

ESTIMATED WORLDWIDE CCD CONSUMPTION

	1977	1978	1979	1980	1981	1982
Value ($ in Millions)						
16K	$ 2	$ 2	$ 1	$ 0	$ 0	$ 0
64K	1	2	17	51	28	15
256K	0	0	1	13	63	91
1024K	0	0	0	0	1	25
Total	$ 3	$ 4	$ 19	$ 64	$ 92	$ 131
Percent Change From Previous Year		33%	375%	237%	44%	42%
Units (Millions)						
16K	0.25	0.4	0.2	0.1	0	0
64K	0.01	0.05	1.2	7.0	5.0	3.5
256K	N.A.	N.A.	0.02	0.4	3.5	7.0
1024K	N.A.	N.A.	N.A.	N.A.	0.01	0.5
Average Selling Price						
16K	$ 8.00	$ 4.80	$ 3.50	$ 2.20	N.A.	N.A.
64K	$50.00	$30.00	$14.00	$ 7.25	$ 5.50	$ 4.30
256K	N.A.	N.A.	$60.00	$32.00	$ 18.00	$13.00
1024K	N.A.	N.A.	N.A.	N.A.	$125.00	$50.00

N.A. - Product not available

Source: DATAQUEST, Inc.
October 6, 1978

Table 7

ESTIMATED WORLDWIDE MOS MEMORY CONSUMPTION

(Bits in Billions)

	1977	1978	1979	1980	1981	1982	COMPOUND ANNUAL GROWTH RATE 1977-1982
RAM	323.3	774.0	1,326	2,238	3,702	6,009	79%
Dynamic	274.9	665.2	1,144	1,884	3,063	4,904	78%
Static	48.4	108.8	182	354	639	1,105	87%
ROM	246.6	545.8	882	1,434	2,269	3,498	70%
EPROM	38.1	140.5	286	587	1,095	2,023	121%
EEPROM	1.1	3.7	7	12	17	23	84%
CCD	4.8	9.9	87	566	1,256	2,588	252%
Shift Register	19.0	20.0	19	19	19	19	0%
Total MOS Memory	632.9	1,493.9	2,607	4,856	8,358	14,160	86%
Percent Change From Previous Year		136%	75%	86%	72%	69%	

Source: DATAQUEST, Inc.
October 6, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 6, 1978

ADVANCED MICRO DEVICES ANNUAL MEETING

Mr. W. J. Sanders III, President and Chief Executive Officer, displayed extreme optimism at the AMD Annual Meeting on September 12, 1978 as he commented on AMD's present business trends, employment, facilities, and technological innovation. Also present at the meeting were fellow executive officers, John Downey, Terry Jones, George Scalise, and Thomas Skornia.

Fiscal 1978 was the center of attention as the following topics and comments were presented:

Present Business Trends

- AMD recently split its stock 3/2; it is now qualified for listing on the New York Stock Exchange.
- AMD depicted its fiscal year sales history and outlook as follows:

(Dollars in Millions)

Fiscal Year ends March 31

1975	1976	1977	1978	1979 (Est.)
$25.8	$34.4	$62.1	$92.3	$120.0

- Bookings appear strong overall; Japanese bookings were reported particularly strong.
- The June quarter holds the record for AMD bookings at $36 million. However, the bookings in the quarter ending September 30 are expected to surpass this record.

Employment

- Fiscal year 1978 saw a 50 percent increase in AMD employment. Worldwide AMD employment stands at 5,826. Current U.S. employment is 4,523. Manilla employees account for 1,199 of AMD's work force.

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Facilities

- Worldwide AMD facilities were reported at 322,280 square feet.
- October 12, 1978, marks the ground-breaking for AMD's new Austin, Texas, facilities, which will initially occupy 34,000 square feet. These facilities will include four independent fabrication modules providing 25,000 square feet of clean room space.
- New MOS/LSI facilities consisting of 50,000 square feet are nearing completion in Santa Clara, California.
- The Munich plant for the AMD/Siemens unit (Advanced Micro Computer Gmbh) occupies 20,000 square feet and is devoted largely to microcomputers.

Technology

- AMD's AM2900 bit slice has made AMD an industry leader.
- Due to advances in bipolar technology (i.e., low-power Schottky TTL), traditional TTL sales are now only 3 percent of AMD's yearly sales.
- AMD's linear technology has produced its first monolithic D/A converter, which is compatible with all microprocessors.
- AMD introduced the AMC 95/4000 as the industry's fastest monoboard computer with a clock rate of 2 or 4 MHz.
- MOS/LSI has been a large factor in AMD growth. In calendar year 1977, AMD estimated its memory market share was 7.2 percent and is forecasting a 9.1 percent market share for 1978.
- AMD is the world's fourth largest supplier of 4K dynamic RAMs.

MOS/LSI Technology

A resolution for more AMD technological innovation was emphasized as the following new MOS/LSI processes were presented:

- NS-5 This process is responsible for the 16K EPROM production. The 32K EPROM is expected in six months.
- NS-7 This process is the workhorse of AMD's N-channel Si gate and enables high volume production of the 4K Static RAM. A 4-inch wafer is currently utilized in this process.

- NS-8 This process is responsible for the high-speed 4K Static RAM (2147), which is booked through fourth quarter.
- NS-9 This process utilizes projection alignment and a 4-inch wafer. AMD's 9016 (16K RAM) utilizes this process and encompasses 21,700 square mils.

Mary Ellen Hrouda
Daniel L. Klesken

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.06 Motorola | September 29, 1978

UPDATE ON MOTOROLA

Summary

DATAQUEST projects a 15 percent increase in revenues at Motorola to $2.1 billion in 1978, with estimated profits up 16 percent to $123 million. In 1979, DATAQUEST estimates Motorola's revenues could reach $2.4 billion with after-tax profits up 17 percent to $144 million.

- The Communications Group has substantial momentum in its marketplace with a multitude of new product introductions. However, DATAQUEST is uncertain about capital spending trends in 1979, and accordingly we are applying some restraint to our 1979 forecast for the Communications Group projecting an 11 percent increase in 1979 revenues.

- The Semiconductor Group gained market share in 1978. It has made significant progress in gaining dominance in a number of markets.

- The Automotive Products Division (APD) will be in transition through 1979. Certain business with Ford is expected to diminish, but other automotive electronic products, both under-the-hood and entertainment, are rapidly being generated to fill the void.

- Motorola has worked through many of its past problems, and nearly all business areas are now believed to be running smoothly. As a result, increased profit margins are expected in 1979. Future revenue growth is expected not only from the current major business areas, but from new opportunities being generated from combining diverse areas of expertise within the Company.

- The Government Electronics Division (GED) is believed to be having an excellent second half in 1978. DATAQUEST foresees continued progress in 1979.

- As stated in our update on Motorola of February 23, 1978, DATAQUEST expects a new division, Data Communications, to be formed at Motorola, combining Codex, the Data Products Unit, and possibly Microsystems.

- The Codex acquisition is making an increasingly substantial contribution to Motorola's profits and sales. DATAQUEST estimates that Codex's 1978 after-tax profit margins will exceed 11 percent.

- The automotive electronic business will become a production reality in 1979. Motorola will be a prime beneficiary of any acceleration of these programs.

- Note: DATAQUEST has received a number of indications that General Motors is accelerating several of its automotive programs by one year. These programs included the General Motors Custom Microprocessor (GMCM) and closed loop carburetor control. This acceleration, estimated to be worth $20 million to $40 million for Motorola in 1979, is not accounted for in our forecast. This additional volume, to the extent it is realized, is a hedge against disappointment elsewhere.

Motorola has significant opportunities that are still very small in terms of business or that have not yet formed into business units. However, these are important to future corporate growth. We believe it pertinent to examine a number of these areas in this newsletter.

Revenue Projections

Our revenue estimates for each of Motorola's major divisions are shown in Table 1. In estimates for 1979, a moderately slow economic growth—2.5 percent to 3 percent in GNP—is assumed.

Profit Margin Analysis

Motorola's profit margins in the first half of 1978 have been essentially flat, and this is expected to more or less continue for the remainder of the year. On an incremental analysis, Motorola is expected to improve its sales in 1978 by approximately $280 million. On these revenues, it generated an incremental after-tax profit of $17 million, after a $10 million cost increase from its new pension program. After absorbing the cost of this program, DATAQUEST believes that on a similar expected revenue increase of about $275 million in 1979, $21 million at a minimum can accrue to profits. This would result in an expected $144 million profit after-tax, or a 6.0 percent profit margin. Specific areas of profit growth can come from the following:

- Codex, with an estimated 11 percent after-tax profit margin, is becoming a more significant part of the Company. We believe that Codex's profit margin performance will positively affect other parts of the Company.

- Semiconductor margins can improve slightly with the improvement year-to-year in integrated circuit margins.

Table 1

Motorola
ESTIMATED SALES 1976-79

(Dollars in Millions)

Division	1976	Percent Change 1976-77	1977	Percent Change 1977-78	1978 (Est.)	Percent Change 1978-79	1979 (Est.)
Semiconductor	$ 474	23%	$ 582	22%	$ 710[1]	13%	$ 805
Communications	705	17%	823	14%	940	11%	1,040
Automotive	156	28%	199	(2%)	195	0%	195
Government	120	7%	128	9%	140	25%	175
Data Products	30	67%	50	20%	60	33%	80
Codex	27	56%	42	43%	60	33%	80
Other[2]	55	16%	64	28%	82	16%	95
Intracompany	(32)		(40)		(60)		(70)
Total	$1,535	20%	$1,848	15%	$2,127	13%	$2,400
After-Tax Profit Margin	6.0%		5.7%		5.8%		6.0%
After-Tax Profits	$ 91.8	16%	$106.2	16%	$123.0	17%	$144.0
Earnings Per Share	$ 3.04	15%	$ 3.50	17%	$ 4.10	16%	$ 4.75

[1]Figures reflect switch of Information Systems, with estimated 1978 sales of $17 million, from the Communications Group and Other, to Semiconductor Group.

[2]Includes Autovox, International Operations in Israel and South Africa

Source: DATAQUEST, Inc.
Motorola Annual Report
September 1978

- The losses taken overseas in the multinational operations, especially at Autovox, appear to have been substantially reduced and may turn into future profits.

- The Angers Plant for Automotive Products is believed to have been a profit drain since its opening in 1974. DATAQUEST believes this situation has recently been reversed.

Motorola has taken measures to reduce its vulnerability in profits by strengthening, eliminating, or rationalizing past areas of weakness—such as crystals, watch modules, and Autovox—and by consolidating market power in Communications and Semiconductors. The Communications Group has historically been very dependent on sales to local governments. While we do not foresee a large decline in local government spending for communications, the Communications Group is broadening its customer base, and the percentage of products offered to industry by Communications is rapidly increasing.

The Semiconductor Group, in our opinion, reversed the vulnerability of 1974. It is the market and cost leader in several areas.

Government Electronics Division

The Government Electronics Division (GED) participates in four markets:

- Communications
- Radar
- Tactical Electronics
- Missiles

The division books an average of 250 contracts a year. Its customer base is a balanced mix of Navy, Army, Air Force, and NASA. On the basis of rather aggressive marketing over the last several years, DATAQUEST forecasts that this division will grow in excess of 15 percent next year and will maintain its pre-tax profit margin in the range of 8 to 10 percent.

This division has been participating in contracts where there has been a high research and development content. Motorola recently added a fifth group called "The Specialized Production Center." The charter of the group is to enable Motorola GED to bid on government contracts on a more competitive production-oriented basis, while the other four groups can bid on contracts with high research content. This new group has gotten off the ground this year. We understand it currently has two contracts; one of which is EFMV 110 fuse with a $12 million order, and an add-on production order of equivalent size.

In our previous newsletter, we commented on the division's activity in developing commercial product lines. It is our understanding that the commercial business will always make up a rather small percentage of this division's business since each commercial product, as it becomes feasible, will be transferred to the appropriate commercial division. GED has developed a data encryption device for the National Security Agency that has good potential for commercial applications with banks, etc. Marketing activity commenced on this device in 1978; prime markets are banks and computer centers.

Details of this division's business and contracts are difficult to acquire. It is DATAQUEST's impression that about 40 percent of the output in the division is low volume communications contracts such as AWACS, PRC 112, spacecraft transponders, and secure communications. This business has a good synergy with the commercial activities of the Communications Group.

The GED manufacturing is done at its plant in Phoenix which has in excess of 700,000 square feet. We understand that 200,000 square feet will be added. Employment in this division is estimated at about 4,000 people.

The division competes with a large number of very able competitors, i.e., E-Systems, GE, GTE, Harris, Honeywell, Hughes, Northrup, Raytheon, RCA, Sylvania, and TRW.

It is DATAQUEST's opinion that this division enjoys a good reputation with its customers. Its activity with Motorola Integrated Circuit Advanced Research Laboratory (MICARL) enables it to compete very effectively in R&D intensive contracts. MICARL supplies between 70 and 100 custom chips per year to this division. We are optimistic about the division's increased ability to continue to capture production add-on contracts by virtue of its recent organization change. The division has a small semiconductor assembly line fully qualified for military assembly. This gives the division excellent turn-around and good technical capability.

The Communications Group

In DATAQUEST's estimate, the Communications Group introduced in 1977 and 1978 more products than in the preceding ten years combined. Some of these products are described in the section following on product development. The net effect of this effort is to ensure Motorola's pre-eminent position in the communications business in the 1980s.

The Communications Group is organized into four divisions, as outlined below:

Vice President and Group General Manager: Ted Miller
- Assistant to the Vice President: Jack Germain
  - International Division: Ray Farmer
  - C&E Division: Art Sundry

Communications Products Division: Claude Davis
Communications Systems Division: John Battin

International Division: This division has its own product development group to design and market equipment to foreign standards. The division has facilities in Germany, South Africa, Israel, Canada, England, and Mexico. DATAQUEST estimates that the International activity will have revenues of about $150 million in 1978.

C&E Division: This division is the marketing arm for Communications and is a separate cost center. We estimate that it employs approximately 3,500 people, of which 3,000 are in the field. We believe this is one of Motorola's primary stengths in this market.

Communications Products Division: DATAQUEST estimates that this group will have $650-700 million in revenues this year. This group's product line consists of the following:

- Fixed Products (base station and consoles)
- Land Mobile
- Portable
- Pagers
- Market Products (industry-oriented products)
- Point to point

We estimate that the portables and pagers will account for about $270 million in revenues in 1978.

Communications Systems Division: This division has the following product portfolio:

- Radio Telephone
- Cellular Radio
- Marine Radio
- Components (crystals, speakers, antennas and monitors)

Manufacturing

Motorola has recently opened a new 750,000 square foot plant in Fossil Creek, Texas. It is our understanding that the plant has an extremely high order of automation and that land mobile radios will ultimately be manufactured there. We believe this will enhance Motorola's ability to compete in this market in the future on a cost basis. Fixed products are made in Schaumberg, Illinois. We understand that the division has four plants in Puerto Rico known as Tele-Caro, Portales, Portoves, and Radio Mobile.

Product Development

In addition to its successful efforts in the established frequencies, i.e., low-band (30 MHz), high-band (150 MHz) and VHF (450 MHz), Motorola is starting to generate some shipments and market activity in cellular communications (900 MHz).

Other new products that we believe are important are as follows:

- The Mitrek radio, a cost-effective product for trunk mounted two-way installations.

- The Maxar, a lower cost radio for under-dash installation.

- The MX 300, a hand-held radio using modular assembly.

- The HCMTS (High Capacity Mobile Telephone System), a product in the 900 MHz spectrum.

- PDAT (Portable Data Acquisition Terminal), is one of the most exciting new products in the group. It is identified as the MRX 1000 and resembles an intelligent hand-held terminal with a two-way radio, LED display, and the capability to tie in directly to a computer. We understand that the product was developed in Florida and has a selling price of $3,000. Product sales to date have been limited, but the future looks excellent.

Communications is receiving technical support from the MICARL in Mesa, a Corporate entity for developing low-volume, high-customized circuits for sister divisions to semiconductors. The critical space, power, and performance of communications products makes this semiconductor capability an invaluable asset in integrating product design, especially in applying microprocessors to communications.

Automotive Products Division

Motorola, as a corporation, has substantially penetrated the worldwide automotive industry through the Automotive Products Division (APD) and the automotive programs in the Semiconductor Group. Here we will deal with APD only.

DATAQUEST is completing a study on automotive electronics that will be available in October. It provides further details on this complex market.

APD is in a state of transition during 1978 and 1979 due primarily to the decline of the Ford quadraphonic radio business. DATAQUEST estimates that this business in 1978 is in the $25-35 million range. Because of the sales gap caused by the loss of the quadraphonic radio business, DATAQUEST estimates that sales in Automotive will be flat year to year and that pre-tax profit margins will continue in the 4-7 percent range.

The division is divided into the following four departments:

- Electronic Systems
- Entertainment
- Industrial Controls
- International

Ford Motor is by far the division's largest customer, in DATAQUEST's estimate. In addition to Ford, this division does business with American Motors, British Leyland, Caterpillar, International Harvester, John Deere, Peugeot-Citroen, and Volkswagon, among others.

Electronic Systems: This department is estimated to be responsible for 40 percent of the division's sales. It is divided into two areas, alternators and instruments, and ignition systems, with revenues roughly 60 percent-40 percent between the two.

This department has the potential to double over the next two to three years because of the automotive electronics potential. Active programs are underway in the sensor area with Ford, GM, and others. DATAQUEST anticipates minimal shipments (less than $5 million) to Ford Motor in the year 1979 on the engine control module program but we expect them to grow rapidly thereafter. When this business goes into full production, it will be shared 25 percent by Motorola, 50 percent by Ford EED (in-house), and 25 percent by Toshiba.

The bulk of the manufacturing for Electronic Systems is done in Arcade, New York, at a 300,000 square foot manufacturing facility.

Entertainment: This department accounts for about 45 percent of the division's sales. As mentioned earlier, the declining Ford quadraphonic radio business will create a revenue loss of $25-35 million; the department has several active programs to generate new revenue. Among these are:

- Automotive Stereo Power Boosters - these devices are designed to increase the output power of an automotive stereo system, up to 10-20 watts per channel, giving home quality stereo in the auto. The units fit directly under the dashboard. DATAQUEST estimates that this product line could do $4-8 million in 1979.

- Remote CB Auto Unit - this unit will be sold to Ford on an OEM basis and into the after-market.

- Citizen Band Radios - DATAQUEST understands that Motorola is shipping private label CBs, as well as Motorola-branded products.

The bulk of the manufacturing for entertainment is done at a 300,000 square foot manufacturing plant in Seguin, Texas.

Industrial Systems: This is a recently formed department designed to make control panels and other products to penetrate the appliance business using microprocessors and the division's expertise in production of electronic modules. At the moment, this group has three programs: one is a control panel for D&M, which private-labels dishwashers to Sears. We estimate this business to be approximately $3-5 million in 1978. We understand there are two programs for microwave ovens, and one for a garage door opener.

International: This department is responsible for an estimated 15 percent of division revenues. The Angers Plant is expected to operate profitably for the first time in 1979. This plant produces alternators and can be used as a basis for a strong market entry to supply Peugeot-Citroen, now the largest automotive manufacturer in Europe. The department also has small operations in Stotfold, England, making automotive radios, and in South Africa, making alternators.

Data Products

The Data Products Unit was retained by Motorola when its television business was sold to Matsushita. The unit has been recently transferred from Homer Marrs to Carl Lindholm. The product line is basically TV monitors, which currently accounts for 75 percent of its business. This unit has had very good acceptance in the marketplace and we expect it will grow and prosper for several years.

It is our understanding that efforts are commencing in Data Products to incorporate microprocessor technology into new products in order to get into intelligent terminal applications. The unit currently supplies IBM and Memorex with CRTs and electronics for intelligent terminals. Similar electronics are supplied to Midway, Bally, and Atari for games. AMF is a customer for electronics for its electronic scorer.

DATAQUEST believes that this group, along with other sections of the Company, can form the nucleus of a very powerful data communications division.

Codex

The Codex acquisition, which took place in 1976, can be very significant in Motorola's future. It is DATAQUEST's perception that Motorola has wisely allowed Codex to pursue its own market consisting primarily of modem type products. Thus, the acquisition performed smoothly, doubling in size between 1976 and 1978 and Codex profit margins, by DATAQUEST's estimates, are in excess of 11 percent after taxes. We expect Codex to continue to maintain its profits in 1979. Some of the expected synergy is beginning, with MICARL starting to develop a limited number of chips for use in Codex. One initial product is presumably a codec set.

Semiconductor Group

Table 2 represents DATAQUEST's estimates of Motorola semiconductor shipments in 1977, 1978, and 1979.

Table 2

Motorola
ESTIMATED SALES OF SEMICONDUCTOR GROUP
(Dollars in Millions)

	1977	1978 (est.)	1979 (est.)
Total Semiconductor Group	$582	$710	$805
Semiconductor	548	643	714
Total IC	235	303	359
Bipolar Digital	63		
Linear	62		
MOS	110		
CMOS	50		
NMOS	60		
Total Discrete	313	340	355
Transistor	197		
Diode	89		
Thyristor	25		
Opto and Other	2		
Microsystems	18	25	40
Memory Systems	2	7	11
Group III	14	35	40

Source: DATAQUEST, Inc.
September 1978

Highlights of Motorola Semiconductor Group performance for 1978 are given below:

710

- Group revenues are expected to grow from $582 million in 1977 to an estimated $717 million, up 23 percent, exceeding industry growth. Revenues in 1979 are expected to be in the $800-820 million range.

- The profit after tax is expected to increase from $37 million in 1977 to an estimated $49-50 million in 1978.

- Capital spending in 1978 is expected to be in the $60 million range. This has been buttressed by an HMOS 4-inch facility expected to be on stream within six months in Mesa, Arizona.

- The percentage of Motorola's semiconductor business being sold through distribution is growing from an estimated 26 percent last year to 29-30 percent this year, and ultimately could be as high as 35 percent.

- With the EXOR 68 microcomputer, Motorola has entered the small system business.

- Memory systems has become a viable business.

- We believe the automotive business is going to accelerate thereby having an impact on Motorola's shipment and product development efforts in 1979. !

Since 1975, Motorola has moved from being twelfth largest supplier of MOS worldwide to fourth largest.

Motorola has been pursuing a strategy, in our opinion, designed to gain substantial market share and market position in key areas: ECL, MOS, CMOS, discrete, automotive, and TV applications. This is combined with aggressive cost and price reduction. In this effort, they have been singularly successful. However, in NMOS (memory and microprocessor), the Company needs to consolidate its growing sales position, estimated at around $80 million in 1978. This will require successful introduction of the next generation of memory devices, as well as the array of microprocessor support chips and software. Success in NMOS is a critical factor in Motorola's long-term growth potential, and is its area of greatest vulnerability.

Motorola Semiconductor is currently negotiating with Thomson-CSF and the French Government for a technology product exchange focused around microprocessors and NMOS. We believe that if this transaction is successfuly consummated, Motorola will be a prime supplier to both the merchant and the automotive market in France.

We have learned that Motorola has an experimental electronic home known as AWHATUKEE in which substantial applications' research is being done for the home of the future.

Integrated Circuit Division

Automotive: The IC Division has a number of current programs for the automotive industry. The most widely publicized is the GMCM (a five-chip set that may go as high as eight). We expect this program to move into high gear no later than the middle of 1979 for model year 1980. It is anticipated that in the early stages Motorola will enjoy substantially a sole-source position in this business until Delco has production capability. The Cadillac Seville Trip Computer, which was introduced this year, will be expanded in 1979 to other models as an option. As many as 100,000 units could be shipped.

Extensive discussions are taking place with the major Japanese auto manufacturers. DATAQUEST believes that Motorola is the most aggressive American company in Japan in this regard.

Microprocessors: Motorola has been very active this year in microprocessors. A number of product introductions are taking place:

- The 6801, a single-chip microcomputer is currently being sampled. We understand that this device is a derivative from the work with General Motors.
- The 6809, a transitional product with 16-bit internal architecture and 8-bit external architecture, will be sampled in late fourth quarter of 1978.
- The 68000, Motorola's initial entry in the 16-bit market, will be sampled in the first quarter.
- The 3870, a single-chip microcomputer is in production and doing well.
- The 141000, A CMOS version of the TMS 1000, has received excellent acceptance and production is being ramped sharply.
- The 14500, a CMOS one-bit slice, is in production.
- The 6800 is being qualified for military specifications and is also being qualified by IBM.
- The 6805, a stripped-down version of the 6800, is expected to be sampled in the fourth quarter of 1978.
- The 6847, a video display generator, has had outstanding market acceptance and is being used by a wide number of game manufacturers.

Motorola is working quietly with Hitachi to develop complex peripheral devices for the 6800. The success of these newer microprocessors will depend on similar extensive support, perhaps shared with other firms, as well as software development and other types of support. This will require a large investment by Motorola in terms of capital and engineering manpower over the next year.

Production: Efforts have been made all year to upgrade IC production from 3-inch to 4-inch wafers. The plant at Austin, Texas, is converting to 4-inch wafers. In August, a 4-inch N-channel line in Scotland began running and is now in production. A 4-inch line for linear circuits to Toulouse is now on stream and a substantial effort is underway in Mesa to put in an HMOS 4-inch line, which will be operational in the first quarter of 1979. This is expected to be used initially for Motorola's 64K MOS RAM.

ECL: Motorola pioneered ECL and currently has, in our estimate, a commanding position in the ECL logic market (see DATAQUEST ECL Research Newsletter dated August 3, 1978). We understand that the MICARL Group is working to develop extremely fast D/A and A/D converters for use with ECL. Motorola has a 1K ECL RAM which is selling very well. Two gate arrays are being developed that are Motorola's competitive answer to the 100K series of Fairchild. Motorola has been shipping a gate array to Amdahl for several years. The market for ECL is growing rapidly, and Motorola is benefitting from its pioneering position. It is our understanding that this business is extremely profitable for Motorola.

CMOS: Motorola continues to penetrate and upgrade its position in CMOS. This year, revenues in the CMOS market were reasonably flat, but we estimate that Motorola will increase its CMOS sales by 10 to 15 percent in 1978. Motorola is selling CMOS watch circuits to both TI and Timex. The Series 4000 has been certified by a military agency.

Motorola is aggressively moving into the CMOS LSI market in a bid to strengthen its market position, now shared with RCA. In conjunction with its SSI market leadership, this move is expected to eventually establish Motorola solidly in the number one position in CMOS.

Memory: The 2147 4K static RAM is giving Motorola some difficulties in terms of achieving competitive speeds. The 64K dynamic RAM is in development at Mesa.

DATAQUEST understands that Northern Telecom has made a commitment for Motorola to develop bipolar memories for Northern Telecom. If successful, this bipolar business could be as large as the much greater publicized CMOS business with AMI and Intersil can be in the CMOS area.

There is a substantial effort at both APRDL and Austin in Memory Design. Motorola is shipping 16K and 32K ROMs in quantity.

Memory Systems: This business is developing at a good rate and is expected to grow from $4 million last year to about $7 million in 1978 to about $11 million in 1979.

Microsystems: This business has developed quite rapidly for Motorola. It is our estimate that in 1977 shipments were about $18 million, going to $25 million this year. We estimate that next year it could be as high as $40 million. The widely advertised EPIC 68 system has been renamed the EXOR system—over a thousand of these minicomputers have already been sold. This system is essentially a set of building blocks which has substantial design flexibility for the user.

The business of Microsystems is about 60 percent Microprocessor Development Systems (MDS); 15 percent subsystems; and 25 percent systems business.

There are a number of MDS systems being shipped by Motorola including the Exorcizor, introduced in 1975 and selling for approximately $2,750; the Exorcizor 1A, a lower-priced unit; and the Exorcizor 2, a 2 MHz unit which sells for about $3,400. All Motorola MDSs are designed to play with all units shipped by Motorola including the 3870, 2900, 141000, and 14500.

DATAQUEST expects to see Motorola's development system for the MACS computer in the first quarter of 1979. It is our anticipation that this system will be able to take BASIC, FORTRAN, MPL, COBOL, and PASCAL languages. It is also our understanding that it will be completely compatible for 8-bit applications with all of the parts that Motorola has built.

Discrete Semiconductor Division

DATAQUEST estimates that discrete margins will be around 15 percent and flat for the year. We believe this is a conscious decision, with excess profits being used to lower costs and prices, and to gain market share. It is our perception that with the exception of silicon power devices in plastic packages, the Discrete Division is number one or two in nearly every major sector in which it competes. Motorola has been steadily gaining market shares in discretes and has the opportunity to become a dominant supplier in many discrete areas, with the consequent long term profit potential. Some areas of note in discretes are discussed below.

Automotive: DATAQUEST understands that Motorola has 100 percent of Chrysler's automotive rectifier business and 60 percent of GM's automotive rectifier business, which is shipped in the form of buttons. Our understanding is that Motorola is beginning to penetrate Ford at the expense of Toshiba, and we estimate that up to 20 percent of Ford's business could accrue to Motorola in the next year.

DATAQUEST perceives that the Discrete Semiconductor Division is also doing a substantial amount of work with Ford and GM on automotive sensors and a speed control for Ford. This is a new application that could possibly be used on as many as 35 percent of Ford's cars in calendar year 1979.

DATAQUEST understands that Motorola is a major supplier of tuning diodes for all of the new all-electronic radios being developed. This business can be in the $4-8 million range in 1979.

The division has become extemely aggressive in power silicon transistors in plastic packages, and with these units has penetrated Zenith's and RCA's TV horizontal deflection circuits. It is our belief that the same die in a metal can have substantial applications in automotive ignition systems. This area is expected to be the largest growth area for discretes in 1979 with sales in the range of $30 million.

Subsystems: Subsystems is now becoming a business and is currently a part of the Discrete Semiconductor Division. It has developed a line of linear power supplies, a line of soon-to-be announced switching power supplies, and a line of solid-state switches. This business is just getting started, and is probably much less than $5 million in 1978, but has the potential to go to $8-10 million in 1979.

Production: A substantial effort has taken place this year in the Discrete Division to upgrade and modernize facilities. We understand efforts are underway to put all small-signal transistors on 3-inch wafers, all power devices on 5-inch wafers, and all zeners on 4-inch wafers.

SRDL: The Semiconductor R&D Lab, focuses primarily on technology and applications for discretes. It is now looking at plasma etching, sensors, and fiber optics.

Group III

In our previous newsletters and other literature on the Semiconductor Division, there is a category of non-semiconductor products called "Other." In trying to evaluate "Other," DATAQUEST is impressed with the diversity of opportunity that Motorola has lumped into this category. Since Motorola does not have a name for this category, we are calling it Group III for purposes of this newsletter. Group III in 1978 is expected to ship about $35 million to the merchant market as shown below. A description of each of these follows.

Table 3

Motorola
GROUP III SHIPMENTS TO MERCHANT MARKET
(Dollars in Millions)

	1978	1979
Topsil	$ 4	$ 6
Solar	3	4
LCD Displays	7	12
Watch Modules	11	2
Crystals	2	4
Tegal	4	6
Materials	4[1]	6[1]
Total	$ 35	$ 40

[1]Net out-the-door. Total for 1978 $50 million, including in-house.

Source: DATAQUEST, Inc.
September 1978

Topsil: Topsil sells high-purity silicon, with resistivities up to 35,000 ohms per square. The material is neutron-doped, and its application is in high-power rectifiers, up to 1500 volts.

Materials: This group is both captive and merchant market supplier. It sells silicon (both poly and epi) headers, and lead frames and its sales to the merchant market are expected to expand slightly next year. National Semiconductor appears to be a rather large customer of the Materials Department.

Solar: Motorola has some limited contracts in solar panels, systems, and materials. We are aware that discussions are going on with both ERDA and JPL relative to concentrators and other solar applications. The importance of this is that Motorola is maintaining a strong visibility in the market as it develops.

LCD Displays: Several years ago, Motorola purchased the LCD business of AMI and is now able to get a market position in displays and LCD. This business area has a good future in certain consumer applications as well as automotive. Motorola supplies watch displays to Texas Instruments. The division has not been a participant in LED.

Watch Modules: This business was transferred from the Communications Group and consists essentially of a Timex contract. It is DATAQUEST's estimate that this business will shrink substantially next year. We believe Motorola is currently decreasing production and will leave the watch module market thereby cutting losses in this area. However, the experience gained building hybrids under commercial price pressure will be advantageous to the Semiconductor Group.

Crystals: Group III has the market charter for all merchant market crystal sales except those used for Communications Equipment and includes applications such as watches, microprocessors, and TV crystals. This business is expected to double in the next year, since it has been put on a sounder footing with lower costs and upgraded technology after recent problems accruing from Japanese imports, and is believed profitable.

Tegal: Motorola has an 80 percent position in Tegal, Inc. of Berkeley, California which is developing plasma-etch processes. It is our opinion that Motorola will be in the forefront of applying plasma etch profitably and that there may be some commercial fallout from this activity.

Research and Development

DATAQUEST has not discussed this aspect of Motorola in previous newsletters. Recently, an organization change was affected wherein Martin Cooper was made Director of Corporate R&D. His organization has two primary areas:

- Director of Corporate R&D, Phoenix Center (MICARL) under Robert Jenkins. 1st name! place

- Director of Corporate R&D, Schaumberg, under Ray Richardson. We understand this group has a small IC design staff.

The Research and Development Group is directed by a former high-level Communication Products General Manager who in turn reports to the former General Manager of Semiconductors. It is DATAQUEST's perception that this combination should enable Motorola to continue to both actively participate technically in the merchant semiconductor market and to do the research in the small custom jobs necessary for Motorola to continue to compete effectively in its other division. For example, DATAQUEST estimates that the number of different applications for microprocessors, both standard and custom, in communications exceeds 1,000.

Corporate Synergy

In the process of doing our research on Motorola, DATAQUEST is intrigued with a number of areas that we believe represent profitable and exciting potential for Motorola but that are at this point disjointed or too small to be quantified.

Since this newsletter covers the Company through the end of the 1970s, perhaps this section can be viewed as presenting some prospects as yet unquantified for the company in 1980.

- Quartz Crystals: All microprocessors use a quartz crystal. As microprocessor volume goes into the tens of millions per year, the quartz crystal business can be a very significant "drag" business for Motorola, much as the discrete components business will benefit by increased business in microprocessors.

- Solar Energy: Presently, the efficiencies of silicon for solar energy are very low. However, the Company is taking an active stance in the solar energy field. Motorola has activities in solar energy in both the Government Electronics Division (GED) and the Semiconductor Group. The GED is prime contractor for a program to supply half of the electrical power of the Phoenix Airport with silicon solar cells. Both groups are active with ERDA and JPL.

  A possibility that interests DATAQUEST is a solar power supply located in each of the microwave relay stations located around the world. This is currently a very difficult maintenance problem when batteries run down.

- Subsystems: All microprocessors require a power supply and switching power supplies being developed by the Discrete Semiconductor Division are expected to have an excellent future.

- LCD/Automotive: Most of the discussions for automotive displays seem to be centered around gas discharge and LCD technologies. It would appear that Motorola is in a position both to influence the trend and to benefit from LCD technology acceptance on a large-scale basis in the automotive industry.

- MICARL: Motorola has an innovative approach to supplying custom circuits to its own division, while at the same time maintaining volume thrust in the merchant market. DATAQUEST believes that MICARL is a unique asset in the Motorola organization and can contribute substantially to the growth of all Motorola divisions.

- Codex: As microprocessors expand into communications the product and market expertise of Codex will be increasingly valuable to Communications, Semiconductors, and Government.

- Plasma Etching: It is DATAQUEST's opinion that Motorola has been quietly pursuing intensive development in the plasma etch area for its semiconductor business, but we feel that there also may be exciting non-semiconductor products developed by this group.

James F. Riley
Frederick L. Zieber
Daniel L. Klesken

DATAQUEST RESEARCH NEWSLETTER
INCORPORATED

SIS Code: Newsletters September 29, 1978

BIPOLAR MICROPROGRAMMABLE MICROPROCESSORS

Summary

This newsletter examines the market for bipolar microprogrammable microprocessor CPUs manufactured by U.S. companies. Processors in this category are the 8X300 (Signetics) and the bit slice architectures in the 6700 (MMI), 2900 (AMD), 3000 (Intel), 9400 (FCI), and 74S480 (TI) series. Fixed program devices (FCI 9440 and TI SBP9900) are excluded. The support circuit market is addressed, but not examined in detail.

The 1978 market for 2900 CPU parts (2901 and 2909/2911) is expected to more than double over 1977 levels to $7 million, then increase at slower rates to $23 million in 1981. The total microprogrammable microprocessor CPU market is expected to grow to $42 million in 1981.

Historical Overview

The microprogrammable or emulation microprocessor was originated by Monolithic Memories Inc. (MMI) with the introduction of the 57/6701 in the first quarter of 1974. The concept, which has proved to be extremely successful, applied bipolar Schottky technology to a complete 4-bit slice of microprogrammable computer architecture. Provision was made for connecting slices in parallel to permit construction of computers with 4-, 8-, 12-, 16-, etc., bit word length.

The idea proved attractive for high-performance logic replacement, and competition quickly appeared from a 2-bit slice (3002) developed by Intel Corporation. Acceptance of these two offerings was inhibited by the lack of support and second sources.

Signetics introduced its offering (8X300) for microprogrammable microprocessors in the 1974-1975 era. The 8X300 was initially regarded as a fixed-program controller and was sufficiently different from other offerings that its acceptance was slow.

In mid-1975, Advanced Micro Devices (AMD) introduced the 2901, a variation of the 57/6701, followed by a series of support circuits, and executed second-source agreements with Raytheon and Motorola.

Fairchild introduced its bit slice 94XX series (MacroLogic) in 1975 also. MacroLogic has enjoyed good market acceptance for some of the support circuits, but less for the basic bit slice architecture, which is less powerful than the 2901.

The 2901 quickly became the dominant bit slice device and an "industry standard" with several sources of supply. AMD established itself as the leading supplier and has retained that position.

Vendors for the 2901 now include AMD, Fairchild, Motorola, National, NEC, Raytheon, Sescosem, and Signetics. MMI is expected to de-emphasize its efforts on the 6701 and to become a supplier of the 2901.

Meanwhile, the significance of Signetics' 8X300 has become understood by systems designers and it is enjoying a rapidly growing market as a microprogrammable microprocessor as well as a fixed-program controller. The 8X300 represents the largest segment of "Other Bipolar Microprocessors" in Table 1. Motorola offers a 2-bit slice ECL processor, the 10800, in current mode logic.

The Market

The market structure at present is highly fragmented. Although it is clear that the 2900 series of components dominates the bit slice microprocessor market, and that AMD dominates the market for 2900 series components, this is only of partial significance. Bit slice computers make use of relatively large amounts of bipolar memory, SSI and MSI logic, support circuits, and bipolar ROMs and PROMs. In some of these areas, AMD has not displayed great strength, and thus cannot fully exploit this tremendous drag business. The importance of the memory products is expected to enhance the relative positions of Signetics, Fairchild, and National. Furthermore, designers of microprogrammable computers often split device purchasing. This characteristic has been favorable to AMD because it is the sole source for many of the peripheral circuits. On the other hand, to implement the CPU, the designer may choose the 2901 arithmetic unit, but may use the 3002, 8X02, or 9408 control sequencer to best implement his desired architecture. Most of the total revenue remains accessible to existing bipolar component suppliers, some of whom have considerable strength in the area of bipolar PROMs.

By the middle of 1978, all of the major bipolar suppliers are expected to be offering their own 2901, and competition is likely to be fierce. The major competitive factors will be breadth of the 2900 series product line, strength in bipolar PROM, and the ability to meet severe price competition. Table 1 shows that the 1978 market for the 2901 CPU parts is estimated at only $7 million which indicates that several of the suppliers will have to share a rather small market. We expect a major shakeout to occur during 1979, which will leave three or four companies as active participants. We believe that the relatively high level of support provided by AMD will enable the company to retain 50-60 percent of the 2900 series market. National Semiconductor and Signetics can be expected to make a major effort to achieve reasonable shares of the market. The other suppliers are likely to settle for segments of the market where they may have particular strengths.

It should be emphasized that the use of a bipolar bit slice processor opens a very large market for other bipolar devices. This drag business will eventually expand to cover a majority of the bipolar IC market as processor use grows. Thus the offering of a microprocessor in opening much larger sales opportunities is critical. The dollar values understate their importance.

The microprogrammable microprocessor market is normally segmented into three areas—emulation, controllers, and military. Emulation applications are the forte of microprogrammed computers since microprogrammability enables advantage to be taken of the existing software available for the emulated machine. The very high performance and flexibility of microprogrammed microprocessors also makes them suitable for use in high performance controllers. These characteristics, combined with the experience already gained with bipolar technology, have also made the devices attractive for a wide range of military applications. In fact, were it not for the major contribution of the military market segment shown in Table 2, the 2901 market dollars would be considerably lower than those shown in Table 1. DATAQUEST understands that plastic packaged 2901s are being quoted in the $5.00 range for 1978 contracts. Given the increasing competition and the introduction of new components, we expect to see this fall below $4.00 in 1979.

As mentioned previously, we expect to see frequent changes in the basic 2901 to increase yields. Furthermore, since the bit slice microprocessor market is very performance oriented, there will be continued pressure for increased speed from existing designs as well as new components to further improve performance and reduce system level component count. The major design constraint at present remains the amount of power that can be dissipated with industry standard dual in-line packages.

Recently there has been considerable speculation on the impact of high speed, short channel, 16-bit MOS microprocessors upon the bit slice microprocessor market. It is DATAQUEST's opinion that the only significant impact will be felt in that portion of the controller market segment where the high performance and flexible architecture of bit slice microprocessors is not fully utilized. It seems clear that standard computer architectures with well-developed hardware and software support will remain the most cost-effective solution for applications that are within their capabilities. As these capabilities increase, a small part of the total microprocessor application spectrum will be covered by fixed-instruction-set microprocessors. Bipolar fixed-instruction-set microprocessors, like Fairchild's 9440, which emulates the Data General Nova, promise to be popular since they will offer both performance and well-developed software support. DATAQUEST expects the 9440-type microprocessor to be especially successful in military applications.

The chief advantage of microprogrammed computers is the flexibility of the external instruction set, which may provide for a higher performance or more elegant solution to a particular application problem. The danger is that the true cost of flexible architecture tends to be both hard to measure and higher than expected.

Where performance is of overriding concern, or where emulation of existing designs is more cost effective than developing new software around standard hardware, the bipolar microprogrammable microprocessor will retain its advantages. There is also the distinct possibility that the greater familiarity with the techniques of designing microprogrammed computers based upon bit slice processes, which is becoming apparent in the engineering community, will encourage the selection of the bit slice approach in marginal situations.

Willard Booth
Frederick L. Zieber

Table 1

BIPOLAR MICROPROGRAMMABLE MICROPROCESSOR CPU MARKET
(Dollars in Millions, CPU Parts Only)

	1977	1978	1979	1980	1981
2900	$2.7	$ 7	$11	$17	$23
Other	2.0	6	10	16	19
Total	$4.7	$13	$21	$33	$42

Note: 1) The 6701 is included in 2900.
2) "Other" includes: 8X300, 3000, 9400, 10800, and 74S480 CPU parts.
3) The drag market for other components is not included.

Source: DATAQUEST, Inc.
September 1978

Table 2

ESTIMATED MARKET SEGMENTATION

	1977		1978	
	Units	$	Units	$
Emulation	55%	40%	60%	50%
Controllers	40	40	30	25
Military	5	20	10	25

Source: DATAQUEST, Inc.
September 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters August 17, 1978

POTENTIAL STIMULANTS FOR 1979 U.S. SEMICONDUCTOR CONSUMPTION

Summary

DATAQUEST believes that 1979 will be a good, if not great, year for the semiconductor industry, with projected gains of about 11 percent in U.S. consumption over 1978. However, three factors could potentially add to overall demand in 1979 by several percentage points—inflation, IBM, and dollar devaluation. None of these stimulants are included in any econometric model based on history.

Inflation

It is becoming increasingly clear that inflation has a positive—if delayed—effect on semiconductor demand. While semiconductors and equipment using semiconductors are decreasing in price, most other items, including other types of capital equipment and labor, are increasing in price. The economic advantages of using electronic equipment to increase productivity or cut costs are becoming more apparent to management. The rapid growth of the mainframe, minicomputer, word processing, industrial control, and many other markets is due in large part to a recognition of these advantages. Inflation makes users more aware of, and concerned with, rising costs in other areas, thus indirectly increasing the markets for electronic equipment in the industrial and EDP areas.

IBM

IBM has recently placed orders for semiconductor memory in the merchant market. This is the first time IBM has needed to purchase semiconductor memory for its major computer products. IBM is currently faced with three major problems in its semiconductor manufacturing:

1. A major increase in demand which exceeds its current capacity due to the popularity of its new 330X computers;

2. The prospect of completely changing its semiconductor memory product line—a line that has not changed for five years, and, therefore, is not accustomed to change;

3. The need to upgrade its semiconductor technology, at least for its major production products, which has fallen behind the merchant market.

With the problems inherent in changing its technology and products and at the same time increasing production, it is becoming

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apparent that IBM faces the prospect of insufficient semiconductor capability. DATAQUEST estimates that in 1979 IBM could purchase up to $100 million or more of semiconductor memory in the merchant market. This would represent about an 11 percent increment over DATAQUEST's estimated 1979 worldwide MOS memory consumption of $877 million.

Dollar Devaluation

The current low value of the dollar has both direct and indirect effects on demand for U.S. semiconductor manufacturers. U.S. companies now have lower labor costs than their counterparts, not only in Japan but also in Europe—a fact increasingly reflected in semiconductor bookings from these areas. For example, U.S. manufacturers' discrete bookings from Japan and Europe have increased more than 60 percent since September 1977. Overall, semiconductor bookings from Japan and Europe have increased more than 30 percent during the past 11 months as a direct result of the dollar devaluation.

Although late 1977 orders were low due to sluggish economies abroad, a significant factor in these higher foreign bookings is due to the increasing price competitiveness of all U.S. manufacturers. The price differential is becoming so great that many Japanese and European buyers simply cannot afford to buy from their own domestic producers. Not only is this trend expected to continue, it is expected to accelerate due to the recent drop in the exchange rate from about ¥220 per dollar to ¥185 per dollar, which is expected to result in increased overseas sales for most U.S. manufacturers.

This increase in foreign sales of finished U.S. goods will have an indirect impact on demand for U.S. semiconductor manufacturers. As the export sales of electronic items increase, domestic demand for semiconductor components used in their manufacture will also rise. For example, TV manufacturing by U.S. companies has recently increased, thereby increasing domestic consumption of semiconductor devices.

These three developments point to the possibility that 1979 could be a better year for the U.S. semiconductor industry than generally expected. Time will tell.

Frederick L. Zieber
Daniel L. Klesken
James F. Riley

August 11, 1978

SEMICONDUCTOR INDUSTRY SERVICE

Enclosed are the 1978 updated editions of Appendix B - Market Share Estimate Worksheets. They replace last year's Appendix B, dated April 1, 1977, in Volume II of your Semiconductor Industry Service Notebooks.

In addition to providing DATAQUEST estimates of 1977 market shares, some earlier data have been improved as a result of further information obtained throughout the past year.

We apologize for the late delivery this year of Appendix B. Consequently, we have resolved to put out a preliminary edition by January 31, 1979.

The following general comments on Appendix B are noteworthy:

(1) In some cases, worldwide totals are higher than shown in Appendix A. We continue to find more semiconductor production worldwide, especially in Europe, than previously believed. In the near future, our Appendix A will be updated to reflect these changes.

(2) Japanese production is stated at a constant rate of 300 Yen per dollar. Over the period of Appendix B, the dollar value varied from 360 Yen to 220 Yen. Unfortunately, statement in dollars in either current exchange rates or a constant exchange rate is misleading. While the constant rate used is directly translatable to yen value, it does tend to somewhat understate Japanese production.

(3) European shipments are stated at current dollar rates. This was chosen because of the large presence of U.S. manufacturers in the European market and the wide diversity of countries and exchange rates. However, the recent decline of the dollar tends to overstate the growth rate of European production.

(4) In some cases, our data differ markedly from those compiled by various trade associations. DATAQUEST numbers tend to be somewhat higher due to several factors: the inclusion of semiconductor R&D billings; the addition of companies not included in other estimates, particularly in the optoelectronics area; some differences in the measurement of value added, i.e. packaging considerations; the inclusion of production for in-house captive usage by companies that also compete in a merchant market, and other factors.

We welcome your comments and opinions on our data. If you have any questions, please let us know.

Frederick L. Zieber
F. Lane Mason
James F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters

August 11, 1978

GENERAL INDUSTRY FORECAST

Summary

Our forecast for 1978 U.S. semiconductor consumption remains relatively unchanged from our previous forecast (April 14, 1978). U.S. semiconductor consumption in 1978 is expected to be up approximately 17.4 percent over that of 1977, with slower first quarter growth offset by greater than expected growth in the second and third quarters. The strong growth in the first half of this year should slow markedly in the second half. This slowdown—not a downturn—is expected to continue into the first half of 1979, with growth in semiconductor consumption increasing as that year progresses. DATAQUEST estimates approximately 11 percent consumption growth in 1979. The slower growth expected in late 1978 should have some positive effects: The industry will be able to recoup from its too rapid recent expansion with resulting cost efficiencies, having a positive effect on profits.

Recent Economic Trends

The U.S. ecomony remained strong during the second quarter of 1978. However, economic data indicates that the rapid growth that followed the February freeze has begun to slow. Money supply and the Federal Reserve Board (FRB) index of leading indicators have been flat for several months; retail sales in current dollars declined in May and June; growth in industrial production slowed considerably (to

Table 1

ESTIMATED U.S. SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1976	1977	Percent 76-77	1978	Percent 77-78
Discrete Devices	$ 948	$ 913	(3.7%)	$1,011	10.7%
Integrated Circuits	1,414	1,746	23.5%	2,111	20.9%
Total	$2,362	$2,659	12.6%	$3,122	17.4%

Source: DATAQUEST, Inc.
August 11, 1978

0.4 percent) in June. The extent and duration of the developing economic slowdown is difficult to determine. Efforts of the Federal Reserve Board to slow the economy have increased interest rates, but the basic strength of the economy is such that it has not had an exceptional effect. Actual economic downturn is not likely, and we believe the near term slowdown will be followed by a resumption of greater growth.

The following general economic developments during the second quarter are noteworthy:

- The FRB index of leading indicators has remained relatively flat, continuing to indicate an economic slowdown of some length.
- Real money supply has remained below its high in January of this year.
- The Gross National Product (GNP) grew at an annual rate of 7.2 percent in the second quarter of 1978 after a weather-related pause in the first quarter. This combination of a rebound and strong growth is not expected to continue.
- Retail purchases declined in May and June. Coupled with increased prices and production, this indicated increased inventory accumulation.
- Capital spending increased strongly during the second quarter of 1978.
- The dollar has reached historic lows against many foreign currencies.
- The Japanese economy showed increasing vigor as it moved out of its stagnation of 1977. Nevertheless, future growth is not expected to match the pre-1975 rate.
- On the other hand, European economies, including Germany's, continue to remain exceptionally sluggish.

These development indicate both the strong likelihood of (or need for) a slowing of economic growth during the second half of 1978. The economy is apparently repeating the pattern of the previous two years—a strong first half growth and a pause during the second half of the year. However, for several reasons, the slowdown is expected to be less severe than had been anticipated. The inflationary trends are spurring consumer spending with a "buy now" attitude; coupled with record employment, this attitude is maintaining consumer spending at high levels. The devaluation of the dollar with respect to the Japanese Yen and German Mark indicates that as the economy does slow, there may be rising exports and declining imports.

Table 2

ESTIMATED QUARTERLY U.S. SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1977				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Discrete Devices	$223	$234	$227	$229	$ 913
Integrated Circuits	405	430	431	480	1,746
Total	$628	$664	$658	$709	$2,659
Percent Change From Previous Quarter	2.6%	5.7%	(0.9%)	7.8%	-

	1978				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Discrete Devices	$230	$256	$262	$263	$1,011
Integrated Circuits	480	529	547	555	2,111
Total	$710	$785	$809	$818	$3,122
Percent Change From Previous Quarter	0.1%	10.6%	3.1%	1.1%	-

	1979	
	1st Qtr.	2nd Qtr.
Discrete Devices	$265	$271
Integrated Circuits	562	575
Total	$827	$846
Percent Change From Previous Quarter	1.1%	2.3%

Source: DATAQUEST, Inc.
August 11, 1978

Additionally, the Federal Reserve Board is in a position to apply monetary stimulus, if required. Other indicators—such as liquidity, unemployment, inventories, and excess industrial capacity—tend to support data which indicate a major slowdown is not required to adjust economic imbalances. We continue to believe that the possibility of a continuing period of economic growth—erratic, but without downturns—still remains, as outlined by DATAQUEST during its Semiconductor Industry Service conference in October 1977. A slowdown can have the positive effect of giving the economy a breather prior to resumed stronger growth.

Semiconductor Industry Forecast and Trends

The semiconductor industry continued to remain exceptionally strong during the second quarter of 1978. Industry bookings in recent months have remained extremely high with industry book-to-bill ratios above 1.2, and even higher ratios for individual companies and product segments. These bookings primarily have been the result of increased capital equipment spending, especially in the EDP segment; a rebuilding of inventories and catch-up production following the winter freeze; and longer lead times. Because electronic equipment prices have not suffered the general inflation, their relative value has increased. Capital spending for electronics has consequently increased much faster than the general market.

DATAQUEST estimates that second quarter 1978 semiconductor shipments increased by more than 10 percent over the first quarter. This has resulted in supply catching up with the demand backlog. At this time, there are a decreasing number of instances of semiconductor product shortages. The recent past imbalance between supply of large MOS devices and demand is rapidly disappearing. Many large users report ample supplies of 16K RAMs, 4K static RAMs, and other devices. While some temporary shortages have surfaced in other areas, such as bipolar memory, the potential threat of inadequate semiconductor production is rapidly disappearing. Coupled with a slowing economy, this indicates that semiconductor bookings growth may slow measurably in the near future. The exact timing, however, is somewhat uncertain. In the past two years—1976 and 1977—the normal lags between the general economy and semiconductor demand have not held, i.e., semiconductor bookings declined almost immediately in concert with the general economy. This year, however, bookings have remained strong although industrial production has slowed—at least through July. The slowing of bookings growth is expected to materialize soon, but it is difficult to precisely predict the effect on third quarter shipments. As a result of this slower than anticipated response, third quarter shipments are now expected to be higher than our previous forecast.

Semiconductor inventories still appear to be at low levels. They have been growing slightly in recent months, especially at the end equipment level, but this growth is well within normal bounds. Additionally, DATAQUEST sees very little double-ordering in semiconductor bookings. Adequate deliveries by semiconductor manufacturers have kept this practice to a minimum and semiconductor users appear to be more cautious in their purchasing habits than in past periods of bookings strength.

Our current forecast is shown in Tables 1 and 2. Semiconductor consumption is expected to continue quarter-to-quarter improvements throughout the next four quarters. Total semiconductor consumption is expected to increase about 17.4 percent in 1978 above 1977 levels. Consumption in the second quarter has been exceptionally strong, with an increase of over 10 percent above a relatively flat first quarter. That flatness is somewhat statistical, with consumption and/or shipments borrowed by both a strong fourth quarter in 1977 and the second quarter of this year. We expect quarter-to-quarter growth to slow measurably in the third quarter and be relatively weak towards year end.

In 1979 semiconductor consumption is expected to show increasing growth as the year progresses. DATAQUEST sees no downturn in semiconductor demand at this time. We expect 1979 semiconductor consumption to be approximately 11 percent above 1978 levels.

A slackening in semiconductor demand should have some positive effects on the industry. The rapid buildup in semiconductor production and employment has caused considerable inefficiencies in many production lines. Inexperienced workers have had a deleterious effect on semiconductor yields. With slowing growth, semiconductor companies will be able to reestablish their yields, efficiency, and costs. At the same time, price declines have remained at relatively normal levels, partly because most companies have expected a slowdown in the second half of 1978 and forward pricing has reflected this. Consequently, a slackening growth may not cause undue price erosion but may be characterized by improved costs. Thus, industry margins have an excellent chance of continued improvements in future quarters.

Semiconductor industry employment still remains at a critical point. In the Santa Clara Valley (Silicon Valley) the labor market remains extremely tight. The rapid growth of resident light industry since 1975, coupled with the lack of population influx into the area, has resulted in a difficult situation for many companies—for both hourly and professional personnel. Increasingly, this has resulted in exceptionally high wages and salaries, marginal workers, and plans for expansion in other geographical areas. For many companies, increases in semiconductor shipments will have to come from increases in productivity.

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SIS Code: Newsletters August 3, 1978

THE DOMESTIC ECL MARKET

Summary

ECL (Emitter-Coupled Logic) sales are expected to triple from $45 million in 1977 to $175 million in 1980. The "ECL 10K Series" represents over 80 percent of today's ECL sales. ECL sales have shifted from being primarily custom to primarily catalog products and serve a broad customer base. Designs for production in the 1980s are being implemented with subnanosecond ECL, gate arrays, and memory.

History

ECL and its variant, CML (Current-Mode Logic), is bipolar logic in its fastest form.

Motorola introduced ECL in 1962 with its MECL I (Motorola ECL) family. MECL I and its siblings MECL II, MECL II 1/2, and MECL III served very small specialty markets requiring the highest possible logic performance. The introduction of "ECL 10K" in 1971 by Motorola and Signetics marked the beginning of ECL as a broad-usage logic family. Bipolar processing technology had advanced sufficiently that ECL 10Ks speed-power figure-of-merit made ECL MSI feasible; hence, ECL became cost competitive with high-speed TTL logic. It also removed the major incentive for custom ECL, which had been in broad use by the mainframe computer manufacturers. Table 1 shows a comparison of the performance characteristics of the major ECL families.

Mainframe manufacturers, including CDC, Hitachi, ICL, NCR, Univac, and ICL accepted ECL 10K and began designing their high-end systems in this new logic form. The ECL 10K family became a recognized "standard logic family" when Fairchild and Texas Instruments (TI) announced that they would be alternative sources to the family. Market forecasts were aggressive, predicting that ECL 10K sales would surpass the sales of the competitive Schottky-TTL Series "74S" by 1975. A major recession in the computer industry and general unfamiliarity with ECL delayed the forecasted acceptance by about three years. The delay in ECL 10K usage caused Signetics to curtail all new development in the family and TI to withdraw from the market entirely.

Meanwhile, the mainframe manufacturers designed complete product lines with ECL 10K as the dominant logic form. In the present computer boom, the ECL 10K designs at CDC, DEC, NCR, and Univac, represent the most successful models.

The Market

ECL with the 10K series in the mainstream position, has come to life and is growing at a dramatic rate. ECL 10K sales are expected to nearly double from 1977 to 1978, reaching $82 million in 1978 and $125 million in 1979. ECL 10K sales are about equally divided between Logic/LSI and Memory. DATAQUEST estimates of ECL sales are shown in Table 2. U.S. shipments to foreign countries are not included in this Research Newsletter; however, these sales are significant, being about one-third the size of the sales in the United States. Approximately one-half of today's ECL 10K sales are for a wide range of non-computer applications, including test systems, add-on memory, military radar data processing, and telecommunications.

Sales through distribution are reported to be strong and serving a broad customer base. Delivery lead times are long—12 to 20 weeks—owing to two significant occurrences: the mainframe users' demand increased sharply, and Fairchild simultaneously changed its production facility with some temporary production loss. Fairchild reports that normal production has been restored. Motorola and Signetics report that their production rates have been increased in accordance with the demand. To meet the requirements for even higher performance for application in top-end computers, instrumentation, and telecommunications, new ECL forms with subnanosecond switching times have been introduced. New ECL 10K devices (108XX number sequence) utilize the higher speed while maintaining the power-supply and logic-level voltages of the previous ECL 10K devices. ECL 100K represents a new logic family with new power-supply and logic-level voltages. Design activity for the large mainframe computers has shifted to these new ECL forms with at least eight of the world's top computer companies creating new designs for production in the early 1980s.

The gate array is the approach to the future for ECL logic; it seems to be the only practical way to utilize the low propagation delays. Random logic is impractical since signal delays in the wiring would be large compared with the delays within the logic. Dedicated LSI designs would result in excessive proliferation of designs, design costs, and lead times. Future gate arrays will offer the user the opportunity to interconnect "macro functions" with choices of input and output configurations. Thus, reasonable design flexibility is available, but only one or two levels of custom masking are required. Design costs and lead times are kept down by allowing the user to do most of the design and by restricting the design freedom to three masks (two interconnects plus via).

Gate arrays available today contain 168 gates. Advances in process technology now make arrays of considerably higher density feasible; for example, Motorola is expected to announce an array with 750 gates early next year. Signetics is expected to introduce a gate array containing 400 to 600 gates. Fairchild is expected to improve both performance and density in its second-generation array.

New memories at higher performance and density are being offered by an increasing number of suppliers. The ECL memory performance standard today is access times of 10 to 20 ns for 1K RAMs. A 4K RAM with access times on the order of 25 ns has been sampled by Fujitsu. National and Signetics are expected to announce new memory products with competitive performance numbers soon.

Competition

Motorola is the leading supplier of ECL logic by a broad margin. Fairchild is the leading supplier of ECL memory. Signetics is in the third position in both categories. National Semiconductor is expected to enter the market via logic arrays and memory. Table 3 compares the offerings of the ECL suppliers.

Significant amounts of ECL and CML are supplied by captive facilities, and are therefore not reported in this newsletter. Burroughs and Hewlett-Packard are significant captive suppliers.

Willard Booth
Daniel L. Klesken
Frederick L. Zieber

Table 1

ECL PERFORMANCE EVOLUTION

Family Name	Intro. Date	Gate Prop Delay (nsec)	Flip Flop Clock Rate (MHz)	Power (milli-watts)	Speed Power (pico joules)	Comments
ECL I	1962	8	30	30	250	No longer offered
ECL II	1966	4	100	22	88	Being withdrawn this year
ECL II 1/2	1967	2	180	70	140	Being withdrawn this year
ECL III	1968	1	500	60	60	
ECL 10K						
10100	1971	2	150	24	48	Mainstream ECL business
10200	1972	1.5	150	30	45	
10800	1976	1-2.5	N.A.	2.7	5.4	Performance competitive with ECL 100K
ECL 100K	1975	0.75	500	40	30	Expected to become significant about 1980-1981
ECL Gate Arrays						
Fairchild		0.75	N.A.	8.7	6.5	168 gate array
Motorola "Macro Cell"		0.6-0.9	N.A.	5.3	4.0	Approx. 750 gate equivalents. Expected to be announced Q1 1979

Source: DATAQUEST, Inc.
August 3, 1978

Table 2

ESTIMATED U.S. ECL MERCHANT MARKET
(Dollars in Millions)

	1977	1978	1979	1980
ECL 10K	$36	$68	$105	$144
Logic and LSI	20	38	59	81
Memory	16	30	46	63
Other ECL/CML	$ 9	$14	$ 20	$ 31
Logic and LSI	6	9	11	17
Memory	3	5	9	14
Total	$45	$82	$125	$175
Logic and LSI	26	47	70	98
Memory	19	35	55	77

Source: DATAQUEST, Inc.
August 3, 1978

Table 3

SUPPLIERS OF ECL

	ECL 10K Compatible			ECL 100K Compatible		
	Logic	LSI	Memory	Logic	LSI	Memory
Fairchild	X		X	X	X	X
Fujitsu		X	X			
Hitachi	X		X			
Motorola	X	X	X			
National			0			0
NEC	X		X			
Signetics			ROMS: X			
			RAMS: 0		X	0

0 = Expected to be announced soon
X = Now

Source: DATAQUEST, Inc.
August 3, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 25, 1978

MOS MICROPROCESSOR SHIPMENTS

Summary

Worldwide shipments of MOS microprocessors in the second quarter of 1978 were an estimated 5.5 million units, up about 20 percent over the first quarter of 1978. Single-chip microcomputers represented about 52 percent of the total second quarter shipments. The 16-bit microprocessor market is expected to accelerate with the recent entrance of Intel's 8086 product family.

Quarterly Microprocessor Shipments

Table 1 presents DATAQUEST's estimates of worldwide microprocessor CPU shipments for the first and second quarters of 1978. The shipment estimates refer to CPUs and do not include shipments of peripheral products.

In our last Newsletter, dated June 21, 1978, we began listing the single-chip microcomputers separately, and we will continue this practice because of their growing popularity and importance (see Table 2). Second quarter shipments of single-chip microcomputers were an estimated 2.9 million units, up about 35 percent over the estimated first quarter shipments. Single-chip microcomputers in the second quarter represented about 52 percent of total microprocessor shipments.

Despite the fact that the unit pricing of single-chip microcomputers is low and continues to decline, this is a very important market because of its rapidly growing quantities. Although the number of suppliers represented in Table 2 is still small, we expect it to include most suppliers within the next year or so. The capability of putting an entire CPU, RAM, ROM, and I/O on a single chip makes the single-chip microcomputer a very attractively priced and powerful device for most users.

4-Bit Microprocessors

The unit volume of 4-bit microprocessors continues to grow rapidly as indicated in Table 3. In fact, 4-bit microprocessor shipments are growing at a rate faster than the 8- or 16-bit microprocessors, a fact closely related to the low prices of these devices. A single-chip TMS-1000 in large quantities is selling for $1.50 to $2.00. The PPS-4 device is being shipped in large quantities at prices ranging from $2.00 to $3.00. Most other single-chip 4-bit microcomputers are in this under-$3.00 range. It should be noted that our data does not include all 4-bit products, including several marketed in Japan. We hope to provide more complete information in future newsletters.

8-Bit Microprocessors

Worldwide shipments of 8-bit microprocessors in the second quarter of 1978 were an estimated 2.2 million units, up about 2.3 percent over estimated first quarter shipments. Growth of the 8-bit product market is coming from both mature products and new product introductions, but has been impacted in the second quarter by seasonal factors decreasing 6500 shipments.

Prices of the 8-bit microprocessor shipped in the second quarter of 1978 were in the $4.00 to $8.00 range for large quantity shipments, with plastic the predominant packaging technology. Generally, only special computer or military applications require the higher priced ceramic or cerdip packages.

Quarterly shipments of several major 8-bit microprocessor families are presented in Table 4. Data from Table 2 shows further that 8-bit single-chip microcomputers comprised 12 percent of all 8-bit shipments in the second quarter. This compares to less than 8 percent in the first quarter.

16-Bit Microprocessors

Worldwide shipments of 16-bit microprocessors in the second quarter of 1978 were an estimated 88,000 units, up about 31 percent over estimated first quarter shipments. The entry of Intel's 8086 family into this category has added growth to 16-bit products. The emergence of this new family, as well as others expected in the coming months, should add to the rapid growth of 16-bit microprocessors. Although it has taken some time to occur, it now appears that the 16-bit microprocessor market is ready to begin its growth stage.

Daniel L. Klesken
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Frederick L. Zieber

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS
(Units in Thousands)

Company	MPU Products	Bits	MOS Process	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
AMD	8080A	8	N	165	90	105
AMI	6800	8	N	89	35	30
	S2000	4	N	0	0	9
Fairchild	F8	8	N	655	225	250
	3870	8	N	0	3	5
	6800	8	N	15	55	45
GI	CP-1600	16	N	31	10	20
	PIC-1650	8	N	0	75	95
Harris	6100	12	C	13	5	5
Intel	4004	4	P	215	42	42
	8008	8	P	124	28	28
	8080	8	N	510	165	170
	8048/8021	8	N	95	60	100
	8085	8	N	55	50	80
	8086	16	N	0	0	1
Intersil	6100	12	C	16	8	10
MOS Technology	6500	8	N	280	50	55
Mostek	F8	8	N	90	50	30
	Z-80	8	N	85	70	50
	3870	8	N	20	20	50
Motorola	6800	8	N	435	180	205
	3870	8	N	0	10	20
	14100	4	C	0	0	5
National	COPS	4	N	NA	300	500
	4004	4	P	110	30	35
	IMP	4	P	55	20	20
	8080A	8	N	145	85	90
	SC/MP	8	P	189	65	70
	PACE	16	P	47	18	18
NEC	8080	8	N	162	70	85
	COM-4	4	N	225	150	225
RCA	1802	8	C	222	75	90
Rockwell	PPS-4	4	P	575	400	550
	6500	8	N	225	260	200
Sescosem	6800	8	N	10	5	6
Signetics	2650	8	N	39	12	20
Synertek	6500	8	N	250	325	225
TI	TMS 1000	4	P	2,825	1,400	1,800
	TMS 8080A	8	N	100	30	30
	TMS 9900	16	N	95	40	50
Zilog	Z-80	8	N	95	90	100
Total Microprocessors				8,260	4,606	5,524
Percent change from previous quarter					36.1%	19.9%

Source: DATAQUEST, Inc.
July 25, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF SINGLE-CHIP MICROCOMPUTERS
(Units in Thousands)

Company	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
Fairchild	3870	0	3	5
GI	PIC-1650	0	75	95
Intel	8048/8021	95	60	100
Mostek	3870	20	20	50
Motorola	3870	0	10	20
	14100	0	0	5
NEC	COM-4	225	150	225
Rockwell	PPS-4	575	400	550
TI	TMS 1000	2,825	1,400	1,800
Total Single-Chip Microcomputers		3,740	2,118	2,850

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

4-Bit Products	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
AMI	S2000	0	0	9
Intel	4004	215	42	42
Motorola	14100	0	0	5
National	COPS	NA	300	500
	4004	110	30	35
	IMP	55	20	20
NEC	COM-4	225	150	225
Rockwell	PPS-4	575	400	550
TI	TMS 1000	2,825	1,400	1,800
Total		4,005	2,342	3,186
Percent change from previous quarter			52.3%	36.0%

(continued page 5)

Table 3 (continued)

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

8-Bit Products	MPU Products	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
AMD	8080A	165	90	105
AMI	6800	89	35	30
Fairchild	F8	655	225	250
	3870	0	3	5
	6800	15	55	45
GI	PIC-1650	0	75	95
Intel	8008	124	28	28
	8080	510	165	170
	8048/8021	95	60	100
	8085	55	50	80
MOS Technology	6500	280	50	55
Mostek	F8	90	50	30
	Z-80	85	70	50
	3870	20	20	50
Motorola	6800	435	180	205
	3870	0	10	20
National	8080A	145	85	90
	SC/MP	189	65	70
NEC	8080	162	70	85
RCA	1802	222	75	90
Rockwell	6500	225	260	200
Sescosem	6800	10	5	6
Signetics	2650	39	12	20
Synertek	6500	250	325	225
TI	TMS 8080A	100	30	30
Zilog	Z-80	95	90	100
Total		4,055	2,183	2,234
Percent change from previous quarter			27.1%	2.3%
12-Bit Products				
Harris	6100	13	5	5
Intersil	6100	16	8	10
Total		29	13	15
Percent change from previous quarter			30.0%	15.4%
16-Bit Products				
GI	CP-1600	31	10	20
Intel	8086	0	0	1
National	PACE	47	18	18
TI	TMS 9900	95	40	50
Total		173	68	89
Percent change from previous quarter			13.3%	30.9%

Source: DATAQUEST, Inc.
July 25, 1978

Table 4

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]
(Units in Thousands)

Microprocessors	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
8080	1,082	440	480
F8	745	275	280
6800	549	275	286
6500	755	635	480
Total	3,131	1,625	1,526

[1] Numbers in this table include all manufacturers of these types

Source: DATAQUEST, Inc.
July 25, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 19, 1978

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of current issues impacting the U.S. semiconductor industry. Some of these issues have been reported upon in earlier DATAQUEST Newsletters.

- In international negotiations, the U.S. Government is advocating a reduction of export controls on semiconductor devices and production equipment destined for the Communist bloc.
- A high technology firm is denied judicial review of the U.S. Government's decision to deny an export license.
- As a result of changes advocated by Zenith Corporation, some U.S. semiconductor companies may be unable to benefit from substantially reduced penalty provisions in the Customs Reform bill.
- A Congressional Task Force says implementation of the Strauss-Ushiba Communique is proceeding slowly; it will schedule hearings this summer.
- Japanese newspapers report that MITI has proposed lower semiconductor and computer tariffs.
- Buy American legislation has been presented in both the House and the Senate. This is another indication of Congressional sympathy for industries hurt by foreign imports.
- Senate Democrats expect to have a modified Labor Law Reform bill before the Senate by mid-July.
- President Carter has rejected the advice of two members of his own Cabinet and will not modify his intention to phase out DISC.
- A tax reduction bill, probably containing major reforms in the capital gains tax, is likely to emerge from the House Ways and Means Committee this month.

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Export Controls To Be Relaxed For Semiconductors

Late last month, the Department of Commerce, in an unusual move, released a general outline of the U.S. Government's recommendations for the international control of shipments of high technology products into the U.S.S.R. and other socialist countries of Eastern Europe.

DATAQUEST has obtained a copy of this outline, and it appears to contain good news for the U.S. semiconductor industry. In past years, semiconductor devices, and the equipment and machinery for their manufacture and testing, have been considered by the United States and its allies as one of the most sensitive areas and one of the most important for Western security. Under these circumstances, it has been extremely difficult for the U.S. manufacturers to obtain export licenses for the shipment of these products into the Eastern European bloc.

According to the Commerce Department's summary of the current U.S. negotiating position, the U.S. proposals on semiconductor devices and production equipment exportable to Eastern bloc countries are more liberal than existing coverage in virtually every case.

Specifically, in the microcircuits area, the U.S. has proposed that:

- Certain microcomputers and microprocessors be decontrolled
- Embargo parameters be indexed for microcomputers, microprocessors, and certain memory circuits to provide for phased liberalization each year as the technology advances
- Many circuits used in calculators be decontrolled
- The list of uncontrolled circuits be expanded to include non-programmable circuits for use in automobiles, home appliances, personal communications (e.g., CB radios), and certain radio and television circuits.
- Sale of certain integrated circuits in chip form be permitted in the Eastern bloc for the first time.

The United States is also proposing considerable clarification of existing controls on equipment for semiconductor manufacture. According to the Commerce Department, the United States generally seeks to restrict the export of only technologically advanced equipment in the areas of materials processing, masks, maskmaking, and programmable inspection equipment for the production of assemblies and sub-assemblies. (An example in the materials processing area is that non-electronically programmable equipment would be subject to relaxed control.) Although it remains to be seen how many of the U.S. recommendations will be agreed to by our trading partners, this country has historically played a leading role (and often a more restrictive one than our allies) in these negotiations. The apparent willingness of the U.S. Government to relax controls on certain semiconductor production equipment and devices is also important in terms of the future level of U.S. unilateral controls on shipment of these products.

Export License Denial—Judicial Review Refused

The U.S. Court of Appeals in Washington has upheld a lower court order denying judicial review to an exporter whose license application for the sale of an infrared remote scanning device to the People's Republic of China was denied by the U.S. Commerce Department.

The lower court decision held that the complaining exporter, Daedalus Enterprises Inc., had not exhausted all administrative remedies available to it, and that the national security issues involved in the case raise political rather than judicial questions. Specifically, the lower court said that the sale of remote sensing equipment and technology to the People's Republic of China, and the impact of that sale on the national security of the United States, raises political questions entrusted to the jurisdiction of the Executive Branch.

Daedalus has argued that national security should not be an issue in the evaluation of its application, because the PRC has the ability and resources to produce the type of equipment in question without any illegal acquisition of technology.

High technology firms seeking to export to Eastern bloc countries have for years argued with the Commerce Department and other federal agencies over the question of "foreign availability" of those products. The court's decision offers them little encouragement.

Customs Reform Legislation Hits A Snag

The Customs Procedural Reform and Simplification Act of 1978, H.R. 8149, long awaited by many high technology firms using Items 806.30 and 807 of the U.S. Tariff Schedules, contains a potential loophole, according to the Zenith Corporation. If this situation is rectified, the U.S. semiconductor industry could lose the benefit of substantially reduced penalty provisions contained in the legislation.

Both the House and the Senate have now passed slightly different versions of the Customs Reform legislation, whose most controversial feature until recently has been the substantial modification of Section 592 of the Tariff Act of 1930. A House-Senate Conference Committee is now meeting to resolve what heretofore have been considered minor and reasonably non-controversial differences between the two bills.

However, early in July the Zenith Corporation charged that if the House version of the bill becomes law, it could confer retroactive immunity on Japanese television manufacturers and U.S. importers now under civil and criminal investigation for falsifying customs documents.

To correct this situation, Zenith has persuaded the Senate to ammend its bill to apply present Section 592 penalties, which call for an initial penalty assessment equal to the full value of the product, in all cases involving ongoing investigations and international violations. Explaining the intent of the amendment, Senator Robert Morgan (D., N.C.), one of the co-sponsors said:

> "Its purpose is to assure that deliberate false statements and/or false filings made prior to the enactment of H.R. 8149 and already the subject of investigation (formal or informal) will not be affected by the substantive penalty provisions of H.R. 8149."

This statement, together with the ambiguous language of the amendment, casts serious doubt on the applicability of the substantially reduced penalty provisions contained in H.R. 8149 to the U.S. semiconductor industry.

Several years ago, the Treasury Department announced its intent to audit the industry's use of Items 806.30 and 807 of the U.S. Tariff Schedules. A number of semiconductor firms are currently going through this process or have already been audited. Several penalty notices have been issued. If this audit process were considered a "formal or informal investigation" under the terms of the proposed amendment, the industry could find itself facing initial penalty assessments amounting to the full forfeiture value of products erroneously imported into the United States instead of the lesser penalties provided for in the new legislation—especially ironic because the industry has in recent years played a leading role in persuading Congress to amend the penalty provisions of Section 592.

Assuming the Zenith amendment does not survive the House-Senate conference, the semiconductor industry and other high technology companies using offshore assembly plants should be interested in seeing the Senate's version of the Customs Reform bill passed because it contains a significant change in the base for calculating penalties under Section 592. Under the House bill, two bases are used to calculate these penalties: the <u>domestic value</u> of the product if there is duty underpayment, and a percentage of the <u>dutiable value</u> if there is no duty underpayment. The Senate version of the proposed legislation uses only dutiable value to compute maximum penalties. A maximum penalty assessment—already substantially reduced under the proposed legislation—would thus be further reduced for those firms that are shipping U.S. parts and components offshore for assembly and then re-importing the finished product. The dutiable value for most high technology devices is 10-25 percent of the domestic value.

U.S.-Japanese Trade Relations

In the latest Tokyo Round trade negotiations in Geneva, Japan has offered further tariff cuts for semiconductors and computers, according to the Japan Economic Journal. An interim report released in late May by a House Ways and Means Committee task force set up to monitor U.S.-Japanese trade relations, indicates that implementation of the Strauss-Ushiba Communique is proceeding slowly but steadily. The task force is chaired by Rep. James Jones (D., Okla.), and includes Reps. Abner Mikva (D., Ill.) and Bill Frenzel (R., Minn.). The task force and the Trade Subcommittee of the House Ways and Means Committee will schedule hearings later this summer on the issue of U.S.-Japanese Trade Relations.

The task force's preliminary findings include the following:

- Although the Japanese appear "quite committed" to implementing the communique, including the promise to increase quotas on certain U.S. agricultural products, U.S. exporters complain that they are unable to gain direct access to Japanese retailers, and that they are required to sell their products at artifically high prices.
- The Trade Facilitation Committee concept has produced disappointing results.
- Given the Administration's proposals to repeal tax incentives affecting U.S. exporters and U.S.-based multinational corporations, U.S. export promotion efforts are viewed with some skepticism by U.S. businessmen.
- The efforts and expertise of U.S. commercial attachés abroad do not compare with those of their Japanese counterparts.
- Japan's movement on government procurement practices and its continued participation in the multilateral trade talks in Geneva continues to be disappointing.

Nevertheless, a return delegation for trade enhancement is visiting Tokyo in August, reciprocating a recent government sponsored visit here.

Buy American Legislation

Two identical bills with potentially far reaching political consequences have been introduced in the Senate and the House: S-2318, sponsored by Senator John Heinz (D., Pa.), and H.R-9427, sponsored by Rep. Adam Benjamin (D., Ind.). The legislation is basically the product of House and Senate steel caucuses, who have argued that current Buy American policies only exacerbate the steel industry's problems with import competition.

In brief, the two bills make three major changes in the existing Buy American Act:

(1) The legislation would change the current definition of domestic content. For an article to be considered an American product, more than 75 percent of the costs of all its components must be mined, produced, or manufactured in the United States. Current policy, set by regulation, uses a 50 percent test.

(2) Buy American Act coverage would be extended to any contract that is more than one-half financed by appropriations, subsidies, loans, or grants from the U.S. Government or any federal agency. This provision is designed to encompass purchases by state and local governments.

(3) The price differential used to detemine "unreasonable cost of domestic products" would be established by law with a floor of 15 percent and a ceiling of 50 percent.

Despite the fact that some limited Congressional attention was focused on these bills earlier this year, it is extremely unlikely that any action will occur in 1978.

However, an increasing number of Members of Congress are showing greater interest in Buy American policies and other means of restricting imports. Congressional supporters of these concepts could get a strong shot in the arm if the U.S. trade situation with Japan does not begin to show marked signs of improvement and/or if the President's Special Trade Representative, Robert Strauss, does not bring home a trade agreement acceptable to Capitol Hill. Under either of these circumstances, strong Buy America and other protectionist legislation could next year pick up rapid and significant support in the Congress.

<u>Labor Law Reform</u>

The Senate's Democratic leadership expects to have a revised labor law reform bill back and ready for Senate debate by mid-July, although Senate Majority Leader Robert Byrd (D., W. Va.) would not predict when actual debate might begin on any revised legislation.

After 19 days of debate and six unsuccessful attempts to end a filibuster, the Senate sent the labor law reform bill back to the Senate Human Resources Committee late last month. Within a week, that committee had announced two days of public hearings on the legislation.

In commenting on the outlook for the legislation, Senator Byrd indicated that he expects the Human Resources Committee to report a "lean and hard" bill, without some of the controversial features that kept the filibuster alive. Among those features were provisions giving unions access to the workplace, and regarding the time frame within which a union election must be scheduled.

Assuming there were major changes in the Senate form of the labor law bill, and assuming any ensuing filibuster attempt could be broken, the legislation would still have to be reviewed by a joint House-Senate Conference Committee to resolve the differences between the two versions. This can be a long and tedious process, and any major revision of a Senate compromise attempt could provoke another filibuster.

Export Tax Incentives In Doubt

While the debate around possible revisions in the capital gains tax has received center-stage attention, U.S. exporters received a major setback late last month when President Carter rejected a Cabinet-level task force proposal that he withdraw his present plan to phase out the controversial $1.1 billion Domestic International Sales Corporation (DISC) tax break, and, instead, revamp it to shift benefits to medium- and small-sized firms.

In an initial decision, the President reportedly told task force members that they could suggest possible alternatives in an upcoming report on U.S. export policy, but that he would not alter his current intention to phase out DISC.

The task force group was formed by President Carter in mid-April to develop measures to increase U.S. exports, and improve the terms of trade. Juanita Kreps, Secretary of Commerce, was named to head the group, which includes representatives from the Departments of Treasury, Justice, State, Defense, and Labor, the Federal Reserve Board, and eight other federal agencies.

The decision to modify existing export tax benefits rather than to repeal them outright was backed by both Secretary Kreps and Treasury Secretary Blumenthal. The President's decision to overrule his two cabinet members is widely interpreted as a victory for the White House Domestic Policy Staff, which had previously objected strongly to any compromise on Carter's campaign promise to repeal DISC outright.

The President's decision also casts doubt on the usefulness of the task force's other recommendations to stimulate U.S. exports. The Commerce Department has been quoted as saying that "a national export policy will not be viewed as credible unless it contains a tax incentive for exports."

Capital Gains Tax Reduction

A tax reduction bill, probably containing a major reform in the capital gains tax rate sought by the high technology electronics industry, is likely to emerge from the House Ways and Means Committee later this summer. President Carter has said that he would veto any tax legislation containing a change in the capital gains tax.

Early in July, after a private meeting with Administration representatives, House Ways and Means Committee Chairman Al Ullman (D., Ore.) gave the Administration and its supporters on Ways and Means until July 17 to come up with 19 Committee votes to defeat any major changes in the capital gains tax rate this year.

Despite last week's meeting, it is widely assumed that supporters of Rep. William Steiger's proposal to roll back the capital gains tax rate for individuals and corporations to pre-1969 levels had enough votes in the Ways and Means Committee to pass either the Steiger proposal or (more likely) a modification to that proposal offered by Rep. James Jones (D., Okla.). The Jones compromise on capital gains would establish a 35 percent tax rate (as opposed to the 25 percent rate contained in the Steiger proposal).

Since mid-May, Democratic leadership in the House has been trying to head off passage of the Steiger proposal. It is largely because of increasing support for the proposal in the Ways and Means Committee that Chairman Ullman has refused to resume hearings on the Carter tax reform package. Now, the Chairman, who himself reportedly favors the Jones compromise, has apparently set a deadline for those opposed to Steiger's proposal to come up with the necessary votes in the Committee.

It is generally believed that Steiger supporters have 22 of the 37 Ways and Means Committee votes—all 12 Republicans and 10 Democrats. However, some of these Democrats would probably be satisfied with a simple extension of existing tax cuts this year, and would be willing to postpone dealing with the capital gains situation until the next Congress. Thus, the Administration does have some bargaining room.

The strategy of Steiger supporters is simple: Try to hold on to the committed votes in the House Ways and Means Committee while, at the same time, continue to develop support in the House and Senate.

Recent hearings on the issue in the Senate Finance Committee have helped to focus the Senate's attention on the matter, although a companion bill, introduced in June by Senator Clifford Hansen (R., Wyo.), has more than enough co-sponsors (63) to ensure its passage.

In the House, supporters of Steiger claim at least 123 co-sponsors, not enough to assure House passage, but certainly enough to impress the House leadership.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 14, 1978

IBM ENTERS THE COMMERCIAL MEMORY MARKETPLACE AS A CUSTOMER

Summary

IBM's recent awards of a memory device contract to Intel and Texas Instruments and a memory system contract to Intel have the potential to substantially expand the merchant MOS RAM market. Furthermore, since January, IBM has had three other RFQs seeking potential sources of semiconductor memory in the merchant market.

We understand that the IBM award to Intel for memory boards and modules using 2147 4K static MOS RAMs is for $25 million and includes about 1.2 million devices. DATAQUEST estimates that a possible upside potential for this business in 1979 and 1980 is about 5.6 million 2147s on boards and in modules, resulting in about $75 million of business.

The add-on memory business associated with IBM's 303X series of computers has an estimated $850-$1,000 million potential over the next ten years.

The 2147 is the first large volume production device to use the HMOS type wafer processing, a step that is as significant as the 1969 transition from metal gate to silicon gate. Some other corporate efforts in this direction are variously known as Poly 5, VMOS, and XMOS.

Introduction

IBM has probed the merchant semiconductor industry several times in 1978 for bids to supply MOS random access memory to IBM. The purpose of this Research Newsletter is:

- To identify the reasons for IBM activity in the merchant semiconductor market
- To identify the various IBM programs where possible
- To quantify the potential for MOS memory in IBM 303X computers through 1980
- To discuss the impact of these business opportunities on merchant semiconductor participants and add-on suppliers

IBM as a Memory Customer

We believe, the driving forces behind IBM's forays into the merchant semiconductor market this year are:

- When introducing the 303X computer models, IBM substantially underestimated the total demand, mix, and memory requirements that these price/performance upgrades would generate.

- IBM in-house semiconductor activity, like many other in-house activities, has lagged behind technological developments in the merchant market. Currently, the 303X computer contains 2K bit N-channel metal gate memory chips packaged as 4 chips in an 8K bit module.

- For the 3033 to achieve the promised speed/performance, DATAQUEST believes that IBM was required to use a water-cooled memory system, which added substantially to cost and manufacturing problems

- IBM is involved in a substantial product mix change with accompanying learning curve problems

IBM's Present Merchant Market Activity

We believe that IBM's current purchasing activity can be summarized as follows:

1. Dual 16K bit dynamic MOS RAM modules with 150 ns access time—well publicized as the IBM 32KD program. Intel and Texas Instruments received awards for module development and qualification to be followed by production of 32K bit modules containing two 16K bit chips.

2. The recent memory board and module award to Intel, utilizing the Intel 2147, a 4K static MOS RAM.

3. An RFQ from IBM's East Fishkill purchasing organization regarding a slower (250 ns) 4K static MOS RAM.

4. A second RFQ involving 16K dynamic RAMs (probably 200-250 ns).

5. An RFQ for supplying 2K N-channel metal gate die. The industry was surveyed during the first quarter but no orders have been placed to our knowledge.

DATAQUEST does not have details on items 3, 4, and 5. They are presented merely to serve as a reference point for future research. This newsletter will focus on items 1 and 2.

Semiconductor Memory Potential for 303X Systems

Hard data is difficult to acquire, but estimates of IBM's backlog for the 303X series of computers through 1980 varies from 7,000 to 15,000 units. After reviewing several inputs, DATAQUEST has assumed a total mix and memory configuration for the IBM 303X computers in 1978, 1979, and 1980, as shown below:

Computer Model	Percent of Units	Units
3031	45%	4,500 Units
3032	25%	2,500 Units
3033	30%	3,000 Units
Total	100%	10,000 Units

DATAQUEST estimates that an average memory configuration as shipped will be:

Computer Model	Memory Size
3031	2.6 MB
3032	4.0 MB
3033	6.0 MB (Maximum capacity 8.0 MB)

The memory requirements of the 3031 and 3032 computers can be met by 16K dynamic MOS RAMs. However, the speed of the 3033 computer currently dictates the use of the 2147. Add-on memory systems shipped in 1979 may be able to use fast 16K dynamic MOS RAMs to meet the 3033 speed requirements.

Estimated IBM Demand For Memory Components: 1978-80

The example that follows is designed to show the qualitive impact of IBM's requirements in the merchant semiconductor market. DATAQUEST has necessarily had to make assumptions.

IBM Model Number

- 3031: 4,500 computers x 2.6 MB/computer = 11,700 MB = 93,600 Mb = 5.8M 16K dynamic RAMs or 2.9M 32 KD modules
- 3032: 2,500 computers x 4.0 MB/computer = 10,000 MB = 80,000 Mb = 5.0M 16K dynamic RAMs or 2.5M 32 KD modules
- 3033: 3,000 computers x 6.0 MB/computer = 18,000 MB = 144,000 Mb = 36M 4K static RAMs

This analysis includes no additional memory requirements for systems enhancement. For example, the 3033 can handle up to 8 MB. Our calculations are based on a 6 MB configuration. We are assuming that 80 percent of the units listed will be shipped in 1979 and 1980, hence the revised 1979-1980 demand will be as follows:

- 3031: 5.85M 16K chips x 80% = 4.68M 16K chips = 2.3M 32 KD modules
- 3032: 5.0M 16K chips x 80% = 4.0M 16K chips = 2.0M 32 KD modules
- 3033: 36M 4K chips x 80% = 28.8M 4K static RAMs

We expect the demand for 3033 memory to be satisfied with a combination of 4K static RAMs (2147 or equivalent), 8K hybrid units, and 16K dynamic RAMs.

We are assuming that IBM's next generation of computers will truncate the life of the 303X series by 1981. Hence, our analysis deals only with 1979 and 1980 possibilities.

Impact of Memory Potential on Semiconductor Suppliers

It is DATAQUEST's understanding that the only currently available device that will satisfy the 3033 requirements is the 2147 with its power-up options and stand-by power of 50-100 milliwatts.

DATAQUEST believes that the much-publicized dual 16K bit program is designed to satisfy a large part of IBM's memory requirements for the 3031 and 3032 computers. Our estimate of 8.5 million chips puts this potential in the "good order" class. If the semiconductor industry were to procure all this business, it would amount to less than $50 million under the assumptions previously stated. We believe that Intel and TI are well into qualifications on their 150 ns parts. We also anticipate that this business may be opened up to at least one more supplier.

We also believe that the program recently announced by Intel and IBM for Intel to supply boards and modules can potentially have a strong impact on certain semiconductor and memory system suppliers. Again, we are assuming flat shipments for the 303X family and that forthcoming new generations of computers will truncate this volume in two years.

Given the above, DATAQUEST expects the following:

- Before any volume commences, IBM will qualify a system with 2147 parts. This should be completed in early 1979.
- The part being used is the 70 ns 2147. The 2147-3, a 55 ns part, will be binned out and shipped at higher prices to

other customers. Paradoxically, this could mean that next year Intel customers for 2147-3 parts will be in better shape than customers ordering the slower part.

- If the industry supplies just 20 percent of 3033 memory requirements, there will be a demand generated under our assumptions of 2.8 million memory devices a year for 1979 and 1980 which, with an opening average selling price of a unit in the module of $20.00 declining to $10.00 in 1980, generates a market potential of over $75 million.

- DATAQUEST estimates that current market-wide production of the 2147 is at an annual rate of 1.5 million units. The data below shows historical unit production build-up (in millions of units) on other memory products:

	Year 1 Initial Production	Year 2	Year 3	Year 4
4K Dynamic	.7 (1974)	5.0	28	57
16K Dynamic	2.0 (1977	20.0	-	-
4K Static	.9 (1976)	5.0	14	-
2147	1.5 (1978)	7.0	-	-

The above data show a year-to-year historical build up of 6:1 to 10:1. In light of the complexity of the circuit, the fact that it is the first HMOS production vehicle, and the fact that it took Intel almost eighteen months to reach a production rate of 150,000 units per month, we believe that 1979 will see an industry production level of 7 million units, or less than previous industry build ups. We also expect:

- Based on the above market data, the current IBM order of 1.2 million represents 17 percent of the unit production; the more aggressive estimate represents over 40 percent of the unit production in 1979.

- The next two entrants in the 2147 market will have extremely rapid market acceptance because of the conclusions stated earlier. Motorola is the only other supplier with a pin-compatible version. Some production units are expected from Motorola in the fourth quarter; however, Motorola needs to do some more work to get a better yield distribution on its part. EMM has a fast 4K static RAM that is not pin-compatible with the 2147. Its sales should be substantially enhanced if supplies are as tight as expected. Samples are expected in late 1978 or early 1979 from AMI, Fujitsu, Intersil, Mostek, National, Signetics, Synertek, and TI.

- Device prices should firm.

- Early entrants into this market, the first to use HMOS type processing, will enjoy a good learning curve position for future products. Going to HMOS or equivalent type processing is as significant as the change from metal gate to silicon gate.

- Allocation of product between other add-on suppliers, IBM, Intel Memory Systems Division, and Intel component customers may be a problem.

Impact of Current Situation on IBM Add-On Suppliers (EMM, Intel, Intersil, National)

The tabulation below indicates potential business for add-on memory suppliers over the next ten years:

	Minimum Configuration	Maximum Configuration	DQ Avg. Shipped Configuration	Add-On Potential/ Machine	No. Of Machines 1978-80	Potential Add-On
3031	2 MB	6 MB	2.6 MB	3.4 MB	4,000	13,600 MB
3032	2 MB	6 MB	4.0 MB	2.0 MB	2,000	4,000 MB
3033	4 MB	8 MB	6.0 MB	2.0 MB	4,000	8,000 MB
						25,600 MB

It is DATAQUEST's understanding that the current OEM average selling price is between $40,000/MB and $50,000/MB. The price per MB from IBM varies widely from $60,000/MB for 168 add-on to $110,000/MB for 3033 add-on. In terms of today's ASP, the business potential over ten years is greater than $950 million. ASP declines will probably reduce this to about $450 million. This figure assumes that all systems will not exceed IBM specified maximums. DATAQUEST assumes that users will exceed maximum IBM configurations as they have in the past. This could increase the market potential to $850-$1,000 million over the next ten years.

We also foresee the following:

- As IBM customers start opening memory cabinets and seeing non-IBM components, the image of add-on memory system suppliers will be enhanced. DATAQUEST believes that this current activity with IBM will lay to rest the perceived non-permanence of IBM add-on memory system business.

- There may be some potential delivery difficulties with Intel Memory System customers.

- History will again repeat itself. The original memories in 158 and 168 machines were 1K static MOS RAMs. By the time the add-on market developed, 4K dynamic MOS RAM technology had reached a point where it could satisfy the requirement. Likewise, as 303X add-on demand develops, 16K dynamic MOS RAM technology will develop to enable the 3033 100 ns requirement to be met by these devices.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 14, 1978

MOS MEMORY—STATIC AND DYNAMIC RAM AND EPROM SHIPMENTS

Summary

Worldwide shipments of 16K dynamic MOS RAMs increased to an estimated 4.4 million units in the second quarter of 1978, up about 52 percent over an estimated 2.9 million units shipped in the first quarter of 1978.

Worldwide shipments of 4K dynamic MOS RAMs in the second quarter of 1978 reached an estimated 19.6 million units, up about 7 percent over an estimated 18.3 million units shipped in the first quarter of 1978.

We estimate that about 5.0 million units of the 4K static MOS RAM were shipped in the second quarter of 1978, up about 35 percent over an estimated 3.7 million units shipped in the first quarter of 1978.

EPROM shipments were concentrated in 8K and 16K units with 32K units just beginning to be sampled. Second quarter shipments of 2708 8K EPROMs were an estimated 2.3 million units while shipments of 2716 16K EPROMs were an estimated 650,000 units.

Dynamic MOS RAMs

1K. The 1K dynamic MOS RAM market continues to be a good market for the two remaining suppliers, Intel and ITT. Pricing remains stable in the $2.00 range.

4K. DATAQUEST estimates of worldwide 4K dynamic MOS RAM shipments in the second quarter of 1978 are presented in Table 1. We estimate that about 19.6 million units were shipped in the second quarter of 1978, up about 7 percent over an estimated 18.3 million units shipped in the first quarter of 1978.

Unit volumes continue to increase from quarter to quarter, but the rate of growth is definitely slowing. Some suppliers have discontinued product offerings in this marketplace. As a result, some products, such as the 22-pin 4K dynamic RAM, have been in short supply during the second quarter with lead times extending to twenty weeks. The unavailability of product from some suppliers have provided good opportunities for those suppliers that can meet the demand. Prices of 4K dynamics for third quarter deliveries are running in the $1.60 to $2.10 range.

16K. DATAQUEST estimates of worldwide 16K MOS RAM shipments are presented in Table 2. We estimate that worldwide shipments in the second quarter of 1978 were about 4.4 million units. This is an increase of about 52 percent over an estimated 2.9 million units shipped in the first quarter of 1978.

During the second quarter, a number of manufacturers and distributors had 16K dynamic RAMs on the shelf for immediate delivery. Although in some cases this off-the-shelf availability included only the slower speed parts, there were other cases where both slow and fast devices were available for immediate delivery.

Pricing on 16K dynamic RAMs continues to decline. Large quantity shipments of slow speed plastic devices are expected to be priced in the $7.00 to $8.00 range during the third quarter and may go as low as $6.00 in the fourth quarter. Higher speed or quality parts in ceramic or cerdip are expected to be in the $8.00 to $11.00 range.

Static MOS RAMs

1K. The supply of the 2102-type 1K static MOS RAM continues to improve, and lead times are now less than eight weeks. Several manufacturers and distributors have parts available for off-the-shelf delivery. Prices are in the $1.00 range.

4K. Table 3 presents DATAQUEST estimates of 4K static MOS RAMs in the second quarter of 1978. We estimate that about 5.0 million units were shipped in the second quarter, up about 35 percent over an estimated 3.7 million units shipped in the first quarter. Long lead times that were once associated with this product have virtually disappeared. Most manufacturers are able to ship within four to eight weeks; many are able to ship directly out of inventory.

Many second quarter shipments were made in the $5.00 to $6.00 range with the price difference reflecting quality, speed, and package type.

Intel is still the only supplier of the 2147-type high speed MOS static RAM. DATAQUEST believes that about 35 percent of Intel's 4K static shipments in the second quarter were of the 2147-type. Motorola is currently sampling this product and a number of other suppliers are expected to be sampling in the third or fourth quarter of the year. The extremely large market for fast 4K static MOS RAMs was recently emphasized by the IBM order for Intel memory boards using the 2147 device. The subject of IBM orders will be explored more throughly in a separate DATAQUEST Newsletter.

8K and 16K. Several suppliers have announced future 8K and 16K static MOS RAM products. We expect sampling and prototype production on these product types to begin during the third and fourth quarters of 1978.

EPROMS

8K. Table 4 presents DATAQUEST estimates of worldwide shipments of 8K EPROM devices. We estimate that worldwide shipments in the second quarter of 1978 were about 2.3 million units. This is up about 53 percent over an estimated 1.5 million units shipped in the first quarter of 1978. Pricing on the 8K EPROM is in the $5.00 range at this time.

16K. Table 5 presents DATAQUEST estimates of worldwide shipments of 16K EPROMs. We estimate that about 650,000 units were shipped in the second quarter. Note that we have adjusted some of our first quarter estimates in Table 5. Current prices on the 2716 are in the $20.00 to $25.00 range.

32K. Texas Instruments has been sampling its 32K EPROM during the second quarter. Production deliveries are expected to begin soon.

Daniel L. Klesken
James F. Riley
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Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS

(Units in Thousands)

	1977			1978	
Company	3rd Qtr.	4th Qtr.	Total	1st Qtr.	2nd Qtr.
AMD	600	1,000	2,340	1,100	1,500
Fairchild	550	700	2,080	600	600
Fujitsu	800	800	2,900	600	600
Hitachi	250	300	910	330	500
Intel	2,800	3,300	10,400	3,000	3,000
Intersil	220	220	900	240	240
ITT	80	150	300	200	300
Mostek	3,300	3,750	11,800	4,000	4,000
Motorola	750	750	2,740	1,000	1,000
National	925	1,000	3,675	1,200	1,200
NEC	1,600	1,600	6,100	1,600	1,600
Signetics	230	250	870	250	350
TI	3,200	3,900	12,400	4,200	4,700
Total	15,305	17,720	57,415	18,320	19,590
Percent Change From Previous Quarter	14.4%	15.8%		3.4%	6.9%

Source: DATAQUEST, Inc.
July 14, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF
16K DYNAMIC MOS RAMS

(Units in Thousands)

Company	1976 Total	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
Fairchild	0	25	25	40
Fujitsu	0	260	250	350
Hitachi	0	S[1]	120	240
Intel	20	560	600	800
Intersil	0	0	S	S
ITT	0	S	3	25
Mostek	30	760	700	1,000
Motorola	0	50	200	500
National	0	0	12	50
NEC	0	310	650	800
Siemens	0	S	5	15
Signetics	0	0	S	30
TI	4	43	300	500
Toshiba	0	0	S	S
Zilog	0	S	10	15
Total	54	2,008	2,875	4,365
Percent Change From Previous Quarter			163.7%	51.8%

[1]Indicates sampling

Source: DATAQUEST, Inc.
July 14, 1978

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS

(Units in Thousands)

Company	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st Qtr.	1978 2nd Qtr.
AMD	80	100	260	200	250
EMM	550	675	2,035	900	1,150
Fujitsu	0	20	20	50	75
Hitachi	30	50	85	90	130
Intel	250	450	890	800	1,050
Intersil	15	35	60	70	50
Mostek	30	50	95	120	250
Motorola	20	20	50	50	250
NEC	250	350	640	500	600
Synertek	65	100	205	160	280
TI	120	175	405	700	800
Zilog	10	30	40	60	120
Total	1,420	2,055	4,785	3,700	5,005
Percent Change From Previous Quarter	82.1%	44.7%		80.0%	35.3%

Source: DATAQUEST, Inc.
July 14, 1978

Table 4

ESTIMATED WORLDWIDE 8K EPROM SHIPMENTS

(Units in Thousands)

	1977	1978	
Company	Total	1st Qtr.	2nd Qtr.
AMD	0	15	50
Electronic Arrays	150	30	50
Fairchild	5	40	60
Fujitsu	90	50	75
Intel	1,600	700	900
Motorola	70	100	250
National	150	150	300
Signetics	150	75	75
TI	700	350	550
Total	2,915	1,510	2,310

Source: DATAQUEST, Inc.
July 14, 1978

Table 5

ESTIMATED WORLDWIDE 16K EPROM SHIPMENTS

(Units in Thousands)

	1977	1978	
Company	Total	1st Qtr.	2nd Qtr.
Intel	340	250	400
Mostek	0	S[1]	S
Motorola	0	S	S
TI	130	100	250
Total	470	350	650

[1]Indicates sampling

Source: DATAQUEST, Inc.
July 14, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 6, 1978

ELECTRON-BEAM LITHOGRAPHY

Introduction and Summary

Electron-beam equipment is now commercially available from several firms, and it is estimated that 13 or 14 manufacturing systems have been sold. We believe these machines are being used for maskmaking and that they can be justified in that application. The improved turn-around time, virtually unlimited chip size, and accuracy and flexibility of the electron-beam equipment, give it important additional advantages over optical maskmaking equipment.

IBM has been using its EL-1 electron-beam machine as a production device for some time. An analysis of this machine's performance characteristics indicates that it is cost effective in the near term for prototype wafer fabrication where the number of wafers per design is small.

In the long run, electron-beam direct wafer writing will contend with X-ray lithography as the means of achieving submicron line widths. Electron-beam will need to increase its throughput by 20 times to become competitive in this application. The pros and cons of electron-beam and X-ray are reviewed in the last section.

Commercial Suppliers of E-Beam Equipment

CAMBRIDGE SCIENTIFIC INSTRUMENTS, Ltd., Melbourne, ENGLAND. Cambridge has developed a machine that is useful in laboratory applications. We believe that about 16 to 20 of these machines have been sold; however, sales of these units are not included in the figures cited in the first paragraph of this Newsletter because they are not intended for use in a manufacturing environment. The Cambridge machine will expose a 3-inch wafer at 2-micron line width in several hours.

EBM Corporation, San Diego, California. EBM has been developing an image projection electron-beam system under government contract for some years. The target performance for this system is 60 wafers per hour at .5 micron resolution. EBM was formed in 1975, but the technical staff has experience going back to 1969. EBM is also developing a high speed pattern generator system for announcement in early 1979.

ETEC Corporation, Hayward, California. At this writing, ETEC has received at least 13 orders for its MEBES (Manufacturing

Electron-Beam Exposure System) machine, and has already delivered eight machines. Deliveries started in late summer 1977 and have been averaging one every six weeks since then. We understand the machines have better than 90 percent up-time on three-shift operations. The users we talked to are enthusiastic about the performance of the equipment. We have also heard reports of wafer sort yield improvements where electron-beam masks are used in projection aligners. The MEBES system was developed using ETEC technology and technology licensed from Bell Laboratories. It is a gaussian-beam system that writes a 5-inch by 5-inch mask in approximately one hour.

ETEC was organized eight years ago as a company specializing in electron optics. It has developed its own line of electron microscopes and an earlier electron-beam system designed for laboratory use—the LEBES (Laboratory Electron-Beam System). Sales of LEBES units are not included in the figures cited in the first paragraph of this Newsletter because the machine is not for use in a manufacturing environment.

GCA, Burlington, Massachusetts. GCA is working on an electron-beam system, and has said that a system for direct wafer writing will be available in 1982. We believe that this equipment will be a generation ahead of that currently offered by ETEC and Varian. They currently offer a DSW (Direct Step on Wafer) projection aligner said to be capable of geometries in the 1-micron to 2-micron range. GCA believes that its DSW equipment is a more practical solution to wafer exposure than is the currently available electron-beam equipment.

VARIAN EXTRION, Gloucester, Massachusetts. Varian is also a licensee of Bell Laboratories. However, its system adds to Bell's technology, particularly in regard to features that enhance production capability. The present model includes automatic cassette mask loading. One system has been ordered; this system was on display at the recent SEMICON show in San Mateo, California, and has been delivered to Ultratech, a Santa Clara maskmaking company.

In House E-Beam Development Work

Several companies have done in-house development of E-beam systems including IBM, Sescosem, Texas Instruments, and several companies in Japan. These systems have incorporated a variety of design philosophies and are optimized for applications that include R&D, maskmaking, and direct wafer writing. It is not our purpose to comment on the relative progress of these firms but rather to discuss electron-beam applications that presently appear to be economically attractive. IBM's EL-1 system is discussed later in this Newsletter because it appears this system is being used for the direct writing of prototype wafers.

Maskmaking Applications

The currently available electron-beam equipment is used primarily in masking applications, to make either a reticle or a final mask. The reticle contains a single die pattern. If the E-beam machine does not make the final mask, the reticle must be stepped-and-repeated in a photomechanical device in order to obtain masks for wafer exposure. GCA's DSW aligner is an exception to this rule because it can work directly with reticles. (Kasper and Canon make aligners similar to GCA's DSW aligner.)

Most maskmaking shops use photomechanical reticle generators. These devices build up a mask using a series of multiple exposures through a programmable rectangular slit. Between each exposure, both the slit and mask must be mechanically repositioned, limiting the number of exposures that can be obtained to a few per second.

Large die require many exposures in a photomechanical reticle generator. Indeed, a 256K RAM or megabit bubble memory may require 100 or more <u>hours</u> of exposure time per level. By contrast, today's electron-beam machines can produce the same reticle in two hours or less.

While electron-beam reticle generation offers a speed advantage for large die, it could be somewhat slower than the photomechanical method for small die. Thus, the time saved depends on the mix of die sizes going through the mask shop. One mask shop operator we interviewed thought that his electron-beam machine had approximately five times the capacity of a photomechanical system; however, this estimate reflected the mix of die sizes actually passing through his shop.

We estimate that today's electron-beam equipment would have an annual operating cost of between $675,000 and $775,000, depending on whether it were used on one or three shifts. (This cost includes depreciation, interest, operation, and maintenance.) Today, one can purchase a photo-optically produced mask set for a 200-mil square chip for approximately $1,000 per layer. Thus, an electron-beam maskmaker should break even at 675 to 775 layers a year. (If each device contains eight layers, this works out to producing 84 to 97 new designs a year.)

An E-beam maskmaker set up to work three shifts will have 79 percent of its time free at the break-even throughput. This excess capacity, together with the fact that the final mask can be written directly, can reduce the time required for a mask to pass through the mask shop from four weeks to one week. This reduction is significant. In a new LSI product development cycle, the mask must typically transit the mask shop four times before the product design is adequately refined. The product could be ready 12 weeks earlier if prototype masks were made on E-beam equipment, and the manufacturer of the product could gain significantly in increased sales and market share. E-beam maskmaking equipment also offers more accurate masks especially in the large (over 190 x 190 mils) die sizes—accuracy that is due both to the elimination of lens distortion and to the ability to dynamically correct for mechanical stage inaccuracies. In addition, masks are written directly and in a vacuum so there is significantly less opportunity for defects to accumulate. Both these facts should contribute to final product yield.

Prototype Wafer Fabrication

Prototype wafer fabrication using electron-beam equipment appears to be an application economically attractive for the near term. This application will require commercial availability of equipment similar to IBM's EL-1, which has a 2.5 micron square "spot" and can expose twenty-two 2-1/4-inch wafers an hour. Ten EL-1 units are being used to process production wafers in East Fishkill, New York. They are used to write two metal layers and one crossunder layer on a master slice wafer. None of the other 11 layers changes from design to design. These layers are reproduced using projection aligners.

A system like the EL-1 becomes attractive when the number of wafers per design becomes small; it is quicker and less expensive to write the pattern directly on the wafer than to make a mask. It is estimated that a machine similar to the EL-1 could write a layer on a wafer for $11.00. If the mask costs $1,000 per layer, the break-even point would occur at 91 wafers (1000/11). At typical yields, this corresponds to 5,000 to 10,000 good parts, certainly an adequate number for many low-volume production runs.

Production Wafer Fabrication

It appears that electron-beam direct wafer writing may eventually be used in production wafer fabrication. If this happens, the economics of the situation suggest that production electron-beam direct wafer exposure can be economic only for devices employing submicron geometries. Since a great deal of process development needs to occur before useful submicron structures can be made, we do not believe that a demand for high-volume direct slice writing will develop before the mid-1980s.

Basically, submicron geometry is required to make direct slice writing cost effective in production. Small geometries are needed to increase the functional density to the point where enough function is shipped per wafer so that the high cost of the electron-beam equipment can be amortized. Competitive electron-beam equipment would need to write 0.8 micron geometries on a 4-inch wafer at a throughput of 20 wafers per hour—an increase of 20 times the speed of presently available equipment.

The competitive submicron technology is wafer exposure using X-rays and masks; it has already demonstrated submicron lines under laboratory conditions. It could become feasible if a suitable X-ray source and mask technology develops. Even then, submicron geometry work will require that a submicron alignment technique be developed and that the differential temperature between mask and wafer be held within a few tenths of a degree. In addition, wafer processing temperatures will have to be held below 900°C to avoid irreversible wafer deformation that would make alignment impossible.

In contrast, E-beam feasibility depends only on an improvement in writing speed. The mask-to-wafer alignment problems inherent in the X-ray technology are avoided because there is no mask. If the pattern on the wafer has been shifted during processing, it is possible for the computer in the electron-beam equipment to compensate for this shift by modifying the pattern to be written, thereby creating a distorted pattern to align with the distorted wafer.

Howard Z. Bogert

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters June 21, 1978

MOS MICROPROCESSOR SHIPMENTS

Summary

Worldwide shipments of MOS microprocessors in the first quarter of 1978 were an estimated 4.3 million units, up about 29 percent over fourth quarter shipments. Microprocessor shipments and revenues are still heavily weighted toward the 8-bit microprocessor units. However, in 1978, we are beginning to see the impact of the single-chip microcomputer and the 16-bit microprocessors.

Quarterly Microprocessor Shipments

Table 1 presents DATAQUEST's estimates of worldwide microprocessor CPU shipments for the third and fourth quarters of 1977 and the first quarter of 1978 (unit counts of peripheral products are not included). Note the addition of Sescosem and additional products from Fairchild, General Instruments, and NEC.

The growing popularity of single-chip microcomputers is exemplified by the data presented in Table 2, which breaks them out separately. This table presents DATAQUEST's estimates of single-chip microcomputer shipments for the third and fourth quarters of 1977 and the first quarter of 1978. In the case of products such as the TMS 1000 and the PPS-4, which are single chip microcomputers, we have indicated all shipments as single-chip microcomputers, even though some may have been shipped with additional memory or I/O chips. No estimates of the peripheral unit shipments are available. Shipments of single-chip microcomputers were an estimated 2.1 million units in the first quarter of 1978, up about 41 percent over estimated fourth quarter shipments.

4-Bit Microprocessors

The 4-bit microprocessor market is characterized by high-volume shipments of low-priced microprocessors. Although the dollar volume of this market segment is not growing rapidly, the unit volume continues to grow, as indicated in Table 3. We note shipments of a new 4-bit product family from NEC.

8-Bit Microprocessors

Worldwide shipments of microprocessors in the first quarter of 1978 were an estimated 2.2 million units, up about 29 percent over

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS
(Units in Thousands)

Company	MPU Products	Bits	MOS Process	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st. Qtr.
AMD	8080A	8	N	45	50	165	90
AMI	6800	8	N	14	50	89	35
Fairchild	F8	8	N	180	245	655	225
	3870	8	N	0	0	0	3
	6800	8	N	0	15	15	55
GI	CP-1600	16	N	8	10	31	10
	PIC-1650	8	N	0	0	0	75
Harris	6100	12	C	4	4	13	5
Intel	4004	4	P	50	45	215	42
	8008	8	P	32	30	124	28
	8080	8	N	155	170	510	210
	8048	8	N	30	50	95	60
	8085	8	N	15	35	55	50
Intersil	6100	12	C	4	6	16	8
MOS Technology	6500	8	N	80	160	280	50
Mostek	F8	8	N	25	40	90	50
	Z-80	8	N	25	35	85	70
	3870	8	N	5	15	20	20
Motorola	6800	8	N	105	200	435	180
National	4004	4	P	30	30	110	30
	IMP	4	P	15	18	55	20
	8080A	8	N	45	55	145	70
	SC/MP	8	P	50	55	189	65
	PACE	16	P	12	15	47	18
NEC	8080	8	N	45	55	162	70
	μCOM-4	4	N	65	100	225	150
RCA	1802	8	C	40	125	222	75
Rockwell	PPS-4	4	P	140	145	575	420
	6500	8	N	50	170	225	260
Sescosem	6800	8	N	12	15	40	20
Signetics	2650	8	N	10	17	39	4
Synertek	6500	8	N	80	120	250	325
TI	TMS 1000	4	P	1,000	1,200	2,825	1,400
	TMS 8080A	8	N	27	30	100	30
	TMS 9900	16	N	25	35	95	45
Zilog	Z-80	8	N	25	40	95	90
Total Microprocessors				2,448	3,385	8,292	4,358
Percent change from previous quarter				77.5%	38.3%		28.7%

Source: DATAQUEST, Inc.
June 19, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF SINGLE-CHIP MICROCOMPUTERS
(Units in Thousands)

Company	MPU Products	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st Qtr.
Fairchild	3870	0	0	0	3
GI	PIC-1650	0	0	0	75
Intel	8048	30	50	95	60
Mostek	3870	5	15	20	20
NEC	μCOM-4	65	100	225	150
Rockwell	PPS-4	140	145	575	420
TI	TMS 1000	1,000	1,200	2,825	1,400
Total Single-Chip Microcomputers		1,240	1,510	3,740	2,128

Source: DATAQUEST, Inc.
June 19, 1978

estimated fourth quarter shipments. The 8-bit market continues to experience good growth from mature product families as well as new product introductions.

Prices of 8-bit microprocessors shipped in the first quarter of 1978 were in the $4 to $10 range for quantity shipments (10,000 units and greater). A large percentage of the 8-bit microprocessors shipped are in plastic packages because the reliability of these devices is quite high. For the small percentage shipped in ceramic packages, the vendor receives a $1 to $4 premium.

Single-chip 8-bit microcomputer shipments in the first quarter of 1978 were an estimated 158,000 units, up about 143 percent over estimated fourth quarter shipments. Total units shipped in this product category is expected to expand dramatically in 1978.

We note that the single-chip microcomputer products are generally families of products with each family member differing in memory, I/O capability, and computing power. This variety of products enables the user to have a cost-effective solution by choosing the family member that most closely meets his requirements. The quarterly shipments of several major 8-bit microprocessor families are presented in Table 4.

16-Bit Microprocessors

Worldwide shipments of 16-bit microprocessors in the first quarter of 1978 were an estimated 73,000 units, up about 22 percent over estimated fourth quarter 1977 shipments. Although the level of

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

		1977		1977	1978
4-Bit Products	MPU Products	3rd Qtr.	4th Qtr.	Total	1st Qtr.
Intel	4004	50	45	215	42
National	4004	30	30	110	30
	IMP	15	18	55	20
NEC	µCOM-4	65	100	225	150
Rockwell	PPS-4	140	145	575	420
TI	TMS 1000	1,000	1,200	2,825	1,400
Total		1,300	1,538	4,005	2,062
Percent change from previous quarter		93.4%	18.3%		34.1%
8-Bit Products					
AMD	8080A	45	50	165	90
AMI	6800	14	50	89	35
Fairchild	F8	180	245	655	225
	3870	0	0	0	3
	6800	0	15	15	55
GI	PIC-1650	0	0	0	75
Intel	8008	32	30	124	28
	8080	155	170	510	210
	8048	30	50	95	60
	8085	15	35	55	50
MOS Technology	6500	80	160	280	50
Mostek	F8	25	40	90	50
	Z-80	25	35	85	70
	3870	5	15	20	20
Motorola	6800	105	200	435	180
National	8080A	45	55	145	70
	SC/MP	50	55	189	65
NEC	8080	45	55	162	70
RCA	1802	40	125	222	75
Rockwell	6500	50	170	225	260
Sescosem	6800	12	15	40	20
Signetics	2650	10	17	39	4
Synertek	6500	80	120	250	325
TI	TMS 8080A	27	30	100	30
Zilog	Z-80	25	40	95	90
Total		1,095	1,717	4,085	2,210
Percent change from previous quarter		56.7%	62.3%		28.7%
12-Bit Products					
Harris	6100	4	4	13	5
Intersil	6100	4	6	16	8
Total		8	10	29	13
Percent change from previous quarter		33.3%	25.0%		30.0%
16-Bit Products					
GI	CP-1600	8	10	31	10
National	PACE	12	15	47	18
TI	TMS 9900	25	35	95	45
Total		45	60	173	73
Percent change from previous quarter		21.6%	33.3%		21.7%

Source: DATAQUEST, Inc.
June 19, 1978

shipments of 16-bit microprocessors is still relatively low, we expect them to accelerate over the next few quarters as more 16-bit product introductions are made.

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Table 4

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]
(Units in Thousands)

Microprocessors	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st Qtr.
8080	317	360	1,082	470
F8	205	285	745	275
6800	131	280	579	290
6500	210	450	755	635
Total	863	1,375	3,161	1,670

[1]Numbers in this table include all manufacturers of these types

Source: DATAQUEST, Inc.
June 19, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters June 9, 1978

MOS MEMORY—STATIC AND DYNAMIC RAM AND EPROM SHIPMENTS

Summary

Worldwide shipments of 16K dynamic MOS RAMs increased to an estimated 2.9 million units in the first quarter of 1978, up about 162 percent over the 1.1 million units shipped in the fourth quarter of 1977

Worldwide shipments of 4K dynamic MOS RAMs in the first quarter of 1978 reached an estimated 18.7 million units, up about 6 percent over an estimated 17.7 million units in the fourth quarter of 1977. Shipments of 4K dynamic RAMs have begun to level off as many users are switching to 16K dynamic RAMs.

Supply is beginning to come in line with demand for static 4K MOS RAMs. We estimate that about 3.6 million units were shipped in the first quarter of 1978, up about 77 percent over an estimated 2.0 million units shipped in the fourth quarter of 1977.

We estimate that about 1.5 million units of the 2708 8K EPROM and about 0.7 million units of the 2716 16K EPROM were shipped in the first quarter of 1978.

Dynamic MOS RAMs

1K. The 1K dynamic MOS RAM market remains reasonably strong, as many old designs still require this device. Intel and ITT are the remaining suppliers of this product with ITT shipping 1103s to European customers from its Footscray, England, plant. Prices in this mature market remain relatively stable in the $2.00 range.

4K. DATAQUEST estimates of worldwide 4K dynamic MOS RAM shipments in the first quarter of 1978 are presented in Table 1. We estimate that 18.7 million units were shipped in the first quarter of 1978, up about 6 percent over an estimated 17.7 million units shipped in the fourth quarter of 1977.

Although unit volumes are still increasing slightly, dollar revenues are falling because of declining average selling prices. 4K dynamics are now being shipped in the second quarter for prices in the $1.60 to $2.20 range, depending upon quantity and performance specifications. These products are generally in good supply with lead times of about 8 to 10 weeks. However, the 22-pin versions are less plentiful, as some suppliers have stopped producing the device; lead times are in the 16 to 20 week range.

16K. DATAQUEST published a brief Newsletter on 16K dynamic MOS RAM shipments on April 14, 1978. Since the publication of that Newsletter we became aware that Siemens has also begun shipping 16K RAMs, and it is included in an updated table (Table 2).

In the second quarter of 1978, most 16K RAMs shipped are in the $10.00 to $14.00 price range. Some quotes below $10.00 have been made, but these are generally for deliveries later in the year.

Static MOS RAMs

1K. Supply of the 2102-type 1K static MOS RAM has improved during the second quarter of 1978. Lead times, which had been as long as 18 to 24 months, have decreased to under 10 weeks and few suppliers have excess supply of these parts. We estimate that monthly shipping rates are still in the range of 2.3 million units worldwide. Low power CMOS devices are increasing their penetration of this market.

4K. Table 3 presents our estimates of worldwide shipments of 4K static RAMs in the first quarter of 1978. We estimate that about 3.6 million units were shipped in this first quarter, up about 77 percent over an estimated 2.0 million units shipped in the fourth quarter of 1977. Supply is beginning to catch up with demand, and some suppliers are able to ship reasonable quantities of 4K statics directly out of inventory.

Prices for second quarter shipments are in the $5.00 to $6.00 range, with a few shipments being made between $4.00 and $5.00 for very large quantities. Prices on the high-speed 2147 remain in the $20.00 range. However, we expect these to decline rapidly as more suppliers enter this market. Motorola has been sampling 2147 devices and others are expected to follow soon.

EPROMs

8K. Table 4 presents our estimates of worldwide shipments of 8K EPROM devices. We estimate that worldwide shipments in the first quarter of 1978 were about 1.5 million units. This compares to an estimated 2.7 million units shipped in all of 1977.

16K. Table 5 presents our estimates of worldwide shipments of 16K EPROMs. We estimate that 700,000 units were shipped in the first quarter of 1978 versus 470,000 units shipped in all of 1977. A number of companies are choosing to enter the EPROM market directly at the 16K level and bypassing any 8K product introductions.

32K. Texas Instruments began sampling its 32K EPROM in the first quarter of 1978 and production quantities are expected soon. We expect that other suppliers will also soon introduce their 32K EPROMs.

Daniel L. Klesken
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James F. Riley
Frederick L. Zieber

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
(Units in Thousands)

Company	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st Qtr.
AMD	600	1,000	2,340	1,100
Fairchild	550	700	2,080	600
Fujitsu	800	800	2,900	600
Hitachi	250	300	910	330
Intel	2,800	3,300	10,400	3,500
Intersil	220	220	900	240
ITT	80	150	300	300
Mostek	3,300	3,750	11,800	4,000
Motorola	750	750	2,740	1,000
National	925	1,000	3,675	1,200
NEC	1,600	1,600	6,100	1,600
Signetics	230	250	870	250
TI	3,200	3,900	12,400	4,000
Total	15,305	17,720	57,415	18,720
Percent Change From Previous Quarter	14.4%	15.8%		5.6%

Source: DATAQUEST, Inc.
June 9, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF
16K DYNAMIC MOS RAMS
(Units in Thousands)

Company	1976 Total	1977 Total	1978 1st Qtr.
Fairchild	0	25	25
Fujitsu	0	260	250
Hitachi	0	S[1]	120
Intel	20	560	600
Intersil	0	0	S
ITT	0	S	3
Mostek	30	760	700
Motorola	0	50	200
National	0	0	12
NEC	0	310	650
Siemens	0	S	5
Signetics	0	0	S
TI	4	43	300
Toshiba	0	0	S
Zilog	0	S	10
Total	54	2,008	2,875

[1]Indicates sampling

Source: DATAQUEST, Inc.
June 9, 1978

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS
(Units in Thousands)

Company	1977 3rd Qtr.	1977 4th Qtr.	1977 Total	1978 1st Qtr.
AMD	80	100	260	200
EMM	550	675	2,035	850
Fujitsu	0	20	20	50
Hitachi	30	50	85	90
Intel	250	450	890	800
Intersil	15	35	60	70
Mostek	30	50	95	120
Motorola	20	20	50	50
NEC	250	350	640	500
Synertek	65	100	205	160
TI	120	175	405	700
Total	1,410	2,025	4,745	3,590
Percent Change From Previous Quarter	80.8%	43.6%		77.3%

Source: DATAQUEST, Inc.
June 9, 1978

Table 4

ESTIMATED WORLDWIDE 8K EPROM SHIPMENTS
(Units in Thousands)

Company	1977 Total	1978 1st Qtr.
AMD	0	15
Electronic Arrays	150	30
Fairchild	5	40
Fujitsu	90	50
Hitachi	-	-
Intel	1,600	700
Intersil	S[1]	15
ITT	-	-
Motorola	70	100
National	150	150
NEC	-	-
Signetics	0	S
TI	700	350
Total	2,765	1,450

[1]Indicates sampling

Source: DATAQUEST, Inc.
June 9, 1978

Table 5

ESTIMATED WORLDWIDE 16K EPROM SHIPMENTS
(Units in Thousands)

Company	1977 Total	1978 1st Qtr.
Intel	340	600
Mostek	0	S[1]
Motorola	0	S
TI	130	100
Total	470	700

[1]Indicates sampling

Source: DATAQUEST, Inc.
June 9, 1978

SIS Code: Newsletters April 18, 1978

GEOGRAPHIC DISTRIBUTION OF INTEGRATED CIRCUIT SALES

At the request of a number of clients, DATAQUEST has analyzed the geographic distribution of integrated circuit (IC) sales in the United States by OEM and distributor breakdown.

Percent shares of total IC sales during 1976-1977, broken down by state, are shown in Figure 1. These are broken out into either OEM sales use (Figure 2) or sales to distributors (Figure 3) for the same time period. For comparison purposes, OEM sales breakdown for 1972 are presented in Figure 4. These data are summarized again in Table 1.

Two related measures of semiconductor business locations are also presented in Table 1. These show (1) state-by-state totals for multiple subscriptions to Electronics Magazine, and (2) a state-by-state breakdown of semiconductor specifying influences. (See methodology).

Conclusions

Concerning the data presented, DATAQUEST makes the following observations regarding the present geographic concentrations:

- California accounts for one-fifth to one-third of national totals in each category: IC sales; multiple subscriptions; semiconductor specifiers.

- Illinois, Minnesota, New York, New Jersey, and Massachusetts each account for about 5 to 10 percent of the national totals in each category.

- Minnesota, Illinois, and Florida showed significantly higher percentages of OEM-use purchases than distributor purchases: conversely, Ohio, Texas, New York, and Maryland showed higher distributor-use purchases than OEM use. California had somewhat higher percentages of purchases by distributors than OEM sales.

We also observe the following trends in sales patterns:

- In the six years between 1972 and the present, the Northeastern U.S. share of market has fallen off by above one-quarter—from 40.2 percent to 31.2 percent of OEM sales.

- The bulk of the Northeastern loss has been absorbed in the Midwest which has risen from 18.3 percent to 25.5 percent.

- The Far West market share of OEM sales has remained fairly constant.

- Relative to OEM sales in individual states:

  - Massachusetts has shown an increase from 9.4 percent to 10.6 percent. We believe that this relatively high market share is a result of its booming minicomputer operations.

  - Indiana has decreased from 4.9 percent to 1.1 percent.

  - Illinois has increased from 4.7 percent to 9.4 percent.

  - Missouri has decreased substantially from 3.2 percent to under 0.5 percent.

  - Minnesota has increased substantially from 4.6 percent to 11.9 percent. DATAQUEST feels that this is a result of its currently very prosperous EDP companies.

  - Texas has decreased from 3.5 percent to 1.8 percent.

  - Colorado has increased from 1.1 percent to 2.6 percent.

  - California has decreased slightly.

Methodology

Figures 1, 2, and 3, the geographic breakdowns of integrated circuit sales, were prepared using DATAQUEST data with the cooperation of four clients representing 24 percent of the total integrated circuit industry sales. The raw data obtained from these clients was the most recent available and included sales breakdowns from both 1976 and 1977. In Figure 4, DATAQUEST adopted the state breakdowns presented in the Electronics Industries Association (EIA) 1972 yearbook. These data from Figures 1 through 4 are all presented again in Table 1.

The remainder of Table 1 was prepared utilizing data from McGraw-Hill, publishers of Electronics Magazine, and information provided by Technical Information Distribution Service (TIDS™) of Ridgewood, New Jersey.

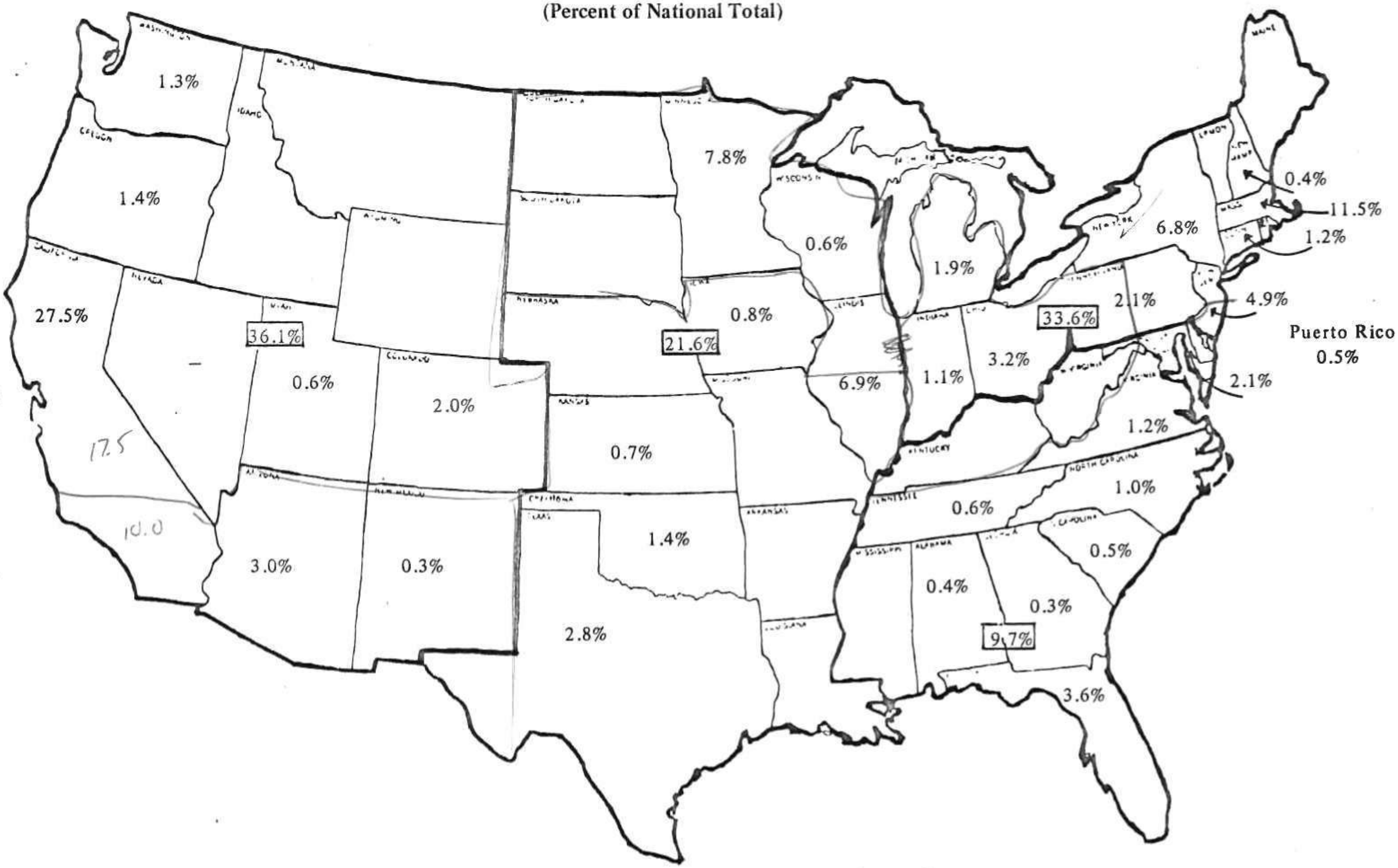
Electronics Magazine provided DATAQUEST with a breakdown of locations of multiple subscriptions of Electronics Magazine. By definition, a multiple subscription is a subscription in which three or more copies are delivered to the same address. This information is shown in Table 1.

Through the cooperation of TIDS, we were able to secure a state-by-state breakdown of its 60,000 name mailing list of semiconductor specifiers. This breakdown is also shown in Table 1.

James F. Riley
F. Lane Mason

Figu

TOTAL SALES INTEGRATED CIRCUITS
BY STATE OR TERRITORY OF PURCHASER – 1976-1977
(Percent of National Total)



Source: DATAQUEST, Inc.
April 1978

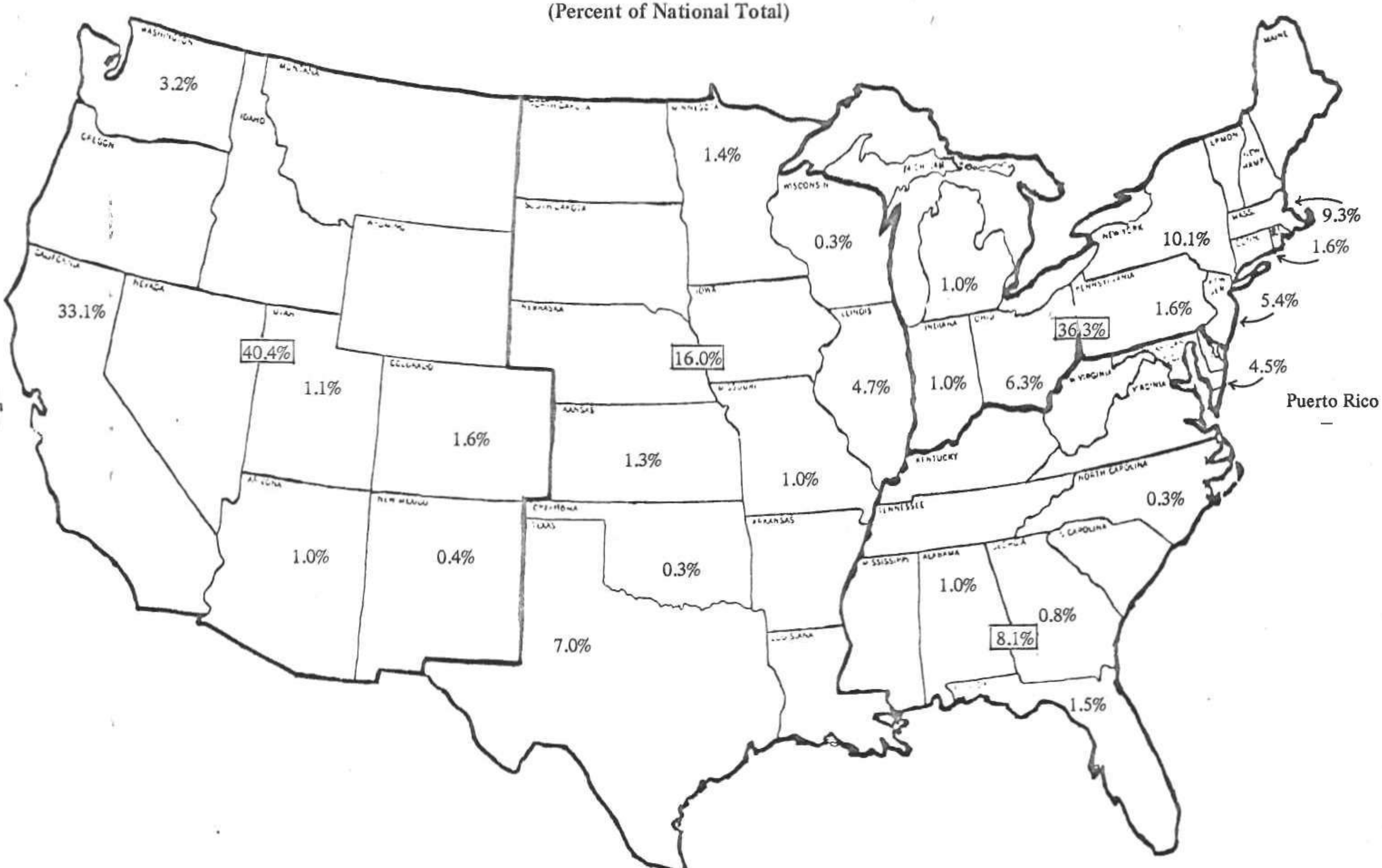
Figur

OEM SALES OF INTEGRATED CIRCUITS
BY STATE OR TERRITORY OF PURCHASER – 1976-1977
(Percent of National Total)

Source: DATAQUEST, Inc.
April 1978

Figu

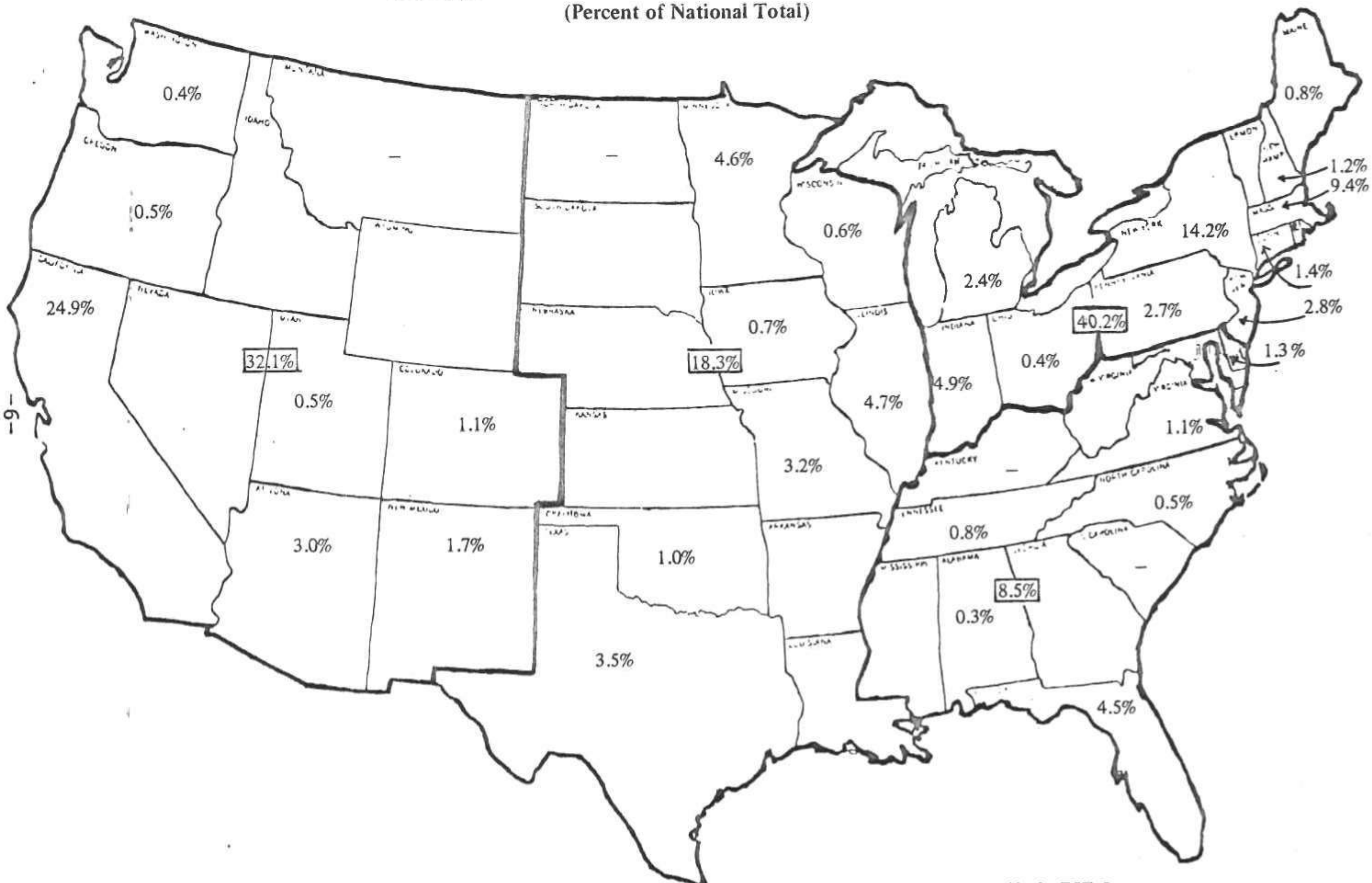
SALES TO DISTRIBUTORS OF INTEGRATED CIRCUITS
BY STATE OR TERRITORY OF PURCHASER – 1976-1977
(Percent of National Total)



Source: DATAQUEST, Inc.
April 1978

Figur

OEM INTEGRATED CIRCUITS
SALES, BY STATE OR TERRITORY OF PURCHASER – 1972
(Percent of National Total)



Source: DATAQUEST, Inc.
April 1978

Table

COMPARATIVE SUMMARY OF BUSINESS LOCATIONS BREAKDOWN
(Integrated Circuits—Multiple Subscriptions—Semiconductor Specifiers)
(Percent of National Totals)

	1976-1977 Totals by			1972	McGraw-Hills	TIDS:
State	Total (Fig.1)	OEM (Fig.2)	Distribution (Fig.3)	EIA (Fig.4)	Multiple Subscriptions	Semiconductor Specifiers
Alabama	0.4%	0.3%	1.0%	0.3%	0.8%	0.7%
Alaska	-	-	-	-	0.2	0.1
Arizona	3.0%	3.4	1.0	3.0	1.0	1.3
Arkansas	0.1%	0.1	-	0.2	-	0.1
California	27.5%	22.9	33.1	24.9	21.0	22.1
Colorado	2.0%	2.6	1.6	1.1	2.0	1.6
Connecticut	1.2%	1.0	1.6	1.4	3.0	2.4
Delaware	0.1%	0.2	-	-	0.2	0.3
D.C.	-	-	-	0.1	2.0	0.9
Florida	3.6%	4.4	1.5	4.5	3.0	3.5
Georgia	0.3%	0.2	0.8	0.1	0.7	0.6
Hawaii	-	-	-	-	0.4	0.2
Idaho	0.1%	0.1	-	-	0.3	0.2
Illinois	6.9%	9.4	4.7	4.7	6.0	4.5
Indiana	1.1%	1.4	1.0	4.9	2.0	1.8
Iowa	0.8%	0.8	-	0.7	0.7	0.7
Kansas	0.7%	0.6	1.3	0.2	0.7	0.5
Kentucky	0.1%	0.1	-	0.1	0.4	0.4
Louisiana	0.1%	0.1	-	-	0.7	0.4
Maine	-	-	-	0.8	0.2	0.1
Maryland	2.1%	0.9	4.5	1.3	3.0	3.3
Massachusetts	11.5%	10.6	9.3	9.4	6.0	6.5
Michigan	1.9%	2.3	1.0	2.4	3.0	2.2
Minnesota	7.8%	11.9	1.4	4.6	2.0	2.3
Mississippi	0.1%	0.1	-	0.2	0.2	0.1
Missouri	0.6%	0.1	1.0	0.4	1.0	1.1
Montana	-	-	-	-	6.2	0.1
Nebraska	-	-	-	-	-	0.2
Nevada	0.1%	0.2	-	0.1	0.5	0.3
New Hampshire	0.4%	0.5	-	1.2	0.5	0.9
New Jersey	4.9%	3.9	5.4	2.8	4.0	6.0
New Mexico	0.3%	0.4	0.4	1.7	0.7	0.8
New York	6.8%	5.8	10.1	14.2	8.0	9.7

Table 1
(Continued)

State	1976-1977 Totals by			1972	McGraw-Hill:	TIDS:
	Total (Fig.1)	OEM (Fig.2)	Distribution (Fig.3)	EIA (Fig.4)	Multiple Subscriptions	Semiconductor Specifiers
North Carolina	1.0%	1.2	0.3	0.5	1.0	0.9
North Dakota	-	-	-	-	-	0.1
Ohio	3.2%	2.4	6.3	3.1	5.0	4.5
Oklahoma	1.4%	0.2	0.3	1.0	1.0	0.6
Oregon	1.4%	1.9	-	0.5	0.8	0.7
Pennsylvania	2.1%	2.4	1.6	2.7	4.0	5.2
Rhode Island	0.2%	0.2	-	0.2	0.3	0.5
South Carolina	0.5%	0.6	0.2	-	0.5	0.4
South Dakota	-	-	-	-	0.2	0.1
Tennessee	0.6%	0.6	-	0.8	1.0	0.8
Texas	2.8%	1.8	7.0	3.4	5.0	4.4
Utah	0.6%	0.4	1.1	0.5	0.1	0.6
Vermont	0.1%	0.1	-	-	0.7	0.2
Virginia	1.2%	1.6	-	1.1	3.0	2.2
Washington	1.3%	0.6	3.2	0.4	2.0	1.5
West Virginia	-	-	-	0.1	0.3	0.2
Wisconsin	0.6%	0.5	0.3	0.6	1.0	1.4
Wyoming	-	-	-	-	-	0.0
Puerto Rico	0.5%	0.6	-	-	-	0.1

Columns may not add to 100% due to rounding.

Source: DATAQUEST, Inc.
April 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters April 14, 1978

GENERAL INDUSTRY FORECAST

Our forecast for U.S. semiconductor consumption for 1978 remains relatively unchanged from our previous forecast (December 30, 1977): U.S semiconductor consumption in 1978 is expected to be approximately 15.1 percent over that of 1977, with strong growth in the first half of the year and markedly slower growth in the second half. Some major questions still remain on first quarter 1979 consumption; it is possible that there could be negative growth in the first quarter of 1979, but it will be one or two months before we have a clearer picture.

The U.S. economy has continued to remain strong during the first quarter of 1978. However, indications of slower growth in the second half of this year are very strong. These are major questions regarding the extent of this slowdown due to conflicting signs from major economic indicators, which have been distorted by the effects of the coal strike and the severe weather in the midwest and east during January and February. Specifically, there are declines in the FRB index of leading indicators, the money supply, and various sectors of consumer spending. However, we believe it is less likely that a slowdown could turn into a modest downturn rather than a resumption of growth.

The following general economic developments during the first quarter are noteworthy:

- Industrial production in February was at essentially the same level as November 1977; its growth is expected to resume in March following a cessation of disruptive influences.
- The gross national product (GNP) grew at a real annual rate of 4.2 percent in the fourth quarter of 1977; in the first quarter of 1978 growth is expected to be somewhat less.
- Capital spending has continued to increase during the first quarter of 1978; it is about 6 to 7 percent higher than the same quarter of 1977.
- There are indications that the German and Japanese economies are showing increased strength and will begin to pull out of their stagnation.
- The money supply declined in January and February as the Federal Reserve Board moved to halt excessively rapid

expansion; however, in recent weeks money supply growth has resumed.

- The Index of Leading Indicators declined markedly in January and remained flat in February. Interpretation is difficult due to the strike, the weather, and the qualitative results of the stock market decline. The extent of a rebound in March and April is critical.

- Weaker automobile sales, retail sales, and housing starts indicate that consumer spending, which has been a driving force in the economy, is running out of steam.

These developments indicate the strong possibility of a slowing of economic growth during the second half of 1978. The economy, and semiconductor demand, appear destined to repeat the pattern of the previous two years—strong first half growth and a pause in the second half of the year. However, we expect growth in the first half of 1979 to resume slowly. There remains the likelihood of an actual (but modest) downturn in the economic activity going into 1979. We believe that a recession is less likely than a gradual resumption of economic growth, but feel the possibility is strong enough to call to the attention of our clients. Despite the bad news, there still remain some real strengths in the economy. A major problem still is the inability of the U.S. government to take action on major problems. The possibilities of a resumption of economic growth in the rest of the world, a tax cut, and stronger capital spending indicate some areas for potential stimulus. These may be augmented by further monetary growth. The U.S. economy still remains in a position of not being overheated. Indicators such as liquidity, unemployment, inventories, and excess industrial capacity tend to support the evidence that brakes do not need to be applied to the economy, and a slowdown in economic growth need not become a downturn. We believe that the possibilities of a long continuing period of economic growth (like that of the 1960s) still remain possible. In that light, and considering the length of the current economic upturn and the resultant signs of wear on the economy, a slowdown can have positive effects.

Contrary to the economy, the semiconductor industry has in recent months shown some signs of overheating, high bookings, full employment, inventory accumulation, and long lead times.

Industry bookings in recent months have been extremely high, with book-to-bill ratios probably in the 1.15 to 1.2 range industry-wide. For various companies and various segments of integrated circuits, book-to-bills have been as high as 1.3 in recent months. These higher bookings are the result of increased orders due to increased capital spending (particularly in the EDP areas), a rebuilding of inventories, and longer lead times in some areas.

Capital spending still continues to increase. This is particularly true in areas that involve electronics where the marked lack of inflation increases their value to the buyer. Most segments of industrial electronic equipment—production control, data processing (mainframes), minicomputers, office equipment, communications, and instruments—have shown strength. Early in 1977 we forecast this likelihood, and it has indeed come true.

Industry employment is at a critical point. In some geographical areas, particularly the Santa Clara Valley (Silicon Valley), the labor market has essentially disappeared. Advertisements for both hourly and professional employment have increased tremendously in recent months. Silicon Valley has seen a very small influx of people, particularly due to its higher home prices, and at the same time its light industry has been expanding rapidly for three years. Increases in semiconductor shipments for many companies will increasingly have to come from increases in productivity.

Semiconductor inventories still appear to be at low levels. However, they have been growing slightly in recent months, although they are still low. The higher bookings have not yet been mirrored by higher semiconductor shipments, and that has kept inventories down.

When lead times in the semiconductor industry lengthen, buyers are required to order sooner. Additionally, they generally are more anxious to get into the queue of the suppliers' backlog and are more inclined to place longer term orders. This is the current situation. However, the excess of bookings at this time is not matched by end equipment deliveries of electronic equipment. As a result, DATAQUEST expects that current excess of bookings to be reversed later this year. This is not necessarily a negative development; bookings are generally more volatile than shipments and a similar but more limited scenario developed in TTL devices in early 1976. Excessive bookings for those devices in the first half of the year were corrected in the second half.

Our current forecast is shown in Tables 1 and 2. Semiconductor consumption is expected to continue quarter to quarter improvements throughout the next three quarters. Total industry consumption is expected to increase about 15.1 percent above 1977 levels. In the first quarter of 1978, consumption is expected to increase about 2.4 percent. There are some indications that the actual figure may be slightly lower, but this belies the actual strength in semiconductor demand; some shipments for the fourth quarter of 1977 may have been "borrowed" from the first quarter of 1978. Real production appears to be up considerably. This strength is expected to increase through the second quarter but should decline rapidly in the second half of 1978. This slowing of growth in the second half of the year will be due not only to economic effects but also to semiconductor supply meeting demand. The current imbalance, particularly in large MOS devices, between demand and supply is expected to disappear rapidly. Many large companies are rapidly increasing their production of 16K RAMs, 4K static RAMs, and other devices. This production should fill the backlog of demand during the second quarter.

We believe the first quarter 1979 consumption will be up slightly over the previous quarter. However, if an economic downturn develops, growth could be negative.

Semiconductor prices have remained relatively stable with respect to cost except in some large chip areas. Because of this, we expect prices to remain fairly stable as demand slackens later in the year. Nevertheless, a few highly visible devices are expected to show marked declines in prices as industry supply increases. This should not be taken with excessive alarm, as it is expected to be an overdue reaction to declining costs. We have noted previously that yields in the industry, particularly for LSI, have risen rapidly over the last few years—at a rate as fast as or faster than ever before. This indicates the possibility of continued rapid price decreases. In the long run, of course, those lower prices will result in greater industry growth as market elasticities take effect. In the short run, because of the declining costs, we do not see a profit squeeze.

In this forecast, we have switched our basis from U.S. factory sales to U.S. semiconductor consumption. U.S. consumption is more closely aligned with the U.S. economy, and it will therefore increase the accuracy of our econometric model. We believe that our data base for consumption is sufficiently accurate to provide excellent equations for that model. Our figures for U.S. consumption are somewhat higher than those reported by the Semiconductor Industry Association (SIA) for U.S. domestic sales, primarily because DATAQUEST's figures include imports of semiconductors. There are also some minor differences in basis and DATAQUEST's figures include some items not reported to the SIA.

Frederick L. Zieber
F. Lane Mason
James F. Riley

Table 1

ESTIMATED U.S. SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1976	1977	Percent 76-77	1978	Percent 77-78
Discrete Devices	$ 948	$ 913	(3.7)%	$1,013	11.0%
Integrated Circuits	1,414	1,746	23.5%	2,047	17.3%
Total	$2,362	$2,659	12.6%	$3,060	15.1%

Source: DATAQUEST, Inc.

Table 2

ESTIMATED QUARTERLY U.S. SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1977				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Discrete Devices	$223	$234	$227	$229	$ 913
Integrated Circuits	$405	$430	$431	$480	$1,746
Total	$628	$664	$658	$709	$2,659
Percent Change From Previous Quarter	2.6%	5.6%	(0.9)%	7.8%	-

	1978				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Discrete Devices	$238	$254	$257	$264	$1,013
Integrated Circuits	$488	$516	$518	$525	$2,047
Total	$726	$770	$775	$789	$3,060
Percent Change From Previous Quarter	2.4%	6.1%	0.6%	1.8%	-

	1979
	1st Qtr.
Discrete Devices	$266
Integrated Circuits	531
Total	$797
Percent Change From Previous Quarter	1.1%

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters April 14, 1978

MOS MEMORY - 16K SHIPMENTS

Summary

Worldwide shipments of 16K dynamic MOS RAMs increased to an estimated 2.9 million units in the first quarter of 1978—up about 162 percent over the 1.1 million units shipped in the fourth quarter of 1977. Eleven companies were shipping 16K dynamic RAMs in the first quarter with several more sampling devices. By the third quarter, several more companies are expected to be shipping devices.

16K Dynamic MOS RAMs

DATAQUEST is publishing this brief newsletter on 16K dynamic RAMs because of the high interest in this product. The complete MOS memory newsletter will be forthcoming in about three weeks.

DATAQUEST's estimates of worldwide 16K dynamic MOS RAMs shipments are presented in Table 1. We estimate that worldwide 16K shipments were 2.9 million units in the first quarter of 1978—up about 162 percent over an estimated 1.1 million units in the fourth quarter of 1977. By our estimates, 11 companies were shipping 16Ks in the first quarter and another four companies were sampling devices.

Although supply has not yet met demand in this product line, pricing is becoming quite aggressive. Quantity prices for second quarter delivery of 16Ks are in the $10 to $14 range with a few prices being quoted even lower. The actual price is dependent upon the size of the order and the speed of the devices. Most companies offer a speed distribution from 150 to 300 NS.

Production rates for 16Ks are increasing rapidly, with several of the larger companies now at run rates in the range of 300,000 units per month. We estimate that the industry is now close to production rates of 1.3 million units per month.

As we have been preparing this newsletter for publication, the IBM 16K procurement has been a topic of discussion in the industry. As of publication time, DATAQUEST's understanding is that IBM plans to spend 1978 qualifying two sources on a 16K RAM with an as-yet unspecified packaging configuration. We understand the field has been narrowed down to four vendors—Intel, Mostek, Motorola, and Texas Instruments. We further understand that IBM plans to award two qualification orders of less than 5,000 pieces, with an average sell-

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ing price of $35 to $40. IBM will use these qualification orders to qualify the selected vendors' process and product, followed by a qualification of the application.

In order to print this newsletter, DATAQUEST stopped its inquiry. We will have more to say on this in our memory newsletter several weeks hence.

Daniel L. Klesken
Frederick L. Zieber
James F. Riley

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF
16K DYNAMIC MOS RAMs
(Units in Thousands)

Company	1976 Total	1977 Total	1978 1st Qtr.
Fairchild	0	25	25
Fujitsu	0	260	250
Hitachi	0	S[1]	120
Intel	20	560	600
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ITT	0	S	3
Mostek	30	760	700
Motorola	0	50	200
National	0	0	12
NEC	0	310	650
Signetics	0	0	S
Synertek	0	0	S
TI	4	43	300
Toshiba	0	0	S
Zilog	0	S	10
Total	54	2,008	2,870

[1]Indicates sampling

Source: DATAQUEST, Inc.
April 14, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters April 13, 1978

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of the following eight issues that impact the U.S. semiconductor industry. Some of these issues have been reported on in earlier DATAQUEST newsletters.

- President Carter's proposals to phase out DISC and deferral probably will not survive a vote in the House Ways and Means Committee; legislation has been introduced to roll back the capital gains tax for individuals and corporations to pre-1969 levels.

- U.S. GATT negotiators support a "selective safeguard system" to protect against foreign competition; many observers see this as a move away from the historical U.S. policy of free and open trade.

- The staff of the International Trade Commission wants to study accessibility of Japanese markets to U.S. integrated circuit manufacturers.

- Congress is growing increasingly sympathetic to industries hurt by imports. The House Ways and Means Committee voted to override the President's negative decision on import relief for the industrial fastener industry, and this vote is seen as being a key reason for the President's recent decision to raise tariffs on imported citizens band radios.

- Direct negotiations involving U.S. Government and industry officials have been proposed as a means of assisting U.S. firms, including the semiconductor industry, in overcoming Japanese trade barriers.

- As a result of complaints from U.S. semiconductor manufacturers, the General Accounting Office has launched a study on U.S. export control policy governing shipments to the U.S.S.R. and other Eastern European countries.

- The Department of Defense has identified several product areas that might be removed from U.S. export controls, as well as a number of "critical technologies" that may become subject to increased control by the U.S. Government.

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- The Civil Aeronautics Board will again consider increased air cargo rates for semiconductors and other electronic components being shipped to destinations in the Pacific.

Tax Reform

According to DATAQUEST's sources, if the House Ways and Means Committee were to vote today, the Carter Administration's proposal to eliminate the Domestic International Sales Corporation (DISC) tax deferral scheme would lose by between eight and twelve votes.

The Administration's proposal to eliminate deferral of taxation of foreign earnings of U.S.-controlled foreign corporations would also probably not survive a Ways and Means Committee vote today, although the vote on "deferral" would likely be much closer than the vote on DISC.

Unfortunately for proponents of both DISC and deferral, the Ways and Means Committee will not focus on these two key elements in the Administration's tax reform program until later this month, by which time early vote counts may have altered as pressures begin to build on individual members of the Committee.

The timing of the Ways and Means Committee's deliberations on tax reform may benefit many smaller and medium sized firms in the high technology electronics industry. As a result of pressure from these companies, the committee will be asked to consider an amendment to the Carter tax reform package that would, in effect, roll back the capital gains tax for both individuals and corporations to pre-1969 levels—an effective capital gains tax rate of approximately 25 percent.

This proposed amendment already has four co-sponsors—two Democrats and two Republicans. Although chances seem slim at the moment, given enough time and some coordinated lobbying, such an amendment could conceivably win approval in the Ways and Means Committee.

GATT Negotiations

Growing concern over the increasing penetration of U.S. markets by foreign suppliers has apparently persuaded some U.S. trade officials to take a backward step from the historical "free and open trade policy" previously advocated by the United States in the present round of multinational trade talks in Geneva.

This new U.S. negotiating posture could be of substantial benefit to the U.S. semiconductor industry (among others) which is facing increasing competition both in U.S. and foreign markets from non-U.S. suppliers, especially the Japanese.

U.S. negotiators in Geneva last month apparently let it be known that they will agree to some loosening of existing GATT rules relating to the so-called "selective safeguard system." Paradoxically, at the same time Secretary of State Cyrus Vance told the National Governors' Conference that in the current round of the GATT trade negotiations the United States was seeking to reduce or eliminate "a wide variety of non-tariff barriers which impede trade."

The European Common Market countries, led by France and Great Britain have been pressing for changes in these rules. These basically allow a country "injured" by imports to apply "selective" retaliatory trade barriers against the offending country. It is generally acknowledged that the current target for such selective barriers would be Japan. However, in the future, emerging industrial nations such as Mexico, Korea, Brazil, and others could also be subjected to the selective safeguard system.

Four years ago, when the discussion of the safeguard system began, the United States urged that its application be strictly limited. Now, with a historically high trade deficit, U.S. negotiators under the direction of Robert Strauss, President Carter's Special Trade Representative, have changed position on this issue. To be sure, Strauss has proved to be an effective negotiator in a number of areas in the past and it is still possible that he will be able to develop a better international system of safeguards than the one currently under discussion in Geneva. On the other hand, a number of Washington observers have interpreted this apparent reversal in U.S. trade policy as a move to go along with European protectionism. This move is believed to be based on a political assessment that long-term U.S. economic interests might well be served by such a system.

For U.S. industries faced with increasing foreign competition in domestic markets, the official position of the Carter Administration in the GATT negotiations must be of paramount importance. For those industries facing immediate problems with foreign imports, such as the semiconductor industry, this emerging U.S. policy suggests some new options in terms of internationally recognized remedial actions. It also suggests that the specter of Congressional approval for any trade agreement that U.S. negotiators bring back from Geneva is increasingly in the mind of Robert Strauss.

ITC Investigation

DATAQUEST has learned that the staff of the International Trade Commission is considering an investigation, based on the allegations of U.S. semiconductor manufacturers, of tariff and non-tariff barriers confronting the importation of integrated circuits into Japan. The study has not been authorized by the commission itself, and it remains questionable as to whether it will be. Nonetheless, the commission staff is hopeful that the commission will give its blessing to the undertaking.

U.S. manufacturers' interests could be substantially affected if the ITC were to engage in such a study. Depending upon its findings, and the nature and scope of its study, the ITC could materially assist in documenting the industry's allegations that Japan remains essentially a closed market for U.S. exporters while, at the same time, the U.S. is an open market for Japanese manufacturers.

Import Policy

About 60 members of the House and approximately 17 members of the Senate are committed to override President Carter's decision to deny import relief to the U.S. industrial fastener industry, as a result of alleged unfair foreign competition. The significance of this effort is that it reflects a "sense of the Congress" with respect to trade issues. While it cannot be considered a move towards protectionism it can, and is, being viewed by trade experts in Washington as a reflection of the mood of Congress as to the need to protect domestic industries threatened by unfair imports.

A direct result of the House Ways and Means Trade Subcommittee's decision to overrule the President on the industrial fastener case may have been the President's decision last week to go along with the pleas of the Citizens Band Radio industry's request for higher duties on imported CBs.

In a last minute effort to assist the domestic CB industry, the semiconductor industry contacted the White House, the Office of the Special Trade Representative, and the Department of Defense to urge the imposition of higher tariffs rather than the implementation of an adjustment assistance program for displaced workers in the U.S. industry. These efforts, plus the pending congressional override on the industrial fastener case, added substantially to the President's decision to impose higher duties on imported CBs.

In the long run, it does not appear that a congressional override in the fastener case will succeed. In the short term, however, it does appear that the effort has been successful in conveying a congressional message to the White House that industries affected by alleged unfair foreign competition will get a sympathetic ear on Capitol Hill.

U.S.-Japanese Trade Relations

A new avenue for U.S. exporters having difficulty exporting into Japan may be opening up. If it does, the U.S. semiconductor industry may be the first beneficiary.

The new approach is an offshoot of the Commerce Department's much publicized "Trade Facilitation Committee." This was designed to bring specific company problems relating to tariff or non-tariff barriers to the attention of the commerce department, and then, with direct intervention of commerce officials, to bring the problems to the attention of the Japanese government. The Trade Facilitation Committee structure was established as an offshoot of the recent U.S.-Japanese Trade Agreement.

Most industry representatives who were briefed by the Commerce Department on this approach designed to deal with Japanese tariff and non-tariff barriers agreed that, while a good first step, it would result in little meaningful action in the long run. As a result, little in the way of overall progress has been made in dealing with the Japanese.

This lack of results, together with growing pressures to increase exports has apparently reached several government agencies, including the Departments of Commerce and State, as well as the Office of the President's Special Trade Representative. The result is a new approach to the problem, this time making it possible for industry sectors to deal with the Japanese. It is understood that, if approved, a principal focus of attention will be the U.S. semiconductor industry, which will become a prime possibility for a test case to determine whether the new system will work.

The objective of the new policy will be to identify specific product markets with the potential for major increased imports by U.S. manufacturers into Japan—imports that are currently being thwarted by either tariff or non-tariff barriers.

Under this new approach, an interested industrial sector would establish a Trade Study Group. Industries interested in using this sectored approach must be able to demonstrate that they have a clear competitive edge over their Japanese counterparts, and must also be able to identify specific Japanese trade barriers that inhibit imports into Japan. In addition to semiconductors, computer products and power generation equipment offer the most promising initial areas of attention.

Assuming that the semiconductor industry were willing to implement a trade study group under this new approach, much of the burden of identifying the specific problems, developing the market research data, and agreeing on a specific list of recommendations to be used in direct negotiations with the Japanese would fall upon industry representatives. Once this background information is prepared, industry executives together with U.S. government officials would participate in direct negotiations with the Japanese.

Government spokespersons admit that the organization and the timing of this effort will vary from market to market and from industry to industry. However, these sources also admit that they would like to see at least one industry group sufficiently organized so that Special Trade Representative Robert Strauss could carry preliminary recommendations to the Japanese when he visits the country in October 1978.

There are some obvious drawbacks to this new plan. In particular, it has not yet been formally approved by all agencies in the U.S. Government. Also, there can be no guarantees by the U.S. Government that any industry sector that allocates the time and money to support this effort will be successful at the negotiating table, even with government support. On the other hand, selected industry groups that do not take advantage of this new technique may find themselves in a disadvantageous position in dealing with the Administration and the Congress on other alternatives, should the efforts of the Trade Study Group and the Trade Facilitation Committee fail.

Export Controls

The General Accounting Office, watchdog of the Congress, has initiated an investigation of the U.S. Government's export licensing process as it is used to control the shipment of high technology products to the U.S.S.R. and other countries in Eastern Europe.

The investigation—the first of its kind to be conducted by any agency in the government—is the result of a request made by Rep. Don Edwards (D-Calif.). Edwards' interest in the issue was stimulated by semiconductor manufacturers from his home district (San Jose) who last year complained that delays in the licensing process were resulting in the loss of business by U.S. firms to foreign competitors. The Congressman asked the GAO to look into these allegations in May 1977, but not until last month were the congressional investigators able to work out an arrangement with the Commerce Department under which the GAO could examine Commerce license application files.

Under the agreement reached between the Commerce Department and the General Accounting Office, the GAO will be able to examine individual applications by tracing them through the interagency decision-making process. This process involves the Departments of Defense, State, and Energy, as well as Commerce, and can include the CIA and other federal agencies depending on the nature of the case. This is the first time that any federal agency or congressional committee has attempted to conduct its own investigation of the interagency licensing process by following up on individual export license applications. Because of this fact, the investigation is being generally supported by industry representatives, especially those in the semiconductor and computer areas.

In a letter to the Secretary of Commerce last year, Representative Edwards noted that he did not disagree with the fundamental premise of the Export Administration Act, i.e., that the United States should restrict the export of goods and technology that could make a significant contribution to the military potential of another nation to the detriment of U.S. security. At the same time, Edwards indicated that the Act, as presently administered by the Commerce Department's Office of Export Administration, "discourages valuable non-strategic trade between Eastern countries and the U.S."

The results of the GAO's investigation are due to be reported to Representative Edwards and to the House International Relations Subcommittee (chaired by representative Jonathan Bingham) by mid-summer. It is expected that Rep. Bingham's Subcommittee, which has jurisdiction over the Export Administration Act and whose help was solicited by Edwards in launching the GAO investigation, will include the GAO's findings in yet to be scheduled hearings on the export control process. These hearings will also include a review of a White House study on U.S. export controls that is currently being conducted by the National Security Council.

In its investigation, the General Accounting Office will focus its attention only on cases that have been "closed." The agency is forbidden to report on the specifics of the cases involved, and the Commerce Department has retained the right to review the GAO report in advance of publication to determine that no proprietary information is disclosed.

Technology Transfer

Seven categories of products that are "candidates" for removal from U.S. export control and nine critical technologies that are also being considered for decontrol were listed by Dr. Ruth Davis, Deputy Under Secretary for Research and Advanced Technology in the Department of Defense, during Congressional hearings last month on the Department's fiscal 1979 budget authorization request.

The seven product categories Dr. Davis listed as being under consideration for decontrol were:

- Selected microwave equipment above one GHz
- Ion microscopes
- Selected semiconductor manufacturing equipment
- Capacitors
- Wide-band VHF/UHF amplifiers
- Array processor computers with specified maximum processing speeds
- Thermal non-imaging detectors

The presently controlled "critical technologies" identified by Dr. Davis as being under "intensive investigation" in order to identify both "keystone" equipment, which should not be exported, and equipment that can be exported without harm to the national security of the United States include:

- Array processor computer technology
- Acoustic array detection system technology
- Computer network technology
- Diffusion bonding technology
- High laser technology
- Infrared detection technology
- LSI integrated circuit production technology
- Jet engine technology

In her statement, Dr. Davis listed as one of the goals of her office to identify "the largest set of equipment in each critical technology which may be exported without harm to the U.S. national security and which will assist U.S. industry in competing in an increasingly tough international marketplace."

It has been rumored that neither the advocates of the so-called "Bucy Report" (which sought to reduce export controls on end-products while emphasizing restrictions primarily on the export of the underlying technologies and the essential equipment associated with those technologies) nor the Department of Defense (which has taken the lead in attempting to implement the report's recommendations) are happy with the progress that has thus far been made in this area.

Pacific Air Cargo Rates to be Increased

Almost four years ago, after a year-long battle between the airlines that carry electronic components to destinations in the Pacific and U.S. manufacturers that send parts and components to off-shore plants in these destinations, the Civil Aeronautics Board approved an increase in the freight rates that could be charged for such shipments. In approving the increase, the CAB invited the carriers to come back with specific rate increases for these commodities and a justification for them.

Last month, the airlines finally came back to the CAB with their specific proposals and justifications. There is a good chance that an ad hoc group of manufacturers will again fight these proposed increases, as they so successfully did four years ago.

It is understood that the recently proposed air cargo rate increases will represent a 17 to 25 percent increase in the current air freight rates for electronic components. It is estimated that such an increase would result in at least a $7 million annual increase in shipping costs for U.S. manufacturers.

The new air cargo rates are somewhat less than those originally proposed—and never implemented—by the airlines five years ago. It is estimated that the implementation of the original rates would have increased U.S. manufacturers' shipping costs in excess of $40 million.

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DATAQUEST RESEARCH NEWSLETTER
A Subsidiary of A.C. Nielsen Co. INCORPORATED

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UPDATE ON FAIRCHILD

Summary

Fairchild reported total revenues of $470 million in 1977, up from $450 million in 1976. Net income in 1977 was approximately $11.2 million, down slightly from $12.5 million the previous year. This income was maintained despite serious difficulties in consumer electronics. Although those problems are past, the Company still faces intense competition, especially in semiconductors. The following major considerations will shape Fairchild's future:

- Fairchild lost market share in semiconductors in 1977 due to end-market loss in calculator and watch components and to product positioning problems in some of its key product lines. We expect these factors will maintain Fairchild's growth in 1978 at a slower rate than prior to 1977.

- Fairchild's major LSI strength, bipolar memories, faces intense new competition from other companies as well as from MOS products.

- DATAQUEST perceives that the MOS LSI Group, unprofitable in 1977, needs growth and profitability if Fairchild is to continue to be a strong supplier in the future. Startup costs in San Jose for 16K RAMs, and 64K CCDs contributed to MOS LSI losses in 1977.

- DATAQUEST perceives that Fairchild has limited the size and impact of its consumer electronics operations thereby freeing management to focus its attention on its basic component business.

- The Watch Division has overcome the tremendous losses of 1977 and is currently profitable, with excellent growth expected in 1978.

- The Instrumentation and Systems Group continues to have rapid growth and excellent profits. DATAQUEST estimates 1978 revenues at approximately $70 million.

- The growth and performance of the Federal Systems Group and Industrial Products Division remain steady, if not spectacular. Increased collection efforts on royalties and technical licensing may increase revenues this year. New products will have to replace profit losses from declining royalty incomes as they are phased out after 1979.

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- Fairchild's capital expenditures were about $25 million in 1977. We believe the Company will duplicate this amount in 1978, but with the major difference that none of these expenditures will go toward new buildings.

- Fairchild has actively considered takeovers, especially in the area of minicomputers or related EDP systems. As this newsletter goes to press we understand that Fairchild is negotiating for a 30 percent interest at $4 million of Magnuson Industries in Santa Clara, California. Magnuson is a new company that manufactures plug-to-plug compatible with the IBM 138 and 148.

- We believe management is not favorably inclined to encourage merger action. Nevertheless, it is DATAQUEST's understanding that Fairchild had tentative discussions on joint operations with a major international corporation which did not progress further.

- For 1978, DATAQUEST expects Fairchild revenues will grow about 16 percent to about $545 million. Because profit margins have been slim, the Company has a potential to rapidly increase profits if business remains good.

Estimated Revenues

Estimated revenues by division for Fairchild Camera and Instrument Corporation are shown in Table 1. DATAQUEST estimates that Fairchild's total revenues will be about $545 million in 1978 with growth expected in all major groups. In 1977, major growth areas were in the Systems Group and in the Federal Systems Group and Industrial Products Division. Slower growth was experienced in semiconductors, and consumer electronic products experienced a major decline in watch sales that was instrumental in limiting corporate growth. In 1978, DATAQUEST expects excellent revenue growth from the Systems Group, with other revenue segments expected to show more moderate growth.

The largest product group in Fairchild is semiconductors. Estimated revenues for the Components and Large Scale Integration Groups are shown in Table 2. Because of changes in bases, year-to-year comparisons for this breakdown are hazardous. In particular, Linear Products in 1976 included substantial hybrid components from the Automotive Products Division. Revenues in the optoelectronics area have declined in 1977 due partly to problems in the Watch Products Division, which has seen a shift to LCD displays from LED displays.

Margin Analysis

Fairchild's 1977 pretax profits of $18.3 million were heavily impacted by losses from the Consumer Products Group. DATAQUEST esti-

Table 1

Fairchild Camera and Instrument Corporation

ESTIMATED REVENUES
(Dollars in Millions)

	1976	1977	1978
Semiconductor	$307	$325	$360
Government & Industrial	42	48	60
Systems	23	43	70
Consumer	104	-	-
Games	10	30	30
Watches	69	30	30
Components[1]	25	-	-
Intracompany	(33)	(16)	(15)
Royalties & Licensing	7	10	10
Total Corporation	$450	$470	$545

[1]This figure representing primarily optoelectronics is included in the semiconductor number for 1977.

Source: DATAQUEST, Inc.
March 1978

Table 2

Fairchild Camera and Instrument Corporation

ESTIMATED SEMICONDUCTOR REVENUES 1976-78
(Dollars in Millions)

Components	1976	1977	1978
Digital ICs	$ 70	$ 78	$ 85
Linear	63	52	61
Discrete	78	82	82
Optoelectronics	25	16	16
Total Components	$236	$228	$246
LSI			
Bipolar	$ 36	$ 42	$ 51
MOS	35	55	65
Total LSI	$ 71	$ 97	$116
Total Semiconductor	$307	$325	$360

Source: DATAQUEST, Inc.
March 1978

mates that last year Fairchild lost approximately $25 million on electronic watches. This may have been ameliorated somewhat by profits from the sales of video games and by reserves taken prior to last year.

DATAQUEST estimates that year-end pretax margins in games were running about 8 percent; thus, estimated profits for this division are about $2.5 million. The Government and Industiral Product Groups had estimated margins of about 12 percent (10 percent for Government Products), for estimated revenues of $5.2 million. We feel the Systems Group had the highest margin in the Company, ranging between 20 and 25 percent, or approximately $9 million. Corporate items affecting pretax profits include intracompany profits of about $1 million and interest of about $7.2 million.

This analysis indicates that profits in the semiconductor area are approximately $34.4 million, or somewhat above 10 percent.

Due to the wide possible flucuations, it is difficult to estimate profits for 1978. This is further confused by changes in the corporate structure during 1977. However, several points can be made:

- Profits in the semiconductor group are better than generally realized, indicating a healthy business outlook for 1978. However, it must be remembered that semiconductor profits include approximately $10.3 million from royalties and licensing. Nevertheless, these margins indicate that this area has the operating margins to support investments in new product areas that will have potential long run benefits.

- If major problems do not recur in any group or division, reasonable profit margins for 1978 could show significant upward leverage in total corporate profits. Fairchild has the potential to increase profits rapidly and show a tremendous increase in earnings per share.

- Despite the elimination of heavy losses in the Watch Division by the end of 1977, total corporate margins did not improve commensurately as the year progressed. Indeed, some of the increase in margins in the fourth quarter may be attributed to Consumer Products. In short, overall corporate margins were still low at year end 1977 despite a breakeven in the Watch Division.

Profits for Fairchild could benefit from an increased drive by the Company to increase royalty and licensing revenues in 1978. We believe that Fairchild will actively pursue collection on its patents and will also actively pursue technical exchanges and licensing in 1978. For example, Fairchild has recently closed an agreement with Tungsram in Hungary to provide them with T^2L assembly technology.

Fairchild is making a major effort on previous nonroyalty-paying semiconductor companies, including foreign corporations, especially in Japan.

Semiconductor Groups

In 1978, the Semiconductor Groups in Fairchild should not be hampered by the very heavy losses in consumer electronics. DATAQUEST believes Fairchild will be much more aggressive in the semiconductor market this year than it has been in the recent past, and this may catch some competitors unaware.

Fairchild's semiconductor revenues are approximately one-third discrete devices and two-thirds integrated circuits. Despite the preponderance of integrated circuits in its revenues, the Company currently has some product positioning problems in semiconductors. A number of major revenue segments are in product areas currently experiencing slow growth. These include small signal transistors and diodes, digital bipolar integrated circuits, some linear circuits, and some MOS products. The discrete devices are primarily small signal transistors and diodes that make up the majority of the discrete devices. This market segment has been experiencing small growth for several years due to market incursion by ICs, and limited growth is expected in the future.

The Digital IC Group consists primarily of small scale integration (SSI) TTL integrated circuits, as well as some ECL parts. The SSI TTL market is being replaced by bipolar and MOS large scale integration (LSI) devices, which are more economical, thereby giving this market segment slower growth. The Company does, however, have a good market position—second to Texas Instruments—in Schottky TTL.

The overall linear market has been experiencing rapid growth. Fairchild is well positioned here, with the exception of some older operational amplifiers currently being phased out in many designs. The extent of these products makes rapid growth in this market segment difficult for the Company.

Fairchild's strongest product segment is in bipolar memory where it has dominated the bipolar RAM market for several years. Fairchild's bipolar memory shipments, about $39 million, account for nearly all bipolar LSI revenues. In 1977, this market saw intense competition from Motorola, Signetics, and Texas Instruments. It is expected that National Semiconductor will also enter this market more competitively in 1978. We believe these companies have been gaining market share with competitive pricing. Although Fairchild is still the dominant supplier of bipolar memory, the renewed competitive pressure from other companies has hurt both growth and profits. Additionally, the bipolar memory market has been impacted by the advent of fast MOS memories, particularly the 2147 fast 4K static RAM and the 2115 fast 1K static RAM manufactured by Intel Corporation. These MOS devices are usurping the market segment for slower devices. However, the bipolar memory area and other associated bipolar LSI parts remain as the most promising areas in the Semiconductor Group.

Fairchild lost some of its momentum last year in bipolar memory due to processing and yield problems. However, we feel the Company recovered most of this momentum in the last half of 1977, particularly in 1K static RAMs. The Company has also made a heavily concentrated effort to introduce the 4K static bipolar RAM, and we believe this part is proving popular with many users. Additionally, the Company made a major effort to penetrate the PROM market.

Fairchild has been quietly updating its wafer fabrication modules and, at this time, all of its bipolar memory is fabricated using projection alignment masking. For the entire Company, about one-third of production currently uses projection alignment.

A new product area for Fairchild is its 16-bit bipolar microprocessor, the 9440, which will be marketed both as a component and as a board product. The Company currently is committing considerable investment to the development of peripheral products, software, and other development in marketing aids. The 9440 microprocessor is fabricated using I^2L technology. Currently, a fabrication area in Mountain View, California, has been converted to I^2L to support this product. These products will be marketed under the trade name μflame. They will face stiff competition from other 16-bit devices and systems by General Instrument, Intel, NEC, Texas Instruments, and Zilog, currently on the marketplace or being introduced. One competitive advantage, however, is the ability of the Fairchild device to utilize existing software.

Fairchild still has a limited product line in MOS devices with a definite lack of breadth and depth. Out of an estimated $55 million in MOS shipments in 1977, about $22 million are believed to be in MOS memory and about about $21 million in CMOS logic. In the latter market, Fairchild is third in the market behind Motorola and RCA. Fairchild is a major manufacturer of 1K static MOS RAMs, but these products will soon be replaced by newer 4K static MOS RAMs. The MOS segment underscores the need for the Company to have a number of product introductions in major new product areas where it can gain significant market share. We understand the Company currently is sampling 16K dynamic RAMs, 4K static RAMs, and the 6800 microprocessor.

We believe Fairchild is de-emphasizing production of 4K dynamic RAMs in favor of more profitable business for the 2102 1K static RAM. In that market of about 2.3 million units per month, Fairchild has a significant market share.

Fairchild currently has a lead position in the development and production of charge-coupled devices (CCDs). If this market develops, it will give the Company a badly needed leadership in a growth area. However, significant growth is not expected until 1979 for this market.

The Imaging Systems Department of the Government Products Division utilizes CCD devices for its aerial cameras. This group had sales last year of between $4 million and $5 million. These CCD devices for optical uses are quite large. We are aware of one chip measuring approximately 166,000 square mils. In this market, Fairchild has a definite technical lead.

The Company plans to use its South San Jose, California, facility as the fabrication module to spearhead its penetration into state-of-the-art technology MOS products. Initially, this includes 16K dynamic RAMs, with later production of 64K CCD memories, 64K dynamic RAMs, and 256K CCD memory devices as time progresses.

These product positions underscore the fact that Fairchild lost market share in semiconductors in 1977; this problem may not be rectified in 1978. Nevertheless, a healthy semiconductor market (as forecast by DATAQUEST) indicates that this group should have moderate growth. This beneficial market growth should buy the Company time to bring solutions to its problem.

Instrumentation and Systems Group

The Instrumentation and Systems Group continues to show excellent growth. DATAQUEST estimates that 1977 revenues were approximately $43 million. Sentry Testers accounted for about $35 million and XINCOM Testers had estimated revenues of about $5 million. All other areas had total revenues of about $2 million. About 30 percent of group revenues were to overseas customers, roughly split between Japan and the rest of the world.

The Microsystems Division has been folded back into the LSI Division of the Components Group at a write-off cost of about $1 million. The Group has also abandoned its digital appliance control business, with Amana and others, at a cost of about $1 million.

The Systems Group is extremely profitable. We believe that pretax profits across the Division have been about 25 percent including write-offs. Because the Division has excellent market share, with near dominance of Sentry Testers (for general purpose LSI devices), we believe margins will continue in 1978.

DATAQUEST expects the Division to experience substantial revenue increases in 1978 over 1977. The Division has already booked a large number of Sentry VII and Sentry VIII Testers for shipment to Japan and we understand that IBM has placed a major order exceeding $8 million for Sentry VIIIs. With this impetus, it is expected that the Division will have revenues of about $70 million in 1978 of which $60 million will be Sentry type machines.

The Systems Division is expected to introduce a linear testing machine in 1978 and perhaps also a machine to test printed circuit boards. We believe the initial product will be an adaptation of the Sentry Testers. It is our understanding the Fairchild is working closely with Intel to develop testing capability for telecommunications and other linear products.

The introduction of memory board products and systems is not expected to occur at least until the Company has production volumes of 16K dynamic MOS RAMs.

Federal Systems Group and Industrial Products Division

These two groups have been consistently profitable for Fairchild over the last several years. The Industrial Products Division makes rear screen slide projectors, crash recorders, cockpit voice recorders, and weight and balance systems for aircraft. DATAQUEST estimates that the Industrial Products Division has a pretax profit in the 13-15 percent range.

The Federal Systems Group makes aerial reconnaissance cameras and electronic counter measure equipment. Much of the work is classified. Additionally, the group manufactures special analog-to-digital equipment priced in the $10,000-$15,000 range. Because the revenues are from the Government, the group is technically limited to 10 percent net profit before taxes.

Consumer Products Group

The Consumer Products Group has been divided into two divisions—watches and games. We understand that by management edict, total consumer product revenues will likely be aimed at approaching a level of 10 percent of total Company levels or less. However, this may not be possible until 1979.

Watch Division

In 1977, Fairchild lost a substantial amount of money from its electronic watch business, an estimated $25 million. Its watch problems have resulted from a number of causes, particularly a precipitous price decrease initiated by Texas Instruments, substantial inventory problems after Christmas 1976, and changes in consumer attitude from LED watches to LCD watches. The inventory problems resulted both from too much segmentation of its product mix and a mismatch with consumer demand.

We believe that these problems are behind Fairchild at this time, and that the Company currently holds a reasonable market position in the jewelry departments of mass merchandisers. It is believed that the watch business is currently profitable, but the operations should be observed very closely for problems of inventory control and write-offs.

Games Division

In 1977, Fairchild's revenues from games were approximately $30 million. In 1978 the Company has the potential to raise games revenues substantially, but DATAQUEST believes that to limit risks, revenues will be held to $30 million or less. It is our estimate that the Games Division had a profit before taxes in the 7 to 9 percent range.

There are currently 13 cartridges available for the Channel F video game, with seven more due in 1978. We understand further that there will be two new products this year in the games area. One of these will include a shift for the game program from the current cartridge to a device that resembles an IC being inserted in its carrier. This should have a substantial effect upon costs. Secondly, a lower-cost control module is expected to be introduced. It is our understanding that Fairchild is currently buying 4K RAMs for its Games Division from other vendors. In 1978, we estimate that Fairchild should ship about four cartridges for every game. Fairchild currently has marketing arrangements with eight firms in Europe, which purchase unassembled kits, assemble the components into finished games, and market them. Substantial revenue increases could probably be generated if Fairchild takes that added value in-house.

Fairchild is being extremely cautious with its investments in this area after its problems in watches last year. The withholding of needed advertising and product development dollars may have an adverse long term effect. These considerations, plus the volatility in inventory and consumer preference, make consumer electronics a sensitive area for the Company.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.04 Intel March 7, 1978

UPDATE ON INTEL

Summary

Intel's revenues rose to $283 million during 1977, a 25 percent increase over the previous year. Net income for 1977 totaled $31.7 million, an increase of 26 percent over 1976. Intel maintained its profit margins despite the high cost of overcoming major problems and large investments:

- The Microma Division was successfully disbanded with a minimal impact on the Company's profits.
- The tremendous price erosion in some product lines, especially EPROMs, was successfully countered.
- Major organizational changes were effected to reflect the greater size and maturity of the Company.
- Union elections at the Livermore facility in February were handled successfully. The vote of the 300 person bargaining unit was 80 percent in favor of the Company.
- Major new investments were undertaken for capacity expansion and addition of new product areas such as magnetic bubbles and telecommunication products.

For 1978, DATAQUEST expects a planned growth at Intel to result in revenues of about $345 million. With major potential problems behind it, we expect after-tax margins of about 11.5 percent, for a net profit of about $39.7 million, or $3.71 a share.

Estimated Revenues

Estimated revenues by division for Intel are shown in Table 1. DATAQUEST estimates that Intel's total sales will be about $345 million in 1978, with excellent growth expected in all remaining divisions.

The largest division of Intel is the Memory Components Group. A breakdown of its estimated 1977 revenues by major product category is shown in Table 2. In 1978, these revenues should increasingly shift to the newer products—i.e., the 16K dynamic RAMs, 4K static RAMs, 16K EPROMs, and others.

Table 1

Intel Corporation

ESTIMATED REVENUES 1977-78
(Dollars in Millions)

	1977	1978
Special Products Division	$ 98	$110
Memory Components Division	$ 69	$100
Total Memory Components Group	$167	$210
Microcomputer Components Division	40	60
Microcomputer Systems Division	37	50
Memory Systems Division	38	50
Microma Division	17	0
Intel Magnetics	0	0
Intracompany	(16)	(25)
Total Company Revenues	$283	$345

Source: DATAQUEST, Inc.
March 1978

Table 2

Intel Corporation

MEMORY COMPONENTS GROUP
ESTIMATED 1977 REVENUES

Memory Type	Major Product	Units (Millions)	Average Selling	Estimated Revenues ($ in Millions)
MEMORY COMPONENTS DIVISION (Ron Whittier)				
Dynamic RAMs				
1K	1103	6.5	$ 2.35	$ 15.3
4K	2107	10.4	3.50	36.4
16K	2116,17	0.56	18.00	10.0
High Speed RAMs				
1K	2115	.5	$ 5.00	$ 2.5
4K	2147	.1	24.00	2.5
CCDs and Others	2416	.25	10.00	2.5
Total Division				$ 69.2
SPECIAL PRODUCTS DIVISION (George Schneer)				
Static RAMs				
1K	2101	10.0	$ 1.50	$ 15.0
4K	2114	.89	14.00	12.5
EPROMs				
2K	1702	1.4	$ 6.50	$ 9.1
8K	2708	1.5	15.10	22.7
16K	2716	.35	30.00	10.5
ROMs				7.0
Bipolar				15.0
CMOS, Memory Peripheral, Other				6.0
Total Division				$ 97.8
TOTAL MEMORY COMPONENTS GROUP (Ed Gelbach)				$167.0

Source: DATAQUEST, Inc.
March 1978

Margin Analysis

Intel was able to survive substantial competitive inroads on many of its proprietary products in 1977 while maintaining its margins. Our data suggest that Intel, without Microma, actually increased its margins slightly. Table 3 gives estimated revenue and profits for Microma in 1976 and 1977. These figures are used to estimate Intel's revenues and profits, excluding Microma, for 1976 and 1977.

Table 3

Intel Corporation

ESTIMATED MICROMA REVENUE AND PROFITS 1976-77
(Dollars in Millions)

	1976			1977		
	Microma Division	Intel With Microma	Intel Without Microma	Microma Division	Intel With Microma	Intel Without Microma
Revenues	25	226	201	17	283	266
Net Profits Before Taxes	2	51	49	(2.5)	63	66
Percent Margin			24.5			24.9

Source: DATAQUEST, Inc.

In 1977, margins were held down by the losses at Microma and additionally impacted by the rapid price declines for 8K EPROMs (2708s) and other devices. Intel last year successfully made the transition from the position of having a technical monopoly on a large volume, very high margin product, to the current situation where there is considerable competitive pressure on substantially all of its product line. In addition, expenses for research, development, and substantially new marketing efforts were all very large. During that time, however, margins actually increased. Thus we believe it is reasonable to conclude that Intel is the industry's low-cost producer for memory and microprocessor components.

In 1978, the above problems are reduced. Although some well publicized, highly profitable areas of the past no longer exist, major areas of high margins remain:

- Fast 4K static RAMs (2147s) and other HMOS products

- The 2114 4K static RAM
- Microcomputer Systems
- Microprocessor peripheral components
- Some older, mature products such as the 1103 1K RAM and the 1702 2K EPROM

The dominant product breadth of Intel and its position as the low-cost manufacturer should combine to ensure excellent margins overall. Based on the foregoing analysis, we belive the Company should be able to maintain a 23 percent pretax profit margin in 1978.

Organization

In 1977, Intel made major organizational changes. These included a decentralization of the decision-making process into the five operating divisions, a change toward an interdependent matrix organization under the office of the president, and major management changes in the Memory Systems Division.

Intel's five operating divisions are the Microcomputer Components Division under Les Vadasz; the Microcomputer Systems Division under William Davidow; the Memory Systems Division under its new General Manager, William S. McCalmont; the Memory Components Division under Ron Whittier; and the Special Products Division under George Schneer. The last two divisions are part of the Memory Components Group headed by Ed Gelbach. In addition, a separate group is Intel Magnetics, set up in 1977 to pursue research and development on magnetic bubbles.

Corporate Analysis

Although Intel has fierce competition in most of its product lines, it still remains a major competitor in all areas. It has excellent product breadth, and products developed in 1978 should maintain its position for some time. In 1977, revenues were limited because of capacity considerations and this is still true. Many of Intel's major products—such as the 16K RAMs and 4K static devices—have demand in excess of current supply. Although we feel that this situation may change by the end of 1978, Intel enjoys an excellent competitive position today. Major problem areas in the Company were attacked in 1977 and we believe that Intel currently has fewer weaknesses and greater stability.

Because of the volatility of the semiconductor industry, Intel's long-term success cannot be assured. At this time, however, Intel seems well equipped to meet any potential competitive threats. Potential problems could come from several areas that need to be closely watched. These include:

- Problems arising from overcapacity in N-channel as yields rapidly increase and planned expansions come on stream.
- Price pressure from Japanese semiconductor manufacturers in the memory and microprocessor markets.

- Problems arising from the fast pace of the changing N-channel technology.
- Increasing competition in the microprocessor and microcomputer systems markets.

Each division of the Company is analyzed in greater detail in the following sections of this newsletter

Microma

Intel has successfully finessed its way out of the digital watch business with minimal impact on its profit and loss statement, its reputation, and no large-scale returns from retailers. A warranty reserve of well over $1 million will more than cover problems on Microma watches in the field. DATAQUEST understands that the warranty work will be handled by Timex.

Microcomputer Components Division

Microcomputer Components, by definition, includes all off-board components, except standard memories. DATAQUEST believes that this division, headed by Les Vadasz, will be the fastest growing division in Intel in 1978.

This division has been set up separately from the Microcomputer Systems Division because the two groups approach different markets. Microcomputer components are designed to replace a substantial amount of in-house work, such as logical systems built via TTL and other approaches; its customers are sophisticated electronics companies. However, it is our perception that the marketing applied to this area will ultimately create customers for the microcomputer systems division as well.

With a variety of new microprocessors such as the 8086, 16-bit microprocessor; the 8048, one-chip 8-bit microcomputer; the 8085, high performance 8-bit microprocessor; and the low-cost 8021 microprocessor; the Company is well positioned in microcomputer breadth in both old and new products. Additionally, Intel has a very wide array of microprocessor peripheral components recently introduced or nearing completion of development. These peripheral devices, plus its extensive software support give Intel a strong package pricing lever.

Special Products Division

The Special Products Division of the Memory Components Group consists primarily of non-EDP memory devices and some other special components. These include the slower static RAMs such as the 2102, 1K RAM and the 2114, 4K RAM; all ROMs; all EPROMs; all bipolar devices including bipolar PROMs; memory peripheral support circuits; and CMOS memory. Although this division is the largest part of the Memory

Components Group, DATAQUEST estimates that its growth will be substantially slower in 1978.

The recent codec chip announced by Intel is its first entry in the telecommunications market. Its ability to fabricate linear electronic devices with N-channel technology indicates an important technical advance usable in many potential markets.

Memory Components Division

The Memory Components Division under Ron Whittier includes most memory devices aimed at the EDP markets. These include all dynamic RAMs, the fast static RAMs, and CCD devices. This division is looking at very rapid market expansion in 1978. In particular, rapid revenue expansion should come from 16K RAMs and the 2147 fast 4K device.

Microcomputer Systems Division

The Microcomputer Systems Division under Dr. William Davidow has three major areas:

- Microprocessor testing equipment for production, laboratory, or field repair. The major product here is the recently announced μScope Systems.

- Microdevelopment systems for microprocessor and microprocessor systems. This includes such products as the Intellec in-circuit emulators. The MDS Group is estimated to have comprised over 60 percent of the revenues of this division in 1977. DATAQUEST estimates that it will maintain about 60 percent of division revenues this year.

- Computer-on-a-board. These small board computers should account for about 30 percent of division revenues in 1980. They were probably under 40 percent in 1977.

DATAQUEST believes that the charter of this Group is to develop new business areas made possible by the advent of microprocessors.

Memory Systems Division

This division has two basic product groups with separate organizations. The IBM Add-On Group represents about 50 percent of division revenues; about one-half of those revenues are from direct sales and the remainder from leases. Unlike the rest of the Company, the IBM Add-On Group has separate marketing and sales. The OEM Business Group consists of both board and system products divided into the following groups:

- Standard Products

- Custom Products - shipped to customers such as Univac, Burroughs, and Honeywell

- Mini- and Microcomputer Add-In and Add-On Memory (mostly additions to DEC Minicomputers)

- Serial Memory (CCD and Bubbles) being shipped to customers such as Singer, Calma, and GE; 100 percent of the OEM product line is sold.

In 1978, DATAQUEST expects several significant new products from the Memory Systems Division due primarily to inclusion of the 2147 fast 4K RAM in the MSD product line. The availability of the 2147 is an important advantage for IBM Add-On Memories. Upgraded IBM Memories for the 3031, 3032, and 3033 computers need this higher speed; the 2147 memory has an advantage over competitive types in terms of power dissipation. The availability of this device for use in Intel's systems should enhance the Company's competitive position. However, DATAQUEST does not look for substantial growth in the IBM Add-On Memory part of this Division's business in 1978.

Intel Magnetics

Intel Magnetics was established in 1977 as a subsidiary to do research and development on magnetic bubbles. We believe this organizational structure was set up to provide an entrepreneurial allure for several key technical people recruited from outside the Company. The subsidiary establishes a mechanism whereby talent can be attracted to Intel. It is DATAQUEST's perception that Intel Magnetics represents a decision on Intel's part to emphasize work on magnetic bubbles. It is expected that very little will be shipped from this group in 1978 and this area is one of the Company's investments for the future.

Capacity

Intel's management has publicly stated on several occasions that 30 percent growth is in about the right range for 1978. DATAQUEST's estimates for a 1978 revenue increase of approximately 30 percent reflect our belief that Intel is deliberately taking a planned growth approach. We believe that the Company is increasing its corporate wafer starts at the rate of about 100 wafers each week. We expect that this activity, plus conversion to 4-inch wafers, will provide Intel with the bulk of its capacity increases this year.

Nevertheless, Intel has an ambitious capital program in 1978. DATAQUEST estimates that 1978 capital expenditures will be in the range of $60 million versus $45 million in 1977. Planned additions of approximately 700,000 square feet are being considered. Although Intel's fourth wafer fabrication area is still being brought on line, an additional four facilities are planned. At this time, Intel has four fabrication facilities in Santa Clara, Mountain View, and Livermore in California, and Aloha in Oregon. New facilities being added are as follows:

- 180,000 sq. ft. - Santa Clara Facility No. 4. This will be the headquarters of the Microcomputer Components Division.

- 150,000 sq. ft. - This building is the former Fairchild Consumer Products Building. It is planned to be the headquarters for the Microcomputer Systems Division.

- 80,000 sq. ft. - Fabrication area No. 5, in Aloha, Oregon.

- 30,000 to 50,000 sq. ft.-An expansion of the fabrication facilities in Santa Clara. This actually uses building space currently employed for other uses and is not a net square footage addition. This area will be for product development.

- 50,000 sq. ft. - A printed circuit board stuffing facility located in Aloha, Oregon.

- 180,000 sq. ft. - Two new fabrication areas currently being planned. DATAQUEST believes that one of these will be adjacent to the present facility in Mountain View and another one will be located outside of California, possibly in the Southwest.

James F. Riley
Frederick L. Zieber
Daniel L. Klesken

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters | March 2, 1978

MOS MICROPROCESSOR SHIPMENTS

Summary

Worldwide shipments of MOS microprocessors in the fourth quarter of 1977 were an estimated 3.2 million units, up about 36 percent over third quarter shipments. Total 1977 MOS microprocessor shipments were an estimated 8.0 million units, up about 235 percent over an estimated 2.4 million units shipped in 1976. Microprocessor shipments and revenues are still concentrated in the 8-bit product area because of the wide proliferation of products.

The newer one-chip microprocessors including the 3870 and 8048 were well received in 1977 and are expected to play an increasingly important role in the market in 1978 and beyond.

Quarterly Microprocessor Shipments

Table 1 presents DATAQUEST's estimates of worldwide microprocessor CPU shipments for the four quarters of 1977 (Unit counts of peripheral products are not included). Estimated microprocessor unit shipments in the fourth quarter were an estimated 3.2 million units, up about 36 percent over estimated third quarter shipments. The estimated total units shipped in the fourth quarter increased about 36 percent over third quarter totals. This percent change was less than the 71 percent change that occurred between the second and third quarters. The large increase in the third quarter resulted from a large increase in TMS-1000 shipments. Several estimates have been restated since our newsletter of November 23, 1977: the 8085, 8080, TMS-1000, F8, and Z-80.

4-Bit Microprocessors

The 4-bit microprocessor market continues to be dominated by the Texas Instruments TMS-1000 family. This microprocessor family is in a state of transition from the older PMOS versions to newer CMOS models. TI's 4-bit family is very competitive in a broad category of controller applications; prices on the TMS-1000 for shipments in the first half of 1978 have been quoted as low as $1.25 to $1.50 in large volumes.

Although the 4-bit market is very price competitive, some new product entries were made in late 1977 as AMI introduced its S-2000 family with sample quantities and NEC brought its μCOM 4 Series into the United States. We expect to see additional 4-bit products introduced in 1978 as the applications for low cost controllers continue to grow.

Table 2 presents our estimates of worldwide microprocessor shipments by bit length. An estimated 1.4 million 4-bit microprocessors were shipped in the fourth quarter of 1977, up about 17 percent over estimated third quarter shipments. This percent increase was rather small in comparison with the 94 percent increase that occurred between the second and third quarters as a result of greatly increased 4-bit microprocessor shipments into seasonal markets such as games.

8-Bit Microprocessors

Worldwide shipments of 8-bit microprocessors in the fourth quarter of 1977 were an estimated 1.7 million units, up about 57 percent over estimated third quarter shipments. The 8-bit market is experiencing growth from recent product introductions including the 6500, 3870, and 8048.

Prices for 8-bit microprocessors are generally in the \$5.00 to \$10.00 range for large quantity shipments. Some large quantity plastic package 8080 microprocessors are being quoted for first half 1978 delivery at prices in the \$4.25 to \$5.00 range. Ceramic packages generally command a \$1.00 to \$2.00 premium over the plastic. The CMOS microprocessors available from a few suppliers generally receive a two to three times price premium over the NMOS microprocessors. This is especially true in applications where their low power consumption is of particular importance and an advantage to the user.

The breadth of the 8-bit microprocessor performance spectrum expanded greatly in 1977. At the low end of the spectrum are products such as the 3870 and 8048 serving a broad variety of applications that might be termed logic replacement. The low cost and versatility of these single-chip microcomputers enables users to replace electromechanical logic with a single chip as well as to add numerous product features at no additional cost. At the high end of the performance spectrum are products such as the Z-80 and the 8085. Applications for these devices include data processing and data communications where high speed, byte handling, or computation are required. In the mid-performance range are products such as the 8080, 6500, 6800, and F-8, with applications spanning a broad spectrum.

The popularity of some of the major 8-bit microprocessors is demonstrated by their shipment volume shown in Table 3. The number shown for a particular microprocessor type includes the shipments of all manufacturers making that microprocessor. The 6500, which was successful in the video-game and home computer market in 1977, shipped approximately 450K units in the fourth quarter of 1977, up about 114 percent over estimated third quarter shipments. For the first time, the quarterly units shipments of the 8080 have been overtaken by another 8-bit product. However, the seasonality of the games market must be taken into account in this comparison.

16-Bit Microprocessor

Worldwide shipments of 16-bit microprocessors in the fourth quarter were an estimated 70K units, up about 32 percent over estimated third quarter shipments. Although this was a relatively small market in 1977, new 16-bit products from Intel (8086) and Zilog (Z-8000) are expected to add notably to 16-bit microprocessor shipments in 1978 and beyond.

The slow development of the 16-bit microprocessor market has been due to several factors. Peripheral and interface circuits for these 16-bit families were not available in variety and quantity until late in 1977. Furthermore, most microprocessor users started with the 8-bit products and have these microprocessors designed into their production runs. The number of applications requiring the capability of a 16-bit microprocessor has been limited to date, but as designers become more familiar with the 16-bit products, it is expected that their ingenuity will result in discovery of many new additional applications for the 16-bit families of microprocessor products.

Daniel L. Klesken
James F. Riley
Frederick L. Zieber

Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS

(Units in Thousands)

Company	MPU Products	Bits	MOS Process	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.	1977 4th Qtr.	1977 Total
AMD	8080A	8	N	67	35	35	45	50	165
AMI	6800	8	N	16	14	11	14	50	89
Fairchild	F8	8	N	180	100	130	180	245	655
	3870	8	N	0	0	0	0	15	15
GI	CP-1600	16	N	14	6	7	8	10	31
Harris	6100	12	C	0	2	3	4	4	13
Intel	4004	4	P	340	65	55	50	45	215
	8008	8	P	125	30	32	32	30	124
	8080	8	N	255	85	100	155	175	515
	8048	8	N	0	0	15	30	60	105
	8085	8	N	0	0	5	10	25	40
Intersil	6100	12	C	2	3	3	4	6	16
MOS Technology	6500	8	N	0	10	30	80	160	280
Mostek	F8	8	N	70	10	15	25	40	90
	Z-80	8	N	13	10	15	25	35	85
	3870	8	N	0	0	0	5	15	20
Motorola	6800	8	N	90	50	80	105	200	435
National	4004	4	P	75	20	20	20	20	80
	IMP	4	P	49	10	12	15	20	57
	8080A	8	N	10	20	25	45	60	150
	SC/MP	8	P	100	40	44	50	55	189
	PACE	16	P	50	10	15	20	25	70
NEC	8080	8	N	42	27	35	45	55	162
RCA	1802	8	C	15	25	32	40	50	147
Rockwell	PPS-4	4	P	450	145	145	140	145	575
	6500	8	N	0	0	5	50	170	225
Signetics	2650	8	N	14	5	7	10	17	39
Synertek	6500	8	N	0	10	40	80	120	250
TI	TMS 1000	4	P	310	225	400	1,000	1,200	2,825
	TMS 8080A	8	N	65	20	23	27	30	100
	TMS 9900	16	N	20	15	20	25	35	95
Zilog	Z-80	8	N	5	10	20	25	40	95
Total Microprocessors				2,377	1,002	1,379	2,364	3,207	7,952
Percent change from previous quarter					27.0%	37.6%	71.4%	35.7%	

Source: DATAQUEST, Inc.
March 2, 1978

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

		1976	1977				1977
4-Bit Products	MPU Products	Total	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Intel	4004	340	65	55	50	45	215
National	4004	75	20	20	20	20	80
	IMP	49	10	12	15	20	57
Rockwell	PPS-4	450	145	145	140	145	575
TI	TMS 1000	310	225	400	1,000	1,200	2,825
Total		1,224	465	632	1,225	1,430	3,752
Percent change from previous quarter			36.8%	35.9%	93.8%	16.7%	
8-Bit Products							
AMD	8080A	67	35	35	45	50	165
AMI	6800	16	14	11	14	50	89
Fairchild	F8	180	100	130	180	245	655
	3870	0	0	0	0	15	15
Intel	8008	125	30	32	32	30	124
	8080	255	85	100	155	175	515
	8048	0	0	15	30	60	105
	8085	0	0	5	10	25	40
MOS Technology	6500	0	10	30	80	160	280
Mostek	F8	70	10	15	25	40	90
	Z-80	13	10	15	25	35	85
	3870	0	0	0	5	15	20
Motorola	6800	90	50	80	105	200	435
National	8080A	10	20	25	45	60	150
	SC/MP	100	40	44	50	55	189
NEC	8080	42	27	35	45	55	162
RCA	1802	15	25	32	40	50	147
Rockwell	6500	0	0	5	50	170	225
Signetics	2650	14	5	7	10	17	39
Synertek	6500	0	10	40	80	120	250
TI	TMS 8080A	65	20	23	27	30	100
Zilog	Z-80	5	10	20	25	40	95
Total		1,067	501	699	1,078	1,697	3,975
Percent change from previous quarter			22.9%	39.5%	54.2%	57.4%	
12-Bit Products							
Harris	6100	0	2	3	4	4	13
Intersil	6100	2	3	3	4	6	16
Total		2	5	6	8	10	29
Percent change from previous quarter			525%	20%	33.3%	25.0%	
16-Bit Products							
GI	CP-1600	14	6	7	8	10	31
National	PACE	50	10	15	20	25	70
TI	TMS 9900	20	15	20	25	35	95
Total		84	31	42	53	70	196
Percent change from previous quarter			3.3%	35.5%	26.2%	32.1%	

Source: DATAQUEST, Inc.
March 2, 1978

Table 3

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]

(Units in Thousands)

Microprocessors	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.	1977 4th Qtr.	1977 Total
8080	439	187	218	317	370	1,092
F8	250	110	145	205	285	745
6800	106	64	91	119	231	505
6500	0	20	75	210	450	755
Total	795	381	529	851	1,336	3,097

[1]Numbers in this table include all manufacturers of these types

Source: DATAQUEST, Inc.
March 2, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters

February 21, 1978

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This newsletter provides a brief analysis of several federal issues likely to affect the U.S. semiconductor industry. Previous newsletters have discussed some of the same and different issues.

- The Department of Defense continues its efforts to implement the recommendations of the Bucy Report on the export of critical technologies and certain keystone products.
- The Council of Environmental Quality is drafting new regulations that could pose a severe threat to a wide range of exporters needing to obtain licenses for the sale of their products abroad.
- Skepticism grows in Congress about the U.S.-Japan Trade Agreement.
- The Chairman of Mostek has outlined a six-point government program to meet the Japanese challenge.
- The Carter Tax Reform package, including repeal of the Domestic International Sales Corporation (DISC) and tax deferral legislation, is in trouble on Capitol Hill.
- Labor Reform Legislation continues to move in Congress. AFL-CIO's legislative goals again include repeal of Items 806.30, 807.00, repeal of DISC, tax deferral, and several other items of major interest to the electronics industry.
- Legislation to modernize customs practices and reform penalty statutes needs a champion in the Senate.

Export Controls

The Department of Defense is moving to implement the recommendations of the Defense Science Board on the Export of Technology (the so-called "Bucy Report") as outlined in the Secretary of Defense's Interim Policy Statement of August 1977. To the extent that DOD philosophy is absorbed in overall U.S. export control policy, high technology exporters will find the exchange of technology and the sale of certain "keystone products" subject to greater governmental control, not only to destinations in Eastern bloc countries, but to

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customers throughout the world.

At the present time, and after meetings with representatives from various affected industry organizations, DOD has selected "for immediate consideration" nine "very important" critical technologies, control of which would be given immediate attention. These selected critical technologies are being considered by technical experts from industry and the Department of Defense to:

1. Develop a list of keystone equipment and/or the specific manufacturing know-how (including technical data) associated with the technology in question to determine whether export controls should be (or should continue to be) applied.

2. Develop a companion list of products associated with each critical technology that are not in themselves critical and therefore can be released from present export controls.

The following critical technologies are currently under review:

1. Array processor computer technology
2. Acoustic array detection system
3. Computer network technology
4. Diffusion bonding technology
5. High-energy laser technology
6. LSI (IC) production technology
7. Infrared detection technology
8. Jet engine technology
9. Wide-body aircraft technology

The Department of Defense has established for each of these areas special technical advisory committees composed of officials from both industry and government who will assess the implications of the exchange of these technologies, and to define both keystone products and equipment associated with the technologies that should be subject to control or decontrol. The deadline for the committees' recommendations is March 1, 1978.

Whether a product or technology remains on the DOD list is obviously significant from a high technology exporter's point of view because export or exchange of the listed items will either be strictly controlled or completely prohibited by the U.S. Government. During the past several months, many high technology companies have been extremely critical of DOD's actions, arguing that the proposed new level of controls will prohibit the sale of all but the most dated technology to Eastern European countries and put severe handicaps on their business dealings with Western allies.

While the Department of Defense continues to proceed on its chosen course of action, it is still too early to tell how its critical technology control policy will fare. The reasons for this include:

1. The National Security Council and the Office of Science and Technology Policy in the White House are still working on a major classified study of East-West technology transfer. The focus of the study is on how current export controls work, and how the Bucy Report should be implemented. The timing of the study has already slipped, and it is not expected to be submitted to the President until late February at the earliest. Current speculation is that the recommendations will be in the direction of tightening controls.

2. The Commerce Department is currently coordinating work on three separate studies mandated last year by Congress. These include an analysis of the effectiveness of international export controls, a review of U. S. unilateral controls over the exchange of technology to determine if changes should be made, and an investigation of the impact of technical data exports on U.S. national security.

Reports on these studies are due to be submitted to the Congress on June 22, 1978, and they will be accompanied by a separate report by the International Trade Commission on the impact on domestic employment of technology transfer to all destinations.

With all of the conflicting and competing government agencies that have suddenly found themselves involved in the issue, it is doubtful that any major policy decisions will be made soon. It appears certain, however, that the question of technology transfer and the sale of many high technology products to the Eastern bloc and throughout the world will come under intense scrutiny by the Administration and the Congress after mid-year. This is a sleeping issue which high technology companies, especially U.S. semiconductor companies, will want to pay close attention to the coming months.

A New Environmental Thrust

The White House Council on Environmental Quality has drafted new regulations that would require a wide range of exporters to file environmental impact statements before an export license could be granted.

The key words are "export licenses," which are required for the shipment of most high technology products. The regulations themselves have not yet been released for public comment, and while it seems clear from the press reports that the proposed rules are intended to cover major projects such as nuclear fuel production and highway construction, there has been much concern over what is reported to be very loosely drafted language that would include a wide range of exports. Fortunately, however, the new regulations have aroused the ire of most federal agencies, including the Department of Defense, the State Department, and the Commerce Department as well as certain elements in the White House. It appears to be a certainty that if they ever appear, they will be substantially modified; in fact, it is also a good bet that the proposed regulations will never go into effect.

Japan

"The most urgent problem that requires prompt solution from the international viewpoint is that of Japan's excessive surplus. For this reason, the Japanese Government will strive for increased imports through domestic-demand-oriented economic management, and for the opening of our market through vigorously instituting a series of measures including the positive cooperation in the Tokyo round of negotiations, the advanced implementation of tariff cuts, the expansion of quotas for items under residual import restrictions and their partial liberalization."

Thus did Prime Minister Fukuda introduce the U.S. Japanese Trade Communique to the Diet in early January of 1978.

Robert Strauss, President Carter's Special Trade Advisor, termed the agreement "a dramatic breakthrough" in U.S.-Japanese trade relations.

Now, a month later, in testimony before the International Trade Subcommittee of the Senate Finance Committee, Strauss has conceded that he was "skeptical" that Tokyo's new stimulus program would spur economic growth to the 7-percent pace that the Japanese pledged, or that Japan can eliminate its current account surplus within two years. Strauss told the Senate panel that he still regards the agreement as a "major change of direction" by the Japanese, who previously had refused to even consider moving away from a purely export-oriented economy. However, he indicated, "it's only a start" and "we can't change this overnight."

Strauss faced a skeptical Congressional audience and, after reviewing the list of 318 items on which the Japanese have already unlaterally reduced duties, many U.S. electronics exporters might share Congressional skepticism. Computer manufacturers might take some solace from the fact that the duty rate on imports into Japan has been reduced from 13.5 percent to 10.5 percent; LEDs have gone from 12 percent to 9.5 percent; and certain peripheral equipment has gone from 22.5 percent to 17.5 percent. (A complete list of the 318 items on which tariffs were cut is available from DATAQUEST).

Mr. Strauss is probably right in that the agreement does represent a major change of direction by the Japanese. However, a number of Congressmen, as well as many industries, will not be willing or able to wait very long for this directional change to be implemented.

For example, Charles Vanik (D-Ohio), Chairman of the Subcommittee on Trade of the House Ways and Means Committee has announced that his subcommittee will hold hearings on the implementation of the agreement early this spring. In announcing the hearings, Mr. Vanik noted his personal reservations that the agreement could result in a satisfactory resolution of the serious problems in U.S.-Japan trading relations. In particular, he expressed skepticism that the agreement would remove the large bilateral trade imbalance, significantly moderate Japanese export promotion to the U.S. market, or that the measures to open the Japanese market to sales and distribution of U.S. products, particularly manufactured goods, would be fully implemented.

In a related development, the International Finance Subcommittee of the Senate Banking Committee has announced a comprehensive series of hearings on the position of U.S. exports in world markets. One of these hearings, scheduled for February 27, 1978, will attempt to analyze and compare major foreign government policies and programs aimed at supporting exports. In announcing these hearings, the subcommittee has indicated that particular attention will be given to the financing, marketing assistance, and other policies employed by our major trading partners, specifically Japan and Germany.

In another set of hearings, tentatively scheduled for late spring 1978, the subcommittee will concentrate on both the explicit and implicit restrictions employed by foreign countries to hold down imports of U.S. goods. Formal tariff and nontariff barriers will be explored by the subcommittee, whose only scheduled witness so far is Robert Strauss. Speaking informally before a group of businessmen, one State Department official summed up the attitude in Washington concerning the Japanese Trade Agreement: If, by the third quarter of 1978, the Japanese have not shown real progress in implementing the provisions of the trade agreement, the relations between the two countries will become strained and the political pressures for protectionism in the United States will become insurmountable.

<u>U.S. Actions Needed To Achieve Parity With Japan</u>

Responding to the question of "How Can Domestic Electronics Firms Respond to the Japanese Marketing Threat in the United States?", Mostek Corporation's L. J. Sevin had several interesting suggestions in the area of increased cooperation between the federal government and industry. Addressing a December 1977 meeting sponsored by <u>Electronics</u> in Washington, Sevin suggested that:

1. <u>The U.S. Government should negotiate reciprocal market share agreements with Japan.</u> "This is in direct contradiction to the principles of free trade, and if given the choice, we would support free trade first," Sevin said. "But we are not given the choice."

2. <u>Items 806.30 and 807.00 of the United States Tariff Schedules must be retained.</u> These rulings "allow the United States semiconductor industry to use some of the same resources that the foreign competitors use, and if repealed will be most damaging to the industry."

3. The capital gains incentive must be retained. "Repeal of capital gains is short sighted and will seriously hamper the ability of growth companies to attract capital."

4. An R&D tax incentive should be enacted. "I envision a company receiving a tax credit, not just an ordinary business expense, on money spent for pure research and development. In this way, we could receive tax incentives to expand our R&D from the present 7 percent to more nearly the 12 percent Japanese levels."

5. The current investment tax credit should be made permanent. "Our industry needs the full investment tax credit of 10 percent in the three to five year range."

6. Depreciation should be accelerated for semiconductor manufacturing equipment. "Equipment is being obsoleted at a faster rate as the innovative pace quickens. Depreciation on testers, for example, should be moved to two years from three years. Some other manufacturing equipment should be depreciated in two to three years rather than the current five. Some items should be depreciated 100 percent the first year."

Tax Reform

Administration witnesses, led by Treasury Secretary W. Michael Blumenthal, spent the last two days of January on Capitol Hill explaining President Carter's tax program to a skeptical, if not hostile, House Ways and Means Committee.

The Committee will resume public hearings on the President's tax package on February 27, 1978, "or possibly later," depending upon the outcome of the energy bill. The Committee has received numerous requests from public witnesses to testify, and expects to accommodate all interests before going into markup. Taxation of foreign source income, specifically repeal of DISC, has surfaced as the most controversial aspect of Carter's tax reform package.

With regard to this issue, the Administration is asking the Congress to reduce DISC benefits by one-third in 1979, two-thirds in 1980,and totally eliminate them in 1981 and thereafter. No recommendation was made that would affect previously-deferred DISC income. The Treasury Department estimates that the three-year phase-out of DISC will increase tax revenues by $0.7 billion in calendar 1979, rising to $1.75 billion in calendar 1983.

Administration representatives argue that DISC has turned out to be a "far more costly and less effective program" than originally envisioned. Treasury figures indicate that DISC may have only contributed $1.3 billion to U.S. exports in 1974 at a tax revenue cost of $1.39 billion in 1975. Changes in flexible exchange rates now provide a more effective means in adjusting to changes in the competitive position of U.S. exports, according to the White House.

Deferral of earnings of U.S.-controlled foreign corporations would also be phased out over a three-year period in the Administration tax reform package. This would be accomplished by treating an appropriate fraction of a U.S.-controlled foreign corporation's gross income, deductions, and taxes eligible for foreign tax credit (one-third in 1979, two-thirds in 1980, and the entire amount in 1981 and thereafter) as having been earned or incurred directly by the U.S. shareholder. Earnings of a U.S.-controlled foreign corporation would be taxed currently under the Administration proposal, whether or not those earnings are paid to U.S. shareholders.

The proposal would allow the Treasury Department to consider the negotiation of tax treaties—providing, in certain situations, that U.S. shareholders will not be taxed currently on certain income of their U.S.-controlled foreign corporations operating in a treaty country.

The Administration argues that by eliminating tax deferral: (1) U.S. business will have no incentive to invest overseas solely for the tax benefits available; (2) the rules relating to the taxation of foreign-source income will be simplified; and (3) practices used to avoid U.S. taxes will be ended. If enacted, the three-year phase-out of deferral will, according to Treasury figures, increase tax liabilities by $0.1 billion in calander 1979 and $0.9 billion in calendar 1983.

Congressional reaction to Carter's tax package in general and reform proposals in particular has been less than enthusiastic. Even before proposals were formally sent to the Hill, Way and Means Committee Chairman Al Ullman (D-Ore.) expressed opposition to elimination of DISC tax deferral. Other Ways and Means Committee members, on both sides of the aisle, have expressed similar sentiments. General feeling seems not so much committed to DISC on merits, but there is skepticism over why it should be eliminated now in light of huge trade deficit and increasing foreign competition.

Labor And The Electronics Industry

The votes of fifteen to twenty currently uncommitted Senators are all that are needed for Senate passage of the so-called "Labor Reform Act" (S. 2567). The bill will be brought up for consideration by the Senate after the debate on the Panama Canal Treaty—probably in late March.

Labeled by its AFL-CIO supporters as merely "technical amendments," the bill, if enacted, would have serious ramifications for the largely nonunion electronics industry. For example, the legislation would require all union elections to be held within thirty days if a majority of employees seek an election; within forty-five days if less than a majority (30-50 percent) seek an election; and within seventy-five days where the National Labor Relations Board determines that complex issues are involved. The legislation would also require the NLRB to award double back pay from the time of discharge to employees found to have been illegally discharged during an organizing campaign or prior to an initial contract.

In 1976, according to U.S. government statistics, only one in five U.S. workers belonged to a labor union. This ratio is substantially less for the high technology electronics industry. There is little question in the minds of most electronics industry executives that S. 2467 will make union organizing much easier and could substantially increase the number of high technology firms that are unionized.

Industry executives will also be interested in the following excerpts from the policy statement adopted by the AFL-CIO National Convention in Los Angeles in December 1977:

1. "Dumping of foreign-made products in the United States must be ended. Both quick enforcement of existing law and new legislation to assure government action should be adopted."

2. "Countervailing duty laws against imports subsidized by foreign governments should be speedily enforced and no injury test should be required for subsidized imports."

3. "Items 806.30 and 807.00 of the Tariff Code, which result in the export of American jobs, should be repealed."

4. "Imports, exports, technology transfers, and investment must be reported in more detail, monitored, and regulated."

5. "Customs laws should be enforced with penalties assessed fairly. More, not less, customs reporting is necessary so that American trade policy can be made on the basis of fact."

6. "Tax loopholes and incentives for multinational companies to move abroad should be ended, the tax deferral halted, the foreign tax credit repealed, and DISC abolished."

7. "The Foreign Trade Zone Act of 1938 should be repealed."

Organized labor can be expected to push for the adoption of these goals through legislation during 1978.

Customs Report Legislation Moves Ahead

Legislation to substantially modify and modernize U.S. Customs practices and penalties (H. R. 8149) was the subject of a brief, almost perfunctory hearing before the International Trade

Subcommittee of the Senate Finance Committee on February 2, 1978.

The Senate hearings were almost anticlimactic after the two-year effort to get the legislation through the House Ways and Means Committee. The major feature of the legislation affecting high technology companies is the revision of Section 59 of the Tariff Act of 1930. Under the proposed legislation, the government would not be required to assess an initial penalty in the full amount of the domestic items erroneously imported. Instead, the bill would impose a three-tier system of penalties covering fraudulent importations, those resulting from gross negligence, and erroneous importations due to simple negligence. Clerical errors would not be subject to any penalty assessment. (See DATAQUEST Newsletter of August 6, 1977, "Government Issues Affecting the Semiconductor Industry," for a full description of the provisions of H.R. 8149).

Senator Arbaham Ribicoff (D-Conn.), Chairman of the International Trade Subcommittee, was the only Senator present as a series of witnesses, including the United States Customs Service, and representatives from the Electronics Industries Association, the Computer and Business Equipment Manufacturers Association, and WEMA paraded to the podium to support, with minor modifications, the pending legislation. The Senator himself seemed little interested in the subject matter, asking only occasional questions of the witnesses during the morning-long hearing.

In fact, the tenor of the hearing is indicative of the major difficulty confronting H.R. 8149 now that it has reached the Senate. There is as yet no one on the Finance Committee to act as a driving force to push for final passage. Proponents are hopeful that Senator Ribicoff will assume this role. If he does, H.R. 8149 could come out of the Finance Committee shortly and be ready for debate in the full Senate. There, proponents of the legislation face another worry—there have been rumors that several protectionistic-minded Senators will use the Customs Reform Bill as a vehicle for a series of nonrelated protectionist amendments.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters February 3, 1978

MOS MEMORY— 4K AND 16K SHIPMENTS

Summary

Worldwide shipments of 4K dynamic MOS RAMs in the fourth quarter of 1977 reached an estimated 17.6 million units, up about 15 percent over an estimated 15.2 million units shipped in the third quarter of 1977. Worldwide shipments for the year 1977 reached an estimated 57.1 million units, up about 101 percent over the 28.5 million units shipped in 1976.

Demand for the 4K static MOS RAM generally exceeds supply, and lead times are in the 12 to 16 week range. We estimate that 2.0 million 4K static MOS RAMs were shipped in the fourth quarter of 1977, up about 43 percent from an estimated 1.4 million units shipped in the third quarter of 1977.

Worldwide shipments of 16K dynamic MOS RAMs increased to an estimated 1.2 million units in the fourth quarter of 1977, up about 132 percent over the 470,000 units shipped in the third quarter of 1977.

1K Dynamic MOS RAMs

The 1K dynamic MOS RAM market remains relatively stable, with Intel remaining the major supplier. User demand for the 1103 1K dynamic MOS RAM remains relatively strong for older designs that have not been upgraded to the 4K or 16K dynamic MOS RAM. Prices remain stable in the $2.00 to $2.50 range.

1K Static MOS RAMs

The 2102-type 1K static MOS RAM (1K x 1) remains in short supply, with lead times extending to as long as 18 to 24 weeks. This shortage reflects the greater cost effectiveness of the 1K static over the 4K static in many applications, as well as a continuing shipment shortfall by some producers experiencing either production problems or a low allocation of wafer starts. We estimate that worldwide shipments of 2102s are remaining at about 1.3 million units per month. Low power 1K static CMOS RAMs are experiencing good demand in applications requiring low power or battery backup capability to maintain memory contents.

4K Dynamic MOS RAMs

DATAQUEST estimates of worldwide 4K dynamic MOS RAM shipments

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through the fourth quarter of 1977 are presented in Table 1. We estimate that 17.6 million units were shipped in the fourth quarter of 1977, up about 15 percent over an estimated 15.2 million units shipped in the third quarter of 1977. Total shipments for the year were an estimated 57.1 million units up from 28.5 million units in 1976. We estimate that the unit volume will increase slightly to 65 million units in 1978 but total revenues will decline because of decreasing average selling prices. TI, Mostek, and Intel were the leading producers of 4K dynamic MOS RAMs in 1977, while NEC and Fujitsu ranked fourth and sixth for the year.

Prices of the slower 4K dynamic MOS RAMs in plastic packages are now as low as $1.75 to $2.00 for high-volume shipments in the first and second quarters of 1978. Higher speed or devices to customer specifications in ceramic packages are being shipped for $2.75 to $3.50 in large quantities.

The shift to the popular 16-pin package accelerated throughout 1977 and most manufacturers are placing increasing emphasis on the 16-pin package. DATAQUEST estimates of worldwide 4K dynamic RAM shipments by package type are presented in Table 2. The 16-pin packages represented about 42 percent of the units shipped, while the 18- and 22-pin packages represented about 12 percent and 46 percent respectively.

4K Static MOS RAMs

Table 3 presents our estimates of the worldwide 4K static MOS RAM shipments. We estimate that 2.0 million 4K static MOS RAMs were shipped in the fourth quarter which is up about 43 percent over the 1.4 million units shipped in the third quarter of the year. Total 4K static MOS RAM shipments for the year were an estimated 4.7 million units up from 865,000 units in 1976. We estimate that 15 million units will be shipped in 1978. Most suppliers already have a version of the 2114-type (1K x 4) static MOS RAM and most either have or plan to eventually offer both the 1K x 4 and 4K x 1 architectures.

Prices of 4K static MOS RAMs for first quarter 1978 delivery remain in the $6.00 to $8.00 range for plastic packages and $7.00 to $9.00 for ceramic packages. Prices on the fast 4K static (2147) are in the $20.00 to $25.00 range. At present, Intel is the only company offering the 2147.

16K Dynamic MOS RAMs

DATAQUEST estimates of worldwide 16K dynamic MOS RAM shipments are presented in Table 4. We estimate that worldwide 16K shipments were 1.1 million units in the fourth quarter of 1977, up about 132 percent over an estimated 470,000 units shipped in the third quarter of this year. In 1977, demand outstripped supply, and prices remained in the $16.00 to $18.00 range through the fourth quarter. However, prices for first quarter 1978 delivery are expected to be in

Table 2

ESTIMATED 1977 WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
BY NUMBER OF PINS

(Units in Thousands)

	1977			
Company	16 Pins	18 Pins	22 Pins	Total
AMD	0	550	1,840	2,340
Fairchild	2,080	0	0	2,080
Fujitsu	1,800	0	1,100	2,900
Hitachi	450	0	460	910
Intel	2,000	0	8,400	10,400
Intersil	500	0	400	900
Mostek	11,800	0	0	11,800
Motorola	1,550	0	1,190	2,740
National	375	0	3,300	3,675
NEC	2,150	250	3,700	6,100
Signetics	540	0	330	870
TI	900	5,900	5,600	12,400
Total	24,145	6,650	26,320	57,115

Source: DATAQUEST, Inc.
February 3, 1978

Table 3

ESTIMATED 1976 AND 1977 WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS
(Units in Thousands)

	1976	1977				
Company	Total	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
AMD	35	30	50	80	100	260
EMM	810	400	410	550	675	2,035
Fujitsu	0	0	0	0	20	20
Hitachi	0	0	5	30	50	85
Intel	20	40	150	250	450	890
Mostek	0	0	15	3 ?	50	95
Motorola	0	0	10	20	20	50
NEC	0	0	40	250	350	640
Synertek	0	15	25	65	100	205
TI	0	35	75	120	175	405
Total	865	520	780	1,395	1,990	4,685
Percent Change From Previous Quarter		40.5%	50.0%	78.8%	42.7%	

Source: DATAQUEST, Inc.
February 3, 1978

Table 4

ESTIMATED 1976 AND 1977 WORLDWIDE SHIPMENTS OF 16K DYNAMIC MOS RAMS
(Units in Thousands)

	1976	1977				
Company	Total	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Fairchild	0	0	0	0	25	25
Fujitsu	0	0	15	70	175	260
Intel	20	55	120	160	225	560
Mostek	30	80	160	170	350	760
Motorola	0	0	0	0	50	50
NEC	0	0	15	70	225	310
TI	4	3	0	0	40	43
Total	54	138	310	470	1,090	2,008
Percent Change From Previous Quarter			124.6%	51.6%	131.9%	

Source: DATAQUEST, Inc.
February 3, 1978

the $12.00 to $16.00 range as supplies increase. We expect that by third or fourth quarter 1978, the supply of 16K dynamic MOS RAMs will finally meet the demand. Projected prices for that time frame are in the $10.00 range. We estimate that approximately 14 million 16K dynamic MOS RAMs will be shipped in 1978, versus the 2.0 million units shipped in 1977.

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Table 1

ESTIMATED 1976 AND 1977 WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
(Units in Thousands)

Company	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.	1977 4th Qtr.	1977 Total
AMD	468	290	450	600	1,000	2,340
Fairchild	1,485	380	450	550	700	2,080
Fujitsu	715	550	750	800	800	2,900
Hitachi	480	140	220	250	300	910
Intel	5,225	2,000	2,300	2,800	3,300	10,400
Intersil	512	240	220	220	220	900
Mostek	5,025	2,150	2,600	3,300	3,750	11,800
Motorola	1,205	540	700	750	750	2,740
National	2,115	825	925	925	1,000	3,675
NEC	3,740	1,400	1,500	1,600	1,600	6,100
Signetics	220	180	210	230	250	870
TI	7,300	2,300	3,000	3,200	3,900	12,400
Total	28,490	10,995	13,325	15,225	17,570	57,115
Percent Change From Previous Quarter		24.1%	21.2%	14.3%	15.4%	

Source: DATAQUEST, Inc.
February 3, 1978

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters F January 23, 1978

JAPANESE SEMICONDUCTOR INDUSTRY

Summary

The value of Japanese worldwide semiconductor shipments increased by about 7 percent in 1977 over 1976. However, the shipment rate throughout the year was approximately level with shipments in the fourth quarter of 1976. There were also significant increases in inventory levels in both components and finished products; actual end use of semiconductors in Japan may have declined somewhat last year.

Japanese semiconductor exports to the United States increased by approximately 50 percent in 1977. Perhaps more significant than the increase, since the Japanese share of the U.S. market is still very small, is the fact that it was concentrated in the high technology end of the semiconductor market, a departure from historic patterns in this industry. At this juncture, the Japanese companies with the strongest technological positions in the high end of the market, particularly MOS memory, are Fujitsu and NEC.

In recent years, the Japanese semiconductor industry has risen to a level of technical and manufacturing expertise comparable to the best found anywhere in the world. Recent emphasis on high technology exports to the United States is a source of concern to U.S. manufacturers, and developments in this area will be monitored closely by DATAQUEST. Later newsletters will explore additional subjects dealing with the industry in greater detail.

Industry Shipments

In 1977, the Japanese shipped about $1,620 million in semiconductor devices, up 7 percent from 1976 levels. Production through the first nine months of 1977 was about $1,216 million dollars. (These figures are based on an exchange rate of 300 yen to one dollar, chosen as a matter of convenience. Actual exchange rates fluctuate considerably and somewhat artificially.)

This 7 percent growth figure may be misleading, however, in terms of evaluating present industry conditions. In 1977, the Japanese economy grew at a very limited rate, partially due to restraints to keep inflation down. Although GNP is expected to show a growth rate of over 5 percent, industrial production growth has been at a much lower level. Between the third quarter of 1976 and the third quarter of 1977, industrial production grew only about 2 percent in Japan. This has caused a very definite lack of demand for semiconductors in that country, particularly for uses in capital equipment. Additionally, the general malaise in 1977 in the consumer electronics market has affected the Japanese semiconductor industry markedly because of its heavy sales to that sector. As a result, monthly production totals for the Japanese semiconductor industry have remained virtually level since about October 1976. At the same time, inventory levels have increased to alarming levels, both for components and finished products that use semiconductor devices. Consequently, it is possible that actual use of semiconductor devices declined throughout 1977.

Although the Japanese semiconductor industry still ships a majority of discrete devices, its integrated circuit shipments have been increasing steadily as a percentage of the total, as shown in Table 1. Integrated circuit shipments are expected to exceed those of discrete devices during 1978 or 1979.

Table 1

ESTIMATED JAPANESE SEMICONDUCTOR FACTORY SHIPMENTS[1]

(Dollars in Millions[2])

	1970	1971	1972	1973	1974	1975	1976	9 mos. 1977
Total Semiconductor	$763	$664	$832	$1,140	$1,156	$921	$1,511	$1,216
Integrated Circuits	167	168	241	372	418	392	657	520
Bipolar Digital	70	63	40	82	105	75	105	93
MOS	20	50	82	140	156	184	286	208
Linear[3]	77	55	109	150	157	133	266	219
Discrete	585	486	568	748	731	505	809	650
Optoelectronic	11	10	23	20	18	24	45	46

[1]Further detail is included in Table A-8, Appendix A of the SIS Notebook

[2]$1 = ¥300

[3]Includes hybrids

Source: MITI
DATAQUEST, Inc.

Imports and Exports

Semiconductor exports from Japan to the United States increased considerably in 1977, although the amounts are still a relatively small percentage of the U.S. market, as shown in Table 2. If the Japanese share of market remained constant in the fourth quarter, total imports are expected to have increased about 50 percent for the full year.

Table 2

ESTIMATED JAPANESE SEMICONDUCTOR EXPORTS TO THE U.S.

Years	Dollars in Millions	Share of Market
1973	$20	1.0%
1974	38	1.7
1975	56	3.1
1976	54	2.3
1977 (9 months)	61	3.3

Source: DATAQUEST, Inc.
MITI
U.S. Dept. of Commerce
Trade

The most significant aspect of the increase, however, is that it is concentrated in devices at the leading edge of technology (microprocessors and semiconductor memories for computers). With some exceptions, such as 16K dynamic RAMs, where the Japanese have captured about 30 percent of the market, Japan's market share for upper-end products is not any higher at present than its overall penetration, since the products had almost no U.S. sales just two years ago. Nevertheless, the Japanese are now placing their export emphasis in the high end of the market. Understandably, this is a concern to U.S. manufacturers, especially in light of Japanese government subsidies to develop the Japanese computer industry.

Imports of semiconductors to the Japanese market, almost totally from U.S. manufacturers, have remained in the 9 to 10 percent range of total Japanese consumption for several years, as shown in Table 3. In 1977, this percentage declined, but it is unclear at this time whether this decline is due to the increased production of high technology devices by the Japanese companies or is a reflection of the Japanese economy.

Table 3

ESTIMATED JAPANESE IMPORTS OF SEMICONDUCTORS
FROM U.S. COMPANIES

Years	Dollars in Millions	Share of Market
1973	$122	9.7%
1974	129	10.0%
1975	102	10.0%
1976	168	9.9%
1977 (9 months)	120	9.0%

Source: SIA
MITI
DATAQUEST Estimates
U.S. Dept. of Commerce

Share of the World Market

Unlike other segments of the Japanese economy, the Japanese semiconductor industry has not been increasing its share of the world market. The Japanese semiconductor industry holds about 24 percent of the world market, as shown in Table 4, a slight decline from 1976. The share of the world market held by Japanese companies tends to fluctuate with the relative position of the Japanese economy versus the world economy, and the decline in market share last year reflects the low rate of growth in Japan. DATAQUEST estimates that in 1970 the Japanese companies held about 27 percent of the world semiconductor market, after rising very rapidly for several years. After that time, a shift in end-market production to less developed countries caused the Japanese semiconductor industry's market share to decline since Japanese semiconductor companies capture a much greater share of final products produced in Japan; however, the industry recovered somewhat in 1976.

Table 4

TOTAL SEMICONDUCTOR MARKET SHARE ESTIMATES
(Dollars in Millions)

	1970		1972		1974		1976		1977	
U.S. Companies	$1,484	57%	$1,865	60%	$3,362	63%	$3,521	61%	$4,106	63%
Japanese Companies	712	27	788	25	1,092	20	1,427	25	1,564	24
European Companies	424	16	481	15	881	16	802	14	847	13
Rest of World	6	0	14	0	38	0	12	0	0	0
Total Market	$2,626	100%	$3,148	100%	$5,373	100%	$5,762	100%	$6,517	100%

Source: DATAQUEST, Inc.

Product Segment Growth Analysis

Growth in the United States and Japan differed considerably in two product areas—MOS integrated circuits and optoelectronic devices (Table 5). MOS integrated circuit production actually declined in Japan last year as the result of weak domestic markets, particularly for calculators. In contrast, this market grew rapidly in the United States during the same year. That decline, of course, is one reason for the increased export drive for MOS circuits by the Japanese companies. While the market for optoelectronic devices declined 24 percent in the United States, it grew by 35 percent last year in Japan. This reflects the collapse of the LED watch market in the United States and some switch by Japanese calculator and watch manufacturers away from purchasing outside of Japan.

Table 5

GROWTH IN SEMICONDUCTOR SHIPMENTS RATES
FIRST NINE MONTHS 1977 VERSUS 1976
(Percent)

	Japanese Companies	U.S. Companies
Total Semiconductor	7%	10%
Integrated Circuits	6%	18%
Bipolar Digital	18%	15%
MOS	(3%)	16%
Linear	10%	26%
Discrete	7%	2%
Optoelectronic	35%	(24%)

Source: DATAQUEST, Inc.
MITI

Major Japanese Company Shipments

The Japanese semiconductor industry is highly concentrated. The vast majority of semiconductor production is by the five largest companies—Hitachi, Matsushita, Mitsubishi, NEC, and Toshiba. These companies rank among the largest in the world. Of the seventeen semiconductor companies in the world, captive and noncaptive, that produce over $100 million in annual semiconductor shipments, five are Japanese.

Semiconductor shipments of the major Japanese companies for 1975 and 1976 are shown in Table 6. Estimates for 1977 shipments are still undefined.

Nippon Electric Company (NEC) is the largest Japanese semiconductor company, as well as the largest Japanese integrated circuit manufacturer. It is the major manufacturer of MOS, LSI, and linear integrated circuits, and a major manufacturer of power transistors and thyristors. A significant percentage of NEC's integrated circuit production is for desk-top and hand-held calculators.

DATAQUEST estimates Hitachi to be the second largest Japanese semiconductor manufacturer. It is the major manufacturer of bipolar integrated circuits and silicon rectifiers and diodes, as well as integrated circuit and discrete devices for the television industry. In recent years, it has been a major supplier to the calculator industry, and limited growth in that market has caused some loss of market share.

Toshiba has been one of the fastest growing of the Japanese semiconductor manufacturers. It has the largest share of markets in CMOS logic and CMOS calculator circuits, and is the major manufacturer of linear ICs for consumer devices. Toshiba also manufactures a wide array of rectifiers, diodes, and thyristors, especially for industrial electrical equipment.

Matsushita and Mitsubishi are major discrete manufacturers. Mitsubishi manufactures a variety of bipolar integrated circuits, some MOS, and a wide range of specialized transistors and thyristors. In both discrete and integrated circuits it is a major manufacturer of semiconductor devices for the television and automotive industries.

Although Fujitsu is one of the smaller Japanese semiconductor companies, it is specialized in integrated circuits for computers, particularly MOS memories and digital bipolar integrated circuits. It has the largest share of the Japanese ECL and bipolar memory markets. Its technology for MOS memory is one of the best in the world.

Table 6

ESTIMATED MAJOR JAPANESE COMPANY SEMICONDUCTOR SHIPMENTS
(Dollars in Millions - $1 = 300¥)

	1975	1976
Total Semiconductor		
Hitachi	$150	$260
Matsushita	98	210
Mitsubishi	56	116
NEC	199	343
Toshiba	133	236
Fujitsu	47	77
Integrated Circuits		
Hitachi	$ 71	$127
Matsushita	21	59
Mitsubishi	25	41
NEC	105	174
Toshiba	49	90
Fujitsu	36	58
Discrete Devices		
Hitachi	$ 78	$132
Matsushita	71	140
Mitsubishi	31	52
NEC	89	158
Toshiba	77	132
Fujitsu	11	19
Optoelectronics		
Hitachi	$ 1	$ 1
Matsushita	6	11
Mitsubishi	0	1
NEC	5	11
Toshiba	7	15
Fujitsu	0	0

Source: DATAQUEST, Inc.

Japanese Semiconductor Markets

The Japanese semiconductor market is very heavily weighted toward consumer electronics, as shown in Table 7. In the United States, by comparison, the consumer market accounts for only 15 to 20 percent of demand. However, industrial and computer market areas in Japan are beginning to increase their relative size. The consumer segment peaked in about 1973 with the rapid market increase in consumer electronics in the early 1970s (due especially to electronic calculators). Japanese statistics include various types of office equipment in the computer market segment. Actual Japanese consumption of semiconductors for EDP applications is probably less than 20 percent of the total market. Of that total, a significant percentage is provided by imports from U.S. semiconductor manufacturers. On the other hand, Japanese electronics manufacturers import a much smaller fraction for consumer and industrial applications.

Table 7

ESTIMATED JAPANESE INTEGRATED CIRCUIT CONSUMPTION
(Percent)

	1971	1973	1977 (est.)
Computer and Office Equipment	28%	27%	31%
Consumer	60%	64%	57%
Industrial, Communications, and Measurement	12%	9%	12%
Total	100%	100%	100%

Source: MITI
DATAQUEST, Inc.

Capital Expenditure Trends

In 1976, the Japanese semiconductor industry had capital expenditures of about $155 million (shown in Table 8), or over 10 percent of their total semiconductor revenues. This is significantly larger than previous years, and expenditures have probably declined slightly in 1977. It is interesting to note that U.S. semiconductor companies also invest about 8 to 10 percent of revenue for capital expansion. Both figures are considerably higher than for most other industries.

Frederick L. Zieber
Daniel L. Klesken
James F. Riley

Table 8

ESTIMATED 1976 JAPANESE CAPITAL EXPENDITURES
FOR SEMICONDUCTOR

	Millions of Dollars ($1 = 300Y)
Toshiba	$ 46.7
NEC	36.7
Hitachi	21.7
Mitsubishi	18.3
Sharp	11.6
Others	20.0
Total INDUSTRY	$155.0
Percent of TOTAL INDUSTRY Revenues	10.3%

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters January 13, 1978

JAPANESE SEMICONDUCTOR INDUSTRY

Summary

This newsletter provides an introduction to the Japanese semiconductor industry. Later newsletters will explore additional subjects dealing with this industry in greater detail. We estimate that the Japanese semiconductor industry will have shipped in excess of $1.6 billion in 1977, accounting for slightly less than 25 percent of world semiconductor merchant manufacture. In recent years, the Japanese semiconductor industry has risen to a level of technical and manufacturing expertise comparable to that of the U.S. technology leaders.

Industry Shipments

As shown in Table 1, Japanese semiconductor production through the first nine months of 1977 was equivalent to about $1,216 million. (For convenience, an exchange rate of 300 yen to one U.S. dollar is used throughout this newsletter. Actual exchange rates have fluctuated considerably and somewhat artificially.) Japan is believed to have shipped about $1,620 million in semiconductor devices in 1977. The growth of the industry in 1977 is estimated at 7 percent over 1976. Although the Japanese semiconductor industry still ships a majority of discrete devices, its integrated circuit shipments have been a steadily increasing percentage of the total. During 1978 or 1979, integrated circuit shipments should exceed discrete device shipments.

During 1977, the Japanese economy grew at a very limited rate, partially due to restraints aimed at controlling inflation. Although GNP is expected to show a growth rate of over 5 percent, industrial production growth is at a much lower level. Between the third quarter of 1976 and the third quarter of 1977, Japanese industrial production grew only about 2 percent. This has caused a very definite lack of demand for semiconductors in that country, particularly for those used in capital equipment. The general malaise in the consumer electronics market during 1977 has also affected Japanese semiconductor demand. As a result, monthly production totals for the Japanese semiconductor industry have remained virtually level since October 1976. During the same period, inventories for both components and finished products that use semiconductor devices have increased to alarming levels; exports have also increased. Consequently, it is possible that actual consumption of semiconductor devices in Japan has declined throughout 1977.

Share of World Market

Unlike other segments of the Japanese economy, the Japanese semiconductor industry has not been increasing its share of the world market. The Japanese semiconductor industry holds about 24 percent of the world market, as shown in Tables 2 and 3. This is a slight decline from 1976. The world semiconductor market continues to be dominated by U.S. companies. The share of the world market held by Japanese companies has fluctuated with the relative position of the Japanese economy versus the world economy. DATAQUEST estimates that in 1970 the Japanese companies peaked at about 27 percent of the world semiconductor market after rising very rapidly for several years. After that time, a shift in end-market production to less developed countries caused the Japanese semiconductor industry's market share to decline. However, the industry recovered much of the lost market share in 1976.

Recent Industry Growth

Industry shipments for 1977 increased about 7 percent over 1976. However, shipment rates have been level since the fourth quarter of 1976. The estimated growth for the major product segments in Japan varies considerably from that in the United States, as shown in Table 4. In particular, MOS integrated circuit production has actually declined in Japan in 1977 despite increased production of memory devices. This is the result of weak markets in Japan, particularly for calculators. In contrast, MOS production grew rapidly in the United States during the same year. The decline in MOS demand in Japan is one reason for the increased export effort for MOS products by Japanese companies. While the market for optoelectronic devices declined considerably in the United States in 1977, in Japan it grew very rapidly.

Shipments of Major Japanese Companies

Estimated 1975 and 1976 semiconductor shipments by the major Japanese companies are shown in Table 5. At this time, we do not have estimates by company for 1977. The Japanese semiconductor industry is highly concentrated. The vast majority of semiconductor production is by the five largest companies—Hitachi, Matsushita, Mitsubishi, NEC, and Toshiba. These companies rank among the largest in the world. Of the seventeen semiconductor companies in the world (both captive and noncaptive) that produce $100 million in annual semiconductor shipments, five are Japanese.

Nippon Electric Company (NEC) is both the largest Japanese semiconductor company and the largest Japanese integrated circuit manufacturer. It is the major manufacturer of MOS, LSI, and linear integrated circuits, and a major manufacturer of power transistors and thyristors. A large percentage of NEC's integrated circuit production is for desk-top and hand-held calculators.

DATAQUEST estimates that Hitachi is the second largest Japanese semiconductor manufacturer. It is the major manufacturer of bipolar integrated circuits and silicon rectifiers and diodes. In recent years, it has been a major supplier to the calculator industry, and limited growth in that market has caused some loss of market share. Hitachi is a major manufacturer of integrated circuits and discrete devices for the television industry.

Toshiba has been one of the fastest growing Japanese semiconductor manufacturers. It is the largest Japanese manufacturer of CMOS logic and CMOS calculator circuits, and is a major manufacturer of linear ICs for consumer devices. Toshiba also manufactures a wide array of rectifiers, diodes, and thyristors, especially for industrial electrical equipment.

Although Fujitsu is one of the smaller Japanese semiconductor companies, it specializes in integrated circuits for computers, particularly MOS memories and digital bipolar integrated circuits. It has the largest share of the Japanese ECL and bipolar memory markets. Fujitsu's technology for MOS memory is one of the best in the world.

Mitsubishi and Matsushita are major discrete device manufacturers. Mitsubishi also manufactures a variety of bipolar and MOS integrated circuits, and a wide range of specialized transistors and thyristors. Matsushita is the largest Japanese manufacturer of transistors. It is a major manufacturer of discrete semiconductors and integrated circuits for the television and automotive industries.

Other Japanese manufacturers include International Rectifier, New Japan Radio, Nippon Precision Circuits (NPC), Oki, Sanken, Sanyo, Sharp, and Sony. NPC, formed by Seiko, makes integrated circuits only, and is a major manufacturer of watch circuits in Japan. New Japan Radio, a joint venture between Raytheon and Japan Radio Company, Ltd., makes a variety of discrete devices and linear integrated circuits. Sony produces semiconductor devices, primarily for its own internal consumption. Sharp produces integrated circuits for its own consumer devices, especially for calculators; it is beginning to compete more aggressively in the merchant market. International Rectifier Corporation Japan Ltd. is a major manufacturer of very high power rectifiers, and Sanken is a major manufacturer of discrete devices.

Oki is a major supplier to the Japanese communications industry. Its semiconductor devices include parts for that market and specialized integrated circuits for custom applications. It has excellent CMOS and linear IC technology. DATAQUEST understands that Oki has completed a major new 100mm (4-inch) wafer fabrication facility, at an estimated cost of about $10 million. In addition, Oki will shortly take delivery of an E-beam installation from ETEC. We understand that this installation will occur bebore the VLSI project order placed by MITI.

Japanese Semiconductor Markets

The Japanese semiconductor market is very heavily weighted toward consumer electronics, as shown in Table 6. However, the industrial and computer market areas are beginning to increase their relative size. The rapid market increase in consumer electronics in the early 1970s was primarily due to electronic calculators; however, we believe that the consumer segment share peaked around 1973.

Japanese statistics include various types of office equipment in the computer market segment. Actual Japanese consumption of semiconductors strictly for EDP applications is probably less than 20 percent of the total semiconductor market. A significant percentage of the EDP market is provided by imports from U.S. semiconductor manufacturers.

Imports and Exports

Imports of semiconductors to the Japanese market are almost totally from U.S. manufacturers. For several years, they have remained in the 9-10 percent range of total Japanese consumption, as shown in Table 7. In 1977, this percentage declined. It is unclear at this time whether this decline is due to the increased production of high-technology devices by Japanese companies or simply a reflection of the slowed Japanese economy.

Exports from Japan to the United States have increased considerably in 1977, although the quantities are still a relatively small percentage of the total U.S. market, as shown in Table 8. However, there has been a major change in the types of products imported, i.e., a large increase in devices at the leading edge of the technology, such as MOS LSI, microprocessors, and memory. (See DATAQUEST Newsletter, "MOS Memory," November 11, 1977.) The 1977 market share of advanced LSI products is significantly higher. For example, in 1977, Japanese companies held close to 30 percent of the 16K dynamic RAMs market. Understandably, this has been a major concern of U.S. manufacturers, especially in light of Japanese government subsidies to develop the Japanese computer industry.

In 1976, the Japanese semiconductor industry had capital expenditures of about $155 million, or over 10 percent of its total semiconductor revenues (Table 9). These expenditures were significantly larger than in previous years, and probably declined slightly in 1977. These capital expenditures are equivalent to those of U.S. semiconductor companies, which generally invest about 8-10 percent of revenue for capital expansion.

Frederick L. Zieber
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James F. Riley

Table 1

ESTIMATED JAPANESE SEMICONDUCTOR FACTORY SHIPMENTS[1]
(Dollars in Millions[2])

	1970	1971	1972	1973	1974	1975	1976	9 mos. 1977
Total Semiconductor	$763	$664	$832	$1140	$1156	$921	$1511	$1216
Integrated Circuits	167	168	241	372	418	392	657	520
Bipolar Digital	70	63	40	82	105	75	105	93
MOS	20	50	82	140	156	184	286	208
Linear[3]	77	55	109	150	157	133	266	219
Discrete	585	486	568	748	731	505	809	650
Optoelectronic	11	10	23	20	18	24	45	46

[1]Further detail is included in Table A-8, Appendix A of the SIS Notebook

[2]$1 = ¥ 300

[3]Includes hybrids

Source: MITI
DATAQUEST, Inc.

Table 2

TOTAL SEMICONDUCTOR MARKET SHARE ESTIMATES
(Dollars in Millions)

	1970	1972	1974	1976
Total Market	$2,626	$3,148	$5,373	$5,762
U.S. Companies	1,484	1,865	3,362	3,521
Japanese Companies[1]	712	788	1,092	1,427
European Companies	424	481	881	802
Rest of World	6	14	38	12

[1] Does not include manufacture in Japan by U.S. companies

Source: DATAQUEST, Inc.

Table 3

TOTAL SEMICONDUCTOR MARKET SHARE ESTIMATES
(Percent of Market)

	1970	1972	1974	1976	1977
U.S. Companies	57%	60%	63%	61%	63%
Japanese Companies	27	25	20	25	24
European Companies	16	15	16	14	13
Rest of World	0	0	1	0	0

Source: DATAQUEST, Inc.

Table 4

ESTIMATED GROWTH IN SEMICONDUCTOR SHIPMENT RATES
FIRST NINE MONTHS 1977 VERSUS 1976
(Percent)

	Japanese Companies	U.S. Companies
Total Semiconductor	7%	10%
Integrated Circuits	6%	18%
Bipolar Digital	18%	15%
MOS	(3%)	16%
Linear	10%	26%
Discrete	7%	2%
Optoelectronic	35%	(24%)

Source: DATAQUEST, Inc.
MITI

Table 5

ESTIMATED MAJOR JAPANESE COMPANY SEMICONDUCTOR SHIPMENTS

(Dollars in Millions - $1 = 300¥)

	1975	1976
Total Semiconductor		
Hitachi	$150	$260
Matsushita	98	210
Mitsubishi	56	116
NEC	199	343
Toshiba	133	236
Fujitsu	47	77
Integrated Circuits		
Hitachi	$ 71	$127
Matsushita	21	59
Mitsubishi	25	41
NEC	105	174
Toshiba	49	90
Fujitsu	36	58
Discrete Devices		
Hitachi	$ 78	$132
Matsushita	71	140
Mitsubishi	31	52
NEC	89	158
Toshiba	77	132
Fujitsu	11	19
Optoelectronics		
Hitachi	$ 1	$ 1
Matsushita	6	11
Mitsubishi	0	1
NEC	5	11
Toshiba	7	15
Fujitsu	0	0

Source: DATAQUEST, Inc.

Table 6

ESTIMATED JAPANESE INTEGRATED CIRCUIT CONSUMPTION

(Percent)

	1971	1973	1977 (Est.)
Computer and Office Equipment	28%	27%	31%
Consumer	60	64	57
Industrial, Communications, and Measurement	12	9	12
Total	100%	100%	100%

Source: MITI
DATAQUEST, Inc.

Table 7

ESTIMATED JAPANESE IMPORTS OF SEMICONDUCTORS
FROM U.S. COMPANIES

Years	Dollars in Millions	Share of Market
1973	$122	9.7%
1974	129	10.0%
1975	102	10.0%
1976	168	9.9%
1977 (9 months)	120	9.0%

Source: SIA
MITI
DATAQUEST, Inc.
U.S. Dept. of Commerce

Table 8

ESTIMATED JAPANESE SEMICONDUCTOR
EXPORTS TO THE U.S.

Years	Dollars in Millions	Share of Market
1973	$20	1.0%
1974	38	1.7%
1975	56	3.1%
1976	54	2.3%
1977 (9 months)	61	3.3%

Source: DATAQUEST, Inc.
MITI
U.S. Dept. of Commerce
Trade

Table 9

ESTIMATED 1976 JAPANESE CAPITAL EXPENDITURES

FOR SEMICONDUCTOR PRODUCTION

	Millions of Dollars ($1 = 300¥)
Toshiba	$ 46.7
NEC	36.7
Hitachi	21.7
Mitsubishi	18.3
Sharp	11.3
Others	20.0
Total Industry	$155.0
Percent of Total Industry Revenues	10.3%

Source: MITI
DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters December 28, 1977

GENERAL INDUSTRY FORECAST

The basic outlook for 1978 U.S. semiconductor shipments remains relatively unchanged from the presentations made at our October 21, 1977, SIS Conference. U.S. factory shipments in 1977 are expected to be about 12 to 13 percent above 1976 levels, and U.S. factory shipments in 1978 are expected to increase about 15 percent over 1977. Quarter-to-quarter growth is still expected to be erratic.

Our general industry forecast has been delayed for two reasons: first, both our forecast in July and our forecast at our October Semiconductor Industry Conference contained an error overstating discrete device shipments and market growth, which is now corrected; second, for timing considerations, our forecast will now be put out at the end of each quarter, i.e., December, March, August, and September.

This is the last industry forecast in which we will estimate U.S. factory shipments. In future forecasts, we will employ U.S. consumption figures. Because consumption does not include devices shipped overseas, it is more closely related to the U.S. economy. In addition, data will be comparable to that reported by the SIA. The cooperation of several industry market researchers has now made adequate historical data available for our regression models.

Given the performance of the U.S. economy, semiconductor shipments in 1977 have been below expectations. Nearly all models of industry demand indicated increases of shipments in 1977 over 1976 considerably higher than the 12 to 13 percent that will actually result. There appear to be several reasons for this:

- The major reason is the lack of economic growth in Europe and Japan. Year-to-year growth in industrial production in Western Europe is flat to slightly down. Industrial growth in Japan this year has been about 2 percent, with rapidly increasing inventories and higher exports. Because these markets are very poor, they affect the decisions of all companies, particularly the large U.S. multinationals having excess capacity abroad. They tend to decrease their worldwide purchases, especially for capital equipment.

- Capital equipment sales have been lower than expected because of the reason cited above, and because of a lack of confidence in U.S. and world economies. At comparable points in past economic cycles, capital spending has been considerably stronger. Apart from the general lack of confidence in future expansion, many companies have postponed investments because of the lack of clear-cut investment payoff due to the regulatory and tax environments.

- The consumer electronics market has been weak all year. Although the TV and automotive markets performed satisfactorily, CB radios and watches have performed extremely poorly. The calculator market also has been sluggish. Overall, semiconductor shipments to the consumer area probably declined in 1977 when compared to 1976.

- For the first time during a period of economic expansion, the pervasiveness of semiconductors in the EDP industry has declined. Computer industry shipments grew faster than shipments of semiconductors to the EDP industry. The reasons for this are not entirely clear, and this trend is not expected to continue. Indeed, recent strong order rates from computer companies have buoyed semiconductor bookings since September.

- There has been a heavy conversion to LSI in 1977, at the expense of small-scale integrated circuits and discrete devices. LSI devices are tremendously lower in cost per function. This indicates that industry use of electronics has increased greatly, but dollar volumes may not have adjusted sufficiently.

Price is one factor that we feel has not affected semiconductor shipments in 1977. Prices, at least for integrated circuits, have been relatively stable—i.e., price declines have been the same as under normal conditions. Increased industry earnings confirm that price erosion has not been excessive, and that costs have declined commensurately.

The U.S. economy continues to remain sound, with growth at a measured pace. The economy certainly is not in a "runaway" situation, nor does it appear to be entering a downturn. The erratic behavior of the economy during the third quarter of 1977 appears to be ended.

- Industrial production has grown steadily, if slowly, for the past few months.

- The GNP grew at about a 5.1 percent annual rate in the third quarter.

- The FRB Index of Leading Indicators has continued to increase rapidly since July, after being flat throughout the second quarter.

- Retail sales continue to be strong.

- The money supply continues to grow slowly in terms of real dollars.

These developments indicate a beneficial climate for the economy and the semiconductor industry in the first half of 1978. The slower growth of the worldwide economy increases the probability that we are breaking out of the recent trend of four-year economic cycles. Indeed, it has been more than four years since industrial production turned down in December 1973, and more than eight years since the downturn of economic growth during the 1960s. The economy remains self-regenerative. In 1978, we expect the economy to be stimulated by increased capital spending and renewed confidence in general.

The economies of Japan and Western Europe, both of which have been performing poorly, remain as major question marks. Industrial production in Western Europe is virtually the same as one year ago and is up no more than 2 percent in Japan. If the governments of Japan and West Germany do not take measures to stimulate their economies, a period of slower U.S. economic growth may occur. We believe these governments will take more stimulative actions.

Semiconductor industry bookings in October and November appear to have been strong, with book-to-bill ratios between 1.1 and 1.2. After a poor summer, bookings picked up at the end of September and have remained strong. Particular strength has come from the computer industry, which is reaping the benefits of price reductions earlier in 1977. The strong bookings have increased optimism for good semiconductor shipments during the fourth quarter of 1977 and the first quarter of 1978. This is in line with the continued improvement of the economy in general. However, real strength in semiconductor bookings from increased industrial capital equipment expenditures may not occur until foreign economies improve. The worldwide economic situation is maintaining capital expenditures at a level below what might be expected at this point in the economic recovery. Inventories of end products, which had been increasing in the second quarter of 1977, have now been worked off and should not further affect semiconductor demand. Component inventory also remains at very low levels.

Our current forecast is shown in Tables 2.1 and 2.2. Semiconductor shipments are expected to continue improving on a quarterly basis throughout 1978. Total industry shipments (U.S. factory sales) are expected to increase in 1978 to about 15.4 percent over 1977. Our econometric model does not give clear indications of quarterly growth rates in 1978, although we expect somewhat greater growth in the fourth quarter of 1977 and the second quarter of 1978, and slower growth in the first and third quarters of 1978. Seasonal factors may accentuate this growth. It is entirely possible that 1978 may be similar to the previous two years, with stronger growth in the first half of the year and slower growth in the second half. In short, good but not great growth is expected.

The limited growth of semiconductor demand has fostered an environment in which the semiconductor industry is not exhibiting extremes:

- Prices remain relatively firm; i.e., they are not declining exceptionally fast, although some specific products have shown weakness due to excessive competition.

- Excess capacity in the semiconductor industry has remained fairly constant, with industry productivity increasing at a rate similar to shipment increases. However, this capacity shows increasing variance among different product lines, with shortages occurring in some MOS LSI products.

- Semiconductor inventories have remained at low levels.

- The industry is at nearly full employment.

As foreseen, heavy capital expenditures by the semiconductor industry this year have not resulted in excess industry capacity. Most expenditures were related to increased automation, cost control, or new technical capability (especially for VLSI), rather than to an increase of overall capacity. Furthermore, many new processes are increasingly wafer fabrication intensive. These wafers require more work to produce, and consequently use up a greater proportion of equipment and capacity. Relative to other industries, the semiconductor industry is still labor intensive, and the ratio of capital costs to labor costs is increasing very slowly.

Yields in the industry, particularly for LSI, have risen very rapidly over the last year. This has caused prices to decline somewhat rapidly for many products. The potential for short-term problems in industry growth before market elasticities take effect should be watched closely. The semiconductor industry is increasingly adept at managing its technical progress, but users of semiconductors often have system restraints that impede their ability to react quickly to that progress.

Frederick L. Zieber
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James F. Riley

Table 2.1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(Dollars in Millions)

	1976	1977	Percent 76 - 77	1978	Percent 77 - 78
Discrete Devices	$1,076	$1,092	1.5%	$1,230	12.6%
Integrated Circuits	1,637	1,969	20.3%	2,302	16.9%
Total	$2,713	$3,061	12.8%	$3,532	15.4%

Source: DATAQUEST, Inc.
December 25, 1977

Table 2.2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

	1977				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$264	$274	$272	$282	$1,092
Integrated Circuits	460	491	497	521	1,969
Total	$724	$765	$769	$803	$3,061
Percent Change From Previous Quarter	2.7%	5.7%	0.5%	4.4%	-

	1978				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Decrete Devices	$289	$302	$311	$328	$1,230
Integrated Circuits	541	569	584	608	2,302
Total	$830	$871	$895	$936	$3,532
Percent Change From Previous Quarter	3.4%	4.9%	2.8%	4.6%	-

Source: DATAQUEST, Inc.
December 25, 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters   November 23, 1977

MOS MICROPROCESSOR SHIPMENTS

Summary

Worldwide shipments of MOS microprocessors were up sharply in the second and third quarters of 1977. DATAQUEST estimates that total MOS microprocessor shipments in the second quarter of 1977 were about 1.2 million units, up 34 percent over the first quarter of the year. We estimate that total MOS microprocessor shipments in the third quarter of 1977 were about 1.8 million units, up 41 percent over the second quarter of this year.

Microprocessor shipment growth is strongest in the 8-bit products, but 4-bit units showed good growth, especially the TMS 1000 family. The last two quarters have been marked by the introduction of several new 8-bit devices. These include the 3870 and 8048 one-chip, 8-bit microcomputers as well as the 6500 8-bit microprocessor. Most of these new introductions are aimed at the low-cost controller and game markets.

Quarterly Microprocessor Shipments

Table 1 shows DATAQUEST's estimates of worldwide microprocessor shipments for the year 1976 and for the first three quarters of 1977. Estimated microprocessor unit shipments in the second quarter were up 34 percent over shipments in the first quarter, and third quarter shipments were up 41 percent over second quarter shipments. We expect that microprocessor shipments in the fourth quarter of this year will also show strong growth.

4-Bit Microprocessors

The 4-bit microprocessor market is currently dominated by Texas Instrument's TMS 1000 family. This family is currently dominated by older PMOS models; however, newer NMOS and CMOS models have been announced and will be available in 1978. We estimate that TI is shipping in excess of 100,000 TMS 1000 units per month. Prices are now in the $2.00 to $3.00 range, but prices as low as $1.60 have been quoted for shipment in the first half of 1978.

Shipments of other 4-bit products (the 4004 family and PPS-4 family) have been level or declining during the second and third quarters of 1977. These older and slower products are expected to be available in quantity for some time to come, however, as they have been designed into many products now in production.

Applications for 4-bit microprocessors continue to grow, and include air conditioners, appliances, beverage dispensers, calculators, cash registers, copying machines, fuel metering devices, games, gas pumps, washers and dryers, and vending machines. The availability of a $2.00 to $3.00 microprocessor as a controller/timer for these applications makes it a popular replacement for older electromechanical timers in an ever-growing variety of applications.

Table 2 presents our estimates of worldwide microprocessor shipments by bit length. An estimated 422,000 4-bit microprocessors were shipped in the second quarter of 1977, up 11 percent over the first quarter of this year. An estimated 500,000 units were shipped in the third quarter of 1977, up 19 percent over the second quarter of this year. We expect similar substantial gains to occur over the coming quarters as additional new devices reach the market, such as the S2000 4-bit microprocessor from AMI currently being sampled.

8-Bit Microprocessors

Shipments of 8-bit microprocessors increased to an estimated 776,000 units in the second quarter of 1977, up 50 percent over the first quarter of this year. They increased to an estimated 1.19 million units in the third quarter, up 53 percent over the second quarter of 1977, as shown in Table 2.

Expanded coverage of the performance spectrum continued with shipments of several new 8-bit microprocessor products in the second and third quarters of 1977. Two notable introductions of 8-bit single-chip microcomputers occurred: the 3870 family from Mostek, with Fairchild and Motorola as second sources; and the 8048 from Intel, with AMD as a second source. The 6500 microprocessor developed by MOS Technology is derived from the Motorola 6800 family. This low-cost microprocessor is aimed at the controller and the games market. It has met with great success in its short lifetime as high volumes are being shipped by three suppliers—MOS Technology, Rockwell, and Synertek. We estimate that some 800,000 units of this new microprocessor will be shipped in calendar 1977. Another 8-bit microprocessor at the low end, which is just being sampled, is the Z8 from Zilog. Production shipments are expected to begin in a few months. The growth of some of the popular 8-bit products is shown in Table 3.

At the high end of the performance spectrum, Intel has introduced the 8085 8-bit microprocessor with a performance capability several times that of the 8080 family. This product is only available in sample quantities at this time.

With the growing number of 8-bit products available and a widening performance range among these products, a growing number of microprocessor market segmentations is emerging. For the purposes of this report, however, we will continue to use a 4-, 8-, and 16-bit segmentation.

Formal second sourcing of microprocessors is becoming increasingly important. Not only does it save on development costs for a new family, but it also provides the customer with the availability of other sources. The 8080 family is now offered by AMD, Intel, National, NEC, and TI; the 6800 family is currently offered by AMI and Motorola; and the F8 family is offered by Fairchild and Mostek. The new 3870 from Mostek will be second sourced by Motorola and Fairchild, while the 8048 from Intel will be second sourced by AMD. This is a healthy situation that will add to the growth and pervasiveness of microprocessors.

Prices for 8-bit microprocessors are generally in the $5.00 to $10.00 range. High volume quantity shipments of the F8 are running at $7.00 to $9.00, while quantity shipments of the 8080 are in the $6.00 to $8.00 range. The 6500 and 6800 are selling in the $8.00 to $10.00 range in quantity. The 3870 is being shipped in low quantities at about $10.00 each, but by the second quarter of 1978, it will be shipped in 5,000-10,000 unit quantities at about $5.00; similar pricing is expected on the 8048.

16-Bit Microprocessors

Worldwide shipments of 16-bit microprocessors increased to an estimated 42,000 units in the second quarter and to an estimated 58,000 units in the third quarter of 1977. The TMS 9900 family from TI still dominates this market segment; 16-bit products from General Instruments and National have not really made significant impact. However, with recent introduction announcements from Intel and Zilog, more products will be coming into this marketplace. Intel has a new 8086 16-bit microprocessor that is software-compatible with the 8080 family, and Zilog is working on a Z8000 16-bit microprocessor.

The 16-bit microprocessor market continues to develop very slowly. It is taking longer than expected for suppliers to complete their peripherals for the 16-bit microprocessors and the new high performance 8-bit microprocessors are giving added strength to the 8-bit market. Many designers still think in terms of the 8-bit microprocessors and consequently very few products employing 16-bit microprocessors have gone into production.

Daniel L. Klesken
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Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS
(Units in Thousands)

Company	MPU Products	Bits	MOS Process	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
AMD	8080A	8	N	67	40	35	45
AMI	6800	8	N	16	14	11	14
Fairchild	F8	8	N	180	100	130	180
GI	CP-1600	16	N	14	6	7	8
Harris	6100	12	C	S[1]	2	3	4
Intel	4004	4	P	340	65	55	50
	8008	8	P	125	30	32	32
	8080	8	N	255	85	100	155
	8048	8	N	0	-	15	30
Intersil	6100	12	C	2	2	3	3
MOS Technology	6500	8	N	0	10	30	80
Mostek	F8	8	N	70	10	25	50
	Z-80	8	N	13	10	65	90
	3870	8	N	0	0	S[1]	5
Motorola	6800	8	N	90	50	80	105
National	4004	4	P	75	20	20	20
	IMP	4	P	49	10	12	15
	8080A	8	N	10	20	35	60
	SC/MP	8	P	100	40	44	50
	PACE	16	P	50	10	15	20
NEC	8080	8	N	42	27	35	42
RCA	1802	8	C	15	25	32	40
Rockwell	PPS-4	4	P	450	145	145	140
	6500	8	N	0	0	5	50
Signetics	2650	8	N	14	5	7	10
Synertek	6500	8	N	0	10	40	80
TI	TMS 1000	4	P	310	140	190	275
	TMS 8080	8	N	65	30	35	40
	TMS 9900	16	N	20	15	20	30
Zilog	Z-80	8	N	5	10	20	30
Total Microprocessors				2,377	931	1,246	1,753
Percent change from previous quarter					18.0%	33.8%	40.7%

[1] S indicates sampling

Source: DATAQUEST, Inc.
November 23, 1977

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF MOS MICROPROCESSORS BY BIT LENGTH
(Units in Thousands)

		1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
4-Bit Products					
Intel	4004	340	65	55	50
National	4004	75	20	20	20
	IMP	49	10	12	15
Rockwell	PPS-4	450	145	145	140
TI	TMS 1000	310	140	190	275
Total		1,224	380	422	500
Percent change from previous quarter			11.8%	11.0%	18.5%
8-Bit Products					
AMD	8080A	67	40	35	45
AMI	6800	16	14	11	14
Fairchild	F8	180	100	130	180
Intel	8008	125	30	32	32
	8080	255	85	100	155
	8048	0	-	15	30
MOS Technol.	6500	0	10	30	80
Mostek	F8	70	10	25	50
	Z-80	13	10	65	90
	3870	0	0	S[1]	5
Motorola	6800	90	50	80	105
National	8080A	10	20	35	60
	SC/MP	100	40	44	50
NEC	8080	42	27	35	42
RCA	1802	15	25	32	40
Rockwell	6500	0	0	5	50
Signetics	2650	14	5	7	10
Synertek	6500	0	10	40	80
TI	TMS 8080	65	30	35	40
Zilog	Z-80	5	10	20	30
Total		1,067	516	776	1,188
Percent change from previous quarter			26.5%	50.4%	53.1%
12-Bit Products					
Harris	6100	S[1]	2	3	4
Intersil	6100	2	2	3	3
Total		2	4	6	7
Percent change from previous quarter			400%	150%	116.7%
16-Bit Products					
GI	CP-1600	14	6	7	8
National	PACE	50	10	15	20
TI	TMS 9900	20	15	20	30
Total		84	31	42	58
Percent change from previous quarter			3.3%	35.5%	38.1%

[1] S indicates sampling

Source: DATAQUEST, Inc.
November 23, 1977

Table 3

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]
(Units in Thousands)

Microprocessors	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
8080	439	202	240	342
F8	250	110	155	230
6800	106	64	91	119
6500	0	20	75	210
Total	795	396	561	901

[1] Numbers in this table include all manufacturers of these types

Source: DATAQUEST, Inc.
November 23, 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletter November 18, 1977

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of several Federal issues that are likely to impact the semiconductor industry. This is the third in a series of newsletters on this subject that DATAQUEST has published. The other newsletters were issued on May 6 and August 16, and cover some of the same issues discussed in this report:

- The current debate on the future of U.S. export controls on critical technologies and keystone products, which involves recent Department of Defense actions and the National Security Council, could profoundly affect the ability of U.S. semiconductor manufacturers to sell products in both Communist and non-Communist markets.

- Concern in Washington continues to mount in light of the projected \$25-\$30 billion trade deficit in 1978. The Office of the President's Special Trade Representative and the U.S. Department of Commerce are concerned about problems affecting the U.S. semiconductor industry but are uncertain about what specific recommendations the industry has to offer.

- The House of Representatives overwhelmingly approves the "Customs Procedural Reform Act" that, among other things, would substantially amend Section 592 of the Tariff Act of 1930. The legislation is almost certain to pass in the Senate next year.

- The outlook for the Domestic International Sales Corporation (DISC) tax deferral program brightens as President Carter's tax reform package is delayed.

Export Controls and Critical Technologies

There is growing debate within the U.S. government over the need for increased control of U.S. exports of "critical technologies" and "keystone" products. This may place a number of high technology exporters, including the semiconductor industry, in a situation where it will become more difficult to export advanced products and technologies to both Communist and non-Communist destinations.

The current focus of the debate is the Department of Defense's recently issued "Interim Policy Statement on the Export Control of U.S. Technology," and the steps the DOD is taking to implement these interim policy guidelines. Later in the year, probably sometime next month, the debate will shift to include a National Security Council study on present export control procedures. NSC is currently surveying 26 Federal agencies to ascertain the effectiveness of present procedures and the problems relating to technology leakage. The result of this study will probably come in the form of recommendations to the President, some of which may have to be acted upon by Congress.

In brief, Defense Secretary Harold Brown's Interim Policy Statement would require a validated export license for "critical technology" and "keystone" product exports to all destinations—not just to the People's Republic of China, the U.S.S.R. and other socialist countries of Eastern Europe.

As explained by Deputy Assistant to the Secretary of Defense (ISA), Dr. Ellen Frost, to a Congressional Committee on October 27, DOD's "primary objective" is to protect U.S. lead time in the application of technology to military capabilities "as long as practical."

Dr. Frost went on to say that:

A. Controls should result in "minimum interference in the normal conduct of commercial trade."

B. DOD will place "primary emphasis" on controlling exports of critical technologies and associated keystone equipment to any country. In doing so, DOD will normally recommend approval of sales of end products where:

   (1) The technology content is either "difficult, impractical, or economically infeasible to extract;"

   (2) The end product by itself will not enhance a potential adversary's military potential, either because of its technological content or because of the quantity to be sold; and

   (3) The product cannot be so analyzed as to reveal U.S. system characteristics and thereby contribute to development of countermeasures.

C. There shall be a presumption for recommending disapproval if the proposed transaction involves "revolutionary" advances in defense-related technology, measured in terms of the receiving country's potential.

D. For end products, recommendations are to be made primarily on the basis of an assessment that the products' "inherent performance capabilities or the quantity to be sold" do not constitute a significant addition to the military potential of the receiving country which would prove detrimental to U.S. national security.

E. End-use statements and safeguards are not to be considered a factor in recommending final disposition of a case.

F. DOD will support the transfer of critical technology to countries in which the United States has a major security interest for such purposes as NATO standardization.

G. In cases where the initial recipient makes unauthorized further transfers or allows compromise of critical technology, the Department of Defense will incorporate its observations of such cases in its assessment of subsequent applications for commercial export, foreign military sales, and similar cases.

H. DOD will maintain a continuously updated list of critical technologies and associated end products.

I. DOD will suggest procedural and other changes to other agencies consistent with these various objectives.

As the first step in implementing this policy statement, DOD last month released a list of some 138 critical technologies for industry review and comment. The Department is currently working on a "keystone" product list, which will be released later. DOD terms its critical technology list a "working draft," and is in the process of reviewing industry and trade association comments on it. Once this has been accomplished, the list will be sent on to the Departments of Commerce and State for further review.

Industry, especially high technology exporters, has been generally critical of recent DOD actions. Various companies have expressed difficulty in preparing comments on the technology list because of the lack of information and criteria for listing specific technologies to be tightly controlled by DOD. Questions have been raised as to whether the listed technologies have, in fact, been "leaked" to the detriment of our national security.

It is also said that both the Commerce and the State Departments are resisting DOD's actions. The State Department is apparently concerned about the reaction of our NATO allies, and both agencies reportedly believe that the new DOD policy would result in more complex export licensing procedures. This, in turn, will result in more delays and backlogs than exist now.

Some of these concerns have already reached Capitol Hill. Late last month, Congressman Jonathan Bingham (D-N.Y.) scheduled a quick hearing to hear from DOD on its actions and its plans. Subcommittees in both the Senate Government Operations and the House International Relations Committees are reportedly giving consideration to hearings next year on the control of technology exports.

With all of these forces interacting, it is difficult to predict the extent to which U.S. export control policy will change in the coming months. However, the situation bears close watching as U.S. high technology firms continue to face increasing competition in both Communist and non-Communist markets. Any additional impediments or restraints on U.S. exporters will further the competitiveness of this situation.

Unfair Foreign Competition

Concern in the Congress and the Administration continues to mount in light of the continuing U.S. trade deficit (approximately $30 billion this year and estimated to be between $25 and $30 billion in 1978), and the resultant loss of jobs and production in the United States. Most of the media's attention has been given to industries that are now in serious trouble; textiles, steel, and television. However, the visit to the nation's capital by several leading executives in the semiconductor industry has not gone unnoticed, at least by some agencies in the government.

Under Secretary of Commerce Sidney Harmon, for example, has apparently taken a personal interest in the growing competitiveness of foreign semiconductor manufacturers, and has asked the National Bureau of Standards to investigate possible U.S. government actions to assist the domestic industry. Reportedly under consideration is the concept of pooled industry research and development to offset alleged subsidies by foreign governments to their semiconductor manufacturers.

Officials at the Office of the President's Special Trade Representative (STR) have also expressed concern over the possibility that the U.S. semiconductor industry is losing its competitive edge and dominant market share both at home and abroad. They view the meeting between STR head Robert Strauss and the delegation from the Semiconductor Industry Association as an "amber light;" a warning that a potential problem exists that should be dealt with now.

The problem is that there has been little followup by the industry with specific plans and recommended actions. STR does not have the staff to do this kind of evaluation, and the Commerce Department will probably flounder without industry guidance and counsel. The industry will also have to find a way to get the Congress interested in its problems. In this regard, it might look at what the steel industry has done in recent weeks. "Steel caucuses" have been formed in both the House and Senate by legislators sympathetic to the industry's trade problems. The House group is the most organized; it has about 70 members now and hopes to get about 150 early next year.

Customs Reform

The House has passed and sent to the Senate legislation (H.R. 8149) that would update many U.S. Customs Service procedures for the processing of imports. This legislation would substantially amend the penalty and fraud provisions of Section 592 of the Tariff Act of 1930.

The house action is the first taken by Congress in 20 years to modify Section 592's penalty provisions, and is the result of over three years of intensive work on the part of the importing community, including the U.S. semiconductor industry.

H.R. 8149 will now go to the Senate Finance Committee, which will not have an opportunity to act on it until next year. The outlook for final approval of H.R. 8149 in 1978 is excellent, however, despite the fact that some isolated complaints remain, particularly with respect to the bill's record-keeping requirements.

As approved by the House, H.R. 8149 would modify Section 592 by establishing a three-tier set of penalties—fraud, gross negligence, and negligence—with various penalty maximums for each level.

Penalties for fraud will not exceed the domestic value of the merchandise (the current penalty level for all violations under Section 592). Grossly negligent violations will carry a maximum penalty of either the domestic value of the merchandise or 400 percent of the duties the U.S. would otherwise lose. If there is no loss of duty, the penalty would not exceed 40 percent of the dutiable value of the importation.

Negligent violations carry a maximum penalty of the domestic value of the merchandise or two times the duties lost, whichever is least. If there is no loss of duty, the maximum penalty would be 20 percent of the dutiable value.

The House-passed legislation also:

1. Allows an alleged violator the opportunity to make representations seeking reduction of a penalty, and assures a violator that he will receive a statement from the Government on its findings of fact and conclusions of law;

2. Establishes penalty levels for voluntary disclosures of Section 592 violations (See DATAQUEST Newsletter dated August 16, 1977);

3. Sets out full <u>de novo</u> review of violations in Federal district courts and establishes separate burden of proof standards for each level of culpability;

4. Establishes a five-year statute of limitation for initiating Section 592 suits, except in cases of fraud;

5. Provides that the judicial review and the statute of limitations provisions will become effective upon the enactment of H.R. 8149. Other amendments will become effective 90 days thereafter.

Because H.R. 8149 not only contains substantial amendments to Section 592, but also would impose new recordkeeping and reporting requirements on all importers, DATAQUEST recommends that all companies carefully study both the bill and the House Ways and Means Committee Report on it (House Report No. 95-621). If we can assist you in obtaining these documents, please let us know.

Domestic International Sales Corporations

President Carter's recent decision to postpone submitting his tax reform package to Congress is generally viewed as a big plus for companies interested in the tax benefits currently being provided by the Domestic International Sales Corporation (DISC) deferral program.

In an option paper submitted to the White House in late September, the Treasury Department recommended that DISC benefits be reduced by 50 percent in 1980 and eliminated for 1981 and subsequent years. In the same paper, the Treasury recommended that deferral of taxes on accumulated untaxed DISC income be continued "as long as these profits are invested in export related assets." Others in government argued that past DISC deferrals should be recaptured and interest paid on them.

Shortly after the Treasury option paper was submitted to the White House, Secretary W. Michael Blumenthal cast doubt on his own agency's recommendation. He said at a press conference, in respect to the elimination of DISC, that any DISC repeal should be considered "in terms of our efforts at the present time to boost exports and to reduce our trade imbalance."

Since that time, a number of members of Congress, including House Ways and Means Committee Chairman Al Ullman and Senate Finance Committee Chairman Russell Long, have cautioned the Administration to "go slow" on the submission of any major tax reform package to Congress. Many observers believe that when the Administration tax package goes to the Hill next year, it will be split into two parts, with the more controversial items, including DISC and other foreign tax issues, in the second part. If this is the case, it is unlikely that any major revision of DISC will occur in 1978.

James F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 11, 1977

MOS MEMORY—4K and 16K SHIPMENTS

Summary

Worldwide shipments of 4K dynamic MOS RAMs in the third quarter of 1977 reached an estimated 15.3 million units. This represents an increase of about 16 percent over the 13.2 million units shipped in the second quarter of 1977. The shift toward 16 pins, plastic packages, and higher speed devices continued in the third quarter.

Demand for the 2102-type 1K static MOS RAM far exceeds available supply, and lead times from some suppliers are now 26 weeks. The 4K static MOS RAM is also in short supply, but lead times are in the 12 to 16 week range. We estimate that 1.3 million 4K static RAMs were shipped in the third quarter of 1977, up 66 percent from an estimated 785,000 units shipped in the second quarter of this year.

Worldwide shipments of the 16K dynamic RAM increased to an estimated 470,000 units in the third quarter of 1977. This represents an increase of about 52 percent over the 310,000 units shipped in the second quarter of this year.

1K Dynamic MOS RAMs

The 1K dynamic MOS RAM market remains relatively stable with Intel remaining the major supplier. Demand for the 1103 is strong and prices remain stable at about $3.00.

1K Static MOS RAMs

The 2102-type 1K static MOS RAM (1K x 1) is currently in extremely short supply with lead times from some suppliers stretching to 26 weeks. This shortage reflects the greater cost effectiveness of the 1K static over the 4K static in many applications, as well as a shipment shortfall by some producers experiencing either production problems or low allocations of wafer starts. We estimate worldwide shipments of 2102s at about 1.3 million units per month. Major producers of the 2102 are AMD, Fairchild, Fujitsu, Intel, National Semiconductor, and NEC. The low power 1K CMOS static RAMs are experiencing good demand as they are designed into more applications such as portable terminals, calculators, and telecommunication devices.

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4K Dynamic MOS RAMs

DATAQUEST's estimates of worldwide 4K dynamic MOS RAM shipments through the third quarter of 1977 are presented in Table 1. We estimate that nearly 15.3 million units were shipped in the third quarter of 1977, up 16 percent over an estimated 13.2 million units shipped in the second quarter of this year. Intel, Mostek, and TI remain the leading producers of 4K dynamic RAMs; NEC and Fujitsu are increasing their shipments on a quarterly basis and now rank fourth and sixth, respectively, in quarterly shipment rates.

Prices of 4K dynamic RAMs are expected to remain relatively stable until the end of the year when many new contracts take effect. High volume quantities of standard 4K dynamic RAMs (100,000-250,000) are currently being shipped in the $2.40 to $2.60 price range with some prices as low as $2.25 per unit. The higher speed 16-pin devices still receive significant price premiums because of capacity limitations.

The shift to the 16-pin 4K dynamic continued in the third quarter. TI shipped an estimated 300,000 of its 16-pin 4027-type 4K dynamic. Plastic packages are now used for some 40 to 60 percent of most producers' 4K dynamic RAM shipments. However, there are exceptions, such as Motorola, which ships all its 4K dynamic RAMs in cerdip packages.

4K Static MOS RAMs

DATAQUEST's estimates of worldwide 4K static MOS RAM shipments are presented in Table 2. We estimate that 1.3 million 4K static RAMs were shipped in the third quarter; up 66 percent over an estimated 785,000 units in the second quarter of the year. The 2114-type is the predominant device and most suppliers now have or are planning their version of it. EMM and Intel are the major suppliers of the fast 4K statics.

Prices are relatively stable in the $7 to $9 range for quantity shipments of 10,000 to 50,000 units. Some aggressive price bidding has been occurring at lower prices, but no major shipments are being made at these prices as yet.

16K Dynamic MOS RAMs

DATAQUEST's estimates of worldwide 16K dynamic MOS RAM shipments are presented in Table 3. We estimate that worldwide 16K shipments were 470,000 units in the third quarter of 1977, up 52 percent over the estimated 310,000 units shipped in the second quarter of this year. Demand far exceeds the available supply, hence prices are remaining relatively stable in the $16 to $20 range until larger supplies become available. A number of suppliers are currently sampling their 16K RAMs, and we expect the number of participants in this market to double by mid-1978, increasing total unit production and adding to price erosion.

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Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
(Units in Thousands)

Company	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
AMD	468	290	450	600
Fairchild	1,485	380	450	550
Fujitsu	715	550	750	800
Hitachi	S[1] 500	25 290	50 360	100 400
Intel	5,225	2,000	2,300	3,000
Intersil	512	240	220	220
Mostek	5,025	2,150	2,600	3,300
Motorola	1,205	540	700	750
National	2,115	825	925	925
NEC	3,740	1,400	1,500	1,600
Signetics	220	180	210	230
TI	7,300	2,300	3,000	3,200
Total	28,010	10,880	13,155	15,275
Percent Change From Previous Quarter		26.1%	20.9%	16.1%

[1] Sampling

Source: DATAQUEST, Inc.
November 11, 1977

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS
(Units in Thousands)

Company	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
AMD	35	30	50	80
EMM	810	400	410	550
Intel	20	40	150	250
Mostek	0	0	15	40
Motorola	0	S[1]	20	45
NEC	0	S[1]	40	150
Synertek	S[1]	15	25	65
TI	S[1]	35	75	120
Total	865	520	785	1,300
Percent Change From Previous Quarter		40.5%	51.0%	65.6%

[1] Sampling

Source: DATAQUEST, Inc.
November 11, 1977

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF 16K DYNAMIC MOS RAMS
(Units In Thousands)

Company	1976 Total	1977 1st Qtr.	1977 2nd Qtr.	1977 3rd Qtr.
Fujitsu	0	0	15	70
Intel	20	55	120	160
Mostek	30	80	160	170
NEC	0	0	15	70
TI	4	3	0	0
Total	54	138	310	470
Percent Change From Previous Quarter			124.6%	51.6%

Source: DATAQUEST, Inc.
November 11, 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 7, 1977

SEMICONDUCTOR MEMORY CONSUMPTION AND MARKET SHARES

Summary

This newsletter is a brief synopsis of an extended section on semiconductor memory which is being published concurrently for holders of the DATAQUEST Semiconductor Industry Service notebooks. Please reference the notebook for additional tables and supporting information.

DATAQUEST estimates that worldwide consumption of semiconductor memory will grow from \$753 million in 1977 to \$1,312 million in 1981. We estimate that worldwide MOS memory consumption will grow from \$558 million in 1977 to \$1,007 million in 1981, which is a compound annual growth rate of 16 percent; and that worldwide consumption of bipolar memory will grow from \$195 million in 1977 to \$305 million in 1981, which is a compound annual growth rate of 12 percent.

The top three producers in the 1976 MOS memory market were Intel, TI, and Mostek, with estimated market shares of 25, 11, and 8 percent respectively. Fairchild, Signetics, and Monolithic Memories were the leading producers of bipolar memory in 1976, with estimated market shares of 25, 16, and 14 percent respectively.

Worldwide Memory Consumption

DATAQUEST's estimates of worldwide semiconductor memory consumption are given in Table 1. Historical information dating back to 1970 is presented since it has not been published elsewhere in our Service. Total semiconductor memory consumption is expected to grow from \$753 million in 1977 to \$1,312 million in 1981, a 14.9 percent compound annual growth rate. MOS memory represents 74 percent of the estimated total market in 1977 and is expected to grow to 77 percent of the estimated total in 1981.

MOS Memory Consumption

DATAQUEST's estimates of worldwide MOS semiconductor memory consumption are presented in Table 2. Historical information dating back to 1970 is presented since it has not been published elsewhere in our Service. Total MOS memory is expected to grow from \$558 million in 1977 to \$1,007 million in 1981, a 15.9 percent compound annual growth rate.

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MOS RAM memory represents 61 percent of the estimated 1977 MOS memory market and 55 percent of the estimated 1981 MOS memory market. Total MOS RAMs are growing at an estimated 12.9 percent compound annual growth rate, with the dynamic RAMs growing at 11.9 percent, and static RAMs growing at 16.2 percent.

ROM and EPROMs, both of which are widely used to store microprocessor program codes, are experiencing good demand. We estimate that the MOS ROM market will grow at a 14.2 percent compound annual growth rate over the next five years, while EPROMs will grow at an 18.9 percent compound annual growth rate from $61 million to $122 million. We do not foresee a large market in EAROMs. CCDs are expected to grow from an estimated $8 million to $120 million over this time frame for a 96.8 percent compound annual growth rate. Shift registers are expected to decline slowly over the next four years to an estimated $18 million in 1981.

Dynamic MOS RAMs

DATAQUEST's estimates of worldwide dynamic MOS RAM consumption are presented in Table 3. Dollar values, unit counts, and average selling prices are presented for the 1K, 4K, 16K, and 64K dynamic MOS RAMs.

We estimate that the 4K dynamic RAM will peak in dollar volume during 1977, whereas the unit volume will peak in 1978. During the 1978-1981 time frame, 16K dynamic RAMs should be growing in unit and dollar volume. We expect to see very limited quantities of the 64K dynamic MOS RAM in 1978; production quantities should follow in 1979.

Prices for dynamic MOS RAMs continue to fall at 30 to 40 percent per year. The 1K dynamic is an exception to this because it is currently a dying market, but there are still many designs incorporating the unit. It should also be noted that there is a range of prices around the average selling price. In 1977, prices on the 4K dynamic have been quoted as low as $2.50 for 250,000 unit quantities; however, they are selling in the $6.00 to $7.00 range for smaller quantities of high speed devices.

Static MOS RAMs

DATAQUEST's estimates of worldwide static MOS RAM consumption are presented in Table 4. We expect the 1K static MOS RAM to peak in unit and dollar volume in 1977. Unit volume on the 4K static should be growing in 1978 through 1980 as the cost cross-over point between 4K and 1K statics occurs sometime in 1978. We expect to see very limited quantities of 16K static in 1978, with production quantities in 1979.

MOS Memory Market Shares

Table 5 gives our estimates of MOS memory market shares for the years 1973 through 1976. Intel has been, and remains, the dominant leader in this market place. In the 1976 MOS RAM market Intel had an estimated $68 million of the $267 million worldwide total. It was followed by TI with $41 million and Mostek with $29 million. Intel still has a very strong 67 percent of the EPROM market, down from 100 percent of the 1974 EPROM market. The ROM market is distinguished by the presence of many suppliers with no single supplier having over 10 percent market share. It should be noted that the ROM market includes both standard masked ROMs as well as special ROMs containing small amounts of I/O circuitry that interface with microprocessor circuits. The category "Other" includes shift registers and CCDs and, again, is marked by a large number of participating firms with only two firms having over a 10 percent share of the market.

Bipolar Memory Consumption

Table 6 gives our estimates of worldwide bipolar memory consumption for the years 1970 through 1981. Bipolar RAMs are expected to grow from $85 million in 1977 to $145 million in 1981, which is a compound annual growth rate of 14.3 percent. Bipolar ROMs and PROMs are expected to grow from $110 million in 1977 to $160 million in 1981 for a compound annual growth rate of 9.8 percent. Bipolar memory is coming under attack from high speed static MOS RAMs in 1977. We expect this competition to continue, which should force bipolar memory to even higher speeds.

Bipolar Memory Market Shares

Table 7 gives our estimates of the bipolar memory market shares. In 1976, Fairchild, Signetics, and Monolithic Memories led the total bipolar memory market, with estimated market shares of $34, $22, and $19 million respectively. In the bipolar RAM market, Fairchild had a dominant $25 million share of the $55 million market, followed by Signetics with $12 million. In bipolar ROMs and PROMs, Monolithic Memories and Harris Semiconductor led the market, with an estimated $18 million and $15 million respectively.

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Table 1

ESTIMATED WORLDWIDE SEMICONDUCTOR MEMORY CONSUMPTION

	Dollars in Millions					
	1970	1971	1972	1973	1974	1975
MOS Memory	$20	$53	$ 97	$157	$280	$295
Bipolar Memory	13	23	39	74	112	98
Total Semiconductor Memory	$33	$76	$136	$231	$392	$393
	Percent of Total					
MOS Memory	61%	70%	71%	68%	71%	75%
Bipolar Memory	39%	30%	29%	32%	29%	25%

	Dollars in Millions					
	1976	1977	1978	1979	1980	1981
MOS Memory	$444	$558	$696	$752	$ 866	$1,007
Bipolar Memory	135	195	230	240	265	305
Total Semiconductor Memory	$579	$753	$926	$992	$1,131	$1,312
	Percent of Total					
MOS Memory	77%	74%	75%	76%	77%	77%
Bipolar Memory	23%	26%	25%	24%	23%	23%

Source: DATAQUEST, Inc.

Table 2

ESTIMATED WORLDWIDE MOS SEMICONDUCTOR MEMORY CONSUMPTION
(Dollars in Millions)

	1970	1971	1972	1973	1974	1975	1976
RAM	$ 2	$13	$40	$ 68	$146	$152	$267
Dynamic	2	13	39	60	97	115	205
Static	0	0	1	8	49	37	62
ROM	8	20	30	50	67	73	88
EPROM	0	0	1	5	17	29	43
EAROM	0	0	0	0	0	0	2
CCD	0	0	0	0	0	1	3
Shift Register	10	20	26	34	50	40	41
Total MOS Memory	$20	$53	$97	$157	$280	$295	$444

	1977	1978	1979	1980	1981	Compound Annual Growth Rate 1977-1981
RAM	$343	$420	$446	$498	$558	12.9%
Dynamic	264	326	338	369	414	11.9%
Static	79	94	108	129	144	16.2%
ROM	103	121	135	160	175	14.2%
EPROM	61	90	96	104	122	18.9%
EAROM	5	8	9	11	14	29.4%
CCD	8	25	41	71	120	96.8%
Shift Register	38	32	25	22	18	(17.0%)
Total MOS Memory	$558	$696	$752	$866	$1,007	15.9%

Source: DATAQUEST, Inc.

Table 3

ESTIMATED WORLDWIDE DYNAMIC MOS RAM CONSUMPTION

	1971	1972	1973	1974	1975	1976
Value (Dollars in Millions)						
1K	$13	$39	$59	$83	$ 70	$ 42
4K	0	0	1	14	45	161
16K	0	0	0	0	0	2
64K	0	0	0	0	0	0
Total Dynamic RAMs	$13	$39	$60	$97	$115	$205
Units (Millions)						
1K	0.9	3.7	8.1	16.6	20.0	14.0
4K	0	0	0	0.7	5.0	28.0
16K	0	0	0	0	0	.05
64K	0	0	0	0	0	0
Average Selling Price						
1K	$15.00	$10.50	$7.25	$5.00	$3.50	$ 3.00
4K	N.A.	N.A.	N.A.	N.A.	$9.00	$ 5.75
16K	N.A.	N.A.	N.A.	N.A.	N.A.	$30.00
64K	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

	1977	1978	1979	1980	1981
Value (Dollars in Millions)					
1K	$ 28	$ 15	$ 10	$ 6	$ 2
4K	204	200	150	117	86
16K	32	110	150	182	182
64K	0	1	28	64	144
Total Dynamic RAMs	$264	$326	$338	$369	$414
Units (Millions)					
1K	11.0	7.0	5.0	3	1
4K	48.0	57.0	50.0	45	38
16K	1.7	10.0	20.0	35	48
64K	0	.02	.8	4	12
Average Selling Price					
1K	$ 2.50	$ 2.20	$ 2.00	$ 1.90	$ 1.80
4K	$ 4.25	$ 3.50	$ 3.00	$ 2.60	$ 2.25
16K	$19.00	$11.00	$ 7.50	$ 5.20	$ 3.80
64K	N.A.	$55.00	$35.00	$16.00	$12.00

N.A.: Indicates that product was not yet introduced.

Source: DATAQUEST, Inc.

Table 4

ESTIMATED WORLDWIDE STATIC MOS RAM CONSUMPTION

	1973	1974	1975	1976	1977	1978	1979	1980	1981
Value (Dollars in Millions)									
1K	$8	$49	$35	$50	$52	$44	$ 38	$ 29	$ 20
4K	0	0	2	12	27	48	48	57	43
16K	0	0	0	0	0	2	22	43	81
Total Static RAMs	$8	$49	$37	$62	$79	$94	$108	$129	$144
Units (Millions)									
1K	0.9	9.6	12.7	25.1	27.1	24.2	23.0	18.0	13.0
4K	0	0	.06	.8	3.0	8.0	10.0	14.0	12.0
16K	0	0	0	0	0	.1	2.0	5.0	12.0
Average Selling Price									
1K	$8.80	$5.10	$ 2.75	$ 2.00	$1.92	$ 1.82	$ 1.65	$1.61	$1.54
4K	N.A.	N.A.	$30.00	$15.00	$9.00	$ 6.00	$ 4.80	$4.10	$3.60
16K	N.A.	N.A.	N.A.	N.A.	N.A.	$18.00	$11.00	$8.50	$6.75

N.A. Indicates that product was not yet introduced.

Source: DATAQUEST, Inc.

Table 5

ESTIMATED MARKET SHARES OF MOS MEMORY PRODUCERS
(Dollars in Millions)

	Total				RAMs				ROMs				EPROM/EAROM				Other (Shift Registers and CCDs)			
	1973	1974	1975	1976	1973	1974	1975	1976	1973	1974	1975	1976	1973	1974	1975	1976	1973	1974	1975	1976
AMD	$ 2	$ 7	$ 11	$ 25	$ 0	$ 1	$ 4	$ 11	$ 0	$ 0	$ 1	$ 2	$0	$ 0	$ 2	$ 6	$ 2	$ 6	$ 4	$ 6
AMI	22	39	32	32	8	23	18	15	4	5	6	8	0	0	0	1	10	11	8	8
EA	3	3	4	6	0	0	0	0	3	3	4	6	0	0	0	0	0	0	0	0
EMM	0	2	7	10	0	2	6	10	0	0	1	0	0	0	0	0	0	0	0	0
Fairchild	3	6	7	18	1	2	4	13	1	2	2	3	0	0	0	0	1	2	1	2
GI	3	4	6	9	0	0	1	2	2	2	3	4	0	0	0	1	1	2	2	2
Harris	1	2	3	5	0	0	1	2	1	2	2	3	0	0	0	0	0	0	0	0
Hughes	2	3	4	5	0	0	0	0	1	2	2	3	0	0	0	0	1	1	2	2
Intel	37	84	85	110	24	57	50	68	4	6	7	9	5	17	25	30	4	4	3	3
Intersil	7	14	12	18	7	13	10	14	0	0	1	2	0	0	0	0	0	1	1	2
Mostek	16	29	22	36	11	23	19	29	3	4	2	5	0	0	0	0	2	2	1	2
Motorola	3	4	5	11	3	2	2	7	0	1	2	3	0	0	0	0	0	1	1	1
National	8	15	19	28	2	3	5	15	4	6	7	6	0	0	2	4	2	6	5	3
Nitron	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
RCA	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Rockwell	9	13	11	9	0	0	0	0	7	10	9	7	0	0	0	0	2	3	2	2
Signetics	1	1	2	4	0	0	0	2	1	1	2	2	0	0	0	0	0	0	0	0
Synertek	0	0	1	4	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0
TI	8	14	23	50	4	8	17	41	1	2	2	4	0	0	0	1	3	4	4	4
Others	19	20	16	17	4	5	5	8	13	14	9	7	0	0	0	0	2	1	2	2
American Companies	$144	$260	$270	$401	$64	$139	$142	$240	$45	$60	$63	$78	$5	$17	$29	$44	$30	$44	$36	$39
Japanese Companies	9	14	20	32	2	4	8	20	4	6	9	8	0	0	0	1	3	4	3	3
European Companies	4	6	5	11	2	3	2	7	1	1	1	2	0	0	0	0	1	2	2	2
Total	$157	$280	$295	$444	$68	$146	$152	$267	$50	$67	$73	$88	$5	$17	$29	$45	$34	$50	$41	$44

Source: DATAQUEST, Inc.

Table 6

ESTIMATED WORLDWIDE BIPOLAR MEMORY CONSUMPTION

	1970	1971	1972	1973	1974	1975	1976
Bipolar							
RAM	$ 9	$16	$28	$36	$ 48	$40	$ 55
ROM/PROM	4	7	11	38	64	58	80
Total Bipolar Memory	$13	$23	$39	$74	$112	$98	$135

	1977	1978	1979	1980	1981	Compound Annual Growth Rate 1977-1981
Bipolar						
RAM	$ 85	$110	$115	$125	$145	14.3%
ROM/PROM	110	120	125	140	160	9.8%
Total Bipolar Memory	$195	$230	$240	$265	$305	11.8%

Source: DATAQUEST, Inc.

Table 7

ESTIMATED MARKET SHARES OF BIPOLAR MEMORY PRODUCERS
(Dollars in Millions)

	Total			RAMs			ROMs/PROMs		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
Fairchild	$ 23	$21	$ 34	$18	$16	$25	$ 5	$ 5	$ 9
Harris	12	10	15	0	0	0	12	10	15
Intel	9	8	9	2	1	1	7	7	8
Intersil	13	8	10	8	5	4	5	3	6
MMI	21	17	19	3	1	1	18	16	18
Motorola	1	1	3	1	1	3	0	0	0
National	2	2	5	1	1	2	1	1	3
Signetics	10	8	22	5	4	12	5	4	10
TI	12	9	16	5	4	6	7	5	10
Others	9	14	2	5	7	1	4	7	1
Total	$112	$98	$135	$48	$40	$55	$64	$58	$80

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters September 30, 1977

MOS MEMORY - 4K AND 16K SHIPMENTS

Summary

Worldwide shipments of 4K dynamic MOS RAMs in the second quarter of 1977 reached approximately 13.3 million units. This represents an increase of about 22 percent over the 10.9 million units shipped in the first quarter of 1977. The shift to 16 pins and higher speed devices continued in the second quarter.

Demand for the 4K static MOS RAMs far exceeds the available supply. We estimate that 820,000 units were shipped in the second quarter of 1977 versus 545,000 units in the first quarter, which represents an increase of about 50 percent over the previous quarter.

Worldwide shipments of the 16K dynamic MOS RAM increased to an estimated 310,000 units in the second quarter, which is up 135 percent from 138,000 units in the first quarter of 1977. NEC and Fujitsu began shipping small quantities in the second quarter, and therefore joined Intel and Mostek who have been shipping since late 1976.

1K Dynamic MOS RAMs

The market for 1K dynamic RAMs remains relatively stable as many designs still incorporate this older device. The 1103 is still the dominant product while a number of fast 1K RAMs also are selling well. Intel and AMI are the major suppliers in this market, and prices are remaining relatively stable.

1K Static MOS RAMs

The 2102-type 1K static (1K X 1) is in extremely high demand in 1977 because the cost crossover point between it and the 4K static has not yet been reached. Most memory manufacturers supply the 1K static and are generally capacity limited. We expect this situation to continue for another six months or so until the crossover occurs. A number of low power CMOS 1K statics are now available and experiencing success in the market. Average selling prices remain in the $1.90 range for all 1K static RAMs.

4K Dynamic MOS RAMs

Table 1 gives DATAQUEST's estimates of worldwide 4K dynamic RAM shipments through the second quarter of 1977. The estimated total of

13.305 million units in the second quarter is up 21.7 percent over an estimated 10.93 million units in the first quarter of 1977. In the second quarter of 1977, the leading producers were TI with 3 million units, Mostek with 2.6 million units, and Intel with 2.3 million units. (Note that Table 1 has been updated since it was last published in our newsletter of June 22, 1977. The 4K statics that were previously included have been removed and are now in Table 2 on 4K statics. The estimates of TI shipments have been revised upward.)

Three Japanese firms—Fujitsu, Hitachi, and NEC—were shipping 4K dynamics in the second quarter to users in Japan, the United States, and Europe. Other Japanese firms are expected to be shipping soon.

Prices continued to decline in the second quarter. Large quantity shipments of standard devices were made at prices in the $3.00 to $3.50 range. Currently, on high volume purchases of 4K dynamic RAMs (100,000 to 250,000 units), prices are running in the $2.50 to $2.75 range for delivery in the fourth quarter of 1977 and the first quarter of 1978. In a few cases, even lower prices have been quoted. The higher speed 16 pin devices continue to receive a significant premium because the suppliers are capacity limited. We expect this premium to diminish as the supply begins to meet the demand.

The shift to the 16 pin 4K dynamic RAM continued in the second quarter. Motorola, TI, and a number of other firms began shipping 16-pin 4027-type devices in the second quarter.

4K Static MOS RAMs

DATAQUEST estimates of worldwide 4K static MOS RAM shipments are shown in Table 2. Note that Electronic Memories and Magnetics Corporation (EMM), which ships only static RAMs, is not shown in Table 1. In the second quarter of 1977, we estimate that seven firms shipped 820,000 units of the 4K static, up 50.4 percent over an estimated 545,000 units shipped in the first quarter of 1977. Most of the new 4K statics are copying the successful 2114 device. To date, only Intel and EMM have high speed 4K statics in the 50 to 90 nanosecond range. We expect that others will be introducing high speed 4K statics in the near future, as the Intel 2147 and the EMM 4402 are in high demand.

Prices are remaining relatively stable on the 4K static. Since demand far exceeds available supply, large quantity prices (10,000 to 50,000 units) are in the $7 to $9 range for the 2114-type device. The 2147 device, being a higher performance unit, is commanding prices in the $17 to $22 price range.

16K Dynamic MOS RAMs

In the second quarter of 1977, we estimate that worldwide shipments of 16K dynamics were 310,000 units, up from 135,000 units in the first quarter of 1977. In the second quarter, NEC and Fujitsu joined Intel and Mostek by shipping small quantities (an estimated 15,000 units each). Several more firms have begun sampling and shipping in the third quarter. TI did not ship any units in the second quarter, as it is currently redesigning its 16K dynamic to more closely match the Mostek specifications. In the second quarter, prices on 16K dynamics were in the $18 to $22 range. Demand far exceeds the available supply of 16K dynamics as mainframe, minicomputer, and terminal manufacturers are rapidly upgrading their memory designs to include the 16K.

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Table 1

ESTIMATED WORLDWIDE SHIPMENTS OF 4K DYNAMIC MOS RAMS
(Units In Thousands)

	1976					1977	
Company	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total	1st Qtr.	2nd Qtr.
AMD	23	105	165	175	468	290	450
Fairchild	290	430	435	330	1,485	380	450
Fujitsu	95	155	205	260	715	550	750
Hitachi	0	0	S[1]	S[1]	S[1]	25	50
Intel	900	1,325	1,500	1,500	5,225	2,000	2,300
Intersil	42	85	190	195	512	240	220
Mostek	600	1,400	1,600	1,425	5,025	2,150	2,600
Motorola	190	180	360	475	1,205	540	700
National	300	480	560	775	2,115	825	925
NEC	575	790	1,100	1,275	3,740	1,450	1,650
Signetics	S[1]	35	65	120	220	180	210
TI	1,400	1,800	2,000	2,100	7,300	2,300	3,000
Total	4,415	6,785	8,180	8,630	28,010	10,930	13,305
Percent Change From Previous Quarter		53.7%	20.6%	5.5%		26.6%	21.7%

[1] Sampling

Source: DATAQUEST, Inc.
September 30, 1977

Table 2

ESTIMATED WORLDWIDE SHIPMENTS OF 4K STATIC MOS RAMS
(Units In Thousands)

	1976					1977	
Company	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total	1st Qtr.	2nd Qtr.
AMD	0	5	10	20	35	30	50
EMM	85	155	240	330	810	400	410
Intel	0	0	0	20	20	40	150
Mostek	0	0	0	0	0	0	10
Motorola	0	0	0	0	0	S[1]	20
NEC	0	0	0	0	0	S[1]	40
Synertek	0	0	0	S[1]	S[1]	40	65
TI	0	0	0	S[1]	S[1]	35	75
Total	85	160	250	370	865	545	820
Percent Change From Previous Quarter		88.2%	56.3%	48.0%		47.3%	50.4%

Source: DATAQUEST, Inc.
September 30, 1977

[1] Sampling

Table 3

ESTIMATED WORLDWIDE SHIPMENTS OF 16K DYNAMIC MOS RAMS
(Units In Thousands)

	1976	1977	
	Total	1st Qtr.	2nd Qtr.
Fujitsu	0	0	15
Intel	20	55	120
Mostek	30	80	160
NEC	0	0	15
TI	4	3	0
Total	54	138	310

Source: DATAQUEST, Inc.
September 30, 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters September 16, 1977

EUROPEAN SEMICONDUCTOR CONSUMPTION

DATAQUEST has accumulated a substantial amount of detail on the European market. This newsletter is intended to present this data and invite feedback from our clients. We provide data on the European economy by country (Table 1); the European semiconductor consumption by product (Table 2), by country (Table 3), and by end user (Table 4); the semiconductor revenues of European companies (Table 5); the semiconductor revenues in Europe of U.S. and Japanese companies (Table 6); and semiconductor revenues in Europe by European, U.S., and Japanese companies (Table 7).

Western European Economy

Within the Western European economy, we include the major industrial countries of England, France, Germany, Italy, and Spain, as well as a number of lesser industrial countries—including Austria, Belgium, Denmark, Finland, Netherlands, Norway, Portugal, Spain, Sweden, and Switzerland. Table 1 presents estimates by the International Monetary Fund for industrial production, real GNP, and the wholesale price index for the Western European economy. The figures for real GNP are expressed as a percentage change of the equivalent U.S. dollars. These GNP growth rates differ from those based on the currency of those countries.

The economy of Western Europe remains somewhat sluggish, with an estimated 5.4 percent real GNP growth in 1977 versus a 7.11 percent compound annual growth for 1970 to 1976. There are a number of economic problems in Europe; the major ones are high inflation rates, high unemployment rates, and erratic levels of industrial production. Although computer and consumer demand for semiconductors remains strong, capital equipment spending has not picked up significantly.

Semiconductor Consumption

Table 2 presents our estimates for European semiconductor consumption. The estimates for 1977 have been lowered from those previously published in Appendix A of the SIS notebook. These lowered estimates reflect the sluggish European economy and the general lack of capital equipment sales in Europe. The European market for semiconductors has been so weak that 1977 is the first year in which total semiconductor consumption should exceed that of 1974.

Table 3 presents our estimate of 1976 semiconductor consumption by country; it emphasizes the fact that the Western European market is

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a conglomerate of many different countries and cannot be considered a single entity. Germany, with 37 percent of the semiconductor consumption in 1976, is the key European market; it consumes more than France and the United Kingdom combined (16 percent and 19 percent, respectively).

Relative to the U.S. semiconductor market, the European market has a much greater emphasis on industrial and consumer markets, and a lesser emphasis on computer and government and military markets (see Table 4). In Europe, consumer applications consume 32 percent of all semiconductors versus 22 percent in the United States. In Europe, television alone consumes 18 percent of total semiconductors, which almost equals the 22 percent of total semiconductors for all consumer applications in the United States. Europe's industrial consumption, at 39 percent of total semiconductors, is even greater than the U.S. consumption for computer applications at 35 percent of the total. Europe's government and military consumption—at 5 percent of total—is less than one third the U.S. total of 18 percent.

European Market Shares

Table 5 presents our estimates of worldwide semiconductor revenues of European based semiconductor manufacturers. These figures include the sales in Europe by these firms, as well as their exports. Table 6 presents our estimated revenues in Europe for U.S. and Japanese semiconductor firms.

Combining Tables 2, 5, and 6, and eliminating the exports of the European firms, yields Table 7. This table presents the estimated revenues in Europe of the European companies, U.S. companies, and Japanese companies expressed both in dollars and as a percent of total. In 1976, U.S. firms captured 52 percent of the European market, European firms had 46 percent of the market, and Japanese firms had 2 percent of the market. The European firms, however, enjoyed 58 percent of the discrete market versus 39 percent for the U.S. firms, while the U.S. firms had 68 percent of the IC market and the Europeans had 31 percent of this market.

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Table 1

WESTERN EUROPEAN ECONOMIC INDICATORS
(Percent Growth)

	Compound Annual Growth Rate 1970-76	Estimated Growth 1976-77
Industrial Production:		
Western Europe	2.65%	4.9%
England	0.66	2.9
France	3.51	6.5
Germany	1.91	8.3
Italy	3.16	5.4
Spain	7.30	2.0
Other	2.46	2.8
Real GNP (in Billions of U.S. Dollars):		
Western Europe	7.11%	5.4%
England	(0.25)	3.5
France	8.97	8.2
Germany	9.74	4.8
Italy	(0.29)	(8.0)
Spain	5.79	6.0
Other	9.87	8.2
Wholesale Price Index:		
Western Europe	9.15%	9.9%
England	14.10	19.7
France	8.18	8.9
Germany	5.87	4.4
Italy	15.42	21.2
Spain	12.07	17.9
Other	8.42	7.3

Source: International Monetary Fund

Table 2

ESTIMATED EUROPEAN SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1974	1975	1976	1977
Total Semiconductor	$1591	$1304	$1521	$1663
Total IC	618	542	659	753
Bipolar Digital	229	180	222	236
MOS	168	158	212	262
Linear	221	204	225	255
Total Discrete	944	728	821	867
Transistor	463	351	401	423
Diode	362	282	303	313
Thyristor	100	82	87	101
Other	19	13	30	30
Optoelectronic	29	34	41	43

Source: DATAQUEST, Inc.
September 1977

Table 3

ESTIMATED 1976 EUROPEAN SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

Country	Semiconductor Consumption	Percent of Total
Austria	$ 24	2%
Belgium	42	3
Denmark	22	1
Finland	21	1
France	243	16
Germany	557	37
Italy	129	9
Netherlands	49	3
Norway	19	1
Portugal	6	<1
Spain	29	2
Sweden	63	4
Switzerland	34	2
United Kingdom	283	19
Total	$1521	100%

Source: DATAQUEST, Inc.
September 1977

Table 4

ESTIMATED END USER MARKETS - 1977
(Percent)

	Western Europe			United States
	Discrete	IC	Total Semiconductor	Total Semiconductor
Computer	14%	36%	24%	35%
Industrial	46	31	39	25
Consumer	35	28	32	22
Television	21	14	18	
All Other Consumer	14	14	14	
Government & Military	5	5	5	18

Source: DATAQUEST Inc.
September 1977

Table 5

ESTIMATED WORLDWIDE REVENUES OF EUROPEAN SEMICONDUCTOR MANUFACTURERS
(Dollars in Millions)

	1975			1976		
Company[1]	Discrete	IC	Total	Discrete	IC	Total
Philips[2]	$200	$ 75	$275	$225	$100	$325
Siemens	96	48	144	110	55	165
Sescosem	60	14	74	n/a[3]	n/a	62
AEG-Telefunken	38	10	48	n/a	n/a	56
SGS	33	23	56	n/a	n/a	51
Silec	20	0	20	20	0	20
Brown-Boveri	16	0	16	16	0	16
Plessey	n/a	n/a	n/a	0	14	14
Ferranti	n/a	n/a	n/a	n/a	n/a	11
Semikron	10	0	10	11	0	11
ASEA	11	0	11	14	0	14
Nortron	10	0	10	n/a	n/a	n/a
RIFA	0	7	7	n/a	n/a	n/a
Bosch	7	0	7	n/a	n/a	n/a
Athom	6	0	6	n/a	n/a	n/a
Eurosil	0	4	4	n/a	n/a	n/a
Other	n/a	n/a	n/a	n/a	n/a	n/a
Total[4]	$510	$198	$708	$567	$235	$802

[1]Includes in-house production and consumption.

[2]Does not include Signetics.

[3]Not available.

[4]Includes others and those companies not estimated.

Source: DATAQUEST, Inc.
September 1977

Table 6

ESTIMATED EUROPEAN MARKET REVENUES
OF FOREIGN SEMICONDUCTOR COMPANIES
(Dollars in Millions)

	1975 Discrete	1975 IC	1975 Total	1976 Discrete	1976 IC	1976 Total
U.S. Companies:						
Texas Instruments	$ 70	$ 90	$160	$ 66	$109	$175
Motorola	63	31	94	72	40	112
ITT	69	20	89	70	25	95
Fairchild	32	13	45	32	24	56
National	2	29	31	3	42	45
Intel	0	30	30	0	45	45
Signetics	0	18	18	0	25	25
RCA	11	29	40	23	15	38
General Instruments	8	8	16	4	15	19
International Rectifier	17	0	17	16	0	16
General Electric	14	0	14	13	0	13
AMD	0	4	4	0	12	12
AMI	0	8	8	0	11	11
Mostek	0	6	6	0	11	11
Westinghouse	n/a[1]	n/a	n/a	10	0	10
Harris	n/a	n/a	n/a	0	8	8
Raytheon (TAG)	7	0	7	8	0	8
MMI	n/a	n/a	n/a	0	7	7
Intersil	0	3	3	0	5	5
Others	21	65	86	22	52	74
Total	$314	$354	$668	$339	$446	$785
Japanese Companies:						
NEC			n/a			5
Toshiba			n/a			10
Hitachi			n/a			11
Others			n/a			9
Total	$ 27	$ 6	$ 33	$ 25	$ 10	$ 35

[1]Not available.

Source: DATAQUEST, Inc.
September 1977

Table 7

ESTIMATED EUROPEAN MARKET REVENUES
(Dollars in Millions)

	1975			1976		
	Discrete	IC	Total	Discrete	IC	Total
European Companies	$421	$182	$ 603	$498	$203	$ 701
U.S. Companies	314	354	668	339	446	785
Japanese Companies	27	6	33	25	10	35
Total	$762	$542	$1,304	$862	$659	$1,521

(Percent of Total)

	1975			1976		
	Discrete	IC	Total	Discrete	IC	Total
European Companies	55%	34%	46%	58%	31%	46%
U.S. Companies	41%	65%	51%	39%	68%	52%
Japanese Companies	4%	1%	3%	3%	1%	2%

Source: DATAQUEST, Inc.
September 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters August 26, 1977

MICROPROCESSOR DEVELOPMENT SYSTEMS

Summary

Microprocessor development systems and other design aids are extremely helpful to the microprocessor user and are participants in the rapidly growing microprocessor market. The total size of the three major components of the microprocessor design aids market—stand-alone development systems, PROM programmers, and evaluation boards and kits—is estimated at $88 million in 1977, growing to $200 million in 1981. Best estimates are that the other miscellaneous markets will not exceed $5 million by 1981. Intel is the leading producer of stand-alone development systems, with an estimated 48 percent of the dollar market in 1976. Motorola and National followed, with an estimated 14 percent and 11 percent share of the dollar market.

Overview

The introduction of microprocessors to the circuit and logic designers of the electronics industry was initially a difficult undertaking. The concept of programmable logic was foreign to most designers; consequently, for the microprocessor to achieve its potential in the electronics industry, a number of education and design aids were introduced. In addition to seminars introducing engineers to the concepts of microprocessors and each manufacturer's products, it was necessary to provide a number of tools by which designers could evaluate various devices, build prototype systems, and write programs for the systems. Furthermore, the programs were to be stored in PROM for use by the microprocessor and thus simple PROM programmers were also introduced.

The evolution of this early system evaluation and development activity has been towards a series of integrated products that enable a supplier to (1) effectively communicate the virtues of his particular processor to the design engineer, and (2) provide a degree of design automation in the writing, debugging, and modifying of microprocessor programs.

Development aids have evolved in two different ways. The initial products, directed to the hardware development lab environment, took the form of a ready-made breadboard which the engineer or technician could use in conjunction with his existing equipment and work methods. Thus, prototype boards or low-cost design aids priced from $200 to

$3,000 comprised the early products offered by the microprocessor suppliers.

As the size of microprocessor-based systems increased and they were applied to more complex applications, software became the primary cost factor and programmers began using traditional software development tools. Initially, this took the form of simulators and cross-assemblers that could be used on commercial time-sharing or a large in-house computer. These techniques became expensive and cumbersome for large projects; as a result, users were soon building systems based on the processor being used for the end product and providing each programmer with his own stand-alone programming station. The sophistication of the programming tools has grown to where the development systems of today are interactive, provide a wide range of software aids, and are very cost-effective—even at a price of $15,000 per station. The complexity of the program development system can now be tailored to the complexity of the processor being used and the specific application.

Available Products

A number of development aids are currently available and are listed below. Stand-alone systems dominate the microprocessor design aid market, but the sales of evaluation boards and kits are important leading indicators of microprocessor chip sales. PROM programmers also maintain an important role in the design of new microprocessor applications.

- Time-sharing—Initial use of assemblers and simulators for various devices was made available to users on the national time-sharing networks such as GE, NCSS, UBC, and McAuto. Terminals consist of Teletypes or other printing terminals. The cost of programming is approximately $20 per hour of connect time.

- Stand-alone Development Systems—These processor-based systems permit the user to interactively write, edit, and debug programs for microprocessors. In most cases the input is by means of a CRT with printers available for program listing. Prices run from $5,000 to $15,000 depending upon sophistication and peripherals used.

- PROM Programmers—This is a specialized area with Data I/O and ProLog supplying virtually all of the programmers used. These systems are priced at about $2,000 and usually contain a microprocessor for control. Some stand-alone development systems also have a provision for PROM programming—either integral or as an option.

- Evaluation Kits—To meet the need for a low-cost method for prospective customers to evaluate their products, chip suppliers provide kits including all necessary semiconductor devices to build a system. Products vary from very simple boards selling for $150 up to sophisticated prototyping systems with assembled and tested boards for $950.

- System Analyzers—These products were introduced by the test equipment suppliers as specialized tools for analysis of complex logic circuits such as microprocessor systems. These logic analyzers permit the designer to view the interaction of program and system by displaying memory locations and register activity. They are helpful in troubleshooting systems during development and in manufacture, and can enable the designer/programmer to be more efficient in program design. Major suppliers are Biomation and Hewlett-Packard. Prices are in the $5,000 range.

- Educational Products—To meet the needs of microprocessor education seminars and classes at universities, a number of chip suppliers have introduced education systems that are somewhere between prototyping boards and development systems in terms of complexity and cost. A typical system has a number of boards including the CPU, a power supply, simple keyboard and display, and instruction books with a sequence of experiments and projects that enable the user to become familiar with the microprocessor and to write simple programs for it. Prices are in the $300 to $1,000 range for assembled products.

Suppliers and Distribution Channels

With few exceptions, the suppliers of development systems are semiconductor manufacturers that view this product as a necessary sales tool to promote use of their particular chip sets.

The leader in the microprocessor market, Intel, is also the leader in development systems. The early Intellec systems have evolved into extremely well-supported CRT-based systems with floppy disc operating systems, printers, and other peripherals, and include high-level language support. An added feature is in-circuit emulation (ICE) which permits the development system to simulate the microprocessor for program development and then to insert the microprocessor in the system for prototype toubleshooting, program debugging, and system checkout. In addition to Intel, AMI, Fairchild, Motorola, National, Signetics, Texas Instruments, and Zilog offer interactive program and system development aids of this type.

A small number of independent suppliers of "universal" development systems have introduced products that allow development on a number of different microprocessors. For the most part, these systems support only the Intel 8080 and Motorola 6800. Suppliers include Microkit, Millenium Systems (rights to this product were recently acquired by Tektronix), muPro, Inc., Ramtek, and Tranti.

The entry of Tektronix into this market indicates the emergence of system development aids as engineering and design tools rather than solely as aids to chip marketing. As a result, the semiconductor companies must reassess their position in this market and either expand the object of development systems to include computer-based design and development systems, or see the market taken over by the instrument suppliers, independents, and Intel. There can be no question as to the importance of development aids to the selection and use of a particular processor family; however, the entry of independents into the market raises the question of whether or not development systems are an independent systems market that should be pursued aggressively by semiconductor suppliers.

Since the primary purpose of the development systems is to aid the customer in the use of semiconductor suppliers' chips and boards, the development aids are generally sold through the same channels as chips. Although direct factory salesmen also sell the development systems and prototype boards, the primary outlet is through distributors who have ready access to the large number of small and first-time microprocessor users and account for a high percentage of units shipped.

Some distributors have set up elaborate "design centers" at their facilities to make the system development tools available to local engineers. In most cases, these centers have not been successful, primarily because the engineer is out of his own environment working in someone else's facilities. As a result, most development systems are sold or rented.

Market Size

The total size of the three major components of the microprocessor design aids market in 1976 was $55.2 million as shown in Table 1. The market is expected to reach $200 million by 1981, a 29.4 percent annual growth rate. Table 2 reflects our estimate of unit shipments. It is difficult to accurately ascertain the size of the market for time-sharing, systems analyzers, and other aids. Best estimates indicate that these miscellaneous markets accounted for less than $2 million total in 1976 and will not exceed $5 million in 1981.

The markets for evaluation boards and kits and PROM programmers should continue to grow in the coming years; however, the growth of both of these areas will be impacted by the increased use of development systems of all sizes which will incorporate in-circuit emulation and PROM programmers.

Table 1

ESTIMATED MAJOR MICROPROCESSOR DESIGN AIDS MARKETS
(Dollars in Millions)

	1976	1977	1978	1979	1980	1981
Stand-alone Development Systems	$41.8	$72.0	$ 94.0	$117.0	$153.0	$175.0
Evaluation Boards and Kits	6.6	7.7	8.6	9.6	10.5	11.5
PROM Programmers	6.8	8.2	9.7	11.4	12.7	14.0
Total	$55.2	$87.9	$112.3	$138.0	$176.2	$200.5

Source: DATAQUEST, Inc.

Table 2

ESTIMATED MAJOR MICROPROCESSOR DESIGN AIDS MARKETS
(Units in Thousands)

	1976	1977	1978	1979	1980	1981
Stand-alone Development Systems	7.4	12.0	14.5	16.7	20.4	21.9
Evaluation Boards and Kits	28.0	32.8	35.8	39.2	42.0	45.1
PROM Programmers	3.5	4.1	4.6	5.0	5.3	5.6
Total	38.9	48.9	54.9	60.9	67.7	72.6

Source: DATAQUEST, Inc.

Market Share

The most vigorous exponents of development systems are the prime sources of the chip sets such as the Intel 8080, the Motorola 6800, the National PACE, the Signetics 2650, the Fairchild F-8, and the Zilog Z-80. Second sources of the 8080 include AMD, National, NEC, and TI, all of which offer only limited development support compared with Intel. Of course, one of the presumed advantages of second sourcing is that much of the product support and software costs can be avoided as this burden is being borne by the prime source. However, until recently it appeared that the market position and support provided by Intel for the 8080 prevented a significant penetration of the chip market by alternate suppliers.

Table 3 provides our estimates of 1976 shipments of development systems by primary suppliers. It should be noted that Millenium Information Systems does not appear in the table because the company sells its development systems on an OEM basis only. Thus, its systems are counted under the share of the OEM such as Signetics and in 1977 Tektronix. Table 4 gives our estimate of market shares in the evaluation board and kit market. The field of PROM programmers has two primary suppliers—ProLog and Data I/O. Estimated market share for PROM programmers is given in Table 5.

Little competition currently exists in the stand-alone development systems market. The semiconductor suppliers are competing for chip sales with the development systems used as their sales aid and marketing support product. Therefore, competition in the "development system market" as such does not exist among chip suppliers.

Currently, the independents are a minor factor in the market; all suppliers are in small, new start-up situations. The affiliation of Tektronix with Millenium Information Systems portends a new dimension of the market, with the traditional suppliers of test equipment and logic analyzers becoming suppliers of systems. The future competition that could develop then is between the general purpose development systems from the independent suppliers and the dedicated systems from the semiconductor suppliers.

Daniel L. Klesken
James F. Riley
Frederick L. Zieber

Table 3

ESTIMATED STAND-ALONE DEVELOPMENT SYSTEM MARKET SHARE 1976

Supplier	Units	Average Selling Price ($)	Value ($) Millions
AMI	120	$10,000	$ 1.2
Fairchild	100	$10,000	1.0
Intel	2,500	$ 8,000	20.0
Motorola	1,000	$ 6,000	6.0
National	2,000	$ 2,200	4.4
Rockwell	100	$ 3,000	0.3
Signetics	150	$10,000	1.5
Texas Instruments	210	$ 4,300	0.9
Zilog	120	$10,000	1.2
Other	1,050	$ 5,000	5.3
Total	7,350	$ 5,700	$41.8

Source: DATAQUEST, Inc.

Table 4

ESTIMATED EVALUATION BOARDS AND KITS MARKET SHARE 1976

Supplier	Units	Average Selling Price ($)	Value ($) Millions
AMI	500	$350	$0.2
Fairchild	1,000	$200	0.2
Intel	3,500	$350	1.2
MOS Technology	8,000	$245	2.0
MOSTEK	500	$297	0.2
Motorola	1,500	$300	0.5
National	10,000	$100	1.0
RCA	1,000	$249	0.3
Rockwell	NIL	–	NIL
Signetics	1,000	$250	0.3
Texas Instruments	–	–	–
Others	1,000	$350	0.7
Total	28,000	$235	$6.6

Source: DATAQUEST, Inc.

Table 5

ESTIMATED PROM PROGRAMMER MARKET SHARE 1976

Supplier	Units	Average Selling Price ($)	Value ($) Millions
Data I/O	2,000	$2,000	$4.0
Prolog	1,000	$2,000	2.0
Others	500	$1,500	0.8
Total	3,500	$1,950	$6.8

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters August 16, 1977

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of several Federal issues likely to affect the U.S. semiconductor industry. Our newsletter of May 6, 1977 discussed some of the same and different issues.

- Customs penalty reform is finally being seriously considered by Congress, providing lower multilevel penalty assessments and judicial relief to importers. However, some undesirable features such as the multiplier penalty would still remain.
- The FTC has released a study on the U.S. semiconductor industry praising its excellent performance and citing, as one reason, the industry's lack of unionization.
- Semiconductor industry complaints on unfair foreign competition have been presented to the Government; industry objectives are aimed toward freer trade and the elimination of protective (and supportive) actions of foreign governments to their local industry. The Commerce Department apparently has now given higher priority to the trade problems of the electronics industry.
- A rapid increase of duty-free watch assemblies into the United States, via the Virgin Islands, may activate a change in the existing U.S. law.
- The Environmental Protection Agency is expected to shortly publish revised rules on imports, deleting chemical reporting requirements on semiconductors.

Customs Penalty Reform Likely

After twenty years of neglect, the House Ways and Means Committee is finally seriously considering Customs modernization and reform, particularly as it relates to the imposition of civil penalties for erroneous importations into the United States.

Following public hearings three weeks ago, the Trade Subcommittee of the House Ways and Means Committee last week approved a bill (H.R. 8149) that would substantially amend Section 592 of the Tariff Act of 1930.

Currently, Section 592 requires the government to assess an initial penalty in the full amount of the domestic value of the items erroneously imported. This is regardless of the source of the components or the degree of culpability involved in the misclassification or erroneous valuation of those items. Application of the statute by the Treasury Department has resulted in some horrendous assessments against U.S. importers.

Sources close to the House Ways and Means Committee have indicated that the proposed legislation amending Section 592 could reach the House floor by September. Such expeditious action, however, does not mean that the legislation will be enacted this year. Assuming passage in the House, the bill would still have to be reviewed by the Senate Finance Committee, approved by the Senate, and signed by President Carter. His recently appointed Commissioner of Customs, Robert Chasen, has expressed some reservations about any far-reaching changes in the government's present authority to assess monetary penalties for violations of Customs law in dollar amounts up to the forfeiture value of the merchandise.

Despite the uncertain outcome this year, proponents of Customs modernization and reform have to be encouraged. This includes the U.S. semiconductor industry that has been under close scrutiny for several years by the government for its importations under Tariff Items 806.30 and 807.00.

H.R. 8149 is the result of an intensive investigation by a special task force of the House Ways and Means Committee into current Customs Service practices and procedures. The task force, headed by Rep. James Jones (D.-Okla.), drafted the legislation after a series of field hearings earlier this year. The bill has the support of the Chairman of the Trade Subcommittee as well as the endorsement of a number of senior Democrats and Republicans on the House Ways and Means Committee. It was also generally endorsed by representatives of a number of industry groups including all of those generally associated with the U.S. electronics industry.

Regarding Section 592, the proposed legislation would require a Customs officer who has reasonable cause to believe that there has been a violation of U.S. Customs law to issue a written notice of his intention to issue a claim for a monetary penalty. That notice must:

1. Describe the merchandise;

2. Specify all laws and regulations allegedly violated;

3. Disclose all the material facts which establish the alleged violation;

4. State whether the violation occurred as a result of fraud, gross negligence, or negligence;

5. State the estimated loss of lawful duties and the amount of the proposed monetary penalty.

Thus, under the provisions of the proposed legislation, an importer who has allegedly committed a violation must be told exactly what that violation was, what the Customs Service's position is regarding his degree of culpability and, of equal importance, be given an opportunity to rebut the allegation before a penalty claim is issued.

The bill would not require an initial penalty assessment to be made in the amount of the full domestic value of the goods in question but would establish a several tier limitation on the dollar amount of penalties which could be assessed by the government.

For fraud cases, the penalty assessment would not exceed the domestic value of the merchandise. For violations resulting from gross negligence, the penalty would not exceed the domestic value of the merchandise <u>or</u> four times the amount of duties owed to the United States. Negligent errors would carry a penalty of two times the amount of underpaid duties, under the proposed legislation. Clerical errors would not be penalized unless "such errors or mistakes establish a pattern of negligent conduct."

Voluntary disclosures of possible violations of Customs law would not be penalized under the proposed legislation provided that such a disclosure "comes prior to, or without knowledge of the commencement of a formal investigation of the violation." Because of the publicly announced intent of the Customs Service to investigate all semiconductor manufacturers with off-shore facilities, it is possible that no company in the industry can take advantage of these provisions.

While a substantial improvement over existing law, the proposed limits in liability do not go as far as some had previously advocated. Last year, for example, a number of importing groups urged the Congress to adopt an IRS approach to Customs penalties. While there was some support for this concept in the Congress, it appeared to be too major a step for the Treasury Department to accept.

Perhaps more important than the statutory limitations H.R. 8149 would impose on monetary penalties associated with Section 592 is the fact that the bill also provides a new form of judicial relief to importers.

Under the proposed legislation, an importer would have the right to go into a Federal district court on all issues associated with the alleged violation, including the amount of the penalty. In cases of fraud and gross negligence, the burden of proof would rest on the United States.

Finally, the proposed legislation would establish a five-year statute of limitations on the imposition of Section 592 penalties unless the violations resulted from an intentional act or omission.

As noted, industry witnesses generally endorsed the provisions of H.R. 8149 during the Ways and Means Committee's hearings two weeks ago. Foremost among the recommended changes in the bill offered by representatives from the electronics industry were:

1. Undisclosed, nonfraudulent violations which surface as a result of a voluntary disclosure should be treated as a part of that voluntary disclosure.

2. Modification in the burden of proof requirements to stipulate that the United States must make a prima facie case in any action based on negligence.

3. Immediate implementation of the sections of the bill relating to judicial review and application of those sections to "any case which has not reached the stage where court action has begun."

4. Use of revenue loss as a base point for calculating penalties wherever possible.

In all, industry criticism of H.R. 8149 was rather muted this year despite the fact that the legislation does contain several features unattractive to industry. Most notable is the multiplier penalty approach, which was strongly criticized by a number of semiconductor industry executives last year when it was first proposed. This year, semiconductor device manufacturers were absent during recent hearings.

FTC Semiconductor Industry Study

The staff of the Federal Trade Commission has concluded that "by any reasonable standard, the performance of the U.S. semiconductor industry has been excellent."

It cites as reasons the industry's "rapid rate of innovation and technological change,...a high rate of expenditures on research and development,...the use of second sourcing (i.e., copying), the mobility of technical personnel, and the relatively low cost and ease of entry into the industry."

Furthermore, the report states: "The ease of starting, ending, or changing new projects may also be explained in part by the fact that they lack the rigidities built into the work rules of many union contracts."

These findings are contained in a Federal Trade Commission staff report entitled The Semiconductor Industry: A Survey of Structure, Conduct and Performance which was prepared in January and recently released. Copies of the report can be obtained by calling the Office of Research and Analysis in the FTC (202) 254-7768.

Semiconductor Industry Views on Foreign Trade

U.S. semiconductor industry executives and the Semiconductor Industry Association (SIA) have often expressed views regarding foreign competition. Recently, a number of U.S. semiconductor industry executives met with senior trade officials in the Carter Administration to discuss the problems associated with "unfair foreign competition." These meetings have received some publicity, but nowhere have the industry's objectives been compiled. DATAQUEST believes these objectives are the following:

- A reduction of foreign import duties to equalize those of the United States;

- The elimination of foreign import quotas and restrictive licensing procedures on semiconductor and computer equipment;

- The elimination of subsidies by foreign governments to non-U.S. semiconductor industry;

- The elimination of export incentives by foreign governments, such as lower interest rates, risk insurance, and extended payment terms;

- The elimination of foreign industry cooperative activities related to U.S. markets and designed to enhance foreign semiconductor exports;

- The elimination of "buy national" programs and policies, and other industry cooperative arrangements in Japan and the EEC, designed to restrict U.S. semiconductor imports;

- The elimination of export quotas;

- The elimination of dumping practices;

- The elimination of government administrative guidance in any form that restricts free trade or infringes on stated policies and procedures; and

- The elimination of special taxes related to imports.

DATAQUEST sources in the U.S. Government indicate that the semiconductor industry's pleas have not fallen on deaf ears, with high priority being placed in the Commerce Department toward resolving the foreign trade problems of the electronics industry.

Watch Imports

An effort is being mounted in the Congress which, if successful, would deny the advantages of duty-free tariff treatment to watches (both conventional and nonconventional) imported into the United States from the Virgin Islands and other insular possessions when those watches contain parts, subassemblies, and assemblies originating in countries which are not eligible for nondiscriminatory tariff treatment.

The cause of concern stems from the rapid growth of shipments of watch assemblies first to the Virgin Islands and then to the United States by the U.S.S.R. According to the U.S. Department of Commerce, such shipments more than quadrupled between 1975 and 1976 (increasing from $400,923 in 1975 to $1,669,788 in 1976). The Department's data indicate that the Soviets shipped almost $1 million in watch assemblies during the first quarter of this year, with about one-half of these recorded as electronic watch assemblies. Meanwhile, direct Soviet shipment of all types of watches into the United States remains negligible, with only 1,000 units valued at $3,265 being recorded in 1976. "It appears clear that the U.S.S.R. has turned to the insular possessions as a means of avoiding duties under the tariff laws of the United States," according to one source following this trend. "By shipping to the Virgin Islands, the U.S.S.R. is able to have the watch assemblies imported into the United States duty free as long as the foreign content is no more than 70 percent of the landed value of the finished product."

The Soviets could bring in up to $7 million dollars worth of watch assemblies virtually free under the provisions of existing U.S. law. Currently, industry sources indicate that the Soviet watch assemblies are entering the Virgin Islands priced at $3.00 to $3.25.

Toxic Substances

The Environmental Protection Agency is expected to publish shortly a revised set of rules designed to implement Section 8 of the Toxic Substances Control Act.

Earlier this year, several U.S. semiconductor manufacturers expressed concern over an original set of rules issued by EPA (originally published in the March 9, 1977, Federal Register) on this subject. The industry's concern stemmed from the fact that the original proposed rulemaking by the EPA was so loosely worded that it would have required any importer to report to the EPA all chemical substances contained in any imported article. Furthermore, the proposed regulations would have specified that no article could be imported into the United States unless each component chemical substance contained in the article was included in an inventory of chemical substances which is even now being compiled by the Federal Government.

Because of its off-shore operations, the U.S. semiconductor industry would have been considered an importer for the purposes of the proposed EPA regulations. As such, it would have been required to analyze and report the chemical content of its products to the EPA as a prior condition to their importation.

After receiving numerous objections from a number of affected industry groups, including the semiconductor industry, the EPA is reportedly going to require only manufacturers of bulk chemical substances or mixtures—and not articles such as semiconductors—to participate in this expensive and time-consuming reporting exercise.

Eben Tisdale

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 29, 1977

GENERAL INDUSTRY FORECAST

Our forecast for U.S. semiconductor sales for 1977 remains relatively unchanged from the previous one (April 20, 1977); U.S. factory shipments are expected to be 19 percent over those of 1976, with somewhat slower growth in the second half of the year. Our forecasts for early 1978 are more optimistic than previously; we expect moderate growth in the first quarter 1978 and an especially strong second quarter.

The U.S. economy continued to remain very strong during the second quarter of 1977. Relatively unaffected long term by the freeze, most major indicators continued to set records throughout the last several months. The following general economic developments during the second quarter are noteworthy:

- Industrial production grew rapidly from February through June; its growth during that period was greater than a 12 percent annual rate.
- Despite record sales of U.S. automobiles and continued inflation, retail sales have shown no increase during the past two months.
- As a result, finished goods inventories, which bottomed out recently, have now begun to grow.
- The European and Japanese economies are still relatively weak compared with that of the United States. The United Kingdom, France, and Italy all have economic problems. Germany's growth has been held at a very slow rate due to structural problems and fears of inflation. The Japanese economy has performed erratically; after a strong first quarter, industrial shipments have declined two months in a row.

These developments indicate the possibility of a slowing of economic growth during the second half of 1977, despite some real strengths in the economy. The alternative, continued rapid growth, creates the possibility of producing a runaway situation with high inflation, which might later result in a downturn. A slowdown—not a recession—might help alleviate the four-year economic cycles that have been prevalent lately. Consequently, a temporary slowdown in economic growth in the United States is not likely to be opposed by business or government.

The possibility of a long period of economic growth (like the one in the 1960s) is quite possible. Currently the economy appears to be self-regenerative. Despite slowing of consumer spending, we expect the economy to be stimulated by increased capital spending (to halt the rapid decline in excess industrial capacity) and renewed confidence in general.

Although capital spending does appear to be somewhat more cautious at this time than in past economic upturns, the spending for electronic equipment (which directly benefits the semicon-

Table 2.1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS

(Dollars in Millions)

	1975	1976	Percent 75-76	1977	Percent 76-77
Discrete Devices	$ 911	$1,076	18.1%	$1,241	15.3%
Integrated Circuits	1,217	1,637	34.5%	1,996	21.9%
Total	$2,128	$2,713	27.5%	$3,237	19.3%

Source: DATAQUEST, Inc.

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Table 2.2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

1976	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	~~$252~~ 267	$269 277	$272 267	~~$283~~ 265	$1,076
Integrated Circuits	~~370~~ 370	412 407	421 420	~~434~~ 440	1,637
Total	~~$622~~ 637	$681 684	$693 687	~~$717~~ 705	$2,713
Percent Change From Previous Quarter	~~12.1%~~ 13.1% 4	~~9.5%~~ 7.4%	~~1.8%~~ 0.5%	~~3.5%~~ 2.6%	—

1977	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$288 264	$307 274	$318 [illegible]	$328 292	$1,241 1092
Integrated Circuits	448 460	488 491	512 ~~[illegible]~~ 497	548 521	1,996 1969
Total	$736 724	$795 ~~[illegible]~~ 765	$830 769	$876 803	$3,237 3061
Percent Change From Previous Quarter	~~3.6%~~ 2.7%	~~8.0%~~ 5.7%	~~4.4%~~ 0.6%	~~5.5%~~ 4.4%	—

1978	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$352	$369			
Integrated Circuits	556	602			
Total	$908	$971			
Percent Change From Previous Quarter	3.7%	6.9%			

Source: DATAQUEST, Inc.

ductor industry) has been less restricted. Most segments of industrial electronic equipment—production control, data processing (mainframes), minicomputers, office equipment, communications, and instruments—have shown increasing market strength. This has provided a major push for semiconductor demand in the second quarter. This demand is expected to last at least through early 1978.

Semiconductor industry bookings in April and May were probably around a book-to-bill ratio of 1.2. Increased semiconductor production and some easing of bookings may have lowered that value in June. The high bookings in the second quarter are partially a result of delayed bookings from the first quarter when extreme caution prevailed due to the uncertain effects on the economy from the freeze in the eastern United States. When it appeared that it would not have deleterious effects, buyers became much less reluctant to make larger or longer-term commitments. However, despite the increased bookings in the second quarter, most orders are still short-term (3 months or less) commitments. Surveys of semiconductor users also indicate that the inventory of components in general, and semiconductors in particular, are still at fairly low levels. However, we believe that inventories of end products have been increasing; this should cause some slowdown in production plans in the second half of 1977, which should in turn cause a slowing of semiconductor bookings growth as production rates are revised.

Our current forecast is shown in tables 2.1 and 2.2. Semiconductor shipments are expected to continue quarter-to-quarter improvements throughout the next four quarters. Total industry shipments (U.S. factory sales) are expected to increase about 19.3 percent above those of 1976. The first quarter of 1977 is estimated to have shown a shipments increase of about 2.6 percent over the fourth quarter of 1976—close to our forecast of 3.4 percent. We believe shipment increases in the second quarter were especially strong (about 8 percent over the first quarter); however, data is not yet available. Our forecast shows some slowing of this growth rate in the second half of the year, but growth will still be at a healthy rate. Although industrial production growth may slow considerably, the continued strength in capital expenditures should maintain somewhat more the momentum in semiconductor demand. We expect this slower growth in semiconductor demand to last through the first quarter of 1978, and stronger growth should resume in the second quarter. However, the results of our econometric model are somewhat ambiguous. Although we expect slower growth initially, with a resumption of more rapid growth later, the timing is not totally clear. It should be emphasized that no downturn is forecast; in short, good but not great growth is expected.

The U.S. economy and semiconductor demand are now relatively normal. However, problems can develop extremely rapidly to affect the forecast scenario. In particular, various factors that might cause either excessive slowing or overheating of the U.S. economy can greatly affect semiconductor demand and should be watched closely.

We see no major problems currently developing in the semiconductor industry:

- Prices are relatively firm; i.e., they are not declining exceptionally fast.
- Although excess capacity in the semiconductor industry has declined considerably, it is still at a reasonable level. Semiconductor demand is undergoing considerable growth, but increases in productivity and investments are keeping pace.
- Semiconductor inventories have grown only slightly, and appear to be at low levels.

Currently, the semiconductor industry is increasing its capital expenditures after being at relatively low levels for some time. TI, Motorola, Intel, National Semiconductor, AMD, and others all have planned large capital expenditures. These increases are not expected to result in excess industry capacity for several reasons: (1) semiconductor demand is increasing; (2) many expenditures are for increased automation to control costs; (3) much equipment is required for the technical capability to manufacture VLSI rather than increase overall capacity.

Traditionally, the semiconductor industry has been labor-intensive and has had a low level of capital investment. Relative to other industries, measurements based on investment per employee or investment per sales dollar rank the semiconductor industry as one of the lowest. But this is changing as the ratio of capital costs to labor costs increases. During the next few years, capital investments by the semiconductor industry are expected to be very high.

We have noted that yields in the industry, particularly for LSI, have risen over the last six months at a rate as fast as or faster than, ever before; this indicates the possibility of continued rapid price decreases. In the long run, of course, those lower prices will result in greater industry growth as market elasticities take effect, but some short-term problems could develop in selected markets if unit growth does not match price drops.

In our last forecast, we mentioned that increased semiconductor production would create increased demands for employees and equipment in the industry; this is proving true. Trained or professional employees are increasingly difficult to find and some equipment deliveries have developed long lead times. Although an easing of growth will likely keep these problems from becoming excessively severe, they are not expected to ease in the near future.

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Figure 27

1978 ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(DOLLARS IN MILLIONS)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	TOTAL YEAR
DISCRETE DEVICES	~~$322~~ 299	~~$337~~ 302	~~$346~~ 311	~~$364~~ 328	~~$1,369~~ 1230
INTEGRATED CIRCUITS	~~531~~ 541	~~558~~ 569	~~573~~ 584	~~597~~ 608	~~2,259~~ 2302
TOTAL	~~$853~~ [illegible]	~~$895~~ [illegible]	~~$919~~ 895	~~$961~~ 936	~~$3,628~~ 3592
PERCENT CHANGE FROM PREVIOUS QUARTER	2.6%	4.9%	2.7%	4.6%	

Figure 28
ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION
(DOLLARS IN MILLIONS)

	1976	1977	1978	1979	1980	1981
TOTAL SEMICONDUCTORS	5,762	6,517	7,592	8,959	10,124	11,643
TOTAL IC	2,936	3,433	4,039	4,812	5,488	6,366
BIPOLAR DIGITAL	903	1,029	1,174	1,357	1,499	1,686
MOS	1,228	1,409	1,715	2,108	2,480	2,960
LINEAR	805	995	1,150	1,347	1,509	1,720
TOTAL DISCRETES	2,546	2,819	3,228	3,744	4,156	4,696
OPTOELECTRONICS	280	265	325	403	480	581

Figure 25

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(DOLLARS IN MILLIONS)

	1976	1977	PERCENT 1976-77	1978	PERCENT 1977-78
DISCRETE DEVICES	$1,076	$~~1,212~~ 1092	~~12.6%~~ 1.5%	$~~1,369~~ 1230	~~13.0%~~ 12.6%
INTEGRATED CIRCUITS	1,637	~~1,931~~ 1969	~~18.0%~~ 20.3%	~~2,259~~ 2303	~~17.0%~~ 17.0%
TOTAL	$2,713	$~~3,143~~ 3061	~~15.8%~~ 12.8%	$~~3,628~~	15.4%

Figure 26

1977 ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(DOLLARS IN MILLIONS)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	TOTAL YEAR
DISCRETE DEVICES	$288	$301	$308	$315	$1,212
INTEGRATED CIRCUITS	448	476	491	516	1,931
TOTAL	$736	$777	$799	$831	$3,143
PERCENT CHANGE FROM PREVIOUS QUARTER	2.6%	5.6%	2.8%	4.0%	

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.12 Texas Instruments July 7, 1977

UPDATE ON TEXAS INSTRUMENTS

Summary

Texas Instruments' semiconductor shipments are forecast by DATAQUEST to be up 20 percent in 1977 (which matches our forecast of 20 percent growth in total U.S. factory shipments). We expect good revenue growth from all major groups and divisions within Texas Instruments. The Consumer Products Group is expected to be up 21 percent, the Digital Systems Division up 27 percent, the Equipment Group up 17 percent, the Materials and Electrical Products Group up 12 percent, and the Services Group up 7 percent. DATAQUEST expects TI's margins to improve slightly over the 5.9 percent of 1976 to approximately 6.1 percent in 1977.

DATAQUEST's major conclusions on Texas Instruments are:

- Texas Instruments' corporate sales are expected to increase 17 percent to $1,945 million, up from $1,659 million in 1976.
- All major divisions and groups are expected to be profitable in 1977.
- Texas Instruments is very well positioned in the consumer electronics market with its calculator and digital watch products.
- Texas Instruments' major investments and growth are expected to be centered in its three major corporate thrusts—semiconductors, consumer products, and distributed computing.

Corporate Analysis

DATAQUEST's estimates of revenues for each of Texas Instruments' major groups or divisions for 1975, 1976, and 1977 are presented in Table 1.

The company has reported that it expects capital expenditures to increase 52 percent to $210 million, up from $138 million in 1976. This large capital expenditure equals 67 percent of TI's net plant, property, and equipment as of December 31, 1976 and indicates a substantial investment in new plant and equipment. We estimate that the Semiconductor Group and Consumer Products Group are recipients of major portions of this $210 million.

Texas Instruments has also reported that its R&D spending in 1977 will increase 31 percent to $94 million from $72 million in 1976; this represents an R&D expenditure of 4.8 percent of estimated total revenues. We believe that TI's three major thrusts—semiconductors, consumer products, and distributed computing—will be major recipients of these R&D dollars. TI's R&D spending has generally been in the range of 4 to 5 percent of sales, whereas most other companies in the semiconductor industry spend 7 to 10 percent of sales on research and development. We believe that TI obtains extremely good value for its R&D expenditures, so that it need invest fewer R&D dollars as a percent of sales. TI probably does not define its R&D expenditures as broadly as other companies do, which could account for a few percentage points difference and thus raise TI's figure on a consistently comparable basis.

Semiconductor Group

DATAQUEST expects the Semiconductor Group's revenues to grow from $669 million to $800 million, a 20 percent increase. Bookings were believed to have been rather weak in January and February. Although they strengthened somewhat in March and April the book-to-bill ratio for the second quarter is estimated to be 1.05 to 1. We believe that this booking weakness is due to TI's losing discrete market share to Motorola and to a sluggish TTL business.

In linear integrated circuits, TI has been very aggressive. TI, National, and Motorola are the leaders in the linear integrated circuits market and TI has been very aggressive in picking up additional new business. The company has added a number of field application engineers during the last six months to enhance its linear sales. Furthermore, TI is double-labeling its products which it had been very hesitant to do in the past; in other words, TI labels its parts with the National or Motorola part number if that happens to be a more popular part number.

The company has recently become very aggressive in the pricing and marketing of its optoelectronics products. DATAQUEST understands that TI has a goal to double or triple its optoelectronics business in the next six months. The company currently has three optoelectronic field applications engineers in the United States and expects to have ten by the end of the year.

In MOS memory, TI shipped 5.7 million 4K RAMs in 1976. We expect that TI will ship in excess of 9 million units in 1977. It is introducing 4K by 1 and 1K by 4 static MOS RAMs during the second and third quarters of 1977. TI does have a 16K dynamic MOS RAM; however, the company is experiencing production problems with it and very limited samples are available in the marketplace. DATAQUEST understands that TI is going back for additional redesign on the 16K devices. The company has not yet become a force in the bipolar memory marketplace although it has been very aggressive in the bipolar PROM market.

TI's microprocessor strategy is beginning to make inroads in the marketplace. TI covers the low-cost, high-volume consumer and control applications with its 4-bit TMS 1000 family of microprocessors. It has a series of more powerful 16-bit microprocessors in its TMS 9900 family for a wide range of applications requiring more computational or control capability than the TMS 1000 family offers. The 9900 family is also software compatible with TI's 990 minicomputer. TI also second sources the Intel 8080, but has not established itself in the large 8-bit marketplace.

The TMS 1000 is beginning to appear in some rather large volume applications. We understand at least two toy manufacturers will be using them in large quantity for this Christmas season. DATAQUEST estimates that TI shipped 140,000 TMS 1000 units in the first quarter, which is up 40 percent over the fourth quarter. We estimate that the company shipped 15,000 TMS 9900 units in the first quarter, up 50 percent over the fourth quarter, as more users are beginning to recognize and appreciate the power of the 9900 family.

Texas Instruments has introduced its 64K CCD and is currently sampling it in small quantities. The company expects to be shipping units in the third quarter. TI began sampling its 92-kilobit magnetic bubble device (MBD) early in 1977. The 92K bit MBD is currently priced at $200; for $250 the MBD is available with a PC board and instructions for building a controller and interface. We expect that TI will be marketing MBDs very aggressively in the coming months. Presently, potential users are evaluating MBDs in their product development labs. However, TI's Digital Systems Division has already introduced two terminals using MBDs for of non-volatile memory. We expect additional commercial and consumer products to be introduced in the coming months using magnetic bubble memories.

Consumer Products Group

DATAQUEST expects TI's Consumer Product Group revenues to increase 21 percent to $315 million, up from $260 million in 1976. The $315 million revenues should be split into $220 million of calculators, $90 million of watches, and $5 million of others (mainly the new CB radios).

Texas Instruments' position in calculators is now secure. It has a broad and solid product line ranging from the low-end consumer models through the scientific hand-held models, to the desk-top scientific and business calculators. At the June Consumer Electronics Show in Chicago, TI showed SR-57, SR-58, and SR-59 models; they are all programmable and have considerable calculating power. The SR-57 is a key programmable calculator with 50 program steps retailing at $79.95. The SR-58 is a key programmable calculator retailing at $124.95, and is substantially more powerful. The SR-59 retails at $299.95 and has both solid state software ROMs and magnetic cards. This machine offers up to 960 program steps with no data locations or the flexibility to trade off program and data storage locations and have 160 program steps and 100 data locations or combinations in between.

We believe that these new calculator introductions by TI will significantly impact the market presently served by competing hand-held programmable calculator models. TI's introductions also have the potential to eventually penetrate the large desktop programmable calculator market.

The SR-59 incorporates a new concept that TI calls "Solid State Software." TI uses plug-in read only memory (ROM) modules to store up to 5,000 preprogrammed steps of software libraries. Previously, the magnetic card stored 224 steps. Going from 224 program steps to 5,000 steps is a 22-fold improvement in program density.

The concept of solid state software was discussed by Mark Shepherd, Jr., Chairman of the Board of TI, at the June NCC Conference held in Dallas. At that time, Mr. Shepherd indicated that solid state software with significant programs stored in ROMs would become increasingly important in the future because it offers the potential for labor-saving in software production. DATAQUEST believes this recent development from TI is quite significant because it makes possible the sale of patented software.

Texas Instruments introduced a broad line of LCD watches at the Chicago show. They are tritium backlighted and retail in the $20 to $35 range. TI's LCD watch unit currently uses the RCA CMOS chip, the Beckman LCD display, and the Motorola crystal. DATAQUEST believes that outside sources for parts were used to bring the product to market sooner, but expects that TI will eventually supply its own CMOS chip and LCD display.

The company's line of LED watches retails in the range of $9.95 to $35.00. TI introduced the $9.95 watch in the second quarter of 1977, upsetting the digital watch market. The $9.95 entry is priced below any of the Timex mechanical watches, so that we believe TI is already picking up market share from Timex. We estimate that the manufacturing cost of the $9.95 LED plastic watch is in the $4.25 to $4.50 range and that TI ships it to the retailer at $7.50, thereby making at least 40 percent gross margin. However, we believe that the low end watch market is still only marginally profitable for TI.

Because until recently TI has apparently not been changing its production schedule to meet fluctuating demand in the consumer market we understand that TI currently has approximately 2.5 million digital watches in inventory. Some 1976 model year watches are believed to be still on retail inventory. We have seen data indicating that in the March time frame 43 percent of the watches selling over $50 were digital whereas 32 percent of the watches selling between $25 and $50 were digital and only 10 percent of the watches under $25 were digital. We believe that as the Christmas season approaches the market will change and and a much larger percentage of the under $25 watches will be digitals. This will benefit both Texas Instruments and Fairchild.

The announcement of TI's CB radio is a very significant event because it marks TI's entry into the personal communications business.

TI has for some time been interested in the personal communications market which it currently estimates at $1 billion. It expects this market to grow to $3 billion by the mid-1980s, and the company intends to be a serious contender.

Although TI has not announced any future products, these products could certainly include items such as cordless telephones, pagers, and eventually private mobile communications. It the company enters the private mobile communications business, it will certainly be competing directly with Motorola. DATAQUEST expects that by approximately 1980 TI will be confronting Motorola in the communications business.

This summer TI is completing the move to Lubbock, Texas of all of the remaining engineering, administration, and marketing functions of its Consumer Products Group. We understand that a number of key people have decided not to make the move and have remained in Dallas; most have found other positions within TI, but a few individuals have left the company.

Digital Systems Division

DATAQUEST estimates that TI's DSD sales will be $140 million in 1977, up 27 percent from $110 million in 1976. This division has two major profit and loss centers—terminals and minicomputers. TI's terminals have been in the marketplace since approximately 1970 and are gaining market share. They are respected for price, technology, and meeting market needs. TI showed two terminals at the recent National Computer Conference using magnetic bubble memories. Additional products such as add-on memory using magnetic bubbles are expected from DSD in the coming months.

TI's minicomputers have been competitive in price and technology, but its software has been substandard compared to the competition. We understand that this situation is improving. TI's 990 minicomputer family is fully software compatible with its 9900 microprocessor. We believe that this is a very important strategy and that it will pay off in the long term. However, in the short term, the 9900 and 990 have experienced limited success.

We understand that this division is actively working on word processing equipment.

Equipment Group

DATAQUEST expects the Equipment Group's revenues to grow to $385 million, up 17 percent from $330 million in 1976. This group has been, and continues to be, solidly profitable. It has a good mix of production and R&D contracts, as well as a good backlog for the future. DATAQUEST expects continued revenue growth and good profits from this group. The four major divisions are the Electro-Optical Division, which manufactures such military products as the FLIR; the Missile and

Ordnance Division, which manufactures missiles such as Paveway, Harpoon, and Harm; the Tactical Weapons Division, which conducts advanced weapons work; and the Radar Division, which manufactures ground and airborne radars. Another major segment is New Business Development, which handles TI's development of the Global Positioning Satellite (GPS).

Materials and Electrical Products

DATAQUEST estimates that this group's revenues will increase 12 percent to $240 million, up from $215 million in 1976. A major product of this group is stainless-steel-clad aluminum used in automotive trim. TI has a patented process which enables it to clad aluminum with a stainless steel finish; this makes it less expensive but attractive and corrosion resistant for automotive trim. We understand that TI is currently production-limited for this product. TI will most likely be allocating capital expenditures to increase its clad metal production capacity.

Services Group

DATAQUEST estimates that the Services Group revenues will increase 7 percent to $160 million, up from $150 million in 1976. Current exploration for oil is still somewhat limited; therefore, DATAQUEST does not expect a particularly large growth from this group.

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Table 1

Texas Instruments Incorporated
ESTIMATED REVENUES
(Dollars in Millions)

Group/Division	1975	Percent Change 1975-1976	1976	Percent Change 1976-1977	1977
Semiconductor Group	$ 537	24.6%	$ 669	19.6%	$ 800
Consumer Products Group	210	23.8%	260	21.1%	315
Digital Systems Division	71	54.9%	110	27.3%	140
Equipment Group	270	22.2%	330	16.6%	385
Materials and Electrical Products Group	195	10.3%	215	11.6%	240
Services Group	145	3.4%	150	6.6%	160
Intracompany Sales	(60)		(75)		(95)
Total Revenues	$1,368	21.3%	$1,659	17.2%	$ 1,945
Total Earnings	$62.14	56.8%	$97.42	21.8%	$118.65
Earnings as a Percent of Sales	4.54%		5.87%		6.10%

Source: DATAQUEST, Inc.
July 1977

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters July 6, 1977

MOS MICROPROCESSOR SHIPMENTS

Summary

Microprocessor shipments continued to grow in the first quarter of 1977. DATAQUEST estimates that first quarter unit shipments were up by 21 percent over fourth quarter 1976. Growth has been concentrated in the 8-bit devices; their unit shipments gained 28 percent over the previous quarter. The units shipments of 4-bit and 16-bit devices were up 13 percent and 3 percent respectively over the previous quarter. A number of single chip microprocessor sets and a variety of peripheral circuits were announced in the first quarter of 1977.

1977 Microprocessor Shipments

Table 1 shows DATAQUEST estimates of microprocessor shipments for 1975, 1976, and the first quarter of 1977 by manufacturer and product type. The total units shipped by the companies reported on have increased by 23 percent between the third and fourth quarters of 1976, and by 21 percent between the fourth quarter of 1976 and the first quarter of 1977. Indications are that shipments in the second quarter of 1977 will be up over the first quarter.

4-Bit Market

Currently Intel, National, Rockwell, and Texas Instruments offer 4-bit microprocessors. TI's TMS 1000 family is rapidly becoming the most popular 4-bit product. TI has recently announced the TMS 2100 which is an NMOS version of the TMS 1100 PMOS device. The new device offers a speed improvement of two or three times over the PMOS version.

Applications for the 4-bit devices vary widely; examples are microwave ovens, appliances, toys, vending machines, pinball machines, scales, and POS terminals. DATAQUEST expects that in the 1977 Christmas season, many toys will incorporate 4-bit microprocessors.

Table 2 shows the estimated MOS microprocessor shipments by bit length. An estimated 385,000 4-bit microprocessors were shipped in the first quarter, up 13 percent over an estimated 340,000 units shipped in the fourth quarter of 1976.

Table 1

ESTIMATED MOS MICROPROCESSOR SHIPMENTS BY COMPANY
(Units in Thousands)

Company	Units	Bits	MOS Process	Year 1975	3rd Qtr. 1976	4th Qtr. 1976	Year 1976	1st Qtr. 1977
AMD	8080A	8	N	10	20	30	67	40
AMI	6800	8	N	5	4	7	16	14
Fairchild	F8[1]	8	N	25-30	70	70	180	100
GI	CP-1600	16	N	-	4	5	14	6
Harris	6100	12	N	-	-	S[2]	S	2
Intel	4004	4	P	250	85	85	340	70
	8008	8	P	200	30	35	125	30
	8080[3]	8	N	60	60	75	255	90
Intersil	2650	8	N	-	S	S	<5	S
	6100	12	C	-	7	11	20	18
Mostek	F8	8	N	5	20	30	70	35
	Z-80	8	N	-	5	8	13	12
Motorola	6800	8	N	45	25	35	90	47
National	4004	4	P	N/A[2]	20	20	75	20
	IMP	4	P	1	12	15	49	10
	PACE	16	P	5-10	15	15	50	10
	SC/MP	8	P	5-10	35	40	100	40
	8080A	8	N	-	2	8	10	12
NEC	8080	8	N	5	10	20	42	27
RCA	1802	8	C	-	S	15	15	25
Rockwell	PPS-4	4	P	450	120	120	450	145
Signetics	2650	8	N	S	4	5	14	5
TI	TMS1000[3]	4	P	50	75[4]	100	310	140
	TMS8080	8	N	1-2	15	25	65	30
	TMS9900	16	N	-	5	10	20	15
Zilog	Z-80	8	N	-	S	5	5	10

[1] 30K in-house, 3rd Quarter; 25K in-house, 4th quarter; 50K in-house, 1st quarter

[2] N/A indicates information not available; S indicates sampling

[3] Family

[4] 75 percent in-house

Source: DATAQUEST, Inc.
July 1977

Table 2

ESTIMATED MOS MICROPROCESSOR SHIPMENTS BY BIT LENGTH
(Units in Thousands)

		3rd Qtr. 1976	Percent Change 3rd Qtr-4th Qtr.	4th Qtr. 1976	Percent Change 4th Qtr-1st Qtr.	1st Qtr. 1977
4-Bit Products						
Intel	4004	85		85		70
National	4004	20		20		20
	IMP	12		15		10
Rockwell	PPS-4	120		120		145
TI	TMS1000	75		100		140
		312	9.0%	340	13.2%	385
8-Bit Products						
AMD	8080A	20		30		40
AMI	6800	4		7		14
FCI	F8	70		70		100
Intel	8008	30		35		30
	8080	60		75		90
Intersil	2650	S		S		S
Mostek	F8	20		30		35
	Z-80	5		8		12
Motorola	6800	25		35		47
National	SC/MP	35		40		40
	8080A	2		8		12
NEC	8080	10		20		27
RCA	1802	S		15		25
Signetics	2650	4		5		5
TI	8080	15		25		30
Zilog	Z-80	S		5		10
		300	36.0%	408	26.7%	517
12-Bit Products						
Harris	6100	-		S		2
Intersil	6100	7		11		18
		7	57.1%	11	81.8%	20
16-Bit Products						
GI	CP1600	4		5		6
National	PACE	15		15		10
TI	9900	5		10		15
		24	25.0%	30	3.3%	31
Total Microprocessors		643	22.7%	789	20.8%	953

Source: DATAQUEST, Inc.
July 1977

8-Bit Market

Total shipments of 8-bit microprocessors were an estimated 517,000 units, up 27 percent over an estimated 408,000 units in the fourth quarter of 1976. Table 3 shows the total shipments of the 8080, F8, and 6800 from all manufacturers. The 8080 continues to dominate the 8-bit marketplace. The 8080 shipments lead the F8 by a ratio of 1.5 to 1 and the 6800 by 3 to 1.

Table 3

ESTIMATED 8-BIT MICROPROCESSOR SHIPMENTS BY TYPE[1]
(Units in Thousands)

Microprocessor	Year 1975	3rd Qtr. 1976	4th Qtr. 1976	Year 1976	1st Qtr. 1977
8080	76	107	158	439	199
F8	30	90	100	250	135
6800	50	29	42	106	61
Total	156	226	300	795	395

[1]Numbers in this table include all manufacturers of these types.

Source: DATAQUEST, Inc.
July 1977

The 8-bit microprocessors are most often used in control applications where the principal function is byte handling rather than computation. The 8-bit devices are used in consumer products ranging from games, appliances, and hobby computers to automobiles. They are also broadly used in instrumentation, process control, and computer peripherals.

An important aspect of marketing a microprocessor is adequate interface and support circuits. The 8080, for example, is supported with a broad line of peripheral interfaces and controllers, which enables it to serve a broad variety of applications. However, because of the great expense in offering a broad line, some manufacturers have chosen to focus their microprocessor marketing efforts on a more narrow segment of the market. This enables them to serve a market with far fewer peripheral circuits.

16-Bit Market

The 16-bit market continues to develop at a much slower pace than the 8-bit market. Total shipments of 16-bit devices were an estimated

31,000 units, up 3 percent over the fourth quarter. Presently General Instruments, National, and Texas Instruments have product offerings in this marketplace. Only TI has shown good growth in the first quarter of 1977 over the fourth quarter of 1976. DATAQUEST understands that TI is having reasonable success in penetrating the marketplace with the 9900 family. Fairchild has not yet sampled the 9440 a 16-bit I^2L microprocessor that emulates Data General's Nova. Furthermore, a suit by Data General against Fairchild for software patent infringements may further delay this product.

The 16-bit microprocessors are primarily used in applications that require moderate to extensive calculations. An important application that is spreading is the computer on a board concept. Moreover, some of the automotive engine control applications are considering the use of 16-bit microprocessors.

CMOS

The CMOS microprocessors offered by Intersil and RCA had substantial gains over the fourth quarter of 1976. Intersil's shipments were up by 64 percent and RCA's were up by 67 percent. It is DATAQUEST's understanding that this rapid ramping in CMOS shipments will continue. DATAQUEST also believes that TI is working on a CMOS version of the TMS 1000 family, which will be introduced in 1978. The growing popularily of the CMOS devices is a result of their low power consumption.

Outlook For 1977

DATAQUEST estimates that 1977 will be a very good year for microprocessor shipments. After the 21 percent gain in the first quarter over the previous quarter, DATAQUEST still expects to see continued quarter-to-quarter gains in shipments. We expect microprocessors to continue their penetration of current applications as well as to uncover new applications. We expect that the toy market will consume a significant number of microprocessors this year. Toys, hobby computers, and automobiles are expected to be major growth markets for microprocessors in 1977 and beyond. Instrumentation and telecommunications are just beginning as significant markets for microprocessors.

Prices continue to decline as production capacities expand. Prices on single chip 4-bit microprocessors used in control and toy applications are now under $4 each. Prices on 8080-type units are in the $8 range in high volume (100,000 unit quantities).

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.02 Fairchild June 24, 1977

UPDATE ON FAIRCHILD

Summary

Fairchild's semiconductor shipments are forecast by DATAQUEST to be up about 19 percent in 1977. For the entire company, three out of four division are expected to report good increases in both sales and profits. These gains are offset by decreased sales and operating losses (estimated at $7 to $8 million in the first quarter) by the Time Products Division of the Consumer Products Group. Fluctuations in Fairchild's profits in the past as well as in the future continue to be determined by the fortunes of the Consumer Products Group. Fairchild can achieve better than last year's earnings if its profit improvement programs in the Consumer Products Group are successful. However, DATAQUEST anticipates that corporate second quarter 1977 profits will be down from the first quarter 1977 on slightly increased revenues.

DATAQUEST's major conclusions on Fairchild are:

- The Consumer Products Group is estimated to have lost money at the rate of about $2.5 million a month in the first quarter. Losses were reduced somewhat in the second quarter. Management plans are for Consumer Products to be profitable in the fourth quarter.

- The remainder of the corporation is believed to have improved its profit margins in 1977. In the first quarter of 1977, DATAQUEST estimates that Fairchild (excluding the Consumer Products Group) shipped $103 million with a pretax profit of $12 million; this is a substantial improvement over 1976.

- All of the semiconductor groups are profitable.

- Fairchild has achieved an impressive market position in LSI testing, including both random access memories (RAMs) and microprocessors.

- The Instrumentation and Systems Group is expected to double its revenues in 1977 to $50 million from revenues of $23 million in 1976. DATAQUEST estimates net profits before taxes (NPBT) for this group of about 20 percent.

Corporate Analysis

DATAQUEST estimates of revenues by each of Fairchild's major business segments are presented in Table 1.

Table 1

Fairchild Camera and Instrument
ESTIMATED REVENUES
(Dollars in Millions)

Division	1975	Percent Change 1975-1976	1976	Percent Change 1976-1977	1977
Semiconductor	$236	30.1%	$307	18.9%	$365
Government and Industrial	35	20.0%	42	19.0%	50
Systems	21	9.5%	23	117.4%	50
Consumer	9	1,055.6%	104 (1)	-42.3%	60 (1)
Intracompany	(10)	230.0%	(33)	-39.4%	(20)
Net Sales	$291	52.2%	$443	14.0%	$505
Royalties	8	-12.5%	7	-14.3%	6
Total Revenues	$299	50.5%	$450	13.6%	$511

(1) 1976 Revenues for the Consumer Products Group include about $25 million in components, including optoelectronics, watch modules and chips. In 1977, these revenues are included in the Semiconductor Groups due to organizational changes at Fairchild. 1977 revenues for the Consumer Group include only time products and video games.

Source: DATAQUEST, Inc.
June 1977

Semiconductor Groups

Revenues for the Semiconductor Groups are expected to increase about 19 percent in 1977 over revenues of 1976. All five semiconductor divisions—Digital Integrated Circuits, Linear Integrated Circuits, Discrete Devices, MOS/CCD Products, and Bipolar Memory Products—are believed to be profitable. This is a considerable improvement from 1975 and 1976.

DATAQUEST estimates for 1977 sales of the Semiconductor Groups are shown in Table 2.

Table 2

Fairchild Camera and Instrument
ESTIMATED 1977 REVENUES—SEMICONDUCTOR GROUPS
(Dollars in Millions)

Components	
Digital IC	$ 90
Linear	75
Discrete	85
Optoelectronics	15
Total Components	$265
LSI	
Bipolar	$ 55
MOS	45
Total LSI	$100
Total Semiconductor	$365

Source: DATAQUEST, Inc.
June 1977

Fairchild's strategy is to separate the semiconductor business into two areas: components, the mature part of the business or "Yesterday's Winners," to generate cash; and LSI or "Tomorrow's Business," whose charter is to generate market share.

The Bipolar Division is expected to grow 50 percent in 1977 to $55 million. This division includes bipolar RAMs, PROMs, MACROLOGIC, ECL (approximately $10 million estimated in 1977), and I^2L (low shipments currently). Fairchild dominates the bipolar RAM market, with more than 50 percent of the market. However, N-channel speed enhancement is a threat to this business.

Concerning the recent lawsuit brought by Data General on the 9440, Fairchild's position is that the software used has been assembled from Nova users and is not proprietary to Data General.

Fairchild is currently involved in the discussions with Mostek regarding a cross-licensing agreement on the 3870 microprocessor. The company is shipping limited quantities of its own version of this device.

The MOS facility at Wappingers Falls is manufacturing at full capacity. MOS manufacturing is currently moving into Fairchild's South San Jose facility. The F8 continues to receive good market acceptance. DATAQUEST estimates that Fairchild shipped 90,000 to 100,000 F8 chip sets during the first quarter of 1977; about 30 to 40 percent of those were used internally. The F8 is doing well in Europe and has been designed into Blaupunkt and Grundig equipment among others. Fairchild's 4K RAM shipments in the first quarter of 1977 were approximately 400,000 units. Shipments are believed to be flat in the second quarter. A faster 4K RAM as well as a second source to the 4027 are being qualified somewhat slower than anticipated. DATAQUEST expects Fairchild to sample 16K RAMs in the third quarter of this year. We understand that the company has prototype devices operating at this time.

DATAQUEST estimates that Fairchild is shipping 400,000 to 500,000 2102s per month at an ASP of $1.00. We understand that Fairchild is currently shipping a few thousand 2708 8K EPROM devices per month. The LSI Division is expected to grow from $60 million to $100 million—a growth of 60 percent.

In the Components Group, Fairchild is experiencing good acceptance of its low power Schottky TTL, with estimated revenues of about $10 million in 1977. These parts (and Motorola's) are faster than Texas Instrument's units and are being chosen for many equipment designs, which is forcing TI to redesign its products. The digital IC group has received a four-year contract to assemble SLT modules for IBM in its Portland plant. Currently, 50 people are receiving training at IBM's facility in Burlington.

In manufacturing, Fairchild has made a commitment to projection alignment with about 12 to 15 units currently installed, and at least that many additional units are on order. The company is directing its E-Beam development toward making masks for VLSI CCD and I^2L circuits. DATAQUEST understands that with E-Beam, substantial progress in yields has been achieved on prototype 64K CCD devices. This should put Fairchild into a very competitive position with this unit.

Intrumentation and Systems Group

This group is one of the least known but most profitable of Fairchild. DATAQUEST estimates of the revenue breakdown for the major segments of this group for 1976 and 1977 are shown in Table 3.

Table 3

Fairchild Camera and Instrument
ESTIMATED REVENUES—INSTRUMENTATION
AND SYSTEMS GROUP
(Dollars in Millions)

	1976	1977
Sentry Testers	$18	$34
XINCOM Testers	3	6
Digital Panel Meters	1	4
Microsystems Division	0.5	4
Memory Systems	0.5	2
Total	$23	$50

Source: DATAQUEST, Inc.
June 1977

DATAQUEST estimates that this group operates at a pretax profit margin of about 20 percent. The strategy of the Instrumentation and Systems Group is to develop leadership in four areas: memory and microprocessor testers where it is well established, and linear IC and printed circuit board testers where it is not established. DATAQUEST perceives that the Instrumentation and Systems Group will achieve linear and printed circuit board testing capability by acquisition. Other tester products such as commodity digital devices, discrete devices, and functional testers (such as watch module testers) are not expected to be pursued by the company. This group has achieved a satisfactory market position in memory testing by the acquisition of XINCOM. In microprocessor and LSI testing (the Fairchild Sentry VI, VII, and VIII), Fairchild has exceeded its expectations and is currently production limited; this should continue into the near future. The MITI VLSI program has ordered 12 Sentry VIII testers with a probable unit price of about $1 million. DATAQUEST estimates that this division had 10 percent of corporate sales for the first quarter of 1977 and about 50 percent of corporate pretax profits.

Consumer Products Group

In 1976 watches and clocks accounted for over an estimated 70 percent of this group's revenues. This year, home video games are expected to account for over half of the group revenues. DATAQUEST perceives that the strategy of Consumer Products Group is to market well-styled watches at prices close to, but not at, the bottom price point. In games, the perceived strategy is the further development of a line of programmable games.

At the June Consumer Electronics Show in Chicago, both Atari and Bally introduced programmable video games with prices equal to or higher than Fairchild. Demand is believed to be sufficient to keep prices for the programmable games firm for 1977. All of these companies should sell this year's production. DATAQUEST estimates that Fairchild will ship 60,000 video games in each of the third and fourth quarters. Fairchild has seven cassettes approved, and four more approvals are expected before the Christmas selling season. DATAQUEST estimates cassette sales at 800,000 to 1,000,000 units at an ASP of $12.00. DATAQUEST game shipment estimates do not include kit sales to several European firms which are marketing the games in Europe. The ROMs for the games are manufactured by the Exetron Division. DATAQUEST estimates that by next Spring, Fairchild will have placed 200,000 units of its video games.

Fairchild's immediate problem with games is not orders, but costs. The console sells OEM for $110, which we believe is currently only marginally profitable. In the third quarter this year, Fairchild is introducing an LSI chip which will replace 35 TTL interface devices as part of its efforts to become more cost competitive.

In watches, Fairchild has been adversely affected by the precipitous price decline to $10 retail for low end LED watches. This was instituted by Texas Instruments and has hurt all watch manufacturers in the industry, including Texas Instruments. DATAQUEST believes that the retail buyers have slowed orders substantially. Fairchild has elected to set its lowest priced watches at $19.95 except for promotion of discontinued units. We believe Fairchild's current production rates are below 50,000 units per month—all with LCD displays. It is DATAQUEST's perception from the Consumer Electronics Show that watch orders will pick up. Fairchild should also benefit from Intel's de-emphasis (wind down) of Microma. In watches, like in video games, Fairchild must substantially reduce costs to make this group profitable again.

DATAQUEST perceives that the following actions by Fairchild will help its Time Products Division profitability:

- A new 100,000 square foot factory is being opened in Hong Kong to fabricate LCD displays (at a savings of 66 percent) and assemble watch cases and watches.

- Fairchild had to use an inventory of cases and crystals during the first and second quarters at costs which were double current market costs.

- Emphasis is on manufacturing and marketing LCD watches, which have higher price points.

- The returns problem (approximately 100,000 units) has been worked through the system.

- Inventories of LED watches have been reduced substantially to an estimated 300,000 to 400,000 equivalent units.

DATAQUEST estimates that the Consumer Products Group (including Optoelectronics) shipped about $13 to $14 million in the first quarter of 1977. We estimate the second quarter revenues will be somewhat below that figure. DATAQUEST believes the Group lost $7 to $8 million in the first quarter, somewhat less in the second quarter of this year, and that losses will continue, although at a reduced level, in the third quarter of this year.

Government and Industrial Groups

These Groups produce products such as imaging systems, gun cameras, electronic counter measure equipment, rear screen projectors, and other related equipment. They are believed to be solidly profitable and have a positive cash flow. We anticipate a reasonable increase in both revenues and profits for both division of this group.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters June 22, 1977

MOS MEMORY—4K AND 16K SHIPMENTS

Summary

DATAQUEST estimates that 4K MOS RAM shipments will grow from 27.2 million units in 1976 to approximately 50 million units in 1977—an 84 percent growth. The 4K shipments in the first quarter of 1977 reached 11.135 million units—an increase of 29 percent over the 8.6 million units shipped in the fourth quarter of 1976. The shift toward the 16-pin device continued in the first quarter as well as the shift toward the faster devices. Demand for static 4K MOS RAMs is growing rapidly and greatly exceeds the available supply.

In the first quarter of 1977, an estimated 113,500 16K dynamic MOS RAMs were shipped. Only Mostek and Intel shipped any significant quantity in the first quarter; others had production problems or were just beginning to sample 16Ks. During the second and third quarters, production devices are expected to be available from a number of other firms.

1K Dynamic MOS RAMs

The unit volume of 1K RAMs continues to decline from its peak in 1975. DATAQUEST estimates that 14 million 1K dynamic MOS RAMs were shipped in 1976 and that 11 million units will be shipped in 1977. The 1103 device is still the dominant product in the 1K RAM market. However, unit prices continue strong because there is little price elasticity and a limited number of suppliers for this product. The fast 1K dynamics remain popular as there are still many designs that incorporate them. Consequently, the market for fast 1K dynamics is expected to remain stable for a few more years.

1K Static MOS RAMs

DATAQUEST estimates that 1K statics will peak out in 1977 at 27 million units, up slightly from 25 million units in 1976. The 2101- and 2102-types will account for the majority of the unit volume in 1977, with a small quantity of special fast or low-power 1K RAMs being shipped this year. Low-power CMOS 1K statics, available from several sources, are experiencing good demand. Average selling prices (ASPs) of 1K statics are expected to remain rather flat, declining just slightly from $2.00 in 1976 to $1.90 in 1977. However, this $1.90 is an average over several different types; some prices range as high as $7.00 for the special units.

Table 1

ESTIMATED 4K MOS RAM SHIPMENTS
(Units in Thousands)

Company	1976 1st Qtr.	1976 2nd Qtr.	1976 3rd Qtr.	1976 4th Qtr.	1976 Total	1977 1st Qtr.
TI	1,000	1,400	1,550	1,750	5,700	2,100
Intel	900	1,325	1,500	1,500	5,225	2,000
Mostek	600	1,400	1,600	1,425	5,025	2,150
NEC	575	790	1,100	1,275	3,740	1,450
NSC	300	480	560	775	2,115	825
Fairchild	290	430	435	330	1,485	380
Motorola	190	180	360	475	1,205	540
EM&M[1]	85	155	240	330	810	400
Fujitsu	95	155	205	260	715	550
AMS	12	55	160	195[2]	512[2]	240[2]
Intersil	30	30	30			
AMD	23	110	175	195	503	320[3]
Signetics	S[4]	35	65	120	220	180
Total	4,100	6,545	7,980	8,630	27,255	11,135

[1]100 percent of shipments are static RAMs

[2]Figure reflects merger of Intersil and AMS

[3]10 percent of first quarter shipments are static RAMs

[4]Sampling

Source: DATAQUEST, Inc.
(June 21, 1977)

4K Dynamic MOS RAMs

Table 1 gives DATAQUEST's estimates of 4K MOS RAM shipments in the first quarter of 1977. The total of 11.135 million units in the first quarter is up 29 percent over an estimated 8.63 million units shipped in the fourth quarter of 1976. In the first quarter of 1977, Mostek took the lead from TI as the volume producer of 4K RAMs. Mostek and TI are followed closely by Intel and NEC. (Note that DATAQUEST has reduced its estimates of TI's 4K RAM shipments in 1976 to 5.7 million units.) Although the unit shipments of Mostek, TI, and Intel are very close, DATAQUEST estimates that the dollar revenues of Mostek and Intel greatly exceed those of TI because of different ASPs.

Fujitsu began shipping 4K RAMs to the United States in the first quarter of 1977; approximately half of its first quarter shipments went to the United States. This steep increase in Fujitsu's rate of shipments brings it from ninth place in 1976 to sixth place in the first quarter of 1977. DATAQUEST understands that Fujitsu's products are being well received in the domestic marketplace.

Prices continued to decline in the first quarter of 1977. High quantity purchases of standard lower-speed devices were in the $3.50 to $3.75 range. Prices for the higher-speed 16-pin devices, however, are commanding a premium of 20 percent or more.

The 16-pin 4027 4K RAM from Mostek is now an industry standard for 4K RAMs. DATAQUEST perceives a continuing shift toward 16 pins away from 18 and 22 pins; most manufacturers are expected to be represented in the 16-pin configuration. TI, National, and AMD are the major 18-pin device suppliers in a fairly stable market. For 22 pins, major suppliers are TI, Intel, NEC, and AMD. We estimate that more than 90 percent of NEC's production is at 22 pins and about half of TI's production is at 22 pins. In the first quarter, TI's production was split between 18 and 22 pins, but it is introducing a 16-pin 4027-type device.

4K Static MOS RAMs

The 4K static RAM was first introduced in early 1975 by EM&M which was the only source until the second half of 1976, when AMD began shipping its 4K static devices. In the second quarter of 1977, Intel, Mostek, NEC, Signetics, and TI began shipping 4K statics. Shipments of 4K static RAMs are increasing monthly and DATAQUEST estimates that 3 million units will be shipped in 1977, up 275 percent from 800,000 units in 1976.

The Intel 2114 static RAM is proving popular because of its similarity to the 2102 1K static RAM and the large number of other sources. The Mostek 4104 is popular because of its low power, but it currently lacks a second source. The Mostek 4104 dissipates 125 milliwatts maximum in the standby mode versus 710 milliwatts for the standard 2114 device.

The 4K statics are available in 1Kx4 and 4Kx1 organizations. The 1Kx4 is finding good acceptance in microprocessor systems and other small memory systems. The 4Kx1 static is being designed into larger memories such as add-on memory systems. Currently, demand exceeds available supply; thus, there has been relative price stability. Quantity prices are in the $7 to $10 range versus the $10 to $12 range in 1976.

16K Dynamic MOS RAMs

In the first quarter of 1977, an estimated 113,500 units of 16Ks were shipped. Intel and Mostek were the only major producers of 16Ks in the first quarter. Mostek shipped 75,000 units and Intel shipped an estimated 37,500 units, while TI is believed to have shipped fewer than 1,000 units. TI was still experiencing production problems, which prevented it from achieving any significant unit volume.

During the first quarter, 16K samples were shown by several suppliers. Others are sampling their 16K RAMs in the second quarter and increased production should be available in the second, third, and fourth quarters of the year. DATAQUEST currently estimates that 2.2 million units will be shipped in 1977 at an average selling price of $17—for $37 million of revenues.

In the first quarter, prices on the 16K were in the $35 to $45 range, but by year-end the 16K is expected to be available at $12 to $16 in high volume.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters May 6, 1977

GOVERNMENT ISSUES AFFECTING THE SEMICONDUCTOR INDUSTRY

Summary

This report provides a brief analysis of the following six specific state and federal issues likely to impact the U.S. semiconductor industry in 1977.

- Items 806.30 and 807 of the U.S. Tariff Schedule allow U.S. semiconductor companies to assemble devices abroad, paying tax only on the value added. Organized labor has been lobbying for a repeal, and its strength has been increasing. The Items do not currently appear in jeopardy (though several factors could rapidly change this situation).

- Customs penalties imposed by the Customs Service are due to the unfortunate applications of an archaic statute. These outrageously high penalties would be modified by new legislation now drafted. However, Treasury Department opposition could halt approval.

- Unfair foreign competition—through dumping, subsidies, and other methods—is an increasingly sensitive issue to the semiconductor industry. Dumping is difficult to prove, and redress through countervailing duties is cumbersome. Contact between U.S. and foreign representatives may be the best approach to desensitize this issue while it is still in its embryonic stage.

- Trade barriers in Europe and Japan impede the semiconductor industry's objective of an open and free world market. High duties, import licensing, and others restrict semiconductor trade. A resolution, however, is likely to be compromised in negotiation by consideration of other industries, unless the semiconductor industry presents its case persistently and persuasively.

- Energy—Rolling blackouts under the California Public Utilities Commission's emergency energy plan could cause extensive hardship within the semiconductor industry. Under current drought conditions, they are a possibility, although remote. Other alternatives are being considered.

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- The current bid for increasing digital watch duties five-six times appears to be losing support. However, the issue is still alive and currently rests with the International Trade Commission.

Items 806.30 and 807, U.S. Tariff Schedules

Special Tariff Items 806.30 and 807 are the core of the industry's internationally integrated operations; moreover, they are an underlying cause for many of the industry's legislative and regulatory problems.

Background

Tariff Items 806.30 and 807 basically allow American manufacturers to (1) produce parts domestically, (2) ship them abroad for assembly or processing, and (3) return them to the United States for final assembly and testing while paying duty only on the value added abroad. In the late 1960s, these items were challenged by organized labor leaders, who argued to Congress that they were a tax loophole and served as a catalyst for the export of U.S. jobs and American capital.

The semiconductor industry has been labor's major opponent on this issue during the past ten years. In brief, the industry argued that offshore operations have made it possible for the industry to be competitive in world markets; consequently, domestic employment has been favorably and significantly influenced. Industry spokesmen have also pointed out that the cost-reducing features of these tariff items have contributed to the industry's ability to maintain research and development budgets at a high level. This is an important consideration, since most major foreign competition has similar tariff provisions available; furthermore, in many instances, direct government subsidies are available to support research and development.

Outlook

Last year was a critical one for the semiconductor industry in its efforts to avoid the repeal of Items 806.30 and 807. For the first time, a Congressional Subcommittee approved a bill to repeal these items (albeit for a single industry—textiles). The fact that this bill did not directly impact the semiconductor industry or that it never went to the House floor should not obscure two of the following significant developments that should be of continuing concern to the semiconductor industry. The first relates to the fact that organized labor finally directed its efforts toward a particular industry in its repeal efforts—in this case, the textile industry. Once this occurred, labor had the capability to begin to actually move a bill. The consensus is that the semiconductor industry will be subject to this same action once the case involving the textile industry is over. Secondly, the fact that a bill was actually approved will probably make it easier for labor to acquire votes the next time around.

The next time around, however, does not appear to be this year. While there have been at least seven bills introduced in the Congress to repeal these items, sources close to the Ways and Means Committee have indicated that no hearings have been scheduled on this issue. It appears that the Carter Administration would prefer not to become involved in such an esoteric and controversial subject at this early stage of the President's term. This is evident as a result of Carter's recent decision not to impose higher import duties on footware shipped from Korea and Taiwan, as had been recommended by the AFL-CIO.

There are two factors that could change this situation rapidly. The first is the appointment of the new chairman of the Trade Subcommittee of the House Ways and Means Committee, Rep. Charles Vanik (D-Ohio). Vanik has been known to be sensitive to labor in the past and he has the power to schedule hearings on this issue. The second relates to a study of 806.30/807 by the staff of the International Trade Commission completed last year for the Ways and Means Committee. This study has not been made public, but if the staff's findings differ substantially from the Commission's 1970 report, labor could use it as a major impetus to renew its campaign for repeal.

Customs Penalties

Section 592 of the Tariff Act contains the civil penalty provisions governing importations into the United States that have created strains in numerous electronics companies. An industry spokesman once said the 50-year-old Act had been enacted to serve as a deterrent to "smugglers, rumrunners, and other nefarious characters." Unfortunately, the archaic statute is currently being applied to modern business transactions, including those of the semiconductor industry, which conducts literally hundreds of thousands of importations a year. There is a good chance of the Act becoming modified during this session of Congress.

Background

Under existing law, each semiconductor manufacturer importing under Items 806.30 and 807 faces a situation in which the initial penalty assessed for an erroneous entry must be in the full amount of the domestic value of the goods; this is the case regardless of the source of the components or the degree of culpability in the misclassification or erroneous valuation under these items. Outrageously high penalties have already been imposed on these firms: Standard Kollsman, $42.5 million; Control Data, $45 million; and Electronic Memories and Magnetics, $110 million. Even though the initial penalty may be mitigated at a later date, the mere issuance of a penalty notice can have a devastating effect on a publicly-held company, since it must make a disclosure to its stockholders of the contingent liability.

During recent years, the semiconductor industry has been particularly concerned with the harshness of Section 592 for the following three reasons. First, obviously, are the extremely high penalties that can be imposed. Secondly, the industry has been subjected to closer scrutiny than most as a result of the Customs Service's intent to investigate every semiconductor manufacturer that claims duty exemptions under Items 806.30 and 807. Finally, the industry is concerned because it is aware that precise compliance with the requirements of these items has been extraordinarily difficult.

During the last session of the Congress, the Trade Subcommittee of the House Ways and Means Committee scheduled hearings on the question of Section 592 and a related issue—the so-called Customs Modernization Act. The latter was a bill introduced at the request of the Treasury Department; one of its purposes was to "insure compliance with Customs laws through modern audit techniques so that more thorough and equitable application of such laws can be enforced." The Modernization Act did not propose any change in Section 592.

Last year's hearings produced both consensus and chaos. The consensus was that Section 592 was archaic and should be changed; however, just how the section should be changed was not determined. There was little agreement among those testifying in this regard. Even within the semiconductor industry, there was disagreement as to what should be done to modify the section.

<u>Outlook</u>

During the past several months, representatives from a number of leading importing groups, including the semiconductor industry acting through WEMA, have been meeting and have now reached agreement on a draft bill to amend Section 592. In brief, the draft would impose a penalty for a violation resulting from negligence of twice the amount of duty lost or twice the domestic value of the merchandise, whichever is the lesser. Penalties for fraudulent entries would be eight times the amount of duties lost. Clerical errors or mistakes of fact or law would not be penalized.

The draft legislation includes a number of other provisions designed to benefit the importer including (1) a provision for lesser penalties for voluntary disclosure, (2) the opportunity to meet with Customs officials other than those who issued the penalty notice to discuss the alleged violation and the amount of the penalty assessment, and (3) a clear designation that the government should be responsible for the proof in the case of alleged fraud.

The fact that industry can agree upon a single set of amendments to Section 592 represents a major improvement and enhances the chances for passage this year. Moreover, other encouraging signs exist. Earlier this year, the House Ways and Means Committee set up a special task force to focus on the question of customs modernization and Section 592. That task force, consisting of Rep. James Jones (D-Okla.) and Rep. Bill Frenzel (R-Minn.), recently completed a series of field hearings during which many cases were revealed where the current Section 592 had created problems. These will be brought to the attention of the Trade Subcommittee of the Ways and Means Committee, which is expected to schedule hearings on this issue in June and could approve a bill by mid-July.

There are only two problems in what would otherwise appear to be an encouraging situation concerning changing Section 592. The first is Trade Subcommittee Chairman Charles Vanik who, while serious about modernizing the Customs Service, is reportedly not in agreement with major reductions in Section 592 penalties. The second problem relates to the power of the Treasury Department on Capitol Hill. Treasury has historically opposed the type of modification to Section 592 that is contained in the industry draft and has developed its own amendment to the section. The Treasury amendment would permit the Department to assess penalties up to the full domestic value of the goods in question. Whether it will be able to sell this approach to the Congress over industry objection remains to be seen.

Unfair Foreign Competition

Although still in its embryonic stage, the question of unfair foreign competition has recently surfaced as a major concern among a number of U.S semiconductor manufacturers. This was one of the issues determined by the Semiconductor Industry Association as being of major interest.

Unfair foreign competition in this case means the dumping of foreign products (selling at less than "fair market value") into the United States and foreign subsidization of exporters. Such subsidies must be in the form of a "bounty or grant" paid either directly or indirectly to the exporter. Existing U.S. law contains remedies for both dumping and subsidization to protect U.S. industry from unfair foreign competition. However, attempting to obtain redress is often a complex, time consuming, and expensive undertaking.

Background

Unquestionably, the U.S. semiconductor industry has continued to maintain its technological superiority over foreign competition. This, in turn, has permitted the industry to acquire a significant portion of the world semiconductor market. In the EEC, for example, it is estimated that U.S. firms now have 75 percent of the market; moreover, industry representatives have indicated that over 50 percent of the semiconductor devices sold in the world are the products of U.S. companies.

These facts have not escaped our foreign competitors; as a result, an increasing number of countries are beginning to support research and development efforts in semiconductors through close cooperation and direct financial support. The following are some examples of this activity:

- The Japanese Ministry of International Trade and Investment is sponsoring a four-year, $233 million LSI research project to develop ultra-complex semiconductor devices; more than $100 million of these funds are coming from the Japanese national budget.

- The Federal Republic of Germany is well aware of the fact that the computers manufactured by Siemens, AEG-Telefunken, and Nixdorf rely on U.S.-generated LSI technology; a government subsidy program of 150 DM million ($60 million) is being made available to German semiconductor firms to develop competitive LSI technology.

- The French Government, according to industry spokesmen, will actually capitalize its fledgling electronic watch industry with a subsidy of greater than $6 million.

- Finally, a recently-announced plan to help the European semiconductor industry compete against U.S. and Japanese companies is being considered by the EEC; this plan envisions financial aid for research and cooperation and mergers between EEC firms.

These developments alone should be enough to create concern in the U.S. industry. However, compounding the concern is the alleged dumping of foreign semiconductor devices in the U.S. markets. The major country involved, according to industry spokesmen, is Japan which has encountered problems in the alleged dumping of its color television sets in this country.

Outlook

As noted, U.S. law does contain provisions that are intended to protect U.S. industry from unfair foreign competition (direct government subsidy or dumping). Concerning the latter, the anti-dumping law requires that two facts be established: (1) that foreign merchandise is being or is likely to be sold in the United States at less than its fair value; and (2) that an industry in the United States is being or is likely to be injured as a result of the dumping. If either of these facts are not affirmed, the investigation is discontinued.

While pricing is a difficult issue to prove, injury is even more difficult. Injury involves loss of U.S. jobs, loss of sales by U.S. manufacturers, loss of foreign market penetration, declining domestic profits, increased domestic inventories, and loss of customers. Injury will not ordinarily be evident—even though some of these criteria are met—if the domestic industry is healthy.

Foreign subsidies are countered by what is called countervailing duties. These duties are assessed against imports to offset "bounties" or "grants" paid either directly or indirectly to exporters; and they are assessed in terms of whether or not there is any injury to the U.S. industry. The definition of what constitutes a "bounty" or a "grant" is the major adversity in establishing countervailing duties. Direct subsidy payments to exporters, excessive tax rebates, preferential income tax rates or accelerated depreciation, price support systems, subsidies for capital, production and distribution costs, and unjustified tax remissions have all constituted "bounties" or "grants" in the past.

As noted earlier, these related issues are still in their embryonic stage; they are at a point where the industry is not certain that it has either a dumping or countervailing duty case. Nevertheless, it would appear that enough information and interest now exists within the industry to further scrutinize the entire matter. Because of the sensitivity over the color television case, a first step probably will be for industry representatives to approach the Japanese directly to determine if an equitable solution can be accomplished.

Tariff and Non-Tariff Trade Barriers

Dumping and foreign subsidies are not, of course, the only impediments to the semiconductor industry's objective of being able to operate in an open and free world market. Despite the fact that U.S. exports of semiconductors have shown a consistent growth over the past decade, tariff and non-tariff trade barriers have denied the U.S. industry access to certain major foreign markets. This is contrasted with the fact that electronic industries of other developed nations have relatively free access to U.S. markets.

Background

The United States maintains a specific duty rate of 6 percent on semiconductor products; however, as the following table indicates, numerous foreign countries have substantially higher rates of duty on imported semiconductors:

Country or Region	Existing Duty
Australia	35.0%
Canada	15.0%
E.E.C.	17.0%
Japan (Discretes)	10.5%
Japan (Integrated Circuits)	12.0%
Mexico	15.0%
Portugal	13.0%
Spain	26.0%
Sweden	7.0%

Industry spokesmen have told the U.S. trade negotiators that a 60 percent reduction in present foreign import duties could result in an annual increased export potential for U.S. semiconductor manufacturers of between $500 and $700 million within the next several years. At the same time, the industry has expressed its willingness to eliminate all duties on U.S. semiconductor imports, in consideration for appropriate concessions by our trading partners.

Tariff concessions alone will not ensure fair market access of U.S. semiconductor products into developed countries. Over the past several years, U.S. manufacturers have been confronted with an increasing number of schemes that would, if implemented, seriously impair their ability to compete in major foreign markets. Two recent examples are the European Community's "Country of Origin Rules," and the EEC/EFTA "Multipartite Accord of Assessment and Certification of Electronic Components." As serious as these two non-tariff trade barriers are to U.S. manufacturers, they are minor compared to the so-called "Japanese situation."

Japan represents the largest potential market for U.S. semiconductors. Currently, most integrated circuits cannot be imported into Japan without obtaining prior approval from the Ministry of International Trade and Industry. U.S. industry spokesmen have charged that this is a direct violation of U.S. rights under GATT (General Agreement on Tariffs and Trade).

All commercial imports into Japan are still subject to an import license. If the imported item has been "liberalized" like some categories of semiconductors, the license is freely granted; however, the fact of its issuance gives the Government a prior knowledge of the purchase of foreign electronic components. This gives MITI (Ministry of International Trade and Industry) the opportunity of attempting to persuade the potential purchaser in Japan to switch his purchase to a Japanese source. Digital computers, accessories, and components are also subject to quota restrictions. Components include integrated circuits for use in digital computers. This would also appear to be a violation of U.S. rights under GATT.

Japan has recently felt out U.S. manufacturers on the effect of raising semiconductor tariffs from 12 percent to greater than 30 percent. Contrast this with the situation confronting foreign manufacturers importing semiconductors into the United States. Semiconductor import duties are 8 percent. Domestic manufacturers have not been able to identify any provisions in U.S. law that are directed at restricting imports of semiconductors. These manufacturers have also told the President's Special Trade Representative that if there are any (perhaps the Buy America Act might qualify in certain instances), they should be eliminated in consideration for equivalent concessions from our major trading partners.

Outlook

Recently a spokesman for National Semiconductor Corporation called for a boycott of Japanese products to highlight the abnormalities that exist in the trading policies of Japan. While there is no question this would generate a certain amount of public attention, any real and meaningful action will come as a result of the complex and often private multilateral trade negotiations in Geneva.

Due to a lack of preparation during the Kennedy Round, U.S. negotiators have, throughout the past two years, worked diligently to seek the advice and counsel of industry and labor to prepare for the current round of trade talks. The semiconductor industry did an excellent job in preparing and presenting its case, together with specific recommendations, to the U.S. negotiators. However, these negotiators will have to formulate a position on a wide range of industrial, consumer, and agricultural products, the producers of which all have vested interests and a desire to see their positions upheld during the negotiations. Compromises will be made, and the challenge to the semiconductor industry will be to see that pressure continues to be exerted on U.S. negotiators in Geneva, as well as those responsible for the conduct of those negotiations in the White House and those interested in them on Capitol Hill, to see that the industry's case is persuasive.

Energy

An immediate and critical question for those semiconductor firms in California is the availability and allocation of electrical energy as a result of the two-year drought in the state. What happens in California could actually happen anywhere, considering the nation's overall energy problem.

For some time, the California Public Utilities Commission has been considering a mandatory emergency energy use curtailment plan. It includes the use of rolling blackouts in which power would be shut down in different areas for one to three hours at a time. Today, with the record drought in the state and a concomitant loss of hydroelectric generating capability, the rolling blackout is becoming a distinct possibility.

This approach to energy curtailment would be disastrous to the semiconductor industry, since much of the industry's production equipment and processes are extremely vulnerable to deterioration or outright catastrophic failure in the event of a power outage. Industry representatives from Santa Clara County have testified that the cost of destroyed materials in their diffusion furnaces could amount to more than $400,000 per shutdown; this figure does not include the cost of labor to repair the furnaces, the loss of productivity, heating filament costs, or equipment recalibration costs.

Severe losses of work in process would also result from a rolling blackout; the degree of loss would be directly proportional to the amount of advance notice given. Estimated losses for Santa Clara County manufacturers in a three-hour shutdown are:

Advance Notice Given	Loss of Work in Process
0 Hours	$1,112,000
1 Hour	592,000
2 Hours	500,000
3 Hours	376,000

Background

Since the possibility of rolling blackouts first appeared in December 1973, the state's semiconductor industry has worked hard to exempt itself from any such mandatory curtailment. While a clear-cut exemption has not been achieved, the industry has been effective in some areas. For example, the State Energy Resources Commission has stated:

"The manufacturer of semiconductor devices is a classic example of an industry whose equipment may be permanently damaged if its temperature is allowed to drop below a specific level. The energy supply to that equipment should be assured."

While the problem has been recognized, a blanket exemption is unlikely for two reasons: (1) there are a number of other industries that also depend on a continuous supply of energy, and they simply cannot all be exempted in a workable emergency plan; and (2) the utilities insist they cannot apply a rolling blackout selectively to some customers in a given service area and not others. Actually, a Pacific Gas and Electric representative indicated recently that this would be difficult to accomplish, but not impossible. He further stated that the utilities were working with the Public Utilities Commission on a plan to accomplish this. However, whether such a plan could be implemented by this summer remains problematical at best.

Outlook

Although the situation seems to worsen daily, the major utilities have all indicated that by exchanging and importing power, they should be able to meet all anticipated needs in 1977. The staffs of the Public Utilities Commission and the Energy Resources Commission have agreed with this projection. All admit, however, that this will be by a very thin margin at best; and any unexpected outage—especially in the PG&E service area—would certainly result in mandatory curtailments and could result in the application of rolling blackouts. Blackouts would only be as a last resort, however, and because of its earlier lobbying efforts, the semiconductor industry has positioned itself as one of the most protected ... albeit not exempt ... industrial users. Furthermore, the industry has probably built a legal basis to go to court to seek an injunction on any contingency calling for rolling blackouts. Finally, the state's regulators seemingly prefer prohibiting certain uses of electricity as a conservation measure instead of adopting the rolling blackout approach.

What actual powers the regulators may have, however, remains to be seen, since the California State Legislature is now becoming involved in the issue. A bill worth watching is Assembly Bill 446, which would expressly include sudden and severe energy shortages within the definition of what constitutes a state emergency. Although this bill does not confer any new powers to the Governor to mitigate the effects of an emergency, a Senate Bill (SB 358, which is moving through the Legislature and would add drought to the definition of a state emergency) would authorize the Governor to impose conservation measures—including rationing in any part of the state or on a statewide basis. If both bills were to pass in their present form, it is possible that the Governor would have the ultimate authority to impose not only water rationing but mandatory energy conservation measures.

Digital Watch Duties

The efforts of Timex Corporation to legislatively impose substantially higher duty rates on digital watches is of direct interest to a number of semiconductor firms and should be of indirect interest to everyone in the industry. The fundamental question in this issue involves the semiconductor industry's use of offshore assembly as a part of its manufacturing process in the production of the digital watch. Imposing a penalty (in this instance, a substantially higher duty rate on digital watches) for certain manufacturers could be the first step towards establishing disincentives in the manufacture of other products whose production depends on the use of offshore assembly. Establishment of a higher duty rate on digital watches in the United States would also likely produce foreign retaliation in the form of higher duties on perhaps a multitude of semiconductor devices.

Background

Last year, at the request of Timex, Congressman Wilbur Mills introduced and pushed to hearings H.R. 10176—a bill that would have increased the duty on digital watches from $0.70 or $0.90 (depending on the size of the module) to $5.37.

The semiconductor industry, led by National, Fairchild, and Intel, with the cooperation of other manufacturers and suppliers, lobbied against the Timex proposal and were successful until the last few days of the session in keeping the bill in Committee. Unfortunately, the members of the Trade Subcommittee decided not to approve the bill (which by then could not have passed anyway); instead, the whole matter was referred to the International Trade Commission for study. The Commission was given until May 31, 1977 to report its findings to the Ways and Means Committee.

During the hearings last year and again this year, Timex argued that the higher duty rate was necessary to protect a domestic industry from foreign competition. The company, several of its suppliers, and one labor union also argued that the current low duty rate on digital watches encouraged offshore assembly to the detriment of U.S. employment. Digital watch manufacturers, on the other hand, argued that the issue was not one of foreign versus domestic competition; instead, it was one that centered on a marketing problem between different segments of the U.S. timekeeping industry.

Outlook

At the moment, the resolution of this issue rests with the International Trade Commission. No legislation similar to H.R. 10176 has been introduced in the Congress and probably will not be until after May 31 when the Commission will submit its report to the Congress.

The Commission's findings and recommendations will depend largely on two factors: (1) considerable data compiled by its staff that has only recently been made available to the parties of record in the Commission's hearings, and (2) the impression left with the Commissioners as a result of the public hearings earlier in the year.

The semiconductor industry was well represented during these hearings; the case was presented forcefully, and it was effective during the cross examination. Timex, on the other hand, appeared to present a weaker case this year than last. Speculation after the hearings was that Timex, now the only major proponent of the legislation, had lost interest in it.

The recently released data substantiate some of the arguments made by the semiconductor industry during the hearings. For example, the Commission's data show that domestic employment in the digital watch industry has substantially increased from the period of 1972-1976, while employment in the conventional watch industry has remained constant during that same period. U.S. exports of non-conventional watches and parts increased by a factor of more than three in the period of 1975-1976, while exports of conventional watches actually declined in that same period, according to the Commission's data.

There are some areas, however, in which the industry's case is not as strong and further analysis will be required. For example, the data show that imports under 806.30 and 807 have increased substantially during the past several years, and that a recent sharp increase has occurred in non-U.S. imports.

Overall, it would appear that the new report is more favorable to the semiconductor industry than to Timex; consequently, the semiconductor industry appears to currently be ahead in this issue.

Eben S. Tisdale
J. F. Riley

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters

April 20, 1977

GENERAL INDUSTRY FORECAST

Our forecast remains relatively unchanged from the previous one (January 21, 1977); 1977 U.S. factory shipments are expected to be about 20 percent over those of 1976. We believe the largest quarter-to-quarter growth in the industry will occur in the second quarter, with slower growth during the last two quarters of the year.

The U.S. and world economies continued to remain strong during the last quarter. Strength is concentrated in the U.S. economy, with somewhat weaker economic recoveries abroad. Continued buildup of the U.S. economy was interrupted by the cold weather during January and February. Although production interruptions during the winter freeze had a definite effect on the economy, the consensus is that long-term effects were relatively negligible as a full recovery occurred in March. In March, industrial production jumped 1.4 percent over February. Several favorable economic developments have continued:

- Record months of industrial production in February and March
- Continued increasing high levels of consumer spending in March
- Decreasing unemployment
- Lessened over-stimulative economic measures by the government
- Continued increases in real GNP
- Increasing capital spending, particularly for electronic equipment

These factors indicate continued strengthening in both the U.S. economy and semiconductor demand throughout 1977. Nevertheless, a major concern at this time is the possibility of renewed inflation. However, increased housing sales, auto production, inventory accumulation, capital goods production, and consumer spending should give the economy a sufficient push throughout the year. Additional stimulus is expected to result from greater confidence in the economy as the year progresses. With these developments, the economy is currently self-regenerative and stimulative measures by the government would only be counterproductive.

Current levels of industrial production and the expected future increases are rapidly beginning to deplete excess industrial capacity. This is expected to stimulate capital spending, although spending has been much more cautious than in past economic upturns. However, there is less reluctance to spend for electronic equipment (which more directly benefits the semiconductor industry) than capital equipment in general. Due to the decreasing cost per function of semiconductor devices, equipment using semiconductors continues to become more cost-effective than other forms of capital equip-

Table 2.1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(Dollars in Millions)

	1975	1976	Percent 75-76	1977	Percent 76-77
Discrete Devices	$ 901	$1,087	20.6%	$1,258	15.7%
Integrated Circuits	1,195	1,571	31.5%	1,934	23.1%
Total	$2,096	$2,658	26.8%	$3,192	20.1%

Source: DATAQUEST, Inc.

Table 2.2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

1976	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$255	$272	$275	$285	$1,087
Integrated Circuits	356	396	403	416	1,571
Total	$611	$668	$678	$701	$2,658
Percent Change From Previous Quarter	11.1%	9.3%	1.5%	3.4%	—

1977	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$295	$311	$325	$327	$1,258
Integrated Circuits	430	476	501	527	1,934
Total	$725	$787	$826	$854	$3,192
Percent Change From Previous Quarter	3.4%	8.6%	5.0%	3.4%	—

1978	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$332				
Integrated Circuits	533				
Total	$865				
Percent Change From Previous Quarter	1.3%				

Source: DATAQUEST, Inc.

ment (where prices have generally inflated). Furthermore, there appears to be more inclination to utilize capital spending for increases in productivity and efficiency of existing plants rather than construction of new facilities.

We expect capital equipment markets to be a primary force in 1977 in increasing total semiconductor demand. The above considerations have been reflected in improved sales for related electronic equipment: production control, data processing (mainframes), office equipment, communications, and instruments. Recently, sales for these items have been showing increasing strength, and these market segments should join minicomputers in providing a major impetus during 1977 for increased semiconductor sales.

Semiconductor bookings and semiconductor shipments, which were essentially flat in the third and fourth quarters of 1976, have begun to increase and were especially strong in March. Bookings increased only slightly in January and February, which we believe was partially due to weather conditions—both directly and indirectly. The freeze made buyers extremely cautious and reluctant to either add inventory or make long-term commitments. This attitude apparently reversed in March as every major company showed excellent booking increases. Most companies had record bookings during either the first quarter of 1977 or in March; however, because of low bookings in the fourth quarter, shipment increases in the first quarter were relatively modest. Nevertheless, these order improvements should result in a major increase in semiconductor shipments during the second quarter. Worldwide, the U.S. lead has not been closely followed. European demand has been increasing steadily, if slowly, but orders and production declined in Japan in the first quarter.

Our current forecast is shown in Tables 2.1 and 2.2. Semiconductor shipments are expected to continue quarter-to-quarter improvements throughout 1977. Total industry shipments (U.S. factory sales are expected to be about 20.1 percent above those of 1976. The current quarter is expected to show a major increase in semiconductor shipments over the first quarter; it should be over 8 percent, as shown in Table 2.2. This increase is expected to slow considerably during the third and fourth quarters of this year. The forecast for the first quarter of 1978 shows essentially no change from the previous quarter. However, this flatness may only reflect erratic statistics that resulted from the winter freeze rather than underlying economic trends and a possible cooling of the U.S. economy in the second half of 1977.

As bookings increase and the U.S. economy improves, confidence in the future should rapidly increase. Although the outlook is favorable, excessive optimism is also similarly unwarranted in the near future. The following major world economic problems still exist:

- Weak national economies
- Inflation
- Excessive deficit spending
- High unemployment

These problems will probably maintain worldwide economic improvements at a modest pace. The fear of inflation or possible shortages should act as a strong incentive to maintain problems that will prevent overheated world economies. During the next year, do not expect a "runaway" situation like the one that developed in 1973.

Semiconductor bookings can increase much faster than industry production. This can occur when users, with increased orders of their own, order both for increased production and inventory building. It is generally the case that buyers place longer-term orders at the same time, which further swells bookings. This can cause short-term effects on lead times for semiconductor devices that give the false appearance of developing shortages. A situation such as this occurred in TTL devices in 1976, and may currently develop in some markets. However, increases in semiconductor production should be sufficient to meet increases in end demand for electronic equipment. We do not foresee industry shortages in the next six months; but increased bookings are expected to increase backlogs and extend delivery times. Accordingly, this should keep price erosion at manageable levels and maintain or increase industry profit margins.

The increase in semiconductor production throughout this year should create increased demands for employees and equipment in the industry. Consequently, some strains should develop as the year progresses. Semiconductor companies in recent months have been reticent in both building capacity and in ordering equipment. Increased bookings may cause excess capacity to rapidly decrease; and this, in turn, could cause a rapid increase in equipment orders.

James F. Riley
Frederick L. Zieber

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters March 25, 1977

MOS MEMORY—4K SHIPMENTS

Summary

4K RAM shipments in 1976 reached 29 million units, which was well in excess of most early 1976 estimates of 20 to 25 million units. The monthly shipping rate for 4K RAMs exceeded 3 million units per month by year-end. The product shift from 22-pin to 16-pin devices continues and demand continues to be strong for the fast 4K dynamic RAMs and the static 4Ks. 4K RAMs from Japan are reported as being of very high quality and their shipments increased monthly through December. The 1K market continued to prosper in 1976; an estimated 50,000 16K RAMs were shipped during the fourth quarter of 1976.

4K RAM Shipments

Table 1 gives DATAQUEST estimates of 4K RAM shipments for the last six months of 1976, which is an update of our Research Newsletter of November 19, 1976. Table 2 gives DATAQUEST estimates of quarterly and total 1976 shipments of 4K RAMs. Shipments increased each month during 1976 to nearly 3.2 million units per month in December for an annual total of 28.9 million units. At year-end 1976, TI was the leader in total units with 7.4 million. However, Intel and Mostek, with 5.2 and 5.0 million units respectively, are not far behind in total revenues because of their different product mix between standard and high performance parts. Prices continued to fall and reached the $3.75 range for standard devices shipped during the fourth quarter. This price decline has cut into revenues; however, this is being moderated somewhat by the increasing demand for the higher-priced, high-speed devices.

The shift toward the 16-pin device and away from the 22-pin device continued in the fourth quarter. It was accelerated by Texas Instruments' announcement of a 16-pin fast 4K RAM for second quarter 1977 introduction. Most of the manufacturers will soon have 16-pin versions available. Our estimates of the unit distribution by pin number in 1976 and 1977 are shown below.

	16 Pins	18 Pins	22 Pins
1976	35%	10%	55%
1977	48%	10%	42%

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Intel, NEC, and TI are the three volume producers of the 22-pin devices; AMD, National, and TI are the major 18-pin producers; and Mostek, Fairchild, and Intel are the major 16-pin device producers. Most of the new designs coming out are 16 pins; a few are at 18 pins, while no new products are coming out with 22 pins.

There is a growing demand for the fast 4K RAMs (access time under 200 nanoseconds). The Mostek 4027 has become the industry standard for fast 4K dynamic RAMs. While NEC was the largest shipper of fast 4K RAMs in December, Mostek was closing rapidly. Intel, Intersil, and National are producing fast 4K devices for their own internal requirements. Most other semiconductor firms are either shipping or sampling fast 4K devices within a few months. Most will be second sourcing the Mostek 4027 16-pin 150 nanosecond device. However, National has decided to go with 18- and 22-pin packages for the sub-200 nanosecond part.

Users indicate that Intel, Mostek, and NEC are the most preferred vendors of 4K RAMs. The high performance, reliability, and sales support of 4K RAMs coming from Japan has been noted by many users. We believe this confirms that Japanese semiconductor companies consider this market extremely important.

Shipments of 4K statics increased in the fourth quarter. DATAQUEST estimates that 1 million 4K static RAMs were shipped in 1976. The primary sources were EM&M and AMD. This total is expected to increase to 3 million units out of a total of between 35 and 40 million 4K RAMs in 1977.

16K RAMs

DATAQUEST estimates that 50,000 16K RAMs were shipped in 1976, with the shipments split roughly between Mostek and Intel. TI's shipments were nil because of a redesign in the fourth quarter. 1976 prices of 16Ks were in the $28 to $40 range. They are expected to start in the high $20's early in 1977 and decline to the $15 to $17 range by fourth quarter; this will make them attractive alternatives to the 4K devices.

During the first quarter of 1977, we estimate that Mostek and Intel will each ship approximately 60,000 units and TI shipments will begin increasing rapidly. By April, the projected industry rate is estimated to be 100,000 units per month; by September, it is estimated to be 250,000 units per month.

Mostek's 4116 16K dynamic RAM is rapidly becoming the industry accepted standard device. Most of the semiconductor companies have or will soon be sampling 16K devices. Fairchild is currently sampling, Motorola and Signetics samples should be available by early May, and Intersil samples should be available by early June. Samples from AMD are expected in the second half of 1977. Of the Japanese semiconductor manufacturers, Fujitsu, Mitsubishi, and Toshiba are already sampling their 16K RAMs. NEC and Hitachi are expected to be sampling soon. Since the Japanese are shipping very high quality 4K RAMs, it can be expected that the same high quality parts will come from Japan in the 16K devices.

Daniel L. Klesken
James F. Riley
Frederick L. Zieber

Table 1

4K RAM SHIPMENT ESTIMATES FOR LAST SIX MONTHS OF 1976
(Units in Thousands)

Company	July	Aug.	Sept.	Oct.	Nov.	Dec.
TI[1]	600	625	700	800	800	800
Intel	500	500	500	500	500	500
Mostek	500	550	550	450	475	500
NEC	330	370	400	425	425	425
NSC[2]	180	180	200	225	250	300
Fairchild[3]	125	150	160	110	110	110
Motorola	110	120	130	150	150	175
EMM[4]	70	75	95	100	115	115
Fujitsu[5]	60	70	75	80	80	100
AMS	40	50	70	65[7]	65[7]	65[7]
Intersil[6]	10	10	10			
AMD[8]	50	60	65	65	65	65
Signetics	15	20	30	40	40	40
Total	2,590	2,780	2,985	3,010	3,075	3,195

[1]80 percent of TI fourth quarter production is in 18-pin package.

[2]25 percent of NSC output used internally

[3]30 percent of FCI output used internally by consumer product division

[4]100 percent of EMM output is static

[5]80 percent of Fujitsu output is used internally

[6]50 percent of Intersil output is used internally

[7]Figures are post-merger

[8]20 percent of AMD fourth quarter output is static

Source: DATAQUEST, Inc.
(March 25, 1977)

Table 2

4K RAM SHIPMENT ESTIMATES FOR 1976
(Units in Thousands)

Company	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
TI	1,400	1,650	1,925	2,400	7,375
Intel	900	1,325	1,500	1,500	5,225
Mostek	600	1,400	1,600	1,425	5,025
NEC	575	790	1,100	1,275	3,740
NSC	300	480	560	775	2,115
Fairchild	290	430	435	330	1,485
Motorola	190	180	360	475	1,205
EMM	85	155	240	330	810
Fujitsu	95	155	205	260	715
AMS	12	55	160	195[1]	512[1]
Intersil	30	30	30		
AMD	23	110	175	195	503
Signetics	S[2]	35	65	120	220
Total	4,500	6,795	8,355	9,280	28,930

[1] Figure reflects merger of Intersil and AMS

[2] Sampling

Source: DATAQUEST, Inc.
(March 25, 1977)

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters March 18, 1977

MOS MICROPROCESSOR SHIPMENTS

Summary

Microprocessor shipments continued to accelerate in the fourth quarter of 1976; this trend is expected to continue in 1977. Growth was concentrated in 8-bit devices, with the 16-bit market far less significant. Among 8-bit units, the 8080 is increasingly dominant; in some smaller market segments, the CMOS devices are proving popular. In recent months, the industry has seen a proliferation of microprocessor chip set products.

1976 Microprocessor Shipments

Table 1 shows microprocessor shipments for 1975 and 1976 by manufacturer and product type. These shipments continue to increase rapidly. DATAQUEST estimates that fourth quarter 1976 shipments in units increased about 50 percent over the third quarter.

16-Bit Market

The 16-bit market has been slow to develop, although DATAQUEST believes Texas Instruments has received several significant orders for the TMS 9900 in the last few months. A survey of microprocessor purchasing expectations for 1977 indicates that 16-bit devices will remain a small percentage of the market and that 8-bit devices will predominate.

Fairchild has recently announced a 16-bit I^2L processor that emulates Data General's NOVA. DATAQUEST believes that Intel has developed a 16-bit microprocessor set but is not prepared to announce its availability. We believe Intel has been sampling this processor on an extremely selective basis in Europe as well as the United States.

CMOS

The CMOS microprocessors of both Intersil and RCA have made quiet but successful entries into the market; these units appear to have been extremely well received with a wide variety of applications. Total fourth quarter 1976 shipments of CMOS units is estimated at 25,000, with increasing sales expected in 1977.

8080 Dominance

Table 2 gives total shipments of the major 8-bit microprocessors. It shows the impact of the additional 8080 sources (National, AMD, and

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Texas Instruments) with increased market share for that device. In 1975, according to DATAQUEST's estimates, the ratio of shipments between the 8080 and 6800 was 1.5 to 1; in 1976, this shifted to 3 to 1. Shipments for 1977 should approach a long-term market equilibrium of 3 or 4 to 1. Similarly, Intel's share of the 8080 market fell to 65 percent in 1976 from 80 percent in 1975. However, DATAQUEST believes Intel has been very successful in adding value to its microprocessor shipments with support chips and board products incorporating its microprocessor; its Microcomputer Systems Division had estimated 1976 revenues of $62 million. Shipments of Fairchild's F8 microprocessor increased rapidly in the second half of 1976 to surpass the total shipments of the 6800. This inexpensive microprocessor is widely used in video games and control applications.

Outlook for 1977

Although the fourth quarter 1976 unit shipments were given added impetus by sales for consumer items such as games, we believe that the accelerating sales of microprocessors will continue through 1977 and 1978.

Increased production capacity of microprocessors and availability from a broader range of suppliers have led to severe price deterioration. For example, we believe a 100,000 piece requirement from a prominent game manufacturer was placed recently at a price of around $6.50 for delivery in 1977. The consumer industry, including the 60 million unit white goods market, is being moved to action by the $10 average selling prices to the auto industry and the $4 prices seen by microwave oven manufacturers.

The 8-bit and 4-bit markets have seen a proliferation of new product introductions in the last six months. These include increased second-sourcing of well-established devices (such as the 8080, TMS1000, 6800, F8, and Z80), new standard devices, and many new custom chips or devices aimed at special markets, products, or applications. In particular, this proliferation extends to support devices for many of the current processors. The automobile contracts, notwithstanding their considerable publicity, are expected to undergo substantial revision in 1977 in specifications, quantities, and vendors. The historical under-the-hood suppliers—such as Bendix—are not going to default their markets to semiconductor manufacturers without a reprisal. Their efforts will likely be assisted by those semiconductor manufacturers not included in current contract awards—such as AMD, AMI, Intersil, Mostek, National, and Signetics.

In addition to current volume applications already opened or near potential (such as games, computers on a board, and appliances), DATAQUEST expects to see significant development in 1977 in the hobby, home security, metering, and instrument markets.

James F. Riley
Daniel L. Klesken
Frederick L. Zieber

Table 1

ESTIMATED MOS MICROPROCESSOR SHIPMENTS BY COMPANY

(Units in Thousands)

Company	Unit	Bits	MOS Process	Year 1975	1st Qtr 1976	2nd Qtr 1976	3rd Qtr 1976	4th Qtr 1976	Year 1976
AMD	8080A	8	N	10	5	12	20	30	67
AMI	6800	8	N	5	2	3	4	7	16
Fairchild	F8	8	N	25-30	8	33[1]	70[1]	70[1]	180
GI	CP-1600	16	N	-	2	3	4	5	14
Intel	4004	4	P	250	85	85	85	85	340
	8008	8	P	200	30	30	30	35	125
	8080[3]	8	N	60	60	60	60	75	255
Intersil	2650	8	N	-	-	S	S	S	<5
	6100	12	C	-	S	2	7	11	20
Mostek	F8	8	N	5	5	15	20	30	70
	Z-80	8	N	-	-	-	5	8	13
Motorola	6800	8	N	45	15	15	25	35	90
National	4004	4	P	N/A[2]	15	20	20	20	75
	IMP	4	P	1	10	12	12	15	49
	PACE	16	P	5-10	10	10	15	15	50
	SC/MP	8	P	5-10	5	20	35	40	100
	8080A	8	N	-	-	-	2	8	10
NEC	8080	8	N	5	5	7	10	20	42
RCA	1802	8	C	-	-	-	S	15	15
Rockwell	PPS-4	4	P	450	100	110	120	120	450
TI	TMS1000[3]	4	P	50	60	75[4]	75[4]	100	310
	TMS8080	8	N	1-2	10	15	15	25	65
	TMS9900	16	N	-	S	5	5	10	20
Signetics	2650	8	N	S	2	3	4	5	14
Zilog	Z-80	8	N	-	S	S	S	5	5

[1] 3K in-house, 2nd quarter; 30K in-house, 3rd quarter; 25K in-house, 4th quarter.

[2] N/A indicates information not available; S indicates sampling.

[3] Family

[4] 75 percent in-house

Source: DATAQUEST, Inc.
(March 18, 1977)

Table 2

ESTIMATED 8-BIT MICROPROCESSOR
SHIPMENTS BY TYPE

(Units in Thousands)

Microprocessor	Year 1975	1st Qtr. 1976	2nd Qtr. 1976	3rd Qtr. 1976	4th Qtr. 1976	Year 1976
8080	76	84	64	77	158	383
6800	50	18	21	30	40	109
F8	30	13	48	90	100	251
Total	156	115	133	197	298	743

Source: DATAQUEST, Inc.
(March 18, 1977)

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 8.02 Fairchild Camera & Instrument March 4, 1977

FAIRCHILD ANALYSTS' MEETING

Summary

On March 1, Fairchild Camera held a security analysts' meeting at its Mountain View facility. President Wilfred J. Corrigan chaired the meeting and presented an overview. Highlights from his overview and the rest of the meeting are summarized below:

- In 1976 Fairchild's sales grew 50 percent but margins were only up 20 percent. Margin improvement will be a major corporate effort in 1977. Inventories were only up 4 percent during 1976.
- The sales outlook for 1977 is generally positive, although the first quarter has been somewhat flat.
- The Components and LSI Groups have experienced substantially increased orders in January and February.
- The computer industry is finally rebounding and ordering components, memories, and LSI components from Fairchild. However, orders for commodity products remain short term.
- The digital watch market is now experiencing seasonality, but January and February orders for March to May delivery have been very encouraging.

Components Group—George D. Wells

- Fairchild's Components Group did not increase personnel and inventories in the second and third quarters of 1976; thus, it was not hurt by the downturn in the second half of 1976.
- The Components Group experienced increased bookings in the OEM and Distributor markets during January and February despite softening in the International components markets. Computer manufacturers are also placing substantial orders.
- Military orders were strong in the first, second, and fourth quarters of 1976, and are expected to remain strong in the first half of 1977.

- Sales increased more than 28 percent in 1976, while the inventories actually decreased.

- Good bookings and billings are expected in the second quarter of 1977.

- Sales growth in 1977 is expected to surpass the semiconductor industry growth.

- Pricing will be adjusted only in accordance with sales and margin goals during the coming year.

- Fairchild plans to introduce 50 new CMOS and low-power Schottky products in 1977.

LSI Group—David J. Marriott

- This group was formed in October 1976 with dedicated sales, marketing, engineering, management, and manufacturing facilities. Its charter is to design, manufacture, and sell a broad line of large-scale integrated products using bipolar and MOS technologies.

- Fairchild estimates that the market for LSI components in 1976 was $1.1 billion, and will grow to $1.35 billion in 1977 and $1.8 billion in 1980. The 1976 split was approximately: EDP, 60 percent; Consumer, 20 percent; and Communications and Control, 20 percent. By 1980, Fairchild expects these three markets to share equally in the LSI market, with the greatest growth occurring in communications.

- Fairchild's estimates of the MOS and bipolar RAM markets are given in Table 1.

Table 1

RAM MARKET ESTIMATES

(10^9 Bits)

RAMs	1976	1977
MOS		
1K	23	23
4K	100	150
16K	0.5	32
Other	11	8
Bipolar	5.5	10
Total	140.0	223

Source: Fairchild Camera & Instrument

- During 1977, the LSI Group plans to introduce 33 new LSI/VLSI products, including 14 memory, 5 logic, 6 microprocessor, and 8 data communications products.

- During 1977, the production capacity of the LSI Group will be increased by yield improvement and new facilities. Factors contributing to yield improvement include 4-inch diameter silicon wafer processing, use of Fairchild's first E-Beam machine to pattern defect-free masks for special products, and the continued shrinking of die sizes. A new 250,000 square foot LSI wafer fabrication plant in San Jose should be completed and occupied in 1977. It will be Fairchild's largest plant and may be the largest dedicated LSI plant in the world.

Consumer Products—Gregorio Reyes

- Fairchild estimates that the entire digital watch industry had an 80 to 90 percent sell-through on digital watches in 1976. Fairchild had an 85 to 90 percent sell-through for the year, which it believes was very good.

- Adverse publicity concerning digital watches and battery problems caused retailers to hesitate and readjust order plans in the September time frame; consequently, orders for the Christmas season were not as large as had been expected.

- The digital watch market was very competitive in 1976 and some 20 firms have dropped out of business in the last 12 months.

- At the Consumer Electronics show in January, the $19.95 prices were maintained by Fairchild and TI. Fairchild is concentrating on better margins and better service turnaround. The $9.95 watch shown by Commodore created little interest.

- At the retail trade level, the quarterly pattern of digital watch sales is: first quarter, 10 percent; second quarter, 25 percent; third quarter, 15 percent; and fourth quarter, 50 percent.

- At the manufacturing level, the cycles are offset by four to six weeks; therefore, the best quarters are the March-May and the September-November quarters.

- Fairchild estimates that the worldwide market for digital watches will be 30 million units in 1977. The ASP is expected to drop 30 to 35 percent in 1977 due to changes in product mix rather than declining margins. Dollar growth will be 20 to 25 percent for the year.

- Fairchild's estimates for digital watch consumption are given in Table 2.

Table 2

DIGITAL WATCH CONSUMPTION ESTIMATES

	1975	1976	1977	1978	1979	1980
Units (Millions)	3.5	15	30	50	70	90
LCD (Percent)	20%	25%	35%	45%	55%	60%
LED (Percent)	80%	75%	65%	55%	45%	40%

Source: Fairchild Camera & Instrument

- Fairchild now supplies one extra set of batteries with each watch. For the small LED digits with the bubble magnifier, this extra set of batteries extends the watch life of the original purchase to nearly three years—a span which retailers believe is the normal life of a low-cost watch.

- Fairchild's video games received excellent acceptance in the fourth quarter of 1976.

- Fairchild's estimates of worldwide unit sales for home video games are given in Table 3. (These are our approximate figures read from a Fairchild graph.)

Table 3

ESTIMATED WORLDWIDE SALES FOR HOME VIDEO GAMES
(Units in Millions)

	1976	1977	1978	1979	1980
Total Games	3.5	7	12.5	16	17
MPU Games	0.5	2	5.5	8	9
Other Games	3.0	5	7	8	8

Source: Fairchild Camera & Instrument

- Fairchild's game now retails at $169.95, with the cartridges selling for $19.95 each. Fairchild believes that it has a six-month lead on the rest of the industry in programmable games and hopes to maintain the price levels well into 1977.

<u>Instrumentation—James D. Bowen</u>

- During 1976, three new systems were introduced—Sentry VII, Integrator, and Xincom III.
- Fairchild believes that it controls 80 percent of the LSI/GSI testing market.
- Xincom III will add three new models in 1977, including a 16K RAM tester to be shown in May.
- This group also makes OEM add-on memories. It currently uses bipolar RAMs, but will also soon be using 64K CCDs and 16K MOS RAMs.
- This group also sells Fairchild's microprocessors and a development system (the F8 formulator).
- Fairchild believes that it will ship more microprocessors than any other company in the industry during 1977 because of the wide acceptance of its F8 and the large number of sockets in the control and game markets.

<u>Answers to Questions</u>

- Capital spending in 1976 was approximately $39 million and should be less than $30 million in 1977, reflecting the anticipated slowdown in the semiconductor industry in the 1978-79 time frame.
- Internal pricing policies between groups are set so that variable costs and a reasonable percent of overhead are covered on internal transfers. Profit is made at the final sales level.
- Fairchild estimates that about 2 million digital watches were left on retailer shelves at the end of 1976, and expects 2 to 3 million units to be left behind at the end of 1977. They believe that a 10 to 15 percent leftover is not bad, but 20 percent is a disaster.
- Fairchild has been very successful on scaling its die sizes down to improve yield and lower costs. It expects to go to 2.5 micron design rules by the late 1970s using the E-beam machine to make the masks, and switch more to projection alignment.

- Fairchild has made major design efforts to incorporate security in its game cartridges to deter other manufacturers from copying them.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters January 28, 1977

OPTOELECTRONICS MARKET

Summary

This newsletter is an expansion and update of optoelectronics market information published in Appendix A of the DATAQUEST Semiconductor Industry Service, Volume II. The Optoelectronics market has been divided into four major categories: LED Lamps, LED Displays, Optical Couplers, and Other Optoelectronics. Important observations regarding the optoelectronics market are:

- The worldwide market for optoelectronics has grown at a 35.1 percent compound annual growth between 1970 and 1976.
- The market is expected to grow at a compound annual growth rate of 12.7 percent between 1976 and 1981.
- The largest market for optoelectronics has been and is expected to be light emitting diode (LED) displays. This market grew at a 48.8 percent compound annual rate between 1970 and 1976 and is expected to grow at a 13.0 percent rate between 1976 and 1981.
- Large digit displays are capturing a major portion of the total LED display market and are expected to grow from $53 million in 1976 to $184 million in 1981.
- The top three manufacturers of optoelectronic devices in 1976 were Texas Instruments, Hewlett-Packard, and Fairchild.

Market Segmentation

DATAQUEST has used the generally accepted segmentation of dividing optoelectronics into the four categories of LED lamps, LED displays, optical couplers, and other optoelectronics. Specifically, these categories include:

- LED Lamps—Visible and infrared LEDs
- LED Displays—Includes monolithic displays for watches and calculators (generally less then 100 mils high), and large digit displays (generally greater than 100 mils high)

- Optical Couplers—Includes optically coupled isolators, but not solid state relays, which are not considered to be an optoelectronic device. However, the optical coupler that is an integral part of the solid state relay is included in optical couplers.

- Other optoelectronics—Includes all photo sensors (i.e., phototransistors, photo-Darlingtons, photodiodes, and photo-FETs), optical switches, and the optoelectronic portion of solid state lasers, fiber optic transmitters and receivers, solar cells, and optoelectronic assemblies.

Estimated Optoelectronics Shipments and Consumption

The DATAQUEST estimates of optoelectronics shipments for the years 1970 through 1976 are shown in Table 1. Worldwide optoelectronics shipments grew from $42 million in 1970 to $255 million in 1976, which is a 35.1 percent compound annual growth rate; this market is larger and growing faster than many had anticipated. LED displays constitute a major portion (55 percent in 1976) of the total optoelectronics shipments.

Table 1 breaks the total optoelectronics shipments into the four major segments of LED lamp, LED display, optical coupler, and other optoelectronics. It also includes a breakdown of shipments by the major regions of the world: North America, Japan, Europe, and Rest of the World. North America has been and remains the major source of optoelectronic devices.

Table 2 is an estimate of worldwide optoelectronics consumption divided into the four major categories and further divided into the four major regions of the world. North America is the major consumer of optoelectronic devices. In comparing tables 1 and 2, Japan, Europe, and Rest of the World consume more than they ship and are net importers of optoelectronic devices, whereas North America is a net exporter of optoelectronics.

LED Display Market

LED displays have been and are expected to be the largest segment of the optoelectronics market. The LED display market is segmented into monolithic displays and large digit displays. Monolithic displays are generally less than 100 mils high and have the entire digit on one chip. Monolithic LED displays are widely used in calculator and watch displays; however, LED displays in calculators are currently under pressure from vacuum fluorescent displays because they offer a larger display for roughly the same cost and power consumption. In watches, LED displays are under pressure from liquid crystal displays (LCDs), which require far less power and thus make continuous watch displays possible. It appears that consumers are willing to pay a premium to have the continuous display; therefore, LEDs are not likely to be the dominant watch display.

Table 1

ESTIMATED OPTOELECTRONICS SHIPMENTS
(Dollars in Millions)

	1970	1971	1972	1973	1974	1975	1976
Estimated Worldwide Optoelectronics Shipments							
Total	42	48	98	165	195	214	255
LED Lamp	6	6	15	22	23	29	36
LED Display	13	21	55	102	120	125	141
Optical Coupler	1	2	7	15	21	22	30
Other Optoelectronics	22	19	21	26	31	38	48
Estimated North American Optoelectronics Shipments							
Total	33	37	71	121	142	152	176
LED Lamp	5	5	9	13	13	15	18
LED Display	11	18	46	83	98	98	107
Optical Coupler	1	2	5	11	15	14	20
Other Optoelectronics	16	12	11	14	16	25	31
Estimated Japanese Optoelectronics Shipments							
Total	3	5	14	20	20	23	29
LED Lamp	0	0	2	3	3	4	5
LED Display	1	2	7	10	9	11	14
Optical Coupler	0	0	1	2	2	3	3
Other Optoelectronics	2	3	4	5	6	5	7
Estimated European Optoelectronics Shipments							
Total	6	6	12	21	24	25	32
LED Lamp	1	1	4	6	6	7	9
LED Display	1	1	2	7	9	10	13
Optical Coupler	0	0	1	2	3	3	4
Other Optoelectronics	4	4	5	6	6	5	6
Estimated Rest of World Optoelectronics Shipments							
Total	0	0	1	3	9	14	18
LED Lamp	0	0	0	0	1	3	4
LED Display	0	0	0	2	4	6	7
Optical Coupler	0	0	0	0	1	2	3
Other Optoelectronics	0	0	1	1	3	3	4

Source: DATAQUEST, Inc.

Table 2

ESTIMATED OPTOELECTRONICS CONSUMPTION
(Dollars in Millions)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Estimated Worldwide Optoelectronics Consumption										
Total	98	165	195	214	255	308	362	343	400	464
LED Lamp	15	22	23	29	36	45	55	50	55	64
LED Display	55	102	120	125	141	168	195	186	220	260
Optical Coupler	7	15	21	22	30	38	47	45	55	62
Other Optoelectronics	21	26	31	38	48	57	65	62	70	78
Estimated North American Optoelectronics Consumption										
Total	59	103	121	127	147	174	202	189	221	259
LED Lamp	8	11	12	13	16	19	24	21	23	28
LED Display	38	72	84	86	94	109	123	117	139	165
Optical Coupler	5	10	13	13	17	22	28	26	30	34
Other Optoelectronics	8	10	12	15	20	24	27	25	29	32
Estimated Japanese Optoelectronics Consumption										
Total	19	28	32	35	42	52	62	59	70	80
LED Lamp	2	4	4	5	6	8	10	9	10	12
LED Display	9	13	15	16	18	23	28	27	32	37
Optical Coupler	1	2	3	3	4	5	6	6	9	10
Other Optoelectronics	7	9	10	11	14	16	18	17	19	21
Estimated European Optoelectronics Consumption										
Total	16	27	29	34	40	49	58	56	64	72
LED Lamp	5	7	6	7	9	11	13	12	13	14
LED Display	5	11	13	14	17	21	25	24	28	33
Optical Coupler	1	3	4	5	5	6	7	7	9	10
Other Optoelectronics	5	6	6	8	9	11	13	13	14	15
Estimated Rest of World Optoelectronics Consumption										
Total	4	7	13	18	26	33	40	39	45	53
LED Lamp	0	0	1	4	5	7	8	8	9	10
LED Display	3	6	8	9	12	15	19	18	21	25
Optical Coupler	0	0	1	1	4	5	6	6	7	8
Other Optoelectronics	1	1	3	4	5	6	7	7	8	10

Source: DATAQUEST, Inc.

Large LED displays are available in the popular sizes of 0.3, 0.5, and 0.7 inches. Some manufacturers offer 1.0 inch high digits but these are not so widely used. The large digits are manufactured in a hybrid like structure, differing from the monolithic displays in that one or more LED chips are used for each segment of the digit; consequently, at least seven chips are required to make one digit. Most large digits are made using small chips (generally 15 mils square) and a light pipe or reflective assembly to evenly distribute the small light source over the area of a digit segment.

DATAQUEST's estimates of the monolithic and large digit display market are provided in Table 3. We estimate that the monolithic LED display market peaked in 1976 because of rapidly declining prices and the lack of rapidly growing demand. However, the large digit display market, which grew 39.5 percent annually between 1972 and 1976, is expected to grow 28.3 percent annually between 1976 and 1981.

Our estimates of the calculator and watch LED consumption are provided in Table 4. The table presents our estimates of total hand-held calculator consumption, the portion of these hand-held calculators using LED displays, the average selling price (ASP) for a nine-digit display, and the total value of calculator consumption of LED displays. Also included are our estimates of total digital watch consumption, the portion of digital watches using LED displays, the average selling price of LED watch displays, and the total value of watch consumption of LED displays.

Optoelectronics Market Share

Our estimates of the market shares of major optoelectronic manufacturers for 1976 are shown in Table 5; these estimates are the company's total optoelectronics production, including both captive and merchant markets. For a more comprehensive review of optoelectronic devices market share estimates for the years 1970 through 1976, see tables B-28 through B-32 of Appendix B of the DATAQUEST Semiconductor Industry Service.

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Table 3

ESTIMATED LED DISPLAY CONSUMPTION
(Dollars in Millions)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total LED Display Consumption	55	102	120	125	141	168	195	186	220	260
Monolithic Displays (<100 Mil Digits)	31	71	82	83	88	83	70	68	70	76
Large Digit Displays (>100 Mil Digits)	24	31	38	42	53	85	125	118	150	184

Source: DATAQUEST, Inc.

Table 4

ESTIMATED MONOLITHIC DISPLAY CONSUMPTION

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Calculators										
Total Hand-Held Calculators (Units in Millions)	4	14	25	45	59	66	71	76	83	90
Percent with LED Displays	93	94	96	98	90	85	75	72	70	65
ASP for 9-Digit LED Displays (Dollars)	7.80	5.20	3.25	1.75	1.28	1.17	1.03	0.99	0.91	0.90
Value of Calculator LED Displays (Dollars in Millions)	29	68	78	77	68	65	55	54	53	53
Watches										
Total Digital Watches (Units in Millions)	.2	.5	1	3.5	22	33	47	67	88	108
Percent with LED Displays	90	92	90	86	77	70	53	36	25	19
ASP for Watch LED Displays (Dollars)	11.00	6.50	4.50	2.00	1.20	0.80	0.60	0.50	0.48	0.46
Value of Watch LED Displays (Dollars in Millions)	2	3	4	6	20	18	15	12	11	9
Other Monolithic	-	-	-	-	-	-	-	2	6	14
Total Monolithic Displays	31	71	82	83	88	83	70	68	70	76

Source: DATAQUEST, Inc.

Table 5

OPTOELECTRONIC DEVICE MARKET SHARE ESTIMATES FOR 1976
(Dollars in Millions)

	Total	LED Lamps	LED Displays	Optical Couplers	Other Optoelectronics
All Manufacturers	255	36	141	30	48
U.S. Companies	219	31	123	25	40
Texas Instruments	60	6	30	4	20
Hewlett-Packard	38	5	26	4	3
Fairchild Camera	33	6	20	4	3
Monsanto	21	5	11	5	0
Litronix	16	3	11	2	0
National Semiconductor	15	4	11	0	0
Bowmar	10	0	8	0	2
Spectronics	7	0	2	1	4
General Electric	6	0	0	3	3
Motorola	2	0	0	0	2
International Rectifier	1	0	0	0	1
Others	10	2	4	2	2
Japanese Companies	24	3	12	3	6
European Companies	12	2	6	2	2

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters January 21, 1977

GENERAL SEMICONDUCTOR INDUSTRY OUTLOOK

As we did last quarter, we have reprinted the Industry Outlook from DATAQUEST's notebook. This outlook is updated on a quarterly basis and distributed to holders of our notebook. It gives DATAQUEST's forecast of semiconductor shipments for 1977.

The industry outlook is based upon DATAQUEST's econometric model of the semiconductor industry. It uses leading indicators of semiconductor demand and does not require forecasts of the general economy.

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2 Markets

GENERAL INDUSTRY OUTLOOK

Throughout 1976, DATAQUEST believed that the semiconductor industry would experience a good 1977, and recent data further confirm this belief. We believe the long pause of level semiconductor bookings during the second half of 1976 has ended. Therefore, we expect 1977 to show an industry increase in bookings and shipping of more than 20 percent over 1976.

The U.S. and world economies continued to build stronger bases throughout the second half of last year, although at a slower rate than earlier; this was not reflected in the slowdown in semiconductor demand. Nevertheless, this base-building was obscured by erratic statistics in areas such as industrial production or leading indicators, discouraging news from foreign economies, and a generally pessimistic outlook. Indeed, lack of confidence in the economy was one of its major problems; however, in the last few months this confidence has been considerably restored. Moreover, there have been many favorable recent developments:

- Two record months of increasing industrial production
- Surprisingly high levels of retail consumer spending in November and December
- Decreasing unemployment in December
- Stimulative economic measures by the government
- Increasing capital spending, particularly for electronic equipment
- Confidence that Carter will not adversely affect the economy
- A three percent increase in real GNP in the fourth quarter

These factors all indicate that the U.S. economy enters 1977 on a much more optimistic note than what has occurred during the last six months. The strong increase in consumer spending should give the economy a strong push in output as inventories are restored and increased—this is also a result of higher confidence. Considering these developments, stimulative measures by the government may only reinforce current trends.

Industrial output is now at a level above previous highs. Consequently, further increases should rapidly begin to use up excess industrial capacity, which should help stimulate capital spending—especially in areas that benefit semiconductor demand. There are strong indications that this is already occurring, particularly in selected areas. Investments in Producers Durable Equipment (IPDE) rose steadily throughout 1976 and those increases are expected to continue; current levels, however, are still far below peaks of 1973. Capital spending appears to be strongest in areas that increase productivity and efficiency of existing plants, rather than con-

Table 2.1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(Dollars in Millions)

	1975	1976	Percent 75-76	1977	Percent 76-77
Discrete Devices	$ 901	$1,080	19.9%	$1,260	16.7%
Integrated Circuits	1,195	1,542	29.0%	1,910	23.9%
Total	$2,096	$2,622	25.1%	$3,170	20.9%

Source: DATAQUEST, Inc.

2 Markets

Table 2.2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

	1976				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$253	$270	$273	$284	$1,080
Integrated Circuits	348	390	397	407	1,542
Total	$601	$660	$670	$691	$2,622

	1977				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$295	$316	$320	$329	$1,260
Integrated Circuits	433	473	494	510	1,910
Total	$728	$789	$814	$839	$3,170

Source: DATAQUEST, Inc.

1/21/77

struction of new factories. This is reflected in improved sales, especially in the fourth quarter, for industrial electronic equipment–production control, data processing, office equipment, communication, and instruments. Although minicomputer sales have been strong all year, other equipment areas are just beginning to show real improvement. Due to the decreasing cost per function of semiconductor devices, equipment using semiconductors offers improved performance and lower costs. With inflationary prices in other areas, this equipment is proving to be the most cost-effective method of increasing productivity for many manufacturers. We expect the capital equipment markets to be a primary force in 1977 in increasing total semiconductor demand.

Increased orders for industrial electronic equipment in the fourth quarter were abruptly reflected in increased semiconductor bookings in December 1976. While these bookings do not affect the fourth quarter of 1976 (which should prove essentially flat from the previous quarter), they are the first indications that 1977 will be a good year for the semiconductor industry. At the same time, electronic watch retail sales at Christmas proved much better than the initial pessimistic outlook for this product. The inventory overhang is not nearly as severe as expected and watch production may not be curtailed as much as anticipated. Because of both (1) the four major semiconductor companies involved—Fairchild, Intel, National, and Texas Instruments--and (2) the extensive use of semiconductor assembly equipment and personnel, watches substantially impact some semiconductor industry capacity factors.

Our current forecast is shown in Tables 2-1 and 2-2. Semiconductor shipments are expected to resume quarter-to-quarter improvements throughout 1977. Total industry shipments (U.S. factory sales) are expected to be about 21 percent above those of 1976. The second quarter is expected to show the largest quarter-to-quarter increase of 1977, with a slowing of industry growth in the second half of the year. By the fourth quarter of this year shipping levels should be more than 20 percent above previous record levels in 1974.

Final figures for 1976 are expected to be about 25 percent above 1975. Although our estimates of U.S. company shipments for 1976 are similar to those compiled by WEMA, our figures for 1975 are considerably higher. Thus, our percentage year-to-year increase is lower.

As bookings increase and the U.S. economy improves as expected, the confidence in the future should increase even more rapidly. Unnecessary pessimism was not warranted at the end of 1976, and we believe that excessive optimism may be similarly unwarranted in the near future. The following major world economic problems remain:

- Weak national economies, particularly England and Italy, but also France and Japan
- Oil prices
- Inflation
- High unemployment
- Excessive deficit spending

These problems should maintain worldwide economic improvements at a modest rate for some time. Pauses in economic improvement, such as in the second half of 1976, may be likely; however, this is preferred instead of a "runaway" situation, which developed in 1973.

The increase in semiconductor production throughout 1977 should create increased demands for employees and equipment in the industry, which could cause some strains as the year progresses. While we do not anticipate any immediate problems, the capacity-shortage situation will be closely monitored. It is likely that as the first quarter progresses, bookings will further increase and lead times should increase to better levels for the semiconductor industry. This in turn should keep price erosion from developing and maintain or increase industry profit margins.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters December 30, 1976

YEAR-END IMPRESSIONS FROM THE SANTA CLARA VALLEY

Summary

Semiconductor bookings have picked up strongly in the last two to three weeks. We believe this may indicate a resumption of industry growth after six stagnant months. DATAQUEST's forecast for about 20 percent growth in the industry next year has not changed.

A survey of Christmas sales indicate that consumer electronic products have moved reasonably well. As a result, the feared inventory overhang of watches is probably much less than expected.

Increased Bookings

Semiconductor bookings in December appear to have picked up strongly across the board. Data for some companies are given below. Moreover, we have information that AMD and Intersil have also experienced sharply higher bookings in December. Due to the holidays, we were not able to obtain specific information on Motorola and Texas Instruments, but we feel they have participated equally. Book-to-bill ratios for the industry, essentially flat in October and November, appear to have increased substantially in December. The strength in bookings seems to be derived from the capital equipment sector. These industrial and computer markets account for about 70 percent of U.S. semiconductor sales. Throughout the fourth quarter of 1976 EDP sales have been good, especially for large computers; minicomputers, of course, have been strong all year. It is likely that with these areas showing strength, sales of other electronic-related capital goods in all industrial areas are strong. Since semiconductor inventories have been extremely low, the increase in finished goods orders has been reflected quickly in semiconductor bookings. Although this order recovery could abort, we believe that a continuation is more likely, with added bookings from longer-term orders and inventory build-up.

This increase in bookings results from an improved economy (industrial production was up 1½ percent in November) and greater confidence that further improvements will come. To meet our forecast of 20 percent growth for 1977 an order resumption was needed prior to mid-February. Although it is too early to draw firm conclusions, we believe this recent strength in bookings indicates that the industry will meet our forecast.

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Consumer Electronics

A survey of retail outlets during the Christmas week, although limited, indicated that consumer electronic items are moving well. As expected, newer products such as video games are showing higher demand (relative to supply) than older products such as calculators. Watches appear to be selling well. Although most stores were not sold out, inventories generally appeared to be at low levels; this was true particularly of Fairchild, TI, and National (Novus) watches. As a result, watch inventories at year-end may not be at the very high levels feared. LED watch capacity, however, is still in excess of demand.

Fairchild

Fairchild has shown strong bookings in the first three weeks of December. However, we expect the fourth quarter shipments for Fairchild to be essentially flat from the third quarter—in the $118 to $120 million range—with profits flat to slightly down. This is partially due to some expected higher reserves established in the consumer products group. Sales of video games for 1976 are estimated to be approximately $3 million or around 30,000 units. These revenues, nearly all in the fourth quarter, have been adversely affected by the delayed approval from the FCC. Fairchild's video game has proved extremely popular in the retail stores and was completely sold out before Christmas.

The following table gives our estimates for Fairchild's semiconductor sales for 1976.

Fairchild Camera & Instrument
SEMICONDUCTOR SHIPMENTS
(Dollars in Millions)

Bipolar Digital	$108
Linear	64
MOS	24
Transistors	51
Diodes	30
Exetron	10
Intercompany Sales	(10)
Total	$277

Source: DATAQUEST, Inc.

Intel

Bookings for Intel in the fourth quarter were very strong, especially in December. We believe that Intel's fourth quarter revenues will be at our prior estimates—$68 to $70 million—which is somewhat higher than earlier estimates stated by the company.

National Semiconductor

National had stronger bookings in December, with particularly strong orders in commodity devices. DATAQUEST expects semiconductor shipments to be flat for the second 1977 fiscal quarter (ended December 18) compared to the first quarter. (Due to the longer accounting period, National's sales of $112 million in the first quarter is equivalent to $84 million for the second quarter.) Total corporate shipments are expected to be at a higher rate due to increased sales of consumer products. Video game sales in calendar 1976 are estimated to be about 125,000 units. National will be at the Consumer Electronics Show in January and we believe it intends to remain in consumer products. National's layoff in mid-December was about a 3 percent trim of overhead, somewhat less than originally believed.

Signetics

Signetics book-to-bill ratio for the fourth quarter is estimated at about 1.15 to 1, indicating strength in commodity ICs.

James F. Riley
Frederick L. Zieber
Daniel L. Klesken

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 24, 1976

MOS MICROPROCESSOR SHIPMENTS

Microprocessor shipments, especially 8-bit units, have increased rapidly throughout 1976. Equipment designed in 1974 and 1975 using microprocessors is now in a production or an early introduction phase. Increasingly, microprocessor orders are for production quantities. At the same time, new applications for processors appear to be generated with continued regularity.

Table 1 estimates MOS microprocessor shipments for 1975 and the first three quarters of 1976 for the major semiconductor companies active in the market. Table 2 totals shipments by microprocessor type for the most popular 8-bit units. Although the 8080 microprocessor family is the most popular, a clear dominance in this market is not evident. Shipments of the 6800 continue strong and have been increasing rapidly during the second half of 1976. Similarly, the F8 microprocessor, after a slow start, appears to be increasing rapidly in unit shipments during the second half of this year. The 8080 has dominated many EDP areas where design time must be short, especially in peripherals. The industrial and consumer markets, where other processors are more competitive, have been slower to develop. Coincident with the popularity of their 8-bit processors, the major companies involved—Intel, Motorola, and Fairchild—have important positions in the microprocessor market. National Semiconductor also has a relatively high quantity of microprocessor shipments with its IMP, PACE, SC/MP, and 8080 microprocessors; much of these shipments are in board products.

In the next six months, the introduction of second-generation microprocessors should become more prevalent. Intel is expected to announce shortly in Europe its 8048 and 8085 microprocessors. Motorola should announce its 6700 and 6900 microprocessors in the first half of 1977. It is expected that these Motorola microprocessors will also be second-sourced by Fairchild. Some microprocessor announcements can also be expected from Texas Instruments; its I^2L version of the 9900 microprocessor (previously announced) should become available in small quantities.

In general, these second generation devices follow two divergent paths from current 8-bit units. They either include more functions on the same chip, and simplify total design, layout, and use; or they are more powerful in that they handle more calculations faster and include more memory, more instructions, and more input/output capability.

James F. Riley
Frederick L. Zieber
Daniel L. Klesken

Table 1

ESTIMATED MOS MICROPROCESSOR SHIPMENTS BY COMPANY

(Units in Thousands)

Company	Unit	Bits	MOS Process	Year 1975	1st Qtr. 1976	2nd Qtr. 1976	3rd Qtr. 1976
AMD	8080A	8	N	10	5	12	20
AMI	6800	8	N	5	2-3	N/A	N/A
EA	9002	8	N	-	-	-	S[1]
EM&M	CP-1600	16	N	-	S	N/A	N/A
Fairchild	F8	8	N	25-30	8	33[2]	70[2]
GI	CP-1600	16	N	-	N/A	N/A	N/A
Intel	4004	4	P	250	N/A	N/A	N/A
	8008	8	P	200	N/A	30	30
	8080	8	N	60	60	90	90
Intersil	2650	8	N	-	-	S	S
Mostek	F8	8	N	5	5	15	20
	Z-80	8	N	-	-	-	5
Motorola	6800	8	N	45	15	15	25
National	IMP	4	P	1	10	12	12
	PACE	16	P	5-10	10	10	15
	SC/MP	8	P	5-10	3-5	20	35
	8080A	8	N	-	-	-	2[3]
NEC	8080	8	N	5	5	7	10
Rockwell	PPS4	4	P	450	100	110	120
TI	TMS1000	4	P	50	60	75[4]	75[4]
	TMS8080	8	N	1-2	10	15	15
	TMS9900	16	N	-	S	5	5
Signetics	2650	8	N	S	2	3	4
Zilog	Z-80	8	N	-	S	N/A	N/A

[1]S indicates sampling, N/A indicates information not available

[2]3K in-house, 2nd quarter; 30K in-house, 3rd quarter

[3]National has sampled over 200 accounts

[4]75 percent in-house

Source: DATAQUEST, Inc.
(November 22, 1976)

Table 2

ESTIMATED 8-BIT MICROPROCESSOR
SHIPMENTS BY TYPE

(Units in Thousands)

Microprocessor	1975	1st Qtr. 1976	2nd Qtr. 1976	3rd Qtr. 1976
8080	76	84	94	107
6800	50	18	21	30
F8	30-35	13	48	90

Source: DATAQUEST, Inc.
(November 22, 1976)

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 19, 1976

MOS MEMORY—4K RAM SHIPMENTS

Summary

4K RAM shipments continue to increase, with totals now approaching three million per month. 16-pin device shipments now exceed 22-pin devices. Faster RAMs and static 4Ks are rapidly increasing their share of the totals, while 16K RAM shipments are ramping rapidly. Japanese efforts include five manufacturers in developments, and they must be considered a potential major competitive factor. Despite the larger RAMs, the 1K market continues to prosper.

4K RAM Shipments

Table 1 gives DATAQUEST's estimates of 4K RAM shipments for March through September, which updates our Research Newsletters of March 17, June 10, and June 18, 1976. 4K RAM monthly shipments continued to increase each month throughout the third quarter. For the first nine months of 1976, they were about 19 million units. At current rates, total shipments for 1976 should be approximately 27 to 28 million units. Because prices have continued to fall, particularly since supply caught up with demand in early summer, the total dollar market for 4K RAMs has not shared this increase. However, the price decreases for standard devices, to under $4 each in quantity, have been offset somewhat by the growing volume of special devices—especially fast 4K RAMs and static RAMs.

Within the relatively stable unit market growth since June, some rapid changes have occurred in device types shipped. At that time, about one-half of the devices shipped were 22-pin RAMs; this fraction has since fallen to approximately one-third. The decline has been offset by large increases in 16- and 18-pin RAM shipments, as manufacturing capability for those devices rapidly increased. In particular, a high percentage of 4K RAMs now shipped by Intel are 16-pin, whereas the opposite was true during early summer. The current high shipments of 16-pin devices represent the fulfillment of backlogged needs, and in 1977 the mix between 16- and 22-pin devices is expected to be about equal.

In June, fast 4K RAMs accounted for about 10 to 12 percent of units shipped, nearly all of which were by NEC. Many manufacturers, including all the major ones, now offer faster 4K devices; and the percentage of fast devices shipped has probably risen to about 18 to 20 percent of the total. Many of these devices are used internally for add-on memory systems and other board applications.

Static devices have increased their share of the total, but are still a small percentage due to limited availability and/or higher price. However, shipments of 4K static RAMs are expected to increase rapidly in 1977.

One characteristic of the 4K RAM market is that a clear market dominance does not exist; market share is well diversified. Intense competition in these markets is probably a major factor in the price attrition throughout this year. Within the major segments, TI and Intel lead the 22-pin market; Mostek, Intel, and Fairchild lead in the 16-pin market. The market for faster devices has been dominated in the past by NEC, but this is being challenged by Mostek and others with newer devices. The static market has been led by EMM and AMS, but several other manufacturers are expected to become important factors, including Texas Instruments.

16K RAMs

16K RAM memories are expected to soon become increasingly important in the MOS memory market. Estimated quantity prices for 1977 in the $15 to $17 range will make them price-competitive with 4K RAMs. Currently, there are only two major producers of 16K RAMs—Intel and Mostek; both companies are expected to ship around 25,000 units in 1976, with shipments ramping upwards rapidly. Although Texas Instruments has sampled customers, both in the United States and overseas, some delay is expected in production due to redesign. However, TI is expected to be an important force in the 1977 market.

Five Japanese semiconductor manufacturers—Fujitsu, Hitachi, Mitsubishi, Nippon Electric (NEC), and Toshiba—have publicly announced that they expect to deliver samples of 16K RAMs by year-end, and Fujitsu and Mitsubishi have already done so. The Fujitsu devices use a 16-pin package and has an access time of about 200 nanoseconds. The Toshiba devices are expected to second source the Mostek 16K RAM. Although all the Japanese companies may not meet their expected deadlines, their efforts in this area must be taken very seriously. As part of Japan's efforts in VLSI, these large RAMs are expected to be one cornerstone in an initial thrust of Japanese exports of semiconductor devices.

1K RAMs

Total 1K RAM shipments are expected to be about 37 million units in 1976, up significantly from 1975. Of this total, about 10 to 12 million units are estimated to be 1103s; 16 to 18 million units are estimated to be 2102s; and 8 to 10 million units comprise all other types—2101s, 2105s, 4006s, 6002s, 7001s, etc.

Table 1

4K RAM SHIPMENT ESTIMATES

(All Figures in Thousands)

Company	March	April	May	June	July	Aug.	Sept.
TI	450	500	550	600	600	625	700
Intel	300	400	425	500	500	500	500
Mostek	375	400	400	550	500	500	550
NEC	250	250	250	290	330	370	400
NSC[1]	125	160	160	160	180	180	200
Fairchild	110	130	150	150	125	150	160
Motorola	50	60	60	60	110	120	130
EMM[2]	40	40	50	65	70	75	95
AMD[3]	15	20	40	50	50	60	65
AMS[4,5]	5	5-10	15-20	30	40	50	70
Intersil[5,6]	10	10	10	10	10	10	10
Signetics	Sampling	5	15	15	15	20	30
Total	1730	1985	2130	2480	2530	2660	2910

[1] 25 percent of this NSC output used internally

[2] All shipments are static

[3] 50 percent of 3rd quarter output is static

[4] 50 percent of this AMS output is used internally

[5] All figures are pre-merger

[6] Expected to increase sharply in fourth quarter

Source: DATAQUEST, Inc.
(November 19, 1976)

The market for the 2102—1K static RAM—continues to show excellent growth. This device is probably the favorite of a majority of microprocessor users, and is enhanced by very low prices (down to $1.10) due to intense competition. The market is led by Intel (1976 shipments are an estimated 5 million) and AMD, although Fairchild, National, and Signetics are also major manufacturers. Several other companies also produce the 1K static RAM.

The 1103 market—1K dynamic MOS RAM—also continues to prosper during this economic upturn. The average selling price remains relatively high. This market is shared primarily by AMI and Intel, although Intel's dominance—with shipments up to 800,000 per month—has grown recently due to slower shipments by AMI.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters November 12, 1976

SEMICONDUCTOR INDUSTRY UPDATE

Industry Overview

DATAQUEST believes that semiconductor industry shipments in the fourth quarter 1976 will be flat to moderately up over the previous quarter, flat through the first quarter of 1977, and will resume increases in the second quarter of next year.

We are optimistic over the longer term; no collapse is imminent. The current weakness is due to slack bookings over the past few months, which affect shipments in the near term. All major downturns have been signalled by cancellations and returns, and we do not believe this is currently occurring. Particularly relevant data include:

- New employee hiring is substantially curtailed at nearly every major semiconductor house. Increased productivity of new employees and seasonal declines in the consumer electronics area have ensured that current production capability is adequate. Major layoffs are not expected, with normal attrition being used to selectively reduce the work force, offsetting some productivity gains. However, small local layoffs may occur; for example, in Singapore, we understand one major house is on a four-day week while another has laid off about 200 workers.

- Inventories appear to be building at the distributor level, particularly in the commodity items (such as TTL) where bookings have been weakest.

- Recent industry data show that the book/bill ratio for September was very close to 1:1. Shipments for the third quarter were marginally up from the second quarter, and bookings declined.

- Lead times have fallen significantly throughout the industry as production has now satisfied the order surge of the first half. Since shorter lead times allow purchasers more time to order, they have the net effect of temporarily reducing bookings even though usage rates remain unchanged.

(NOTE—While completing this report, semiconductor stocks sold off sharply, especially on Wednesday, November 10. The data and inputs we have researched do not justify this pessimism. We will continue to closely monitor the industry and report significant data to our clients.)

The outlook above is more pessimistic than the forecast derived from our econometric model, and it reflects the reality of bookings lower than anticipated. The estimates from our model have not changed, but they do not take psychological aspects into account. General skepticism of the future economic situation is clearly tied to the order situation, especially from the capital equipment sector. Although the outlook—based on economic considerations—still is for a good year for the industry in 1977 (up 20 percent), it is unlikely to begin until confidence becomes more widespread.

The halt in new hiring in the fourth quarter in the semiconductor industry ends a major recent cost throughout the industry—training new employees. For this reason, we expect profits to continue to improve in the industry in the fourth quarter as they have for the past several quarters.

One of key developments that has negatively impacted the industry outlook is the situation in electronic watches. The electronic watch industry has three major problems:

- Supply has caught up with demand, aided by the resumption of limited production by National, and increased capability of TI and Fairchild.
- Retail store buyers are extremely wary of consumer demand and the possibility of post-Christmas inventories. They are withholding orders for the first quarter until Christmas is over.
- Some consumer dissatisfaction is evident with LED watches, especially concerning reliability and battery lifetime. This has caused enough returns to seriously upset the retail store buyers.

These problems have impacted order for LED watches, although LCD watches are still in high demand. Low orders may cause inventory buildup and problems in the first quarter. Reduced production by manufacturers will help, and they are clearly aware of the situation. However, since the consumer is the key, the situation will be clear only after Christmas.

The consumer electronics area in general has been beset by erratic retail sales. Adding to the problem has been a sales downturn in Japan in this area combined with Japanese overproduction. However, the bankruptcy of the world's largest CB producer (Cybernet) and the world's largest calculator manufacturer (Systek) removes them from the market and should benefit remaining competitors. Systek was making about 1.5 million calculators a month, and its failure enhances the competitive position of TI and National.

National Semiconductor Corporation

(Reference to DATAQUEST's August 6, 1976 Research Newsletter, National Semiconductor Update.)

I. Estimated Shipments (Dollars in Millions)

	1976*	1st Quarter 1977	2nd Quarter 1977
Components	$236	$ 88	$ 62
Consumer	80	15	21
POS	10	3	3
Memory Systems	20	10	12
Intracompany Sales	(22)	(5)	(4)
Other	2	2	2
Total	$326	$113	$ 96

*Fiscal year ending May 31, 1976

II. Product/Market Data

A. Microprocessors

1. Estimated Shipments by Calendar Quarter (Units in Thousands)

	2nd Quarter 1976	3rd Quarter 1976
IMP	12	12
SC/MP	20	35
PACE	10	15
8080A	-	2

2. The 8080A has been heavily sampled (by over 200 customers). It has been tested to be very compatible (i.e., interchangeable) with the Intel unit.

3. National is introducing an NMOS version of the SC/MP microprocessor.

B. Memory

1. Estimated 1976 Shipments (Units in Thousands):

	June	July	August	September
4K RAMs	160	180	180	200

2. National has recently received a large order from a major computer house. We believe this is from Honeywell for a fast (200 ns) 4K at a unit price in excess of $4.

3. An 18-pin 4K RAM is being shipped in-house to the Memory Systems Division.

4. 4K static RAM samples are anticipated in the first quarter of 1977.

5. National is developing a 16K RAM (Part Number MM5290) that is pin-compatible with the Mostek 16K RAM. A first quarter 1977 estimate for sample delivery could prove optimistic.

C. Consumer

1. We expect the Consumer Products Division will lose money in the current (second) quarter and in the third quarter.

2. DATAQUEST estimates that National shipped $4.5 million in calculators in the first quarter of fiscal 1977 (ended September 19, 1976), and an estimated $7.0 million in the second quarter. Calculator production volume is believed to be down substantially, to an estimated 250,000 per month. DATAQUEST believes the calculator operation is profitable.

3. Finished watch volume is believed to be also down substantially, to less than 100,000 units per month. National has an order from Timex for 3 million LED watch chips.

4. We expect National to ship somewhat more than 150,000 video games before December 31, 1976 at an ASP of about $60.

D. Systems

1. The Memory Systems Division is estimated to be at an annualized $45 million running rate and to be profitable and growing.

2. The POS Division is estimated to be running at an annual rate of over $13 million and is ramping at a profit.

3. The 158 and 148 Emulators are carried at zero inventory and no capitalized development cost. Initial orders have been received. Gross manufacturing costs for a unit are very low—at an estimated $90,000.

III. Analysis

Fred Bialek, the new Consumer Division general manager, has the confidence and trust of the key personnel in the consumer division; his impact is being felt. DATAQUEST has received information that the consumer products area has laid off 10 to 12 design people, but we believe most of these will be replaced. Mr. Bialek has been on the road contacting customers to obtain commitments. We believe that National plans to go to the Consumer Electronics Show in Chicago in January with a major emphasis on games and some new calculator models. National's problems with declining market shares in calculators and watches indicate a marketing problem. We look for a product line by product line review with the profitable consumer lines being emphasized, and the unprofitable lines being eliminated.

National's decision to go into the 158 second source business may prove to be a large revenue and profit generator. A successful analog to this decision exists in Amdahl Corporation's 168 Emulator, which will likely result in $100 million worth of business in 1976. Some time must elapse before we can determine whether National can duplicate this success.

DATAQUEST estimates that the semiconductor shipment running rate will decline slightly in the fourth quarter. We believe this is due to both a general softening in the market for commodity products, and a slight slip in market share in Europe due to an increased effectiveness by Philips/Signetics.

National has grown by a factor of five in the last five years—from $60 million in 1972 to $325 million in fiscal 1976. The fact that the watch correction problem apparently came as such a surprise raises a question as to whether the management talent influx and the development control procedures have kept pace with National's growth. DATAQUEST feels that this problem such as it currently exists can be rectified.

Texas Instruments, Inc.

I. Bookings Information

A. Estimated Domestic Bookings of the Semiconductor Division (Dollars in Millions):

Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1976	$ 88	$103	$ 96	N/A
1975	76	94	90	N/A

B. There are indications that bookings will be flat to slightly up in the fourth quarter.

C. We do not believe overseas bookings showed the same decline in the third quarter.

II. Product/Market Data

A. Memories

1. We believe 4K RAM shipments in September were 700,000 to 750,000 units, up from an estimated 550,000 to 600,000 units shipped in August. We estimate that about 200,000 units were assembled and shipped from overseas facilities to foreign markets.

2. TI has a 64K CCD memory in layout.

3. 16K RAM development is accelerating. DATAQUEST expects to see samples delivered in the first quarter of 1977.

B. Microprocessors

1. DATAQUEST estimates TI's third quarter shipments of 8080s were 14,000 to 16,000 units, with a substantial percentage of this total being used in-house on projects like the Mark 10 terminal. One major user is Sycor.

2. We estimate 9900 shipments to be fewer than 5,000 per quarter.

3. TMS 1000, 1100, 1200, and 1300—Estimated shipments are about 25,000 to 30,000 per month, with about 75 percent in-house.

C. Calculators—Industry sources estimate that current running rates on total units at TI are about 800,000 per month, with an ASP of $16 to $20.

D. Watches—It is estimated that watch production has ramped rapidly to about 500,000 units per month. DATAQUEST estimates total production in 1976 at about 4 million units.

III. Analysis

According to our estimates, TI's watch program has been successful in implementing high volume production. TI is now a formidable competitor for the low-priced end of the watch market.

DATAQUEST estimates this year that the consumer area is leading TI's growth. DATAQUEST places TI's calculator volume at number two in the world, pushing hard on Casio for the number one position in unit volume.

In the semiconductor area, TI has still not made a solid impact on the microprocessor market. DATAQUEST estimates fourth quarter semiconductor shipments to be flat.

Intel Corporation

I. Estimated 1976 Shipments (Dollars in Millions)

	3rd Quarter	4th Quarter
Components	$ 38	$ 41-42
Microcomputers	19	21-22
Memory Systems	10	12
Microma	9	10
Intracompany Sales	(14)	(16)
Total	$ 62	$ 68-70

II. Product/Market Data

A. Microprocessors

1. Estimated 1976 Shipments (Units in Thousands)

	2nd Quarter	3rd Quarter
8008/8080	80	90

2. About two-thirds of the total above is 8080 microprocessors.

3. New microprocessors (i.e., 8048 and 8085 types) and their availability will likely be announced at the Electronica '76 Trade Fair in Munich, to be held from November 25 to December 1.

B. Memory

1. We estimate that June through September monthly 4K shipments have been flat, in the 500,000 units per month range. 16-pin devices are about 20 percent of the total.

2. A high speed version of the 2107 4K RAM will probably be introduced this month (November).

3. Intel is expected to second source the MOSTEK fast 4K RAM (4027) shortly.

4. We anticipate that Intel will ship about 20,000 to 25,000 16K RAMs in calendar 1976.

5. The Intel 2416 (the 16K CCD memory) is receiving good market acceptance in the $4 to $6 unit price range. We estimate current shipments to be about 50,000 per quarter.

6. Intel's shipments of the 1103 (the 1K dynamic RAM) have increased approximately 25 percent recently due to delivery problems at AMI. This is a (relatively) high ASP part.

7. The Intel 2708 8K EROM is apparently proving to be a strong contributor in the third and fourth quarter. The volume price for this part is $30 to $45; the distributor price is $49. DATAQUEST estimates that Intel shipped in excess of 250,000 parts in the third quarter at an ASP of $40. This is substantially in excess of the current market usage and reflects yield breakthroughs and a catch up of delinquent orders. Shipments in the fourth quarter are expected to be less than the third and the delinquency situation should disappear. This part is currently also being sampled by Electronic Arrays, TI, and Fujitsu, with samples expected from AMD and Motorola soon.

C. Microma—The Microma division (LCD watches) is profitable. Its shipments (as shown) are roughly 15 percent of Intel's total. Therefore, the impact of Microma's 10 to 12 percent pretax on Intel's 23 percent pretax from semiconductor has been felt. Intel is not looking for a buyer for Microma at this time. In January, Microma will introduce a new line of improved styles. DATAQUEST estimates micrõma shipped 850,000 to 950,000 watches in 1976.

D. Memory Systems—The Memory Systems Division has grown rapidly and is apparently profitable. DATAQUEST believes there may have been a slight inventory buildup in this division in the third quarter.

III. Analysis

Microma has settled into about 15 percent of Intel's total volume. DATAQUEST believes that the past negative impact on Intel's margins due to Microma is over, and the future Microma could have a slightly positive impact. It is also DATAQUEST's opinion that at this point, Intel's management is committed to retaining Microma. As the leading LCD watch supplier, Microma has a uniquely positive position.

We believe Intel is looking for 20 to 25 percent growth in 1977 over 1976. We are looking for a substantial series of new product announcements in the first quarter of 1977. Many of them will likely be peripheral circuits to support the microprocessor.

Intel has been very successful with its add-on memory business, which is generating margins we believe are consistent with the corporate margins.

Intel has consistently managed to be on the marketplace with a significant product which is for all intents and purposes a sole source. This has occurred again with the 2708, which has followed the 8080, 2102, and the 1103. DATAQUEST believes that the 2708's volume will make a substantial contribution to Intel's fourth quarter sales. Intel should also benefit in the fourth quarter from the return of a fair amount of 1103 (1K dynamic RAM) business which would have gone to AMI. DATAQUEST believes Intel can continue the product record discussed above.

Fairchild Camera and Instrument Corporation

I. Estimated 1976 Shipments (Dollars in Millions)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Semiconductors	$ 63.0	$ 72.0	$ 72.0	$ 79.0
MOS (Only)	6.0	8.0	8.0	9.0
Systems	3.5	5.5	4.0	4.0
Consumer	21.0	26.0	33.0	33.0
Government, Cameras, and Other	10.0	11.0	11.0	12.0
Intracompany Sales	(2.5)	(2.5)	(2.0)	(3.0)
Total	$ 95.0	$112.0	$118.0	$125.0

II. Product/Market Data

A. DATAQUEST estimates Fairchild has a 1:1 book-to-bill ratio for digital IC's and a 1.4:1 ratio for MOS in the third quarter.

B. Memory

1. Estimated 1976 merchant 4K RAM Shipments (Units in Thousands)

	June	July	August	September
4K RAMs	150	125	150	160

2. Usage of four 4K RAMs per video game should provide a 300,000 to 400,000 unit usage in-house in the fourth quarter.

3. We estimate Fairchild's current running rate of 2102s (1K static RAM) to be about 375,000 per month, which is up from less than 50,000 per month in March.

4. We expect 16K RAM samples in the first quarter 1977. Die size is about 40,000 square mils.

5. The current running rate of all MOS products is estimated to be about $3 million per month, with CMOS at less than $1 million per month of the total.

C. Microprocessor

1. Estimated 1976 Shipments (Units in Thousands)

	2nd Qtr.	3rd Qtr.	4th Qtr.
F8 - Merchant	30	40	45
F8 - In-House	3	30	50-60

2. F8 acceptance is improving rapidly; users include Olivetti, DEC, Univac, Amana, and Recognition Equipment, Inc. Several high volume applications are imminent in such areas as traffic lights, washing machines, and microwave ovens.

D. Consumer

1. DATAQUEST estimates that 100,000 video games will be shipped in the fourth quarter this year at an ASP of $90 to $100. Each game uses four 4Ks and one F8.

2. DATAQUEST estimates Fairchild watch volume at 2.5 million units in 1976.

III. Analysis

DATAQUEST estimates that about $10 million of Consumer Group shipments in the fourth quarter will be games. Fairchild has built up an impressive Consumer Products activity, as indicated by the numbers.

DATAQUEST is reserving judgement on the final result of 1976 LED watch sales by Fairchild (and the outlook for the first quarter 1977) until the Christmas season has passed and the final 1976 retailer's sell-through has been evaluated.

Fairchild is still relatively weak in the MOS area, as indicated by our volume estimates. It has done a good job, having entered the 2102 market late, and its F8 market penetration over the last six months has been improving.

The Motorola/Fairchild exchange should benefit both companies. It should enhance the F8 and 6800 market penetration and give Fairchild a better position in the rather limited ECL market.

Motorola Semiconductor Products Division

I. Estimated 1976 Shipments (Dollars in Millions)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Total Semiconductor	$111	$120	$117	$130	$460
MOS Division	10	14	18	20	62

II. Product/Market Data

A. Approximately 66 percent of MOS shipments estimated for 1976 are CMOS.

B. The MOS Division was apparently profitable in the third quarter of 1976.

C. Microprocessors

1. Estimated 1976 Shipments (Units in Thousands)

	1st Qtr.	2nd Qtr.	3rd Qtr.
Microprocessors	13	14	25
Associated Circuits	35	46	71

2. DATAQUEST estimates September shipments of the 6800 microprocessor at 16,000 to 18,000 with 14,000 associated circuits.

D. Estimated 1976 4K RAM Shipments (Units in Thousands)

	1st Qtr.	2nd Qtr.	3rd Qtr.
4K RAMs	152	187	352*

*50 percent to Univac

E. The book-to-bill ratio in the third quarter was about 1:1.

F. Motorola has a 3 million unit LCD watch module order from Timex. Current module run rate is 60,000 to 70,000 units per month.

III. Analysis

The recent technology exchange between Motorola and Fairchild apparently benefited both companies. Motorola is becoming packaged out of TTL procurements by virtue of not having low-power Schottky. This problem has now been essentially resolved. The exchange gives both sides a high end and a low end microprocessor, which will aid marketing.

Motorola's MOS has apparently crossed over the critical mass in both volume and profits. Motorola is very close to first, if not in first place, in CMOS.

We believe that the Semiconductor Division's margins for the second half of 1976 are as high as they have ever been in the history of the division. While the discrete business appears rather mundane to some observers, Motorola continues to take steps to enhance its market position in its various discrete lines. Historically, these lines have been very profitable.

Signetics Corporation

I. Estimated 1976 Shipments (Dollars in Millions)

1st Qtr.	2nd Qtr.	3rd Qtr. (16 Weeks)	4th Qtr.	Total Year
$21	$27	$40	$35	$121

A. Domestic shipments are 75 to 80 percent of the total with foreign at 20 to 25 percent.

B. We estimated that the book-to-bill ratio was less than 1:1 in the late third quarter and to date in the fourth quarter.

II. Product/Market Data

A. Estimated 1976 Product Mix:

Product Category	Percent of Total
Logic	43%
Bipolar Memory	25%
Linear	22%
MOS	10%

B. Estimated 1976 Microprocessor Shipments (Units in Thousands)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
2650s	2	3	4	5

C. Estimated 1976 4K RAM Shipments (Units in Thousands)

	June	July	August	September
4K RAMs	20	20	20	30

D. A 16K MOS ROM is under development.

E. Signetics' penetration of Europe is up significantly. DATAQUEST estimates that Philips has 130 salesmen in Europe selling Signetics as well as other Philips products.

F. Philips currently accounts for less than 5 percent of Signetics' business.

III. Analysis

Signetics' penetration of Europe continues to increase. The 2650 should be a much larger factor in Europe than in the United States. Signetics' TTL market penetration is increasing, possibly at the expense of National and TI.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: 2.8 Markets

November 5, 1976

CHARGE COUPLED DEVICES AND MAGNETIC BUBBLE DEVICES

Summary

The market for Charge Coupled Devices (CCDs) is expected to grow to $130 million by 1981 while the market for Magnetic Bubble Devices (MBDs) is forecast at $141 million in 1981. The largest market for these technologies is mass storage. Both technologies combined should have $150 million of sales for mass storage by 1981. Other markets for CCDs and MBDs include a host of applications such as microcomputer systems, military systems, video terminals, intelligent terminals, programmable calculators, entertainment systems, and automotive systems. Non-memory applications of CCDs such as video cameras and signal processing filters are not included in the market estimates.

Currently only Fairchild and Intel have CCD products on the market. Fairchild offers a 9K and 16K device while Intel offers a 16K device. Both firms are expected to unveil 65K CCDs by mid 1977. Motorola may be second sourcing the Fairchild 65K CCD as a result of a recent technology exchange. Texas Instruments is expected to begin sampling its 65K CCD in early 1977. Another seven firms are actively working on CCDs.

To date Hitachi, Rockwell International, and Texas Instruments have announced MBD products for the merchant market. Western Electric and IBM are pursuing MBDs in the captive market. A number of mini-computer and mainframe firms as well as some foreign firms are following MBD device technology and system applications.

Gap Filler Technologies

Research and product announcements for Charge Coupled Devices and Magnetic Bubble Devices appearing this year have generated interest in the potential markets for these devices. These two devices and their technologies are often referred to as "gap filler technologies." The name arises because their cost and performance (i.e., access time) falls between that of high speed, high cost main memory, and low speed, low cost auxiliary storage (See Figure 1 and Table 1).

Table 1

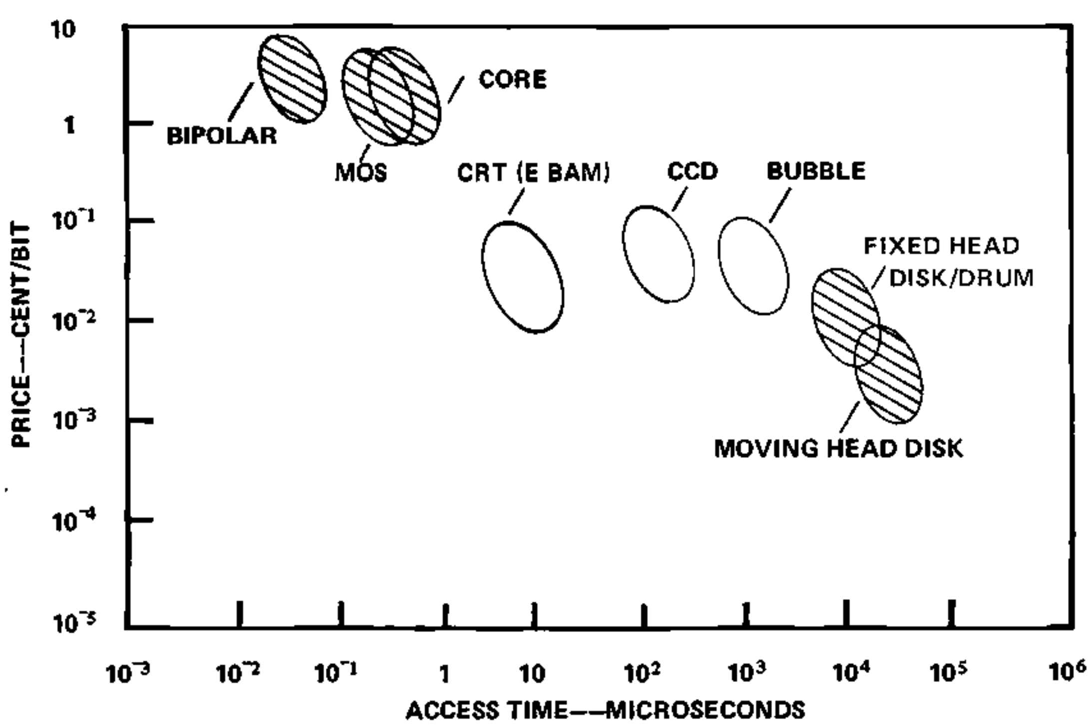
1977 CHARACTERISTICS OF CCDS AND MBDS
(Compared With MOS RAMs and Floppy Discs)

	MOS RAMs	CCDs	MBDs	Floppy Discs
Access Time	150-350nsec	100µsec	1-3msec	300msec
Transfer Rate	2M bit/s per chip	1-5M bit/s per chip	100K bit/s per chip	250K bit/s per disc
Typical Storage Capacity	16K bit per chip	65K bit per chip	92K bit per chip	3M bit per disc
Read Error Rate	1 in 10^{10}	1 in 10^{10}	1 in 10^{12}	1 in 10^{8}
Reliability, MTBF in hours	7000	7000	7000	4500
Removable Media	No	No	No	Yes
Non-volatile	With battery	With battery	Yes	Yes

Source: DATAQUEST, Inc.
11/5/76

Figure 1

PRICE/PERFORMANCE OF MEMORY TECHNOLOGIES



Source: DATAQUEST, Inc., Computer 2/75

Interest is high in both technologies because they offer the promise of high speed, high reliability, small size, and low error rates. They offer the possibility of replacing failure-prone, rotating magnetic memories with reliable solid-state memories. CCDs have high transfer rates on the order of 1 to 5 megabits per second, similar to main memory, magnetic bubbles have much lower transfer rates on the order of 100 to 200 kilobits per second much like that of floppy discs. CCDs are being packaged as 16- and 65-kilobit chips while magnetic bubbles are appearing in 20- and 92-kilobit packages. CCDs are volatile while MBDs are non-volatile (that is, they will not lose the stored information when the power is turned off. This difference will lead to a preference for magnetic bubbles in some applications.

Markets for CCDs and MBDs

Table 2 lists the estimated market for CCDs and MBDs over the five-year period 1977 through 1981. The market for CCDs is expected to grow to $130 million by 1981 while the MBD market is forecast at $141 million in 1981. The largest market for these technolgies is mass storage systems whose size ranges from one-half to 20 megabits. This market is expected to total $150 million in 1981 for both technologies. This is primarily a disc replacement market replacing smaller fixed head and moving head discs as well as floppy discs plus cartridge tapes. We have projected equal market shares in mass storage applications because neither technology presently has a clear cut advantage in this market. Advantages will develop for one technology over the other as one technology with greater availablility (including second sources), lower price, higher density, and other attractive features becomes the choice of designers.

The secondary market for these devices is in a host of other applications including microcomputer systems, military systems, video terminals, intelligent terminals, programmable calculators, entertainment systems, and automotive systems. In these other applications, a larger market is forecast for one technology when it appears to have a performance or market advantage. For example, the military prefers magnetic bubbles over CCDs because they are non-volatile. In games and video systems, CCDs have the advantage of their higher transfer rate; in intelligent terminals and programmable calculators, magnetic bubbles are preferred because they are non-volatile.

Aside from the memory applications discussed above, CCDs are also finding applications in TV cameras, line scanners, and filters for radar and communications signal processing. The markets for these video and signal processing applications are not included in Table 2.

Table 2

ESTIMATED WORLDWIDE MARKET FOR CHARGE COUPLED DEVICES
AND MAGNETIC BUBBLE DEVICES
(Dollars in Millions)

	Charged Coupled Devices*			Magnetic Bubble Devices		
	1977	1978	1981	1977	1978	1981
Mass Storage Systems						
Fixed and Moving Head Disc	2	7	35	2	7	35
Floppy Disc and Cassette	2	11	40	2	11	40
Subtotal	4	18	75	4	18	75
Other Applications						
Microcomputer Systems	1	2	15	1	2	18
Military Systems	-	2	12	-	2	20
Intelligent Terminals	-	-	2	-	1	5
Programmable Calculators	-	-	1	-	1	4
Games	-	3	15	-	-	1
Automotive	-	-	3	-	-	8
Other	1	1	7	1	1	10
Subtotal	2	8	55	2	5	66
Total Market	6	26	130	6	23	141

Source: DATAQUEST, Inc.
11/5/76

*Non-memory applications for CCDs are not included in these estimates.

Average Selling Price

Table 3 shows our forecast of the average selling price of CCDs and MBDs for the period 1977 to 1981. It also includes the expected average selling price of MOS RAMs. The table shows that magnetic bubbles and CCDs should be price competitive with one another. It further shows that the price advantage of CCDs and MBDs over MOS RAMs should be in the range of 2.5 to 3 over the next five years. This is a true price advantage, but since price and performance are always a trade off, price alone does not create an overwhelming mandate for the use of CCDs and MBDs. They must be marketed on the basis of performance and price.

Table 3

ESTIMATED AVERAGE SELLING PRICE OF CCDs, MBDs, AND MOS RAMs
(Millicents per Bit)

	1977	1978	1979	1980	1981
Charge Coupled Devices (CCDs)					
9K CCD	60	-	-	-	-
16K CCD	50	30	-	-	-
64K CCD	40*	25	15	10	9
256K CCD	-	-	18	12	9
Magnetic Bubble Devices (MBDs)					
20K MBD	50	35	20	-	-
92K MBD	40**	26	15	10	9
256K MBD	-	35	18	12	9
1M MBD	-	-	-	15	12
MOS RAMs (ASP for Standard Device)					
1K RAM (Static)	220	190	160	140	125
4K RAM (16-Pin, Dynamic)	113	88	75	63	50
4K RAM (Static)	200	160	140	125	110
16K RAM (16-Pin, Dynamic)	106	69	44	31	25
64K RAM	-	78	47	28	22

Source: DATAQUEST, Inc.
11/5/76

*Samples—1st quarter 1977
**Samples—4th quarter 1976

Competition

CCDs

Presently only Fairchild and Intel have CCD memory devices on the market. Fairchild started shipping its 9K CCD in early 1975 and its 16K device in late 1975. Intel came to market with its 16K CCD in February 1975. Both companies are expected to introduce 65K CCDs in 1977.

Under the terms of the recent Fairchild-Motorola technology exchange, Motorola has the right to produce Fairchild's upcoming 65K CCD memory. If this comes to pass, the Fairchild 65K CCD could be the first CCD with a second source. This is a significant announcement as the availability of a second source often stimulates the use of new devices.

Besides selling CCD devices Intel offers a 1 megabit CCD memory board aimed at the mass memory market. We believe this is becoming a very successful product for Intel. Fairchild is following Intel's lead in the memory system business, and we believe they will soon be selling CCD memory systems.

It is important to realize that CCDs are MOS devices; hence, it is a fairly straightforward operation for a semiconductor company with MOS capability to develop the process and begin making and selling CCDs. Texas Instruments has announced a 65K CCD product which is expected in sample quantities in the first quarter of 1977. Other companies known to be working on CCD devices are: AMD, AMS, Hitachi, Motorola, National Semiconductor, Signetics, and Toshiba. We expect that by mid to late 1977 a half dozen companies will have CCD products on the market. As more product and second sources become available in late 1977 and early 1978, CCDs should begin to come into their own.

MBDs

Magnetic bubble technology is not a silicon technology; rather, it is a technology using garnet and is highly dependent upon magnetics. Therefore, more specialized experience is required on the part of engineers and processing personnel. Although processing resembles that of semiconductors, bubble technology is not a simple extension of the in-house capability for a semiconductor firm. It requires a definite commitment of people, facilities, and some special capital equipment.

At present there are two captive manufacturers of magnetic bubbles—Western Electric and IBM. In 1976 Western Electric put a magnetic bubble production line into operation in Eastern Pennsylvania. Its first application for magnetic bubbles will be a voice announcement system to play recorded messages such as "this is no longer a working number." Western Electric will package several 20-kilobit chips into a 272-kilobit module for recording ten seconds of digitized voice.

IBM is still in a research mode on magnetic bubbles and is working energetically on bubbles at its Watson Research Laboratory in Yorkton Heights, New York as well as at its San Jose California research laboratory. Although IBM will be a captive manufacturer, it is expected to be a powerful force in the market once it begins putting magnetic bubbles into mass storage systems. With bubbles IBM could insert a modest amount of data processing into the storage areas. While this may not significantly change computer throughput, it would certainly disrupt the markets of plug compatible disc manufacturers. Furthermore, MBDs promise about a ten-fold improvement in access time that would not be easy to duplicate in standard disc technology.

Texas Instruments has an engineering pilot line which began producing MBD chips in the second quarter of 1976. It will ship sample quantities in the fourth quarter of 1976 and begin delivery of higher volumes in the first quarter of 1977. TI has about 100 people working on magnetic bubbles including engineers, technicians, and production workers. The company has made a major commitment to make magnetic bubbles a success. In addition to the corporate commitment, it has received substantial government funding in magnetic bubble research and development since 1974. TI plans to sell magnetic bubble chips in the merchant market. At this time they have no announced plans to make and sell magnetic bubble memory systems, but those plans can certainly be developed quickly if TI finds the memory system business an attractive opportunity.

Rockwell International has a small bubble pilot line and has been funded by several major government contracts. Its capacity is much less than that of TI, and it has a different marketing plan; namely, to make and market magnetic bubble systems rather than to sell chips. One of its initial offerings will be memory system for POS terminals. This 800-kilobit memory will include eight 100-kilobit chips plus all the necessary peripheral support circuits.

In addition there are several minicomputer and mainframe computer manufacturers that are actively following magnetic bubbles but are not in a position to be manufacturing them in the near future. These include Burroughs, Hewlett-Packard, and Univac. Typically, they have fewer than ten people and in some cases fewer than five working on magnetic bubbles for both device and system application aspects. In Japan, Hitachi has announced and begun sampling a 20-kilobit magnetic bubble device. It will begin shipments of larger quantities in the first quarter of 1977. Its pilot line capacity is believed to be comparable to that of Texas Instruments. Fujitsu has reportedly made an 80-kilobit chip which is still in the laboratory stages. Nippon Electric has demonstrated 16-kilobit chips and has a 100-megabyte system that is still in development. In Europe, Plessey has reportedly made some 8- and 16-kilobit chips, but it is in a laboratory phase. Philips and Siemens are performing magnetic bubble research.

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters October 26, 1976

GENERAL SEMICONDUCTOR INDUSTRY OUTLOOK

We have received many inquiries from clients regarding DATAQUEST's forecast of semiconductor shipments for the coming year. In response we have reprinted the industry outlook from DATAQUEST's notebook. This outlook is updated on a quarterly basis and distributed to holders of our notebook.

This industry outlook is based upon DATAQUEST's econometric model of the semiconductor industry which assumes that industry demand is determined by macroeconomic variables. The model uses leading indicators of semiconductor demand—such as industrial production, money supply, etc.—to forecast industry shipments twelve months into the future. This model uses current economic information and does not require forecasts of the general economy.

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2 Markets

GENERAL INDUSTRY OUTLOOK

In the third quarter of 1976, the recovery of the semiconductor industry from the recent recession slowed considerably. Shipments appear to have changed little from the second quarter, and bookings in the third quarter dropped dramatically from the high book-to-bill ratios of the previous quarter. However, for the next 12 months, we expect industry shipments to continue their recovery and increase at a rate of about 3 to 7 percent each quarter over the previous quarter.

In the third quarter of this year, the U.S. and world economies continued to recover, but at a slower pace than earlier. In particular, recovery in the United States was affected by a slowdown in consumer spending in the early part of the summer; this caused a reaction in other economic measures. As consumer spending slowed, manufacturers moved quickly to reduce inventory accumulation, which had been strong throughout the first half of the year. We feel this was a major factor in the slowdown of bookings by the semiconductor industry. Manufacturers that use semiconductors are still sensitive from 1974 and skeptical of the economic situation. Besides inventories, the sluggishness in the overall economy caused a slowing of long term orders.

A second major factor in the third quarter has been the continued problems of several other national economies. The Japanese economy, which came to life remarkably in the second quarter with major increases in manufacturing output, slowed again during the summer. The Japanese economy has been sluggish due to reduced levels of consumer spending. In the summer, inflation increased markedly in Japan and has been running at a level of about 9.5 percent, which has resulted in a dampening effect throughout its economy. It is felt that the Japanese consumer has been faced with level—or possibly decreasing—real spendable income, and this has been reflected in the marketplace. Although GNP in Japan is now above previous highs, Japanese industrial output is still about 5 percent below record levels. Of critical importance, Japanese spending for plant and equipment is at levels considerably below 1973.

In Europe, the economic picture is highly mixed. The economies of the United Kingdom, France, and Italy have been plagued with problems, and improvements in their general economies have been very sluggish. These countries have been affected by high rates of inflation, relatively high unemployment, and poor trade balances. Austerity measures to slow the rate of inflation have braking effects on their econo-

Table 2-1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(Dollars in Millions)

	1974	1975	Percent 74-75	1976	Percent 75-76
Discrete Devices	$1,103	$ 901	-18.3%	$1,091	21.1%
Integrated Circuits	1,471	1,195	-18.8%	1,512	26.5%
Total	$2,574	$2,096	-18.6%	$2,603	24.2%

Source: DATAQUEST, Inc.

Table 2-2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

1975	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$232	$221	$214	$234	$ 901
Integrated Circuits	305	297	288	305	1,195
Total	$537	$518	$502	$539	$2,096

1976	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$255	$272	$269	$295	$1,091
Integrated Circuits	344	379	378	411	1,512
Total	$599	$651	$647	$706	$2,603

1977	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$308	$325	$317		
Integrated Circuits	433	461	473		
Total	$741	$786	$790		

10/26/76

Source: DATAQUEST, Inc.

mies. Like Japan, industrial production of European nations is still about 5 percent below previous levels. Most forecasts show only a low expected rate of increase.

Despite these problems, we feel the next 12 months should reveal a growing U.S. and worldwide economy. Throughout 1976, major indications of an improving economy have continued to appear. These include increasing industrial production, worker productivity, consumer expending, and corporate liquidity. Furthermore, the industrial and housing segments are beginning to move.

Although semiconductor demand is at record levels, strong bases of semiconductor usage, which include the capital equipment market and foreign markets, have not yet been a factor in the recovery. Capital spending, or fixed investment, has not recovered from the last recession, particularly in Japan and Europe, but also in the United States. Excess production capacity and general caution in the business community have combined to keep capital equipment spending down. As business expands capacity, capital spending purchases are expected to provide a major increase in semiconductor demand in 1977.

2 Markets

European and Japanese semiconductor demand is expected to increase as those economies continue to recover. In particular, this should mean an overflow business for U.S. manufacturers as domestic capacity is exceeded. However, orders and shipments of Japanese manufacturers, which increased dramatically through the second quarter of this year (a doubling), fell considerably during the third quarter.

Our current forecast is shown in Tables 2-1 and 2-2. Semiconductor shipments are expected to show continued improvement throughout the remainder of 1976 and the first three quarters of 1977. Total industry shipments (U.S. factory sales) are expected to be 24 percent above those of 1975. By the fourth quarter of this year, shipping levels should be at new records. The high rate of increase in 1976 is a result of very strong first and second quarters, with a slowing in improvements during the third and fourth quarters. Shipping rates are expected to enter 1977 about 10 percent above the 1976 average, which is somewhat lower than our previous forecast. Increased shipments in 1977 should bring that year to a level of about 20 to 25 percent above 1976.

This forecast reflects higher shipments for 1976 than our previous forecast and a slower rate of increase for 1977. Our forecast is derived from an econometric model that is based on government data, in which recent revisions are contributing to the higher figures for 1976. Coincidentally, this is in line with the shipping rates reported for the first half of the year by WEMA.

The weakness of semiconductor demand during the summer has halted some of the following more positive trends seen during the second quarter: larger, longer term orders; price firming; longer lead times; and a decrease in excess capacity. These trends should be revived in the fourth quarter. Unemployment, particularly for professionals, has continued to decline throughout the summer and is now at a very low level. Industry profits have been improving, although with erratic results from company to company.

The slowdown in the world economies and the resultant softness of semiconductor demand over the summer has had a positive effect on the major question of semiconductor industry capacity and its ability to meet potential demand. The possibilities of a future "runaway" situation, like the one that developed in 1973, are becoming unlikely. Nevertheless, shortages could begin to develop in some product lines sometime in 1977. We feel a limitation on semiconductor production may be caused by the lack of both equipment and personnel. A 20 to 30 percent increase in semiconductor production, over and above previous record levels (as forecast for 1977), will likely cause strains in finding and training capable employees, and in installing production equipment.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters September 3, 1976

MICROPROCESSOR STATUS

DATAQUEST has reviewed the market for N- and P-channel microprocessors and assembled a record of past shipments. Table 1 is our estimate of microprocessor shipments by most manufacturers from January 1, 1975 through April 1, 1976. In the interest of organizing and publishing this data, DATAQUEST has not considered bipolar and CMOS based microprocessors; however, this will be done in future reports.

Comments on several of the leading suppliers are given below. These comments do not include all manufacturers, nor are they intended to reflect on any company's relative importance in the marketplace.

- Intel—Intel is making substantial effort on new products, some of which have been announced.

- National—National is now shipping 8080As. Market acceptance for the SC/MP is accelerating. DATAQUEST understands that Gottlieb and Williams (electronic games) have committed to SC/MP. An N-channel version of SC/MP is scheduled for introduction this summer.

- Texas Instruments—TI has expanded the TMS 1000 and 1200 into a family of microprocessors, including the 1070 and 1270 with 8K of ROM. In the fourth quarter of 1975, TI introduced the 1100 and 1300 with 16K of ROM. DATAQUEST estimates the ASP of the first quarter shipments of the TMS 1000 family to be in the $6.00 range.

  TI has standardized on the 8080 internally and the bulk of the first quarter shipments were internal; the company is not delivering the 8080A.

  We believe the ASP for the first quarter shipments of the SBP 0400 (an I^2L 4-bit microprocessor) to be in the area of $12.00. TI plans to introduce the SPB 0481 soon.

  The TMS 9900 was released to production in the second quarter of 1976. The chip is 53,000 square mils in a 64-pin package.

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- Rockwell—Rockwell shipped additional custom microprocessors to business machine and automotive applications. Inclusion of these shipments would raise our estimate 30 to 40 percent.

- Motorola—The market position of the 6800 has been strengthened by the second sourcing agreement with Hitachi and Thompson-CSF.

James F. Riley

Table 1

ESTIMATED UNIT SHIPMENTS OF
NMOS AND PMOS MICROPROCESSORS
(1975 and First Quarter 1976)

Company	Unit	Description	Shipments (Units in Thousands) Year 1975	1st Qtr. 1976
AMD	8080	8-bit, NMOS	10	5
AMI	6800	8-bit, NMOS	5	2-3
EA	9002	8-bit, NMOS	-	-
EMM	CP-1600	16-bit, NMOS	-	Samples
Fairchild	F-8	8-bit, NMOS	25-30	8
GI	CP-1600	16-bit, NMOS	N/A	N/A
Intel	4004	4-bit, PMOS	250-300	*
	8008	8-bit, PMOS	200-300	*
	8080	8-bit, NMOS	60	60
Mostek	F-8	8-bit, NMOS	5	5
Motorola	6800	8-bit, NMOS	45	15
National	IMP	4-bit, PMOS	1	10-15
	PACE	16-bit, PMOS	5-10	10
	SC/MP	8-bit, PMOS	5-10	Small
NEC	8080	8-bit, NMOS	5	5
Rockwell	PPS4	4-bit, PMOS	400	90
	PPS8	8-bit ,PMOS	-	-
Texas Instruments	TMS 1000	4-bit, PMOS	50	60
	TMS 8080	8-bit, NMOS	1-2	10
	SBP 0400	4-bit, I^2L	-	5
	TMS 9900	16-bit, NMOS	-	Samples
Signetics	2650	8-bit, NMOS	Samples	5

*DATAQUEST research was oriented primarily to newer 8-bit units. We do not have a reasonable estimate on the 4004 or 8008 at time of publication.

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters

June 18, 1976

UPDATED 4K RAM SHIPMENTS AND STATUS

Based on information received this week, we wish to modify our Research Newsletter dated June 10.

DATAQUEST estimates that Signetics shipped the following quantities in March, April, and May:

March	-	Samples
April	-	5,000
May	-	15,000

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DATAQUEST INCORPORATED RESEARCH NEWSLETTER

SIS Code: Newsletters June 10, 1976

UPDATED 4K RAM SHIPMENTS, STATUS, AND COMMENTS

Table 1 represents DATAQUEST's estimates of 4K RAM shipments for March, April, and May.

We have made the following observations about this data:

1. The semiconductor industry appears to be in an inventory position for both 16 and 22 pin 4K RAMs. Table 1 reports shipments of slightly over 2.1 million units in May. DATAQUEST estimates production at 2.4 million. This situation should produce some price softness.

2. The 4K static RAM is becoming more of a factor in the marketplace. For many microprocessor applications, static memory is preferred over dynamic memory, providing a ready market for these devices. AMD and EMM are shipping 4K statics while Intel, NEC, and others are in advanced development.

3. We feel our estimates of Texas Instruments' February shipments were slightly high. Our adjusted figure for TI is 450,000 units shipped in February, and flat continuing through March.

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Table 1

4K RAM SHIPMENT ESTIMATES
FOR MARCH, APRIL, MAY 1976

(All figures in thousands)

Company	March	April	May
TI	450	500	550
Intel	300	400	425
Mostek	375	400	400
NEC	250	250	250
NSC(1)	125	160	160
Fairchild	110	130	150
Motorola	70	70	70
EMM(2)	40	40	50
AMD(3)	15	20	40
AMS(4)	5	5-10	15-20
Intersil	10	10	10
EA	Sampling	Sampling	5

(1) 25% of NSC output used internally.

(2) All shipments are static.

(3) Figures include 4K static shipments of 5,000, 5,000, and 15,000, respectively.

(4) 50% of AMS output is used internally.

DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS CODE: Newsletters

April 14, 1976

TTL ORDER RATES INCREASE--DELIVERY TIMES EXTEND

TTL products have recently experienced a major upsurge in orders. The sales upturn in commodity devices marks the final major key in the revival of semiconductor demand. The increase in TTL demand has been large and has caught the industry somewhat unprepared. Lead times for many TTL devices have increased to 16 to 18 weeks, as opposed to lead times of about 8 to 10 weeks a month ago. Quotations for delivery by major TTL manufacturers are shown in Table 1. Because TTL is basically a commodity device, differences in delivery times among suppliers are expected to diminish rapidly. Additionally, shortages of material such as lead frames for the plastic devices have appeared; quotations for delivery of the lead frames have increased from two weeks in January to six to ten weeks more recently. TTL is assembly intensive, and the recent increase has caused a major decrease in excess capacity in Far Eastern assembly facilities. Combined with the assembly demands of such things as calculators and watch modules, which are increasing, it is possible to foresee short-term strains on assembly capacity.

Table 1

TTL DELIVERY

Company	Lead Time	Comment
TI	18 Weeks	-
National	12-16 Weeks	-
Fairchild	14-18 Weeks	SSI
Fairchild	8-12 Weeks	MSI
Motorola	14-15 Weeks	Some items
Signetics	12 Weeks	Allocating to top customers
AMD	12-16 Weeks	Some items

Source: DATAQUEST, Inc. (April 7, 1976)

There are several major causes for the sudden increase in TTL lead times. These include:

- An inventory turn-around
- An increase in real demand
- Longer term orders
- Lack of new capacity
- A "buying panic."

The inventory situation for TTL has been well publicized. Throughout 1975 large TTL inventories were being depleted. Now that the economic recovery seems firmly based, this depletion has been reversed; inventory accumulation for both real inventory and pipeline considerations has been increasing. This is probably the single most important factor in the increase in TTL orders. However, since inventory is currently accumulating, this factor will not add further to increasing demand.

With the revival of the economy, real demand, in terms of consumption of end products using TTL, is increasing. This is especially true with the minicomputers, and to a lesser extent with other product areas. Additionally, the large mainframe houses which have withheld large orders are now entering the marketplace for TTL. They envision an upturn in spending for capital equipment later in the year. It should be remembered that TTL is designed into an extremely wide range of products. Although many new designs may use other forms of LSI, those designs currently have much less force in the marketplace.

Longer term orders are becoming very apparent. Large users of TTL are looking to the future and placing orders to ensure their position in the allocation for priority delivery and prices in the current upward cycle. Long term orders swell bookings, and have caused the higher book-to-bill ratios which the industry experienced in March.

Because TTL has been widely regarded as having slower future growth than other semiconductor products, and because the decline in demand during the recession was so severe, the industry has been reluctant to add any capacity for TTL manufacturing. Facilities were switched to other product areas, and there has been a large net decrease of people employed for bipolar digital products. Actual short term manufacturing capacity has probably declined considerably. Capacity can be increased, but it will take time for new wafer starts, build up of facilities, addition of people, or addition of second shifts. In times of high demand, of course, semiconductor manufacturers will shift production to the most profitable areas, and at the same time shift engineering personnel and facilities to production. This was very evident in the 1972-1973 period.

The current upsurge in TTL orders, for all of the factors mentioned above, tends to create the spectre of possible shortages. The 1973 shortage period is still in everyone's mind and concern over shortages may be self-fulfilling. However, the current flurry of "buying panic" should subside if deliveries continue to be met.

The TTL situation has several major implications. First of all, devices are going to become more difficult to obtain. Users who have maintained strong relations with their semiconductor suppliers during the downturn will probably be treated well. Those manufacturers who have not cemented relationships with the semiconductor manufacturers may have some future problems in obtaining reliable sources of supply. For those companies that have not already done so, now is the time to begin placing longer-term orders. The semiconductor manufacturers will have several major benefits:

- Firmer prices
- Higher employment
- Less excess capacity
- Increased profits and profit margins.

The semiconductor industry is still operating considerably below the peak levels of 1974. In this context, it is premature to talk of real shortages or strains on capacity. However, semiconductor manufacturers, whatever their excess capacity, can only increase their output at a limited rate. We do not mean to imply that lead times may soon decrease, but future supply should be adequate for real demand in the near term.

The effect of TTL on assembly capacity should generate action among semiconductor manufacturers in planning for expansion of that capacity in the current cycle. This should have a positive effect shortly on the order rates of assembly equipment manufacturers. Semiconductor manufacturers know that if they delay ordering equipment for too long, their deliveries will be hopelessly stretched.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

MCIS Code: Newsletters

April 14, 1976

TTL SEMICONDUCTOR SHORTAGE MAY EFFECT SOME MINICOMPUTER SUPPLIERS

TTL Orders

TTL semiconductor products have recently experienced a major upsurge in orders. Lead times for products are extending significantly and there is a potential problem developing for smaller minicomputer suppliers should the shortage intensify. The enclosed newsletter just released by DATAQUEST's Electronics Group details the magnitude and reasons for the current situation.

Impact on Minicomputer Suppliers

A shortage of TTL parts, if it intensifies beyond current levels, could have a major impact on some of the general purpose minicomputer suppliers. During the 1973 TTL shortages, the smaller manufacturers tended to be most affected by the problem. Because of its enormous buying power and strong supplier relationships, Digital Equipment would not be expected to experience any significant parts problems regardless of the magnitude of the shortage. Data General's move into semiconductor manufacturing should insulate it from major impact. Also, the parental protection available to Interdata through Perkin-Elmer and Varian Data Machines through Varian Associates should help them through a supply shortage without significant difficulty. However, the other companies could well be caught between a strong demand for minicomputers and an acute shortage of key parts that could seriously hinder growth should the TTL problem intensify.

Compounding the potential TTL shortage is a significant extension of delivery times for peripheral products. Some recent quotes from independent peripheral suppliers are for six to eight

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months after receipt of order with further increases expected. The net of this would appear to be a strain on supply in the face of a very strong demand for minicomputers. The result could be an impact on minicomputer industry growth and a strain on margins, particularly for the smaller companies in the industry. DATAQUEST's Minicomputer Group will be working closely with our Semiconductor Group to monitor the semiconductor parts supply situation and other variables that could affect minicomputer industry growth.

Richard J. Matlack
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DATAQUEST INCORPORATED

SIS CODE: Newsletters

April 9, 1976

WEMA SEMICONDUCTOR STATISTICAL PROGRAM

The Western Electronic Manufacturers' Association (WEMA) has begun a limited program of compiling statistics on industry shipments based on data from semiconductor manufacturers. Initial data covers 1973, 1974, and 1975.

The WEMA program covers 10 major product classifications. The data for total semiconductors, integrated circuits, and discrete semiconductors has been released by WEMA and is shown in Table 1. The data are based both on actual shipments data reported by 49 semiconductor companies and on estimates on those companies which did not supply detailed data. (The only major manufacturer which did not report was Texas Instruments.) More detailed data may be purchased from WEMA.

The WEMA program covers worldwide shipments of semiconductors by U.S.-based manufacturers; the data excludes foreign manufacturers. Furthermore, captive U.S. manufacturers--such as IBM and Western Electric--are excluded. Captive or in-house shipments of U.S. companies competing in the open marketplace are included at estimated market value. These are essentially the same definitions used by DATAQUEST, except DATAQUEST includes shipments by foreign manufacturers.

The data given breaks out shipments of U.S.-based manufacturers by the various major geographical markets. These are not a representation of the total size of those markets, but the value for the U.S. market is a rough approximation of U.S. semiconductor consumption since imports from foreign manufacturers are not large.

WEMA's estimates of total worldwide sales, which include only worldwide shipments of U.S.-based manufacturers, is comparable to the value given in Appendix B of the Semiconductor Industry Service for U.S. companies. A comparison of DATAQUEST's figures with WEMA's

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for 1974 (the most recent year available) is given in Table 2. DATAQUEST's estimates are closely related to the WEMA values.

The WEMA figures confirm that 1975 was a bad year for the semiconductor industry. Table 3 shows the percent change of shipments from 1973 to 1974 and 1974 to 1975, comparing WEMA data with DATAQUEST estimates and DATAQUEST forecasts. The forecasts by DATAQUEST (for U.S. factory shipments) and the WEMA data (for worldwide shipments of U.S. companies) are not completely comparable; however, they do change in tandem. We are happy to note that the WEMA figures vindicate our estimates.

WEMA will soon begin to collect data on monthly shipments by U.S.-based companies, and publish estimated monthly shipments. This should help the industry monitor itself while providing a valuable service toward stabilization in the industry. In particular, it will help the industry and industry observers identify inventory accumulation of semiconductors by matching shipments with end-use product consumption.

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Table 1

ESTIMATED U.S. SEMICONDUCTOR INDUSTRY WORLDWIDE SHIPMENTS

(Dollars in Thousands)

	1973	1974	1975
DISCRETE SEMICONDUCTORS			
U.S.-OEM Sales	$ 721,288	$ 743,350	$ 611,561
U.S.-Distributor Sales	178,234	178,688	148,870
Total U.S. Sales	$ 899,522	$ 922,038	$ 760,431
Western Europe	302,591	378,036	286,873
Japan	32,433	29,034	18,845
Other International	100,102	107,574	88,038
Total Worldwide Sales	$1,334,648	$1,436,682	$1,154,187
MONOLITHIC INTEGRATED CIRCUITS			
U.S.-OEM Sales	$ 795,801	$ 969,135	$ 797,833
U.S.-Distributor Sales	208,017	230,375	175,993
Total U.S. Sales	$1,003,818	$1,199,510	$ 973,826
Western Europe	288,718	417,386	343,342
Japan	89,758	100,520	83,215
Other International	38,654	49,822	57,213
Total Worldwide Sales	$1,420,948	$1,767,238	$1,457,596
TOTAL SEMICONDUCTOR SHIPMENTS			
U.S.-OEM Sales	$1,517,089	$1,712,485	$1,409,394
U.S.-Distributor Sales	386,251	409,063	324,863
Total U.S. Sales	$1,903,340	$2,121,548	$1,734,257
Western Europe	591,309	795,422	630,215
Japan	122,191	129,554	102,060
Other International	138,756	157,396	145,251
Total Worldwide Sales	$2,755,596	$3,203,920	$2,611,783

Source: WEMA (April 2, 1976)

Table 2

ESTIMATED 1974 U.S.-BASED COMPANY SALES

	WEMA ($ in Millions)	DATAQUEST ($ in Millions)	Difference (Percent)
Total Semiconductor	$3,204	$3,219	0.5%
Total IC	1,767	1,803	2.0
Total Discrete[1]	1,437	1,416	1.5

[1]Includes Optoelectronics

Source: DATAQUEST, Inc.
March 18, 1976

Table 3

SEMICONDUCTOR SHIPMENT ESTIMATES

(Percent Change in Shipments[1])

	Percent Change 1973-1974		
	Discretes	IC's	Total Semiconductor
WEMA	7.3%	24.4%	16.1%
DATAQUEST	2.8%	24.1%	13.7%

	Percent Change 1974-1975		
	Discretes	IC's	Total Semiconductor
WEMA	-19.7%	-17.5%	-18.5%
DATAQUEST (Jan. 1976)	-20.0%	-18.5%	-19.1%
DQ Forecast (Oct. 1975)	-19.6%	-18.6%	-19.0%
DQ Forecast (June 1975)	-21.3%	-17.3%	-19.1%
DQ Forecast (Feb. 1975)	-19.4%	-15.6%	-17.2%

[1]WEMA-U.S.-based companies, Worldwide Shipments
DATAQUEST-U.S. Factory Shipments

Source: DATAQUEST, Inc.
March 18, 1976

DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS CODE: Newsletters

March 17, 1976

UPDATED 4K RAMS SHIPMENTS, STATUS AND COMMENTS

DATAQUEST, Inc. has been following and reporting the shipment growth in 4K RAMs since last fall. We have reported our findings in Research Newsletters dated November 26, 1975 and January 9, 1976.

Table 1 represents DATAQUEST's current estimates for December 1975 and January and February 1976. Based on new inputs we have reestimated shipments for December. The reasons for major changes are discussed below:

- Texas Instruments - Our January 9, 1976 Research Newsletter updated TI at 300,000 units for December. DATAQUEST has received inputs relative to TI's European penetration and has raised our December estimate from 300,000 to 400,000. DATAQUEST estimates that TI is doing in excess of 100,000 units per month internationally.

- Intel - DATAQUEST overestimated Intel in December and has adjusted its estimate downward to 300,000 units.

- NEC (Nippon Electric) - DATAQUEST's estimate of NEC for 40,000 units in December covered U.S. shipments only. Further research indicates that NEC's U.S. shipments were slightly in excess of 50,000 units and that shipments to Europe and Japan were 50,000 additional units. DATAQUEST estimates that NEC's February shipments of 200,000 units were broken down as follows:

USA	$125,000
Europe	50,000
Japan	25,000

- AMI - Shipments were subtantially overestimated in December. We have received reports that AMI is withdrawing from the 4K high volume business.

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Table 1

4K RAM SHIPMENT ESTIMATES
DECEMBER 1975, JANUARY AND FEBRUARY 1976
(All figures in Thousands)

COMPANY	DECEMBER	JANUARY	FEBRUARY
Texas Instruments	400	450	500
Intel	300	275	325
Mostek	170	200	225
Motorola	115	70	70 (1)
Fairchild	50	80	100
National	50	70	105
NEC	100	125	200
Intersil	30	25	10 (1)
Electronic Memories and Magnetics	20	20	25
AMI	2	3	3
AMD	3	3	5
AMS	Sampling	5	7.5
Signetics	Sampling	Sampling	Sampling
Electronic Arrays	Sampling	Sampling	Sampling

(1) Order hold by a large customer

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

Code: SIS

February 24, 1976

GAMES

Following is a reprint of the Summary from our recently published report on Electronic Games. The full text of the report is in Section 2.6.8 of your Semiconductor Industry Service notebook.

Summary

In the last few years, a new market for sophisticated semiconductor electronics--games--has been going through its formative stages. In the next five years, and especially in the next two years, this fascinating market should experience dynamic growth. In Table 2.6.8-1, we have outlined our estimate of the worldwide electronic games market for 1975, 1976, and 1980. Additionally, we have provided our estimates of semiconductor shipments into this market.

Table 2.6.8-1

ESTIMATED WORLDWIDE ELECTRONIC GAMES MARKET
(Dollars in Millions)

	1975	1976	1980
Pinball Machines	$ 127	$ 132	$ 160
Coin Operated Video Games	59	90	190
Home Video Games	39	240	630
Slot Machines	50	53	65
Other	25	40	80
Total	$ 300	$ 555	$1,125
Semiconductor Content	$ 15	$ 44	$ 111

Source: DATAQUEST, Inc.

In two segments of this market--pinball machines and slot machines--current equipment is presently mechanical and electromechanical. In these segments, the opportunity for electronics is in replacing existing mechanical components because of lower cost, improved reliability, and lower maintenance. The primary objective in these markets will be to retain the feel of the mechanical pinball and slot machine; however, in some cases electronics may provide improved displays and user interaction. Almost all 1975 sales of pinball machines and slot machines were fully mechanical or electromechanical units. As our table shows, we are expecting little growth in the basic market; but we do foresee significant growth in their electronic content.

The other three market segments--home video games utilizing in-home television sets, coin-operated video games such as Pong for use in amusement centers, and other electronic games--are new markets which are developing because of the capability of semiconductor electronics. In these markets there are opportunities for semiconductor companies to provide not only semiconductor devices or electronic modules but the whole retail item, especially in home video games. This is an opportunity for semiconductor manufacturers--similar to the experience in calculators and watches--to provide added value, and consequently gain significant revenue. In this light, the games market represents an opportunity for semiconductor companies in excess of one-half billion dollars by 1980. The $100 million market opportunity in semiconductors would be supplemented by an opportunity of over $400 million in retail products sales.

Because of the extreme importance of marketing channels, high tooling cost, and low value added, we expect the pinball and slot machine market to continue to be strongly controlled by existing operators such as Bally Corporation, Williams Electronics, and Gottlieb, Inc. However, new companies such as Atari can find a market in the specialized segments that develop from technological innovation, e.g., the coin-operated video game.

Magnavox led the development of the home video game market, and Atari became a major factor in this market in 1975. We expect several semiconductor companies, including Fairchild, Motorola, National, and Texas Instruments to announce products in 1976. The television manufacturers are likely to develop the market by featuring new sets with games built-in, rather than the current add-on approach. Thus, the most interesting segments of games, home entertainment video-based devices, will have competitors from three industry segments-semiconductor manufacturers, television manufacturers, and independent producers.

1976 should be an important year for game manufacturers. Leading this growth will be home video games, where we expect retail sales to move from about $39 million to about $240 million. The market will move rapidly to penetrate the home entertainment field, prices will fall rapidly, and competition--always the banner word in the semiconductor industry--should be keen. We are forecasting semiconductor shipments for use in all electronic games to almost triple to the $44 million level.

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DATAQUEST
INCORPORATED

RESEARCH
NEWSLETTER

Code: SIS Newsletters

January 28, 1976

SEMICONDUCTOR INDUSTRY REVIEW

1975 was a bad year for the semiconductor industry with U.S. factory shipments dropping about 19 percent. The six major companies discussed below all experienced a decline in semiconductor shipments. TTL shipments lead the way for these companies with a drop of about 40 percent.

Semiconductor shipments turned up sharply in the fourth quarter and we expect this trend to continue with increases of 5 to 7 percent per quarter in 1976. Annually, we estimate 1976 shipments should be 16.7 percent above 1975.

We expect excess capacity in the industry to be minimal by the end of 1976. This will be caused by:

- An expected increase of 32 percent in the semiconductor production rate from its bottom level.
- The final resolution of the TTL inventory problem with a resultant significant increase in TTL manufacture.
- Increasing calculator and watch assembly.

This Research Newsletter gives our estimates of the revenue breakdowns for the major U.S. semiconductor companies. Also included are key comments on their current status. We feel highly confident of the 1975 numbers, and any discrepancies between years may lie in the 1974 figures.

Below is a summary table of semiconductor shipments. These companies represent about 60 percent of all U.S. company shipments and the percent declines are reasonably close to the forecast we had made at the beginning of the year.

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SUMMARY OF ESTIMATED SEMICONDUCTOR SHIPMENTS
(Dollars in Millions)

	1974	1975
Texas Instruments	$ 630	$ 520
Motorola	480	360
National Semiconductor	202	197
Fairchild	323	240
Intel	115	111
Signetics	121	78
Total	$1873	$1506

Percent Change in Total 1974-1975 -19.6%
DATAQUEST's Forecast of February 1975 -17.5%

TEXAS INSTRUMENTS ESTIMATED SEMICONDUCTOR SALES

(Dollars in Millions--Includes In-house)

	1974	1975
Total Semiconductor	$632	$520
Total IC	372	300
Bipolar Digital	232	145
TTL	204	120
DTL	9	15
ECL	12	10
Other	7	0
MOS	88	100
Linear	44	55
Hybrid	8	0
Total Discrete	218	180
Optoelectronic	42	40

<u>Comments</u>

- 1975 MOS Sales - $100 million
  - $45 million internal; $55 million external
  - Geographic Breakdown:

    United States - $67 million
    Europe - 25 million
    Japan - 8 million

- Discretes - Our estimate ($180 million) does not have our full confidence, and may be lower.

- 1975 TTL sales geographic breakdown:

    United States - $80 million
    Europe - 30 million
    Japan - 10 million

- 1975 Optoelectronics - LED sales are almost 100 percent internal. Optoelectronics also has considerable IR sensor and special device sales, particularly to the military.

- The Houston Division is still suffering from turn-over:

  - George Graham, Vice President, was relieved of duties in December. The position was taken by Dean Toombs who stayed two weeks; the new head of the Digital IC division is Pierre Bonelli, brought in from TI/France.

  - Key people are still leaving - H. Hollack, who was operations manager of the Digital IC division, and Dr. Perry, who headed microprocessor development.

- It is our understanding that Mr. Shepherd is working a limited schedule and that Mr. Haggery is assuming a more active role.

- Low priced watches have stimulated the watch market, but TI does not have costs low enough at this time to make money on the $20 unit.

MOTOROLA ESTIMATED SEMICONDUCTOR SALES
(Dollars in Millions)

	1974	1975
Total Semiconductor	$480	$360
Total IC	168	120
Bipolar Digital	85	48
TTL	36	15
DTL & Other	18	14
ECL	31	19
MOS	23	24
Linear	55	48
Total Discrete	305	238
Transistor	202	158
Small Signal	118	94
Power	84	64
Diode	72	62
Thyristor	16	16
Other	5	0
Optoelectronic	7	2

Comments

- Aggressive in the 4K memory market - 115,000 units were shipped in December, 1975.
- The 6800 microprocessor is getting specified for many applications.
- Morale is improving.
- Profitability returned to the Semiconductor Division in the fourth quarter of 1975.

NATIONAL SEMICONDUCTOR ESTIMATED CORPORATE SALES
(Dollars in Millions)

	1974	1975*
Semiconductors	$202	$197
NOVUS	37	55
Point-of-Sale Systems	10	13
Memory Systems	4	10
Dynacraft	1	3
Intercompany	(10)	(9)
Total Revenues	$244	$269

*December 16, 1974 through December 15, 1975.

Comments

- NOVUS

  - Shipped in excess of an estimated 2.75 million calculators in calendar year 1975.
  - Shipped in excess of an estimated 100,000 finished watches in the calendar year 1975--60 percent in the fourth quarter.
  - Introduced Model 4640 to compete with HP-21 and HP-22.
  - Introduced Models 834 ($9.95) and 835 ($12.95) to compete with TI's 1200 and 1250.
  - We anticipate the introduction of a desk top unit at approximately $150.00 by summer of 1976.
  - NOVUS sales for the fourth quarter calendar year 1975 were over three times the first quarter. Its profit contribution was substantially higher.

- Memory Systems - Business is very good. DATAQUEST estimates the group exceeded $1 million in its monthly sales rate in August or September.

- Dynacraft is a subsidiary which manufactures lead frames, PC boards, and chemicals. It has some limited selling to the outside world and continues to expand. Dynacraft represents a major thrust by National toward downward vertical integration.

FAIRCHILD ESTIMATED SEMICONDUCTOR SALES
(Dollars in Millions)

	1974	1975
Total Semiconductor	$323	$240
Total IC	214	154
Bipolar Digital	141	80
MOS	20	31
Linear	46	43
Total Discrete	99	80
Optoelectronic	10	6

Comments

- MOS is still Fairchild's weakest sector. DATAQUEST estimates MOS is losing moderate amounts of money each month and has lost some valuable technical people.
- Bipolar Digital - Manufacturing problems have been solved.
- Consumer is doing very well; shipped over $10MM in watches in 1975 - all in last half of the year.
- Consumer will expand into home video games in 1976. This is a rapidly expanding market.
- We anticipate the fourth quarter 1975 corporate revenues to total $78-80 million.

INTEL ESTIMATED SEMICONDUCTOR SALES
(Dollars in Millions)

	1974	1975
Total Company Revenues	$135	$137
Total Semiconductor Revenues	115	111
Total Integrated Circuits	115	111
Bipolar Digital	15	12
MOS	100	99*
Microma	6	9
Systems	13	17

*Includes an estimated $5 million of microprocessor design aids.

Comments

- Microma
  - Watch units shown at the Consumer Electronics Show were very well received.
  - Microma turned profitable in 1975 and will expand substantially in 1976.
- Microprocessors
  - Intel has won the first three major procurements, DEC, Chrysler, and a to-be-announced European contract.
  - Intel will move aggressively into the computer-on-a-board market this year.
- Memory Systems - Operating at a profit. Estimated current sales rate is $2 million per month.

SIGNETICS ESTIMATED SEMICONDUCTOR SALES
(Dollars in Millions)

	1974	1975
Total Company Revenues	$121	$ 78
Total Semiconductor Revenues	121	78
Total Integrated Circuits	121	78
Bipolar Digital	86	51
TTL	76	45
DTL	8	6
MOS	11	10
Linear	24	17

Comments

- De-emphasis on commodity products
- Still losing money
- Heavy emphasis on 2650 microprocessor

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS Code: Newsletters January 9, 1976

4K RAMs--UPDATED SHIPMENTS ESTIMATES AND STATUS

Following are DATAQUEST's estimates of 4K RAM shipments in the month of December:

Intel	-	400,000 Units (15% are 16 pin)
TI	-	300,000 Units
Mostek	-	170,000 Units
Motorola	-	115,000 Units
Fairchild	-	50,000 Units
National	-	50,000 Units
NEC	-	40,000 Units
Intersil	-	30,000 Units
Electronic Memory & Magnetics	-	20,000 Units - all static
AMI	-	15,000 Units
AMD	-	5,000 Units
EA	-	In sampling stage
Signetics	-	In sampling stage
AMS	-	Initial sampling

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS Code: Newsletters — November 26, 1975

4K RAMs--UPDATED SHIPMENTS ESTIMATES AND STATUS

Following are DATAQUEST's estimates of 4K RAM shipments in the month of November:

Intel	-	400,000+ Units (90 percent of which are 22 pin)
TI	-	250,000+ Units
Mostek	-	125,000 Units
NEC	-	50,000 Units
National	-	40,000 Units
Fairchild	-	30,000-50,000 Units
Motorola	-	10,000-30,000 Units
Electronic Memory & Magnetics	-	20,000 Units - all static
AMI	-	10,000 Units
Intersil	-	10,000 Units
EA	-	In sampling stage
AMD	-	In development and initial sampling stage

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

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October 17, 1975

4K RAM--ESTIMATED SHIPPING RATE

Orders and shipments for 4K RAMs are currently ramping very rapidly. In our Research Newsletter of September 19, 1975, "Order Upturn--Current Outlook" we estimated industry 4K RAM shipments at 300,000 per month. That estimate is now obsolete (and may have also been too low at that time). Here are our estimates of current levels:

- Intel's current shipping rate is currently in excess of 350,000 units per month and increasing.

- Total industry shipments are about 600,000 per month and increasing.

These figures clearly put Intel in the lead in 4K RAM shipments, although shipping rates have been increasing among all producers. The rapid rise in orders and shipments reinforces our belief in a 4 to 5 times increase in unit shipments in 1976 over 1975.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

September 19, 1975

ORDER UPTURN--CURRENT OUTLOOK

WESCON week has provided a wealth of information coming from industry sources. We felt it important to share this information with our clients as rapidly as possible.

Increased Orders

Several segments of the semiconductor market have shown a real upturn in orders in the last few weeks.

- Orders are increasing across the board in LSI devices. Large chips are in the fastest growing markets and it is not surprising to see them react earlier than other market areas. These markets had been essentially flat for several months and never had an inventory overhang. Thus an increase in orders here is encouraging.

- Commodity devices, such as TTL, have also put in their best order performance in over a year. However, TTL still suffers from remaining inventory.

- In discrete and linear devices, orders have been increasing steadily in the consumer market segment.

- Silicon shipments this month are up about 10 percent over August, adding weight to the indications that unit shipments are increasing.

Price cutting has been very severe and is to the point now where it really hurts. In the early part of this year, orders increased merely as a resumption of levels consistent with current usage after an almost complete halt at the end of 1974. However, that trend proved temporal. We feel that the current activity actually marks the final phase of the slump. The industry is exhibiting its usual reaction to the business cycle, which is very reminiscent of 1971 and 1967 that is, it is experiencing:

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- Uneven initial order upturn, but stronger in growth markets and consumer areas

- Larger orders with longer lead times

- A winding down of the inventory workoff

- Longer lead times with a book/bill ratio greater than one and increased backlogs

- Increasing unit shipments

- Continued industry overcapacity

- The final (and worst) wave of price cutting

In many markets prices have fallen about 60 percent from a year ago and some--CMOS, Low Power Schotty TTL, and Memory--look like the TTL price war of 1971. Price pressure results from the excess capacity in the industry, marginal pricing as companies strive to keep employees busy (knowing layoffs now would seriously hurt as the market advances), and positioning in the new markets. Current orders help cement customer-vendor relationships and are important to future company growth rates. Now is the time competitive companies are separated from those less competitive in the growth markets.

We expect price declines to delay a meaningful increase in dollar shipments in the industry. While some improvement may be seen in the fourth quarter, much of that is expected to be simply a seasonal improvement over the third quarter. However, DATAQUEST expects a signficant increase in semiconductor shipments to occur in the first quarter of 1976.

In the longer run we do not expect a fast or V-shaped recovery in the industry. First, capital spending worldwide was still decreasing through July, and low industrial capacity utilization worldwide should hold capital spending down. This is the largest driving force in semiconductor demand affecting the EDP, industrial automation, and process control markets. Second, capacity in the industry is low--about 50 to 60 percent--and therefore, stable pricing cannot be expected for some time.

4K RAMs

Our estimates for the 4K RAM market are given in Table 1. The 1975 market has been severely affected by the recession, but the market should grow rapidly in 1976 with unit output up a factor of about four. This market is not currently production limited. However shortages of devices may materialize as the other manufacturers which are coming into full scale production, including Motorola, Fairchild, and National Semiconductor experience build up

Table 1

4K RAMS
ESTIMATED MARKET

Year	Units (In Millions)	Dollars (In Millions)
1975	3	$24
1976	13	$75

Table 2

4K RAMS
ESTIMATED CURRENT SHIPPING RATE

Company	Devices Per Month
Texas Instruments	100,000-120,000
Intel	100,000-120,000
MOSTEK	20,000- 35,000
NEC	~10,000
Motorola	< 5,000
Fairchild	< 5,000
NSC	< 5,000
Western Digital	< 5,000
AMI	< 1,000
Intersil	< 1,000
Total	~300,000

problems. Industry production may lag the fast ramp in orders now underway.

The 4K RAM market currently has two major producers--Texas Instruments and Intel. Table 2 gives estimated production levels which have been derived from a number of inputs from the industry.

National has apparently solved its production problems. It is sampling both its 18-pin and 22-pin versions, and should be in full scale production soon. It is strengthened by picking up AMS as a second source. Motorola, on the other hand, has been having some production problems. However, with the move to Austin complete and new, capable, production-oriented management in the MOS division, we expect those problems to be resolved soon. Motorola is strengthened by the addition of Intersil as a second source after a lack of performance by AMI. Motorola and Intersil have picked up a $7 million order from Univac--a major plum in the current market. Both Fairchild and Intel are now shipping evaluation quantities of 16-pin devices to important customers.

The 16-pin 4K RAM is becoming increasingly popular, especially with the larger EDP customers. They like the device technically and the possibility of several major manufacturers available for backup sourcing and price competition. The 22-pin units, however, are still popular with smaller users and have had the initial jump in availability. They are designed in many more application. As a result, next years markets should still favor the 22-pin device.

<u>Microprocessors</u>

Key trends in microprocessor include the following:

- Proliferation of sources - Many ore firms are entering the Microprocessor market and are in small quantity production--AMD, MOS Technology, Mostek, NEC, and others.

- Second sourcing - They are all capable of greatly increasing production.

- Fast-rising industry production capability - Companies have increased second sourcing in the industry (or, at least, pin compatability). MOS Technology second-sources the Motorola 6800, Synertek second-sources MOS Technology as well as making the General Automation microprocessor (the one that used to be SOS). MOSTEK second-sources the Fairchild F8. AMD and NEC second-source the 8080. Texas Instruments has committed to the unit. Motorola is now meeting demand on the 6800 and shipping on all orders.

- The price war is on - With this action it is not surprising that small quantity prices have plummeted to the $30 and $100 level depending on the device. Large quantity quotes have been much lower for some time, and all prices are still falling.

Watches and Calculators

The watch market is still production limited. The three major watch (or watch module) manufacturers are currently Hughes, Litronix, and National Semiconductor. Each recently had monthly production rates ranging from 100,000 to 150,000 units.

Fairchild and Texas Instruments both have minimal production at this time. TI is expected to introduce its products this month, but only in Dallas and Houston.

We expect National to build up to a rate of 700,000 calculators a month in its second fiscal quarter placing it among the top three with Casio and Texas Instruments. National's consumer division is expected to be running at an annual rate of over $100 million in its second quarter.

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RESEARCH
NEWSLETTER

September 16, 1975

ESTIMATED 1974 BIPOLAR MEMORY MARKET

Summary

The 1974 worldwide bipolar memory market is estimated to have been $110 million, of which $64 million was ROMs and PROMs and $48 million was RAMs. Fairchild was the leading supplier in the RAM market while Monolithic Memories was the leading ROM/PROM manufacturer. Falling prices from a weak semiconductor market and rapid state-of-the-art technology improvements should cause the bipolar memory market to decrease in 1975. However, this market is expected to grow rapidly when semiconductor demand strengthens, reaching $180 million in 1977.

Historical Bipolar Memory Market

Table 1 gives estimated values for the total 1974 worldwide bipolar memory market and estimated market shares for the leading participants. The market is estimated to have been $110 million in 1974. DATAQUEST estimates the random access memory (RAM) segment of this market at $48 million. Bipolar random access memories are primarily used for fast memories in the computer and minicomputer industry either for cache, scratchpad, or other virtual memory applications. Less expensive MOS memories are used for the main memory. Fairchild's isoplanar process for bipolar devices and a long dedication to the bipolar RAM market has given it a dominant position. It has an estimated half of the total market.

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Table 1

1974 ESTIMATED WORLDWIDE BIPOLAR MEMORY MARKET
(Dollars in Millions)

	RAM	ROM/PROM	TOTAL
Total Market Worldwide	48	64	112
Major Participants			
Fairchild	24	1	25
Harris	0	6	6
Intel	3	9	12
Intersil	2	12	14
Monolithic Memories	1	20	21
Motorola	1	1	2
National	1	1	2
Signetics	7	6	13
Texas Instruments	4	7	11
Others	5	1	6

Source: DATAQUEST, Inc.

The Read Only Memory (ROM) market and the Programmable Read Only Memory (PROM) market are estimated to have been $64 million in 1974. ROMs and PROMs are used not only for fixed, non-alterable, memory applications where bipolar speed is required, but also in applications where they substitute for discretionary logic. Because of the lack of LSI bipolar logic devices, ROMs and PROMs have provided an economical alternative to the use of many MSI or SSI devices. Because of this dual application, the ROM/PROM market is larger than the RAM market. PROMs have decreased rapidly in price in recent years relative to ROMs and now are significantly more expensive. Due to the custom mask costs and other handling considerations, ROMs are only economical for very large quantity applicatons. As a result, the bipolar PROM market is now considerably larger than the bipolar ROM market. (This is not true for MOS ROMs and PROMs.) The increasing popularity of bipolar PROMs over ROMs should increase in the future.

In 1974 Monolithic Memories had the largest share of the bipolar ROM/PROM market. Other major competitors included Harris, Intel, Intersil, Signetics, and Texas Instruments. This market is highly competitive (expecially for PROMs) and no company has a major competitive advantage, in either technology or marketing.

Future Bipolar Memory Market

The bipolar memory market is one of the fastest growing segments of the semiconductor market. The rapid price deterioration for bipolar memories in 1974 and 1975, combined with the current economic recession, is expected to cause a decline in the market in 1974 to about $100 million. However, unit volume has grown during this year and volume expressed in bits of memory has grown even more. This growth will be further fueled in the future by the price drops that have occurred in the past two years, as normal market elasticities take effect. Futhermore, bipolar memory is finding increasing use in the minicomputer and other EDP markets and PROMs are rapidly becoming a solution to the non-avilability of LSI/TTL. With a revived semiconductor market, DATAQUEST expects the bipolar memory market to grow very rapidly. We estimate this market will grow to $180 million by 1977, assuming a continued improvement in the general worldwide economy.

Decreasing Prices

The bipolar memory market has been marked by rapidly falling prices in the past year. DATAQUEST estimates that average prices for these devices has fallen overy 60 percent in the past year. In addition, newer devices offer higher memory densities and improved performance. The bipolar RAM market is dominated by the 1K bit RAM, especially the Fairchild 93415. Prices for this and similar memories in very high quantities have decreased rapidly to around $8.00 for the standard device. 4K bipolar RAMs will likely be introduced near the end of this year. However, they are not expected to become a significant factor in the marketplace until 1977. PROMs have seen even more dramatic price decreases. 4K PROMs now sell at prices comparable with year-ago prices of 1K PROMs--a 4 to 1 decline.

The decrease of prices in the bipolar memory market has been caused by rapidly improving state-of-the-art technology. There have been considerable reductions in chip sizes for comparable devices, resulting in higher yields and lower costs. This increase in bit density has also allowed the design of devices with more bits per chip. Improvements in the state-fo-the-art have come from the maturation of several processing technologies (not all of which are employed on any one device or by any one company). These include:

- Tighter masking tolerances
- Overlays of silicon or polysilicon for interconnections
- Use of Schottky diodes
- Improvements in isoplanar processing
- Ion inplantation
- Greater process control
- Improved circuitry
- Polysilicon fuses

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

Code: 2.4 Markets

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HISTORICAL U.S. FACTORY SEMICONDUCTOR SHIPMENTS

In response to requests from several clients, we are distributing the following information from our data base on historical U.S. factory semiconductor shipments. Table 1 gives total U.S. factory shipments of semiconductors by year from 1963 to 1974. Table 2 gives quarterly U.S. factory semiconductor shipments from 1967 through the first quarter of 1975. These totals are further divided into discrete (including optoelectronics) and integrated circuits.

In the past, information on U.S. factory semiconductor shipments has been compiled by the Electronics Industry Association (EIA). The DATAQUEST data differ from the EIA statistics by featuring:

- A consistent basis (EIA basis changed over time)
- Inclusion of hybrid intergrated circuits
- Continuation of the data to present

The DATAQUEST data employ the same basis used throughout the Semiconductor Industry Service. U.S. factory shipments include all devices shipped (point of invoice) from within the United States. Captive suppliers are excluded, but in-house use of semiconductors by companies actively competing in the marketplace are included at market prices.

The data clearly show the seasonal variations in semiconductor shipments despite the large magnitude of increases and decreases in semiconductor shipments reflected by general economic conditions. Generally, shipments are higher in the second and fourth quarters and lower in the first and third quarters; volume is lowest in the third quarter of the year and highest in the fourth quarter. These seasonal factors affect shipments even if long term shipment rates are rapidly changing. For example, during a period of rapidly dropping demand in 1970 shipments decreased much more in the third quarter than in the second or the fourth. In 1973, with demand rapidly rising, shipments increased at a higher rate in the second and fourth quarters than in the third quarter.

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Table 1

U.S. FACTORY SEMICONDUCTORS SHIPMENTS
(Dollars in Millions)

Year	Discrete	Integrated Circuits	Total
1963	$ 555	$ 20	$ 575
1964	609	51	660
1965	711	94	805
1966	876	173	1,049
1967	750	273	1,023
1968	735	367	1,102
1969	829	498	1,327
1970	686	525	1,211
1971	623	533	1,156
1972	748	718	1,466
1973	1,000	1,040	2,040
1974	1,023	1,297	2,320

Source: DATAQUEST, Inc.
(July 1975)

Table 2

U.S. FACTORY SEMICONDUCTOR SHIPMENTS
(Dollars in Millions)

Year and Quarter		Discrete	Integrated Circuits	Total
	1	$ 197	$ 58	$ 255
	2	190	66	256
1967	3	177	70	247
	4	186	79	265
	Total	750	273	1,023
	1	188	85	273
	2	187	95	282
1968	3	174	88	262
	4	186	99	285
	Total	735	367	1,102
	1	195	108	303
	2	214	129	343
1969	3	203	125	328
	4	217	136	353
	Total	829	498	1,327
	1	194	142	336
	2	185	139	324
1970	3	164	120	284
	4	143	124	267
	Total	686	525	1,211
	1	151	113	264
	2	154	116	270
1971	3	152	144	296
	4	166	160	326
	Total	623	533	1,156
	1	168	158	326
	2	184	174	358
1972	3	196	181	377
	4	200	205	405
	Total	748	718	1,466
	1	225	230	455
	2	250	265	515
1973	3	262	255	517
	4	263	290	553
	Total	1,000	1,040	2,040
	1	263	322	585
	2	260	343	603
1974	3	260	327	587
	4	240	305	545
	Total	1,023	1,297	2,320
1975	1	209	278	487

Source: DATAQUEST, Inc. (July 1975)

DATAQUEST
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RESEARCH
NEWSLETTER

May 30, 1975

SEMICONDUCTOR INDUSTRY MID-YEAR STATUS

Summary

We believe that any significant upturn in the semiconductor industry may be delayed until the first quarter of 1976.

The patterns we observe in silicon and package shipments indicate a continued plateau through the next three or four months.

In addition, the current behavior of distributors' sales are a leading indicator in a recovery which does not dampen our enthusiasm for semiconductors in the long term, but indicates no imminent sharp recovery.

Silicon Valley, Inc. (Fairchild, Intel, National, etc.) is gaining market share, profit and performance at the expense of Southwest Semiconductors, Inc. (Motorola, Texas Instruments, etc.).

General

On March 14, 1975, Dataquest, Inc. published the Econometric Model (Section 2.1) of its Semiconductor Industry Service, with a four quarter forecast of the industry. This forecast indicated a mild upturn in the fourth quarter. Our second forecast will be published within 30 days. In order to gain perspective on the current state of the industry, we are going to detail and summarize recent inputs regarding:

- Silicon shipments
- Package shipments
- Distributor Sales

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Silicon Shipments

A poll of a number of silicon houses show that silicon shipments peaked in the March/June period of 1974. Figure 1 shows relative shipments as a fraction of that peak since then. Combining this data with the facts that Texas Instruments' silicon operation is closed down and Fairchild's Healdsburg plant is operating only two pullers (which is less than 50 percent capacity) leads us to the conclusion that after a year of inventory work-off throughout the production pipeline, silicon inventories are at a much better level but that product demand is not increasing.

Package Shipments

Referring again to Figure 1, package shipments from a leading package supplier bottomed out in October 1974 and are forecast to go into the third quarter this year at a slightly increased rate. Assuming that the fourth quarter 1974 and the first quarter 1975 were inventory work-off quarters, package usage looks to be flat. While these inputs are for ceramic packages, they are indicative of the state of the industry. A case could be made for hermetic packages to be stronger than plastic packages because of the relative strength of the military business which is primarily ceramic and MOS LSI. In addition, packages are indicative of unit sales, which are down less than dollar volume.

Distribution

Dataquest has surveyed the Los Angeles market. Our data comes from distributor sales of four of the major and three of the smaller manufacturers. The first quarters' sales for one major Los Angeles distributor were approximately $13 million in 1974; the equivalent sales level in 1975 was less than $7 million, a decline of almost 50 percent. So far the second quarter shows no significant change. Another major distributor apparently had its worst month in 22 months in April. Los Angeles represents an estimated 16 percent of the U.S. semiconductor market. Cursory checks of Boston-New York indicate the same general levels.

Company Comments

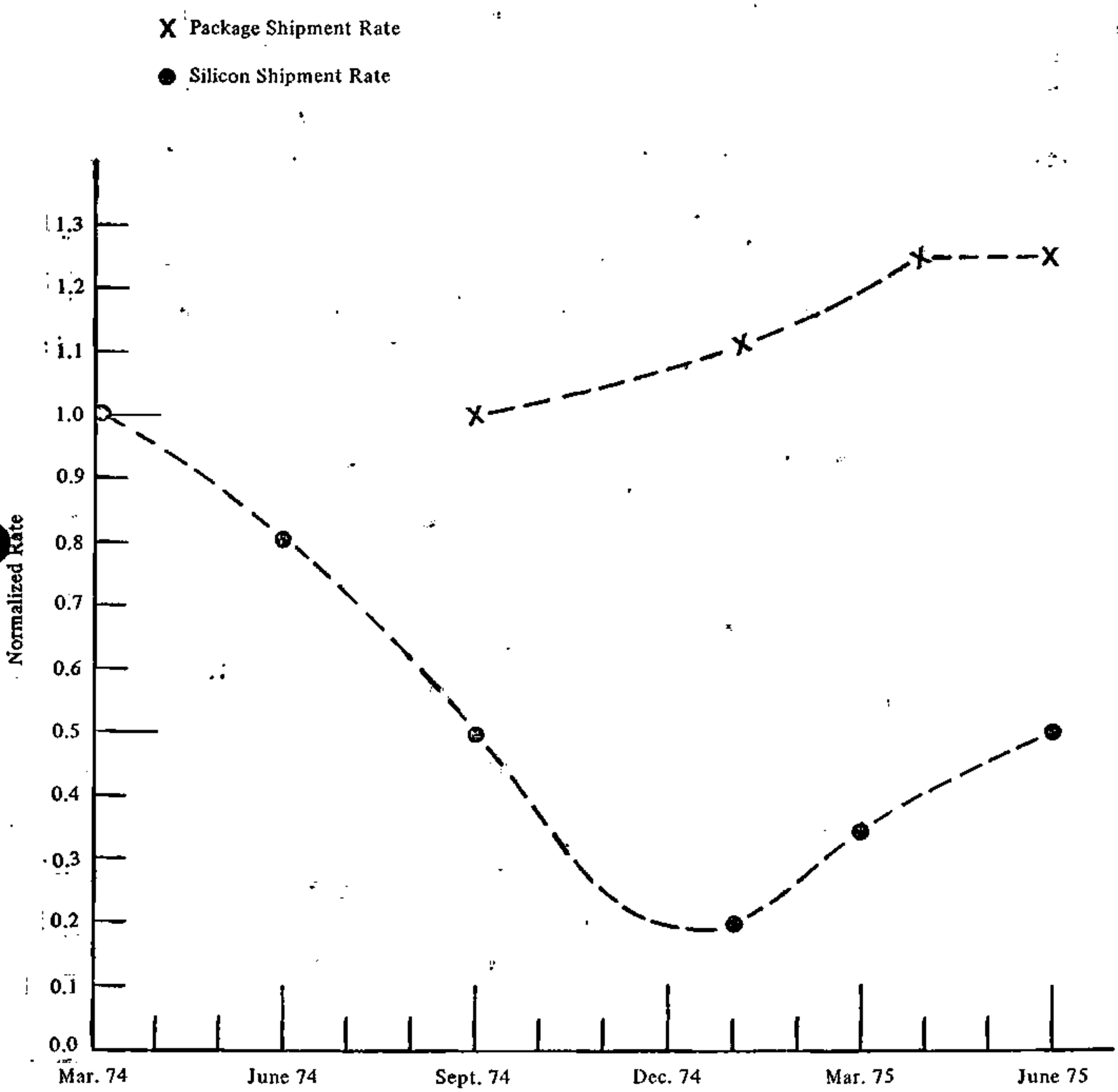
Brief comments regarding the five major companies follow.

Texas Instruments (TI)

TI has not introduced a major new product in the last 18 months. It is still the largest and probably the strongest of the semiconductor companies, but apparently is suffering from some of the problem areas described below.

Figure 1

PACKAGE/SILICON SHIPMENT COMPARISON



Source: DATAQUEST, Inc.

- Sales - First quarter 1975 semiconductor shipments are estimated to be down $50 million or more from the first quarter of 1974. We expect no significant improvement in the second quarter of 1975 over the first quarter of 1975.

- Calculators - TI has been very slow to re-design the older consumer models in its calculator line. With the large number of passive and discrete components on these boards, these units do not appear to be cost competitive.

- TI finds itself in a market positioning problem, with Hewlett-Packard's H-P 21 declaring itself a contender for units of $125.00 and up and National Semiconductor, Litronix, and others staking out very aggressively the $50.00 and under market. All of these units are very clean in design with a minimum number of components whereas the redesigned SR50 is still a 3 chip unit (42 total components).

- Digital Watches - TI is very late getting into the watch market. Several semiconductor firms are already carving out market shares.

- TTL - Standard TTL was one-third of TI's business in 1974 (see TI Estimated Semiconductor Revenues--Section 8.44.2 in Notebook). The standard TTL business is undergoing significant changes, which are covered in a separate Research Newsletter dated May 30, 1975. These changes essentially involve impacts from displacement technologies that include microprocessors, PLAs, low power Schottky, CMOS, ROM/PROMS, MOS Logic, and ECL.

- MOS - TI was the seventh ranking MOS merchant vendor in 1974 (see our Research Newsletter of March 21, 1975). The merchant calculator market is not growing this year and, in fact, may be shrinking in dollar volume. TI has no NMOS microprocessor in production and recently announced the second-sourced Intel 8080.

- People - For the first time since the Mostek spinout, major people defections are taking place at TI-Houston as exemplified by Jack Carsten and Tom Hartman to Intel, Barry Cox to Fairchild, and Dave Simpson to Electronic Arrays, among others. Once other firms gain a recruiting foothold, it is easier to recruit other people.

Motorola

Dataquest does not expect profitable operations until the fourth quarter of 1975. Some of the reasons for this position are discussed below.

- As the strongest supplier of discrete components, it is retaining its position.
- Motorola is very strong in ECL and CMOS.
- Two of its major markets--television and automotive--have been hit very hard by the current economic recession.
- The company appears to be overly heavy in middle management.
- With General Instrument's takeover of Bowmar-Chandler, there is another viable MOS employer in Phoenix.
- Motorola is encountering resistance of some technical people to move to Austin.
- Motorola lagged the industry in laying off employees so that it was continuing to lay off after other major firms in the industry had stablized employment.
- It is the only firm of the top five to operate unprofitably for an extended period. This indicates problems of some standing that will have to be dealt with.
- The 6800 microprocessor is generaly considered to be an excellent unit, with superior technical capabilities to Intel 8080.

However, we believe that the company has recognized its problems and is moving to fix them, as described below.

- John Welty is an extremely capable general manager who understands the business and who will take the tough moves.
- We anticipate that there will be a reorganization at the top level reporting to Welty and a number of top level people will be removed.
- The bulge in middle management will likely be solved by terminations and relocations.
- We anticipate that the executive offices will be closed and that the executive group will move back into the factory.
- The appointment of Chuck Thompson as Marketing Manager denotes an increased emphasis on customer service and customer responsiveness, which was Motorola's strength in the late 1960's and early 1970's.

- We expect a new Assistant General Manager who will be a top-notch internal man who is extremely profit-oriented.
- We anticipate that the new organization will be heavily line-oriented, with minimal staff.
- We feel that an extensive overhaul of overhead functions will be undertaken.
- A substantial effort in MOS and other technical areas is continuing.

<u>Fairchild</u>
We believe that Fairchild is currently being under-rated by investors and competitors relative to other industry participants. For reasons discussed below, we feel the company is in a relatively strong position.

- Fairchild established its ability to make money in this downturn as opposed to 1970.
- It is the strongest bipolar memory supplier.
- It is shipping the F8 microprocessor.
- Substantial efforts are being made in new technologies--CCD, I^2L, microprocessors, CMOS, low power Schottky, and optoelectronics.
- It is attracting excellent people from other top notch firms. Recent hires include an excellent man from Texas Instruments and a top notch linear man from National.
- Fairchild has an excellent position in low power Schottky.
- It is starting to make its move into vertical integration.
- The company is currently weak in MOS, but both MOS and CMOS shipments are increasing monthly.

<u>Intel</u>
Intel's current strong position is explained below.

- It is the acknowledged leader in NMOS.
- Its extensive effort on microprocessors have put the company far in front.
- Intel is working extensively on its 16K RAM, and we expect samples this year.

- It is extremely conservative financially.
- We expect Microma (its digital watch operation) to be profitable in the 4th quarter.

We believe that Intel will find itself in a different marketing posture in late 1975 and in 1976 than it has in the past. The bulk, if not all, of its components line will likely have alternate sources at competitive prices. Over the past several years Intel has enjoyed a sole-source position on various products such as the 1103, 2102, 8008, and 8080. In 1976, it will probably not enjoy this advantage to the degree that it has in the past. However, it is apparently still the lowest cost producer.

<u>National</u>

See our Research Newsletter of May 2, 1975.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS Code: 2.2 Markets

May 30, 1975

CHANGING TIDES IN THE MARKETPLACE--TTL UNDER ATTACK

Summary

The TTL marketplace currently faces important changing tides.

1. TTL is not amenable to large scale integration.

2. As a result, displacement technologies (includes microprocessors, PLA's, low power Schottky, CMOS, ROM/PROM's, MOS/LSI, and ECL) are expected to curtail TTL's long-term market growth.

3. The company that has dominated 7400 TTL since 1970 does not dominate the displacement technologies.

4. In 1970 there was one very well financed, large semiconductor company (TI), two $40 million companies (Signetics and National) and one loss-ridden company (Fairchild). In 1974 there were five semiconductor companies whose IC sales exceeded $100 million, plus several large semiconductor divisions of extremely large, well-financed companies.

5. Four of these five companies have no significant position in standard TTL and, therefore, are free to devote their corporate resources in technology and marketing to the displacement effort.

Background

As one contemplates the extended 1974-75 semiconductor recession drawing to a close in late 1975, one reflects back to the recession of 1970-71 to find similarities and differences. One of the similarities is the presence of TTL as a dominant factor during both periods. One of the differences is the nature of the TTL marketplace.

In 1970-71 TTL was a technology which was felt to have enormous growth potential over the next five years. Indeed, it did make good on its promise, growing from $172 million in 1970 to about $671 million in 1975. The 1970 recession was the time frame of a vicious battle for market share among Fairchild, National, Signetics, Texas Instruments, and ten other companies, many of whom subsequently dropped their TTL line or their semiconductor business in total. The battle was scarcely a fair one--pitting the substantial resources of Texas Instruments against two $40 million companies and a loss-ridden Fairchild.

Contrasting 1970-71 to 1974-75, we find that standard TTL has matured as a technology. It has suffered this year from the recession and its dollar volume has dipped. Far more important, however, is the fact that standard TTL is finding increasing technical competition from other solutions to getting the logic memory job done. This newsletter examines the various technologies infringing upon the standard TTL marketplace, the applications, and the leading producers at this time.

Figure 1 illustrates pictorially the "nibbling effect" of the displacement technologies on the standard TTL market. Each of them is explored below in its turn:

- Microprocessors - Much has been written about microprocessors as they have expanded in complexity and capability from 4 bits to 12 and 16 bits. Essentially, microprocessors can handle many of the logic/memory jobs formerly requiring 50 and over MSI/TTL parts. In microprocessors, the leading technology is NMOS and the shippers dominating the market at this point are Intel, Rockwell, and National. The Motorola 6800 unit and the Fairchild F8 are currently finding increasing acceptance.

- CMOS - For logic jobs requiring low power--which should find wide application in instrumentation and federal markets--CMOS will likely be replacing TTL on an increasing basis. The dominant shippers in CMOS at this writing are RCA, Motorola, and National.

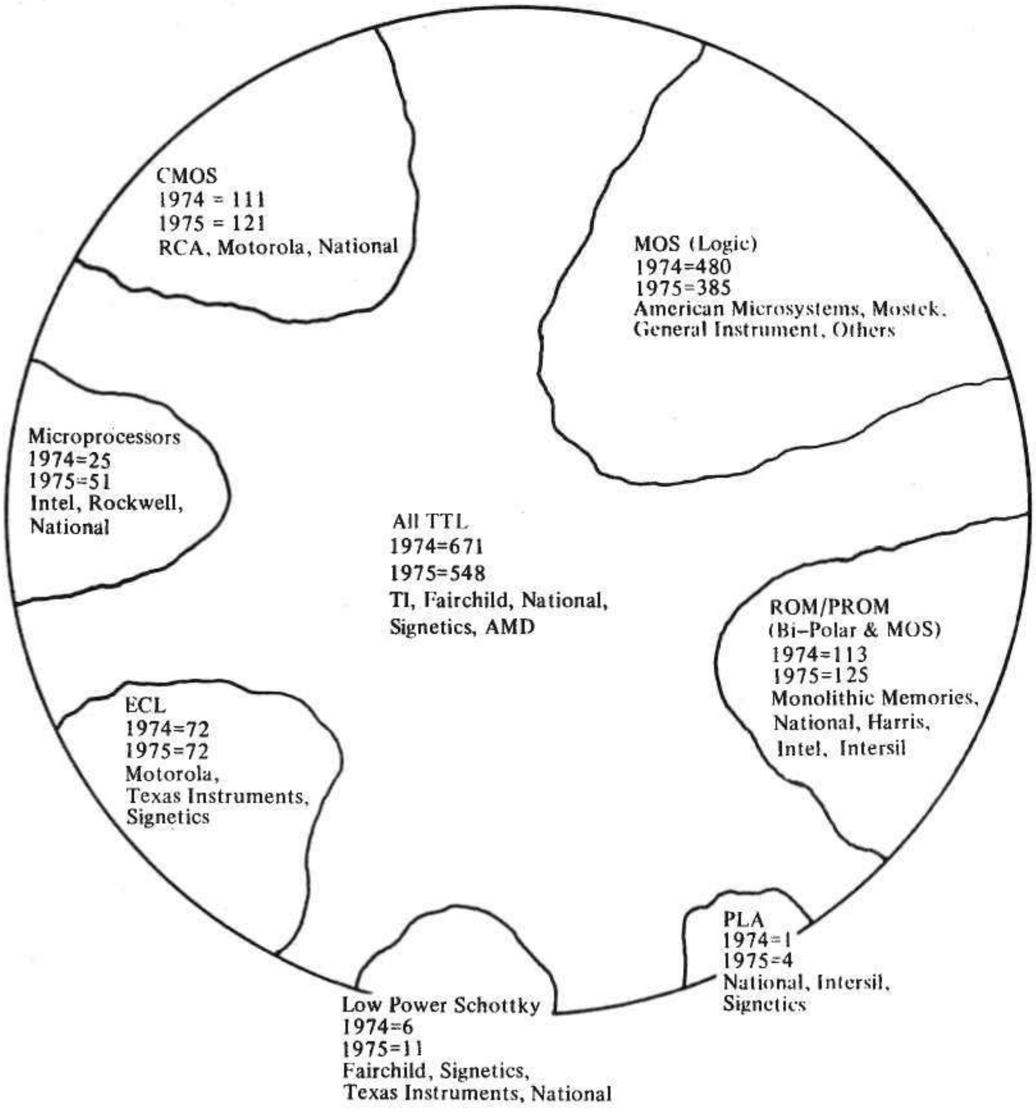
- ECL - For the very high speed, complex computer systems, ECL has been designed into some major computer programs within the last 12 months. The significant shippers in ECL are Motorola, Texas Instruments, and Signetics.

- Low power Schottky TTL - This technology was examined fully in our Research Newsletter of November 29, 1974. Basically, low power Schottky can replace almost all of the design work being done in standard TTL and can be retrofitted in many cases. Because of the nature of the production process, a given function in low power Schottky has a smaller die size and lower power, which gives the customer the ultimate value--more speed for less money. The key shippers in this technology are Fairchild, Signetics, Texas Instruments, National and AMD.

Figure 1

TTL UNDER ATTACK

(Dollars In Millions)



Source: DATAQUEST, Inc.

12 May 1975

- PLA's - A new technology/application known as the Programmed Logic Array, PLA's are LSI bipolar devices containing from 2,000 to 4,000 transistors. These devices essentially do to logic applications what PROM's do for ROM applications. By use of a programmer, custom logic applications can be programmed on these chips very quickly. A PLA has the logic power to displace from 200 to 400 SSI packages or 30 to 40 MSI packages, depending upon the manufacturer. National, Signetics, and Intersil have announced PLA products.

- ROM/PROM - Many of the functions formerly performed with logic are now being hard wired with ROM's and PROM's. The key suppliers in this technology are Intel, Monolithic Memories, TI, National, Harris, and Intersil.

- MOS Logic - Where a given design has enough volume, single chip LSI custom designs are replacing multiple device TTL. The key shippers in this area are American Microsystems, MOSTEK, and General Instruments.

Denny K. Paul
James F. Riley
Frederick L. Zieber

DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

SIS Code 2.2 Markets

March 28, 1975

THE DIGITAL WATCH MARKET

Summary

The digital (electronic) watch industry is expected to grow from an estimated $60 million of factory shipments in 1974 to $550 million in 1980. Unit volume is estimated to expand to 50 million watches from an estimated 600,000 in 1974, while average retail selling prices fall from $200 to under $20.

This downward trend in prices will be made possible by expected sharp reductions in manufacturing costs. Watch module manufacturing costs are now estimated at $17 for Light Emitting Diode watches and $24 for Liquid Crystal Display watches. Vertically integrated semiconductor companies such as Hughes, Litronix, National Semiconductor, and Texas Instruments have a definite manufacturing cost advantage in LED watches that should enable them to dominate LED module assembly.

Final market growth will be dependent on consumer acceptance (as well as price) and the mix of consumer choice between LED and LCD displays. Neither of these are well determined at this time.

Current trends that we have identified are:

- The bulk of the marketing activity this year will be outside of normal retail channels.
- The proliferation of suppliers is expected to end in 1975 and 1976, with a shake-out similar to that in calculators.
- Semiconductor houses will likely have difficulty penetrating traditional retail channels, but should be successful in mass market channels.
- CMOS is expected to be the standard chip production technology for the next several years.
- The lowest cost producers will be the companies that make both the timing chip and display.

480 California Ave. / Palo Alto, California 94306 / (415) 327-8210 / TWX (910) 373-1160 / DATAQUEST PLA

Background

The digital watch industry began in the late 1960s and early 1970s as development programs by Bulova, HMW (Pulsar), Omega, and Seiko. Every element of the digital watch--circuit, crystal, display, and battery--required substantial development. While these problems were being solved, the cost of watches remained high and sales were very limited, amounting to approximately 12,000 watches in 1972. Starting in 1973, solutions to these problems enabled the high end of the market to be pentrated by firms such as Bulova, HMW, Microma, and Seiko. The market now appears to be entering a phase of rapid growth.

The Market

Estimated market growth is shown in Table 1. Market size is dependent on several factors:

- The total watch market, segmented as a function of price.
- Future manufacturing costs.
- Consumer acceptance of electronic digital watches.
- Consumer choice of display.

The first factor is well known--watches have a 400-year sales history. Retail prices can be approximated through rough estimates of future manufacturing costs and normal margins. Consumer acceptance, however, is difficult to forecast at this time. Although many similarities exist between calculators and electronic watches, substantial dissimilarities exist. Hand-held calculators created a new market but digital watches will be a displacement market. Therefore, the rate of growth will be determined by consumer choice. Dataquest believes a 16 percent penetration of units is likely by 1980. A number of factors could accelerate or decelerate this trend. The long run consumer preference between displays also has yet to be determined. Neither type can be expected to prevail.

Distribution Channels

Channels of distribution fall into two categories--mass market and class market.

Unlike the hand-held calculator, watches have well established retailing channels. In particular, jewelry retailers have been traditional outlets for the higher priced class market. However, Dataquest expects electronic watches to accelerate trends to increased mass retailing. Calculator markets have provided some semiconductor manufacturers with experience in mass marketing, and the consumer can be offered a price advantage over traditional outlets. It should be recalled that as calculator prices fell, distribution channels changed radically. Both class and mass retailing will likely endure, depending on whether a consumer views a watch as jewelry or a

Table 1

ESTIMATED WORLDWIDE ELECTRONIC
WATCH SHIPMENTS

	1973	1974	1975	1976	1977	1978	1979	1980
ASP - Retail[1]	$200	$200	$ 80	$ 43	$ 34	$ 30	$ 24	$19.50
ASP - Factory[1]	$100	$100	$ 45	$ 24	$ 19	$ 17	$13.5	$ 11
Total Watches (Millions of Units)	200	220	230	240	255	270	285	300
Digital Watches (Millions of Units)	0.22	0.60	2.0	8.0	16.0	26.0	37.0	50.0
Factory Shipments (Dollars in Millions)	$ 22	$ 60	$ 90	$192	$304	$442	$500	$500
Light Emitting Diode Displays (Percent of Units)	60	70	70	60	55	--[2]	--[2]	--[2]
Liquid Crystal Displays (Percent of Units)	40	30	30	40	45	--[2]	--[2]	--[2]
U.S. Sales (Percent of Units)	66							50
Foreign Sales (Percent of Units)	34							50

[1]Average Selling Price

Assumptions include:

a. This market curve assumes the availability of a watch at a $50 retail price within 6 months.

b. The availability of a ladies digital watch at competitive prices in 1975 is assumed.

[2]The perfect display for watches does not yet exist. The market in 1978 may use a display not yet perfected, combining the brightness of current LED with the low power of LCD.

Source: DATAQUEST, Inc.
(March 27, 1975)

functional aid, but Dataquest feels an increasingly larger percentage (in units) will be mass marketed.

Major mass marketers, such as the razor, tobacco, radio/electronic, or soap industries may enter the watch market through association with module manufacturers.

The class market is held by old line firms who have the distribution depth and the financial strength to offer retailers six month terms and consigned inventory. Major firms that will participate in this market include Bulova, Seiko, Citizens, Omega, Longines, and Gruen.

Class marketers (i.e., classical jewelry suppliers) are using a variety of methods to get modules. For example:

- Seiko has its own line and a close relationship with Micropower.
- Bulova has an equity interest in Synertek.
- Omega has an equity interest in Optel.
- Others are buying modules and are doing their own case designs.

Some of these firms presently get their conventional movements from the Swiss movement manufacturing trust, Ebauche, which shipped approximately $0.5 billion in watch movements in 1974. Considerable shaking out will occur until a centralized electronic module source is established by the Swiss. However, due to prior antitrust action, the Swiss consortium of manufacturers cannot jointly approach U.S. semiconductor companies. Thus, current Swiss efforts are somewhat uncoordinated, which has aided others entering the market.

Manufacturing

Estimated current manufacturing costs of watch modules are shown in Table 2. As volume and experience increase, we expect that many of these costs will significantly decrease and yield will improve. Thus, future module costs will be lower.

LED displays presently have a learning curve advantage over LCD displays because of the huge volume of LEDs used in hand-held calculators.

The greatest cost differentials between LED watches and LCD watches are for the display, timing chip, and hybrid assembly. Therefore, the greatest value added, and the competitive advantage, lies with those semiconductor manufacturers that make LED's and CMOS LSI, and that have low cost offshore assembly facilities. The technology is still rapidly changing across a broad front, including timing chip, display, crystal, driver, battery, and the interface among these components.

Table 2

ESTIMATED CURRENT MANUFACTURING COSTS FOR DIGITAL WATCHES[1]

	LED		LCD	
	Assembler	Vertically Integrated Semiconductor House	Assembler	Vertically Integrated Semiconductor House
Chip Size (sq.mils)	22,500	22,500	15,600	15,600
Chip Cost [2]	$ 5.00	$ 1.00	$ 5.00	$ 1.00
Crystal Cost	3.00	1.00[3]	3.00	1.00[3]
Display (With Drivers)	4.00	2.00	6.00	5.00
Outboard Components (Inc. Trimmer)	1.00	1.00	1.00	1.00
Ceramic Substrate	1.00	.50[3]	1.00	.50[3]
Batteries	.80	.80	.40	.40
Overseas Assembly	2.00	1.25	2.00	1.25
Plastic Pod	.50	.50	.50	.50
Subtotal	$17.30	$ 8.05	$18.90	$10.65
70% Yield	$24.70	$11.50	$27.00	$15.20
Warranty	$ 2.00	$ 2.00	$ 5.00	$ 5.00
Direct Cost of Module[4]	$26.70	$13.50[4]	$32.00	$20.20[4]

[1]Displays hours, minutes, seconds, and date.

[2]Uncased chips should be available at $2.50 - $3.00 in the second half of 1975.

[3]At this time no manufacturer has integrated crystal and ceramic fabrication. Manufacturing costs for LED watches with these items not integrated is currently estimated at $17.00, and for LCD watches at $23.80, for vertically integrated semiconductor companies. Crystal and ceramic costs should drop significantly in 1975 and 1976 as volume increases.

[4]$5.00 and up can be added to the above for a case and $5.00 and up for a band and box. Plastic cases at less than $0.50 are anticipated before mid 1976.

Source: DATAQUEST, Inc. (March 27, 1975)

I^2L has the ability to drive LED's directly, low voltage requirements, and a power/frequency advantage and thus may displace CMOS--provided production capability can be achieved. However, this displacement (if any) will occur primarily in LED watches and is not expected to be significant before 1976-1977.

Both LED displays and LCD displays have drawbacks in the consumer market. LED watches have high power dissipation and therefore usually have turn-on buttons to read the time thus requiring two hands. LCDs cannot be seen in the dark (unless a light is added). Major display improvements are possible in the next few years, and combination LCD-LED displays are not unforeseeable for some models.

Competition

Major participants in the electronic watch market are given in Tables 3 and 4. In the mass market, including premium models, the dominant forces are expected to be the vertically integrated semiconductor houses, plus Timex and General Time. Dataquest expects the leading semiconductor participants to be Hughes, Litronix, National Semiconductor, and Texas Instruments for LED watches. A cost advantage will accrue to the companies able to spread overhead over a wide product base of displays and chips and foreign assembly of other devices.

In 1974, Dataquest estimates Hughes supplied approximately half of the modules for the LED watch market. Hughes and HMW are the only well-established manufacturers to date. However, the market is still in its infancy, and market share can change very rapidly. Litronix, National Semiconductor, and Texas Instruments have natural market and manufacturing advantages because of their calculator business. National Semiconductor has been very aggressive recently in the watch market and Litronix has recently entered it. Both are price leaders at this time. Texas Instruments recently delayed entry into the market, but Dataquest feels this move is only temporary.

The LCD market is less clear at this time, and future market leaders have yet to be determined. Semiconductor manufacturers that make both the LCD display and the timing chip include Intel, AMI, and Solid State Scientific.

The class market will likely remain the domain of the traditional watch marketers, although they may buy modules from the semiconductor houses. Because they have a cost disadvantage, they are expected to be less competitive in the growing mass markets.

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Denny K. Paul

Table 3

MAJOR U.S. LCD WATCH MANUFACTURERS

BRAND	MANUFACTURER	MOVEMENT
Microma	Microma (Intel)	Microma
Gruen	Gruen	AMI
Timex	Timex, Inc.	Integrated Microsystems/RCA
Time Capsule	Elgin	Electronic Research/Exetron
Terrestrial	Croton Time	--
Quartzmatic	General Time	AMI/Exetron
Computime	Wyler	Cox/Solid State Scientific
Zodiac	Zodiac	NESS/Microma
Exetron	Exetron	Exetron
Mike	Micro Elect. System	AMI/Exetron
Quartza	Cox Electronics	Cox/Solid State Scientific
Seiko	Eiko Seiko	Frontier Seiko/Micropower
NESS	NESS Time	NESS/Microma
Time Modulator	Speidel	Electronic Research
--	AMI	AMI
General Electric	GE/Solid State Scientific	GE/Solid State Scientific

Source: DATAQUEST, Inc.

Table 4

MAJOR U.S. LED WATCH MANUFACTURERS

BRAND	MANUFACTURER	MOVEMENT
Timex	Timex	Timex/Hughes
Pulsar	HMW [1]	HMW/RCA
Hamilton	SSIH [2]	HMW/RCA
Accuquartz	Bulova	Bulova/Hughes
Polara	Longines	Hughes
Benrus	Benrus	Hughes
Uranus	Uranus	Uranus/Hughes
Croton	Croton Time	HAC
Novus	National	National
Litronix	Litronix	Litronix
Helbros	Helbros[3]	Hughes
HH Digital	Hudson Harris	Hughes
Nebula	Siliconix (Harper)	Siliconix (Harper)
Micrel	Windert	Hughes
Rockwell	Rockwell	Rockwell
Compucheon	Unisonics	Hughes

[1]Formerly Hamilton Watch.

[2]Societe Suisse pour l'Industrie Horlogere

[3]A subsidiary of General Time

Source: DATAQUEST, Inc.

DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

March 7, 1975

ESTIMATED WORLD SEMICONDUCTOR CONSUMPTION

Summary

Revised estimates show a sharp downturn of 17.5 percent in 1975 for world semiconductor consumption. The market is expected to rebound in 1976 and 1977, maintaining the industry's estimated 15 percent long term growth rate. U.S. companies will continue to dominate the industry, maintaining their 82 percent share of the IC market.

World Semiconductor Consumption

In October at the annual Western Electronic Manufacturers' Association (WEMA) financial conference held in Monterey, an industry forecast was submitted to the participating companies and analysts. We provided those estimates to our clients because we felt they were good estimates of actual industry shipments and reasonable forecasts for 1975. Since that time, of course, the economy has taken a turn for the worse, necessitating a revised outlook. This newsletter presents Dataquest's estimates of world semiconductor consumption, updating our newsletter of October 25, 1974.

The data for 1973 are from WEMA, except for some minor areas where we felt revisions were necessary. Total estimates of MOS consumption and production were raised as a result of our analysis of manufacturers' estimated production. Japanese consumption was revised to agree with values supplied by the Ministry of International Trade and Industry (MITI).

The 1974 and 1975 estimates have been revised downward to reflect our estimates of 1974 consumption due to the poor fourth quarter and our forecast of the total market in 1975. The forecast values in 1975 are derived from our econometric modeling and extensive contact with industry. In recent months, U.S. industrial production has dropped about 10 percent, and the percentage drop from the free-world is probably only slightly less. Our estimates of the semiconductor market for 1975 are a reflection of this situation. Either a

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worsening of the recession or an extremely fast pickup of the economy could alter our estimates somewhat.

The long term growth rate for the semiconductor industry has been about 15 percent and is due, basically, to elasticities of demand and the continuing rapid reduction of semiconductor prices. We feel that this growth rate will continue. Lower prices are expected to open new markets, expand old ones, and create opportunities to substitute components. A down market, such as in 1975, creates a situation where industry sales may expand very rapidly after general economic conditions improve. Our forecasts for 1976 and 1977 assume a healthy world economy in 1976 in which semiconductor demand rebounds. At this time these estimates should be considered highly uncertain. Due to its high sensitivity to the economy the demand for semiconductors is subject to wide swings. Inasmuch as the general world economy is uncertain, the demand for semiconductors is several times more uncertain.

The scope of these consumption figures is the free-world noncaptive markets. It includes use of semiconductors by manufacturers that also sell devices to the outside world--i.e., the in-house use of semiconductors for calculators by Texas Instruments is included. It does not include those manufacturers that make semiconductors for their own use and do not market them.

The world consumption estimates represent, with some qualifications, an open market for U.S. manufacturers. This is particularly true when recent easing of restrictions by the Japanese is considered. Dataquest estimates that in 1974 U.S. companies supplied about 62 percent of the total world semiconductor consumption, and an impressive 82 percent of integrated circuit consumption. The inclusion of IBM and Western Electric, of course, would make these totals even higher. We feel these percentages will not be eroded in the near future and, therefore, the estimates of world consumption presented are good indications of the total available market for U.S. companies.

Frederick L. Zieber
James F. Riley
Denny K. Paul

Table 1

ESTIMATED WORLD SEMICONDUCTOR CONSUMPTION[1]
SUMMARY
(Dollars in Millions)

	1973	1974	1975	1976	1977
Integrated Circuits	$1,832	$2,183	$1,848	$2,262	$2,881
Percent Change		19.2%	(15.3)%	22.4%	27.4%
Discrete Devices	$2,407	$2,578	$2,078	$2,307	$2,583
Percent Change		7.1%	(19.4)%	11%	12%
Total Semiconductor Consumption	$4,239	$4,761	$3,926	$4,569	$5,464
Percent Change		12.3%	(17.5)%	16.4%	19.6%

[1] Markets includes open market plus controlled captive, but exclude dedicated captive.

Source: DATAQUEST, Inc.

(February 24, 1975)

Table 2

ESTIMATED MOS CONSUMPTION
(Dollars in Millions)

	1973	1974	1975	1976	1977
Worldwide Total	$ 602	$ 792	$ 705	$ 928	$1,247
Breakdown by Technology					
P Channel	$ 534	$ 610	$ 490	$ 547	$ 607
N Channel	13	72	93	198	387
C MOS	55	111	121	183	253
Breakdown by Function					
Logic	$ 427	$ 532	$ 452	$ 580	$ 730
Memory	175	260	253	348	517
RAM	75	144	146	221	371
ROM/PROM	50	67	64	84	101
Shift Register	50	49	43	43	45
Breakdown by Geography					
North America	$ 288	$ 404	$ 355	$ 446	$ 584
Europe	91	141	138	195	275
Japan	216	235	198	269	364
Rest of World	6	12	13	18	25

Source: DATAQUEST, Inc.

(February 24, 1975)

Table 3

ESTIMATED DIGITAL BIPOLAR CONSUMPTION
(Dollars in Millions)

	1973	1974	1975	1976	1977
Worldwide Total	$ 815	$ 920	$ 750	$ 868	$1,034
Breakdown by Product					
TTL	$ 560	$ 671	$ 549	$ 648	$ 786
DTL	120	110	80	72	63
ECL	65	72	72	102	142
Other	70	67	50	46	43
Breakdown by Function					
Logic	$ 750	$ 810	$ 641	$ 727	$ 841
Memory	65	110	110	141	193
RAM	40	63	61	72	98
ROM/PROM	25	48	50	69	95
Breakdown by Geography					
North America	$ 485	$ 590	$ 470	$ 517	$ 592
Europe	185	191	159	201	256
Japan	110	100	87	110	142
Rest of World	35	39	34	38	43

Source: DATAQUEST, Inc.

(February 24, 1975)

Table 4

ESTIMATED LINEAR CONSUMPTION
(Dollars in Millions)

	1973	1974	1975	1976	1977
Worldwide Total	$ 415	$ 469	$ 394	$ 468	$ 600
Breakdown by Function					
Op-Amp	$ 95	$ 110	$ 95	$ 103	$ 122
Interface	70	81	72	84	103
Voltage Regulator	40	43	38	46	49
Consumer	150	163	129	168	225
Other	60	72	61	68	91
Breakdown by Geography					
North America	$ 197	$ 225	$ 186	$ 213	$ 265
Europe	104	115	99	122	158
Japan	104	110	91	110	146
Rest of World	10	19	19	23	32

Source: DATAQUEST, Inc.

(February 24, 1975)

Table 5

ESTIMATED DISCRETE SEMICONDUCTOR CONSUMPTION
(Dollars in Millions)

	1973	1974	1975	1976	1977
Worldwide Total	$2,407	$2,578	$2,078	$2,307	$2,583
Percent Change		7.1%	(19.4)%	11%	12%
<u>Breakdown by Product</u>					
Si Small Signal Trans.	$ 720	$ 742	$ 561	$ 588	$ 602
Si Power Transistors	432	490	424	494	589
Rectifiers	391	412	343	385	442
Si Diodes	181	180	139	145	147
Thyristors	187	209	185	217	253
Zeners	113	121	102	111	124
Opto Electronics	155	191	162	208	261
Other	228	229	162	159	165
<u>Breakdown by Geography</u>					
North America	$ 942	$ 977	$ 788	$ 879	$ 984
Europe	634	717	586	653	731
Japan	732	768	607	669	749
Rest of World	99	116	98	106	119

Source: DATAQUEST, Inc.

(February 24, 1975)

DATAQUEST
INCORPORATED

RESEARCH
NEWSLETTER

February 19, 1975

OBSERVATIONS WHILE TOURING A SEMICONDUCTOR FACILITY

This note is intended to acquaint Dataquest's clients with specific observations that can be made on a cursory tour of a semiconductor facility, and to help analyze those observations as a means of evaluating the facility. Cogent observations can provide valuable information, either on the quality or efficiency of a facility, or on the total quantity output of a facility.

While it is helpful to have the eyes of an eagle and total recall, it is not the purpose of field observations to provide precise information. Rather, the total information gathered from inspection of a plant should be used qualitatively in conjunction with other known information and answers to various questions asked. In summary the tour should provide substantiation to what is already known.

Some caveats are needed. First observations are necessarily made in a brief amount of time, and it is easy to make errors. Secondly, any observation is a sample of one. For example, an observation of low yields at a particular point, may only be due to a single run and may not be representative of the facility's true yield. Finally, precisely what is being observed may be perceived incorrectly.

Observations should be used to cross check other information, and no information gained by observation should be considered absolutely true. Its veracity should be cross checked by other information. The analyst should always use observations carefully with their importance and context carefully considered.

Specific items to observe are itemized below in the order of manufacturing work flow in a facility. Some general observations are included as well as some general observational errors that are often made.

- How many cars are in the lot?

  There are a number of ways to evaluate the output of a manufacturing facility and total personnel is a good one. The

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number of workers in a semiconductor plant is about 1.3 times the number of autos in the parking lot, for any given shift. For a semiconductor facility this should be adjusted for the number of shifts in operation, whether or not assembly is performed locally or in Asia, and the general labor content of the product. For example, TTL has a lower sales revenue per employee (down to $12,000) than LSI MOS (up to $30,000).

- Cleanliness of wafer fab

  Be careful! Many items in wafer fabrication cleanliness are impossible to observe. For example, the cleanliness of materials such as photoresist, water, or gas cannot be observed. Secondly, gross efforts in cleanliness often are more symbolic than successful--such as laminar flow walls or ceilings and elaborate precautions to keep particles out of an area. Look for the little things: are the smocks clean. Are they taken out of the fabrication area? Do the girls eat their lunch in them? Is there dust in the fabrication area? (Run your finger along the top of a diffusion tube.) Are the floors, shoes, etc. clean? Is there control of personnel in and out of the fabrication area or is there a great deal of traffic going in and out of the area? Is there positive air pressure (i.e., does the air blow out instead of in) and double doors used for the are area?

- Is the equipment up to date?

  Are 3-inch wafers and the associated equipment used at every step or is the company still using smaller wafers.

- How much handling of wafers is done, particularly in the photomasking alignment area?

  Large die, such as the 4K RAM, should be handled as little as possible to minimize damage to potentially good die. In some masking operations, a wafer is rarely touched by the operators.

- How is work in process handled?

  Wafers should be stored under laminar flow hoods or in desiccators. Is there a large number of wafers lying around?

- Count (or estimate) the number of aligners

  The aligners will give you the fastest most accurate estimate of a facility's production capacity. Empty alignment stations are also an indication of unused capacity product. The number of aligners needed for a process depends on the volume of wafers, number of masking steps per wafer, fab yield, re-work rate, downtime of the machines, and the number of equivalent shifts per month that the machines are manned. For an efficient facility:

  Wafers aligned per month =
  (800 to 1300) x (number of aligners)

This information can be used to calculate the number of wafers produced. For a 5 mask process, and average of 1,100 wafers aligned per month per operator would equal an average of 220 wafers per operator out of fabrication. If production is known, it can provide an extremely valuable check on wafer fabrication productivity.

- Count the number of diffusion furnaces

  Unless the number of diffusion steps in a particular manufacturers' process is known, the answer to this question may not be too meaningful. Manufacturers with half the number of tubes as their competitors may have only half the number of diffusion steps and may actually have a higher potential capacity because of a shorter process throughput time. You must also determine how many of the tubes are used for engineering evaluations and process development.

- Are process specification or process flow charts readily available to the operator?

  Either operators follow process specifications closely or each operator does the process as she sees fit--which can lead to anarchy. Detailed process definition is an important aspect of process control in an LSI facility.

- Are the supervisors around?

  Interaction between supervisors and operators is important.

- Production Control Chart

  Very often Production Control will have a wall chart that shows where runs are in wafer fabrication. If true, this valuable piece of graffiti can tell you total volume in wafer fabrication, product mix, and other pertinent information. For example, there may be a piece of paper on the chart for each run. In this way you can tell how many runs are in wafer fabrication. If there are dates placed by each process step you can determine how long runs remain in wafer fabrication. The previous two together give a broad indication of the total quantity of wafer production. Bunching may indicate poor production control or processing hang-ups. Very often these run tags are coded by product or process, so that an examination will give the relative mix of different types of product in a facility. You should order your observations accordingly:

1. Get a quick impression of the number of runs.

2. Get a quick impression of bunching.

3. Check a tag at the end for starting date and number of starting wafers.

- Production Goal Chart

  There is often a wall chart that details wafer production for a given week or month. This, of course, directly relates to the total output of the facility. Check for this in wafer fabrication, but also in other areas of the plant where an indication of total units out may be stated.

- Wafer fabrication yield

  At the end of wafer fabrication, wafers will go to some sort of wafer evaluation. Each tray of wafers generally contains one run. A tray with a number of wafers missing--i.e., it is relatively empty (possibily with a lot of space between individual wafers)--is an indication that wafer yield in wafer fabrication has been poor.

- Run Travelers

  Look for run travelers, particularly at the end of wafer fabrication. (See Table 2.1-2, of our Semiconductor Industry Service Manufacturing Model.) A run traveler can provide three extemely valuable pieces of information:

  (1) The number of wafers started and finished (usually through wafer evaluation) will be on the run traveler. This will give at least a single sample of wafer fabrication cumulative yield.

  (2) The date that particular processes are performed are always written on the run traveler for quality control purposes. The starting date (top) and finishing date (bottom) will give an indication of the total time it has taken a run to progress through wafer fabrication. Time in excess of six weeks is far too long. Generally, a run should go through wafer fabrication in two to three weeks. If wafers remain too long in wafer fabrication, there is a chance that yield will be lower because of a higher chance of particles landing on the wafers, moisture absorption, or other factors.

  (3) The run traveler will also give an excellent indication of the number of processing steps and the number of total masks for a particular process. More steps can mean higher costs and lower yield. (See page 3.3-7 of the Manufacturing Model for a full discussion.) Keep your eyes open for a run traveler!

- Look at a wafer under a microscope

  Generally, at some point, such as an inspection point in wafer fabrication, you can get a good close look at a wafer under a high power microscope. Although this can tell a great deal about process cleanliness and process control, it will not mean too much to you without experience. However, if you do see many different facilities, you will gain some qualitative feeling over time.

- Wafer Sort Yields

Look around for indications of wafer sort yield in the wafer sort area. More than anything else, this can tell you that a company is competitive. Anyone can process wafers, but getting good yield is rough. All companies have some wafers where yield is very bad, but a poor facility will rarely have a wafer that has extremely high yield.

(1) Tested wafers are usually lying around. Visually you can get a good feeling for yields by a simple glance at one or more wafers. This is relative to die size, of course, and is most important for large die. Ten percent yield for die greater than 1/10 inch square is good.

(2) Assembly travelers are often started here (or Fab Run Travelers end here). Usually they will have a "die-in" and "die-out" count on them. Look around for that piece of paper.

(3) Wafer sort testers have counters on them both for total die and good die. Look at the counters, and be sure and find out what is being tested.

- Lead Bonding

In assembly, try to look at a device through a low power scope after it has been bonded (and, naturally, before it has been encapsulated). If bonding quality is bad it will be obvious. No facility should have bonding where the leads (wires) look sloppily done.

- Check the quantity of material flow in assembly

If a facility is having problems in wafer fabrication not much will be going through assembly, and chances are the batches in assembly will be small. If this is a manufacturing assembly line, and this is true, you have a facility in trouble.

- What are final test yields?

Check for a traveler that will give you final test yields, or look for counters on the testing equipment. If final test yield is below 70 percent, then there may be serious problems either in fabrication or general plant efficiency. Be careful that your count is on a production run, i.e., several hundred or more units, and not simply an experimental run.

- Information feedback

  Is there a continual feedback of information to process and product engineering? Ask if yields and different categories of device failures are recorded at all testing stations and fed back to engineering and processing personnel.

- What is the general level of automation in the plant?

  Facilities can either be over- or under-automated, and both can be dangerous. This questions is often difficult to answer for the inexperienced observer. But, it can be noted if equipment is up-to-date, if it is being used to its full throughput rate most of the time or if its throughput rate is too great for the amount of material to be handled (i.e., sitting idle). Overly expensive testing equipment for automatic wafer or die handling equipment may be indications of excessive spending. Alternately, a reliance on older equipment and equipment that has much lower throughput rates, a greater degree of required labor, or less precision may indicate that the facility's equipment is either out-of-date or that the company is under financed. This might indicate serious problems. Note: A company relying on older equipment can gain a short term cost advantage but suffer long term disadvantages. This was the case of Fairchild Semiconductor in the late 1960s.

- Is the company operating at capacity?

  Casual observation throughout the manufacturing facility, especially at assembly and mask alignment, will show whether the company is operating near capacity or far below capacity. If less than 80 or 90 percent of the stations are occupied, it is a good indication that order rates for the company are down. Alternately, low capacity utilization gives an indication of the company's ability to increase sales when orders turn up.

- Work efficiency

  In most semiconductor facilities there is a large proportion of support personnel. This often leaves an impression to a casual observer of a lack of order in the manufacturing work flow. Too many people walking around may be an indication of an inefficient facility, but conclusions can be dangerous. Are support people actively pursuing tasks, or are they simply wasting time? Try to get qualitative feeling.

- Work Attitude

  Do the personnel in the facility have a generally enthusiastic attitude toward their work? If they do not, it can be disastrous to the facility. Indifferent attitudes can be tolerable for some industrial production lines, but not for LSI.

- Mask making

  In a mask making facility, see if the rubyliths are clean or patched up. Many re-done rubies, i.e., with patches, indicate that there are problems in device/process design.

- Lot sizes

  If the size of lots in assembly or testing is low, i.e., the order of 100 devices or less, it can be a sure sign that the facility is either inefficient or that processing yields are low. Alternately, if the lot sizes are large, over 500 devices, production may be progressing smoothly.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

November 29, 1974

LOW POWER SCHOTTKY TTL

Summary

In our last newsletter, we mentioned low power Schottky TTL as one of the promising new state-of-the-art processes that is expected to help determine future market leaders. Low power Schottky TTL possesses definite advantages over other logic families--vastly improved product performance, lower manufacturing costs, and greater adaptability to MSI and LSI devices. We expect the market for this family to rapidly expand.

Low Power Schottky TTL

Low power Schottky TTL (LS-TTL) is one of the newest digital logic families. Dataquest feels that low power Schottky TTL will become a major logic family for three reasons:

- Vastly improved product performance.
- Equal or lower prices in comparison with standard TTL in the future.
- Greater adaptability to MSI and LSI devices.

LS-TTL is generating considerable interest among semiconductor users. As a result, all major TTL manufacturers are giving this logic family prime consideration.

LS-TTL is the current evolutionary culmination of TTL processing. It incorporates several improvements made in semiconductor processing technology over the last few years, including improved Schottky diodes, improved masking tolerance, better high resistivity epitaxial layers, ion inplanted resistors, and other less significant developments. Nearly all components on an LS-TTL chip are smaller and have lower capacitance, resulting in a faster device. Because the components are smaller, the general chip size is smaller, particularly for MSI and LSI devices. The smaller chip size for LS-TTL devices offsets the increased processing that is required, so that the chip cost, and ultimately the selling price, can be less than that for standard TTL devices. In addition, the lower power dissipation of the devices means less heat generation, avoiding one of the major problems in manufacturing devices with TTL technology.

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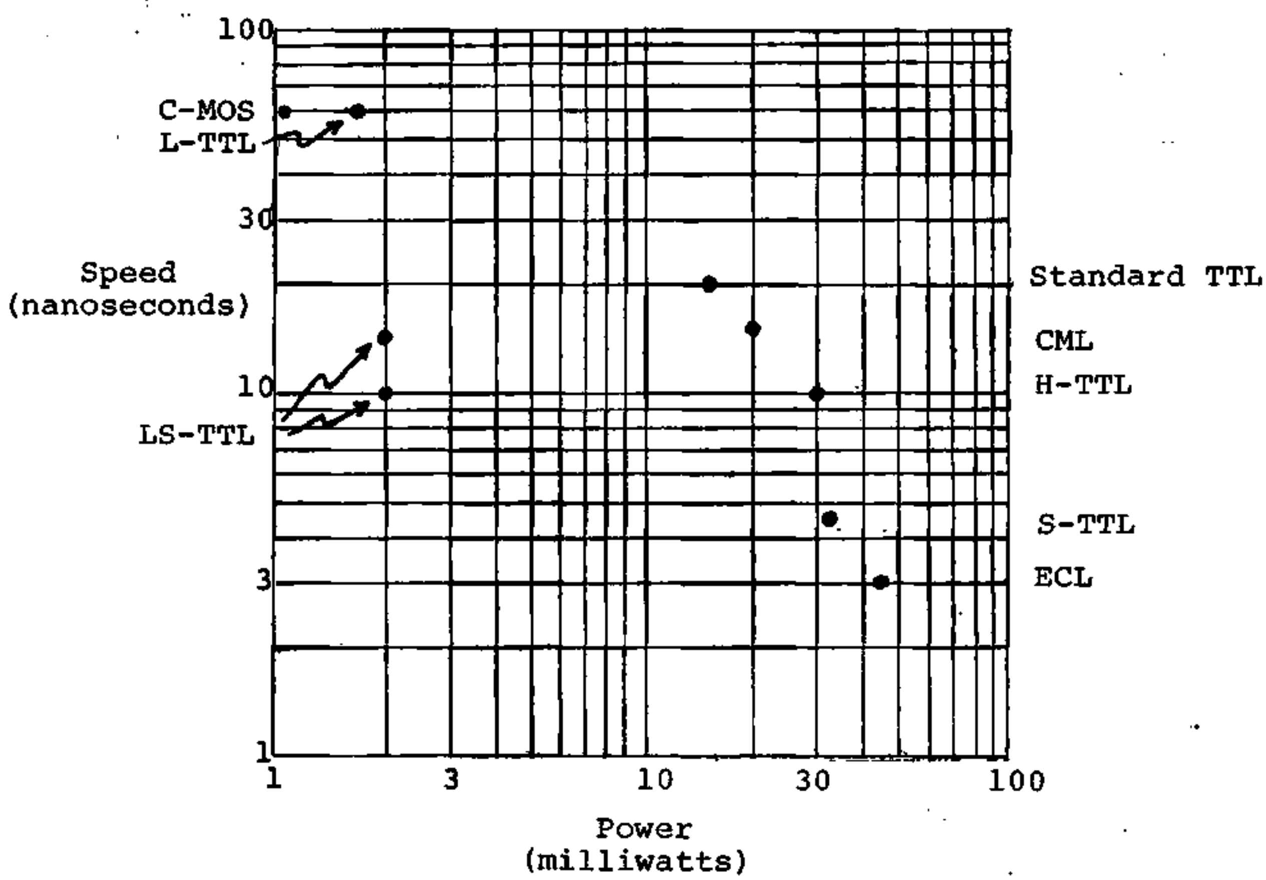
Product Performance

Figure 1 shows the speed-power performance of various semiconductor logic families. State-of-the-art improvements move the data points toward the bottom left of the chart. The speed-power trade-off is an important design consideration for many applications. The points on this graph represent specified maximum values for a very simple gate. It should be noted that typical gate propagation delays are about one-half of the values shown. The original Schottky TTL (S-TTL) was aimed toward high speeds, rather than power improvements. As an older process, it does not incorporate current processing improvements. The relative advantage of low power Schottky TTL is obvious.

Figure 1

DIGITAL LOGIC SERIES

Comparison of Speed-Power Performance



Because low power Schottky TTL will be easier to manufacture, semiconductor manufacturers have a vested interest in getting users of standard TTL to substitute this new family for the older devices. Because of this the propagation delays have been set to be very similar to those of standard TTL. Power dissipation, on the average, is only about one-fifth that of the standard devices. However, it is quite possible that in the future an even faster series will emerge. It can be noted from Figure 1 that standard Schottky TTL, or S-TTL series, is superior to high speed TTL, or H-TTL. This H series is now obsolete and has found very little acceptance. The same fate awaits the low power TTL series, or L-TTL, which lies between both the new low power Schottky series and C-MOS devices, and has a far less attractive speed-power product.

Pricing

As mentioned previously, LS-TTL devices hold the promise of lower prices due to smaller chip size. This is not to say, of course, that LS-TTL prices will initially be as low as those for standard TTL. Nevertheless, the LS-TTL family can take advantage of past experience in processing of the standard Schottky TTL devices, and past assembly and testing experience for all of TTL. Since material, assembly, and testing are the major percentage of cost for TTL, the start-up and processing costs do not add greatly to the final selling price. For this reason, even though chip costs can initially be several times higher than those for standard TTL, prices can quickly approach those for standard devices. In the past two weeks, prices have decreased about 25 percent. High quantity prices for gates are about $0.35 per unit, and high quantity prices for flipflops are about $0.55 per unit. These prices should decrease rapidly throughout 1975 and by some time in 1976 the prices for LS-TTL should be comparable to those for standard TTL. Prices of MSI devices are now within 25 percent of the prices for standard TTL, and should be equal by the end of 1975.

LS-TTL Market

The worldwide market for TTL devices is shown in Table 1 which gives forecasts for unit sales and revenues for the next five years. It has been assumed in this forecast that the market for 1975 will be slow, reflecting the general outlook for semiconductor devices in general, and that the market will pick up in 1976. The TTL market for commerical and industrial uses is subdivided into the standard TTL family, the standard Schottky TTL family, the LS series family, and all other TTL type familes. Because of its relative newness, the market for low power Schottky devices is somewhat uncertain. However, we believe that, if anything, our forecast is conservative, and may not fully reflect conversion from standard TTL devices to low power Schottky devices. At any rate, it seems clear that low power Schottky devices should gain wide acceptance. All manufacturers report a great deal of interest in this family by their customers and many semiconductor users are currently designing in LS-TTL, insuring its future.

Table 1

WORLDWIDE TTL CONSUMPTION

(Free World, Non-Captive)

(Millions of Units)

	1974	1975	1976	1977	1978
LS-TTL	12	33	82	186	367
S-TTL	43	69	111	161	248
Standard TTL	889	951	1,159	1,622	2,189
TTL-Other	183	209	267	337	425
Total Commercial/ Industrial TTL	1,127	1,262	1,619	2,306	3,229
Memory	16	20	27	35	44
Military	37	43	51	60	70
Total TTL	1,179	1,325	1,825	2,401	3,343

Table 2

WORLDWIDE TTL CONSUMPTION

(Free World, Non-Captive)

(Millions of U.S. Dollars)

	1974	1975	1976	1977	1978
LS-TTL	7	14	29	48	75
S-TTL	23	28	37	41	50
Standard TTL	400	366	421	466	491
TTL-Other	95	90	100	108	115
Total Commercial/ Industrial TTL	525	498	585	662	731
Memory	105	125	170	225	290
Military	70	79	94	108	124
Total TTL	700	702	850	995	1,145

Source: DATAQUEST, Inc.
(November 27, 1974)

Market Participants

Product introductions are occurring at a rapid pace for LS-TTL devices. TI has the largest family of standard and MSI LS-TTL devices. Fairchild is currently manufacturing about 20 devices, and has many more devices being prepared for introduction in the next few months. Fairchild is very bullish on the future of LS-TTL and currently appears to have the best technology. Signetics has about 15 standard devices in production, with another 15 devices scheduled to go into production within the next three months. However, Signetics has had some production delays, reportedly due to problems with Schottky processing. American Micro Devices will introduce about six MSI LS-TTL devices in December and another five devices are scheduled to be introduced in February. The major thrust of AMD's efforts are directed at the more complex functions not being made by its competitors. National Semiconductor is also currently working on LS-TTL and should announce availability of devices around the first of the year.

Product performance of LS-TTL among manufacturers falls into two groups. Those devices manufactured by Texas Instruments and Signetics have average gate propagation delays of about 8 to 10 nanoseconds. The devices manufactured by Fairchild and Advanced Micro Devices have average gate propagation delays of about 6 nanoseconds. However, TI is currently redesigning its family of devices and probably will come out with an A series that matches the propagation delays of the Fairchild devices. Other manufacturers may be expected to follow suit.

With the current slowdown in the semiconductor market, companies currently have the engineering resources and the desire to give the LS series considerable attention toward bringing it into production and filling out the limited family of devices that are now available. It is relatively simple to bring new devices into production for this series. By the middle of next year, complete families of standard gates and MSI devices will be available from several major manufacturers and they should be testing the market with various LSI devices.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

November 29, 1974

REVISED 1975 SEMICONDUCTOR MARKET OUTLOOK

WORSENING ECONOMIC CONDITIONS LOWER OUR 1975 SEMICONDUCTOR SHIPMENT FORECAST TO A 7 PERCENT DROP FROM AN INCREASE OF 4 PERCENT.

Summary

Since our last newsletter the outlook for the U.S. economy has grown increasingly pessimistic. The possibility of an early solution to the world's economic problems has dimmed, and economic indicators have yet to turn up. As a result, the 1975 prospects for the U.S. semiconductor market have deteriorated.

- We estimate that 1974 U.S. factory shipments of semiconductors will be up only 14 percent from 1973.
- We expect U.S. factory production for semiconductors for 1975 to be down 5 to 10 percent from 1974.
- However, we anticipate that profits over the coming year should compare quite favorably with previous downturns, because U.S. manufacturers have been very responsive to the downturn in demand.

The 1975 Semiconductor Industry Outlook

Both the U.S. economy and the world economy have failed to respond to efforts to improve the current economic problems. As a result, the money supply has remained tight, real GNP has continued to decrease, and industrial production has remained fairly level. The U.S. semiconductor market is closely tied to the U.S. economy and many uses for semiconductors are linked to increased automation and plant expansion. Dataquest uses econometric modeling to assist in forecasting the semiconductor market. Market data derived from our models, compared with actual data, show a coefficient of determination (R^2) in excess of 0.98.

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Table 1

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS

(Millions of U.S. Dollars)

	1973	1974	Percent 73-74	1975	Percent 74-75
Discrete Devices	$1,010	$1,023	1.3%	$ 940	-8.1%
Integrated Circuits	1,030	1,297	25.9	1,220	-5.9
Total	$2,040	$2,320	13.7%	$2,160	-6.9%

Source: DATAQUEST, Inc.
(November 27, 1974)

Table 2

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES

(Millions of U.S. Dollars)

	1974				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$263	$260	$260	$240	$1,023
Integrated Circuits	322	343	327	305	1,297
Total	$585	$603	$587	$545	$2,320

	1975				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$230	$230	$235	$245	$ 940
Integrated Circuits	300	300	305	320	1,220
Total	$530	$530	$540	$565	$2,160

Source: DATAQUEST, Inc.
(November 27, 1974)

Although these models use coincident economic variables, models using leading economic variables are nearly as accurate. In general, the semiconductor market lags the U.S. economy by about 6 to 9 months, so that macroeconomic data can give good future visibility on both upturns and downturns in the semiconductor market. Thus, because the U.S. economy has not yet shown improvement, it will be impossible for the semiconductor market to turn up before the fourth quarter of 1975, if past trends persist.

Dataquest estimates that the U.S. factory sales of semiconductors will decrease about 7 percent in 1975, as shown in Table 1. (We feel the downturn in the market could range from 5 to 10 percent, with 6.9 percent the most likely case.) Besides normal forecasting errors and the difficulty of forecasting more than 9 months ahead, new variables cloud the potential for prognostication. The most important of these is inflation. Inflation distorts many of the macroeconomic variables, even when adjusted, and many economists question the accuracy of real GNP under current inflation levels. In addition, it is not clearly known how the economy reacts under the conditions of long term double digit inflation. Our estimates assume no improvement in industrial production or GNP in the first quarter of 1975. Investments in durable equipment are assumed to drop about 3 percent next year, and a moderate expansion in the money supply is assumed.

Estimated U.S. factory semiconductor sales by quarter for 1974 and 1975 are shown in Table 2. Changes in the economy could alter these values. In particular, continuing economic stagnation could decrease the possibility of any recovery in the fourth quarter of 1975, further lowering yearly shipments. Our estimate for the fourth quarter of 1974 has also been decreased. The industry has had extensive layoffs as well as short shutdowns planned for the Thanksgiving and Christmas vacations. This reduces the estimated yearly shipment increase in 1974 to 14 percent.

Although short term prospects for the industry are less favorable than they have been for some time, the industry has been very reponsive in meeting this slowdown in demand. While profits will come under severe pressure, we feel the outlook cannot be compared to the massive losses in the industry in 1970 and 1971.

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DATAQUEST INCORPORATED

RESEARCH NEWSLETTER

October 25, 1974

1975 SEMICONDUCTOR INDUSTRY OUTLOOK

At the annual Western Electronic Manufacturers Association (WEMA) financial conference held in Monterey on October 20 - 23, an industry forecast was submitted to the participating companies and analysts. The forecast was the combined effort of Intel, Fairchild, Signetics, RCA, Intersil, American Microsystems, and National Semiconductor.

Summary

This newsletter includes WEMA's estimates for the semiconductor industry through 1976. These are consumption estimates. For comparison, Dataquest's estimates of U.S. factory production are included with quarterly breakdowns to show more current trends.

Specific causes of the slowdown in industry sales are:

- Scare buying in 1973
- Distributor inventory adjustments
- Leveling of OEM demand
- Price attrition
- Foreign markets

Dataquest believes these factors will determine industry winners when IC sales recover in 1976:

- Vertical integration
- High yields in state-of-the-art processes
- Product positioning
- Uniqueness
- Capitalization
- Control
- Profitability

WEMA's Estimates

Tables 1 through 4 present WEMA's estimates, which we have rearranged for easier interpretation.

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Table 1

TOTAL FREE WORLD SEMICONDUCTOR CONSUMPTION[1]
(Millions of U.S. Dollars)

	1973	1974	1975	1976
Discrete Devices	$2,407	$2,631	$2,552	$2,763
Integrated Circuits	1,758	2,175	2,325	2,824
Total Semiconductor	$4,165	$4,806	$4,877	$5,587

[1]Excludes captive suppliers

Source: WEMA

Table 2

CONSUMPTION OF DISCRETE DEVICES
BY GEOGRAPHIC REGION
(Millions of U.S. Dollars)

	1973	1974	1975	1976
North America	$ 904	$ 997	$ 967	$1,054
Western Europe	649	731	720	781
Japan	747	785	745	800
Rest of World	107	118	120	128
Total	$2,407	$2,631	$2,552	$2,763

Source: WEMA

Table 3

INTEGRATED CIRCUIT CONSUMPTION BY TECHNOLOGY AND GEOGRAPHY
(Millions of U.S. Dollars)

	1973	1974	1975	1976
Total World	$1,758	$2,175	$2,325	$2,824
MOS	528	725	815	1,069
Bipolar Digital	815	960	990	1,140
Linear	415	490	520	615
Total North America	$ 973	$1,220	$1,220	$1,475
MOS	263	370	410	515
Bipolar Digital	505	615	620	680
Linear	205	235	245	280
Total Western Europe	$ 335	$ 450	$ 500	$ 650
MOS	80	130	160	225
Bipolar Digital	175	200	210	265
Linear	100	120	130	160
Total Japan	$ 380	$ 435	$ 465	$ 600
MOS	180	215	230	310
Bipolar Digital	100	105	115	145
Linear	100	115	120	145
Total Rest of World	$ 50	$ 70	$ 85	$ 99
MOS	5	10	15	19
Bipolar Digital	35	40	45	50
Linear	10	20	25	30

Source: **WEMA**

Table 4

World Semiconductor Consumption
(Millions of U.S. Dollars)

	1973	1974	1975	1976
MOS Consumption				
Technology				
P Channel	$460	$535	$545	$595
N Channel	13	75	100	234
CMOS	55	115	160	240
Function				
Logic	$353	$454	$481	$650
Memory	175	271	334	419
RAM	75	150	193	265
ROM/PROM	50	70	84	97
Shift Register	50	51	57	57
Digital Bipolar Consumption				
Product				
TTL	$560	$700	$725	$850
DTL	120	115	105	95
ECL	65	75	95	135
Other	70	70	65	60
Function				
Logic	$750	$845	$845	$955
Memory	65	115	145	185
RAM	40	65	80	95
ROM/PROM	25	50	65	90
Linear Consumption				
Function				
Op-Amp	$ 95	$115	$125	$135
Interface	70	85	95	110
Voltage Regulator	40	45	50	60
Consumer	150	170	170	220
Other	60	75	80	90

Source: WEMA

Dataquest's Estimates

These worldwide estimates correlate closely with Dataquest's estimates of United States factory sales for 1973, 1974, and 1975 which are shown in Table 5. Note that our estimates are for factory sales and differ from North American consumption by net exports. Other differences occur due to slight differences in values for historical consumption and economic forecasts. Dataquest has estimated U.S. factory sales by quarter for 1973 and 1974 in Table 6.

Table 5

ESTIMATED U.S. FACTORY SALES OF SEMICONDUCTORS
(Millions of U.S. Dollars)

	1973	1974	1975
Discrete Devices	$1,010	$1,030	$1,040
Integrated Circuits	1,030	1,320	1,400
Total	$2,040	$2,350	$2,440

Source: DATAQUEST, Inc.

Table 6

ESTIMATED QUARTERLY U.S. FACTORY SEMICONDUCTOR SALES
(Dollars in Millions)

	1973				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$230	$255	$262	$263	$1,010
Integrated Circuits	215	255	265	295	1,030
Total	$445	$510	$527	$558	$2,040
	1974				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total Year
Discrete Devices	$263	$260	$260	$247	$1,030
Integrated Circuits	322	343	330	325	1,320
Total	$585	$603	$590	$572	$2,350

Source: DATAQUEST, Inc.

10/25/74

Both WEMA's forecasts and our own presuppose only a small (3-5 percent) increase in real capital spending in 1975. As the economic outlook changes, these values could also change. Both forecasts also suggest the same scenario--essentially flat sales for six quarters starting just after the second quarter of 1974, followed by a robust $500 million or 21 percent growth in annual worldwide IC consumption in 1976 to a level of $2,824. Since U.S. firms control an estimated 82 percent of world intergrated circuit (IC) shipments, they should realize approximately $410 million of this growth increment. The previous data poses two questions:

- What are the causes of the fall-off in demand beginning the third quarter of 1974 and followed by a flat 1975?
- What are the key factors that determine which companies will participate most profitably in the 1976 market growth?

Causes of the Six Quarter Plateau

The primary underlying cause of slackening in the demand is the current economic recession. Flat 1975 semiconductor sales assume small growth in capital spending. However, the rapid 1974 3rd Quarter fall-off and the ensuing flatness can also be ascribed to a number of specific factors:

- Scare buying in 1973 - 1973 was year of shortages; i.e., power, materials, and components (including semiconductors). As a result, double and triple ordering resulted in an estimated 12 to 14 week supply of finished parts in OEM inventories. With shortages abating, the OEM's began in the second quarter of 1974 to reduce inventories to a more realistic 6 to 8 week supply. Table 5 shows average quarterly IC shipment estimated to be about $330 million this year. With a concurrent inventory reduction of 6 weeks, or one-half of a quarter, the industry is working through a $165 million reduction in OEM inventories. This problem will probably not be fully resolved until mid-1975.
- Distributor inventory adjustments - Approximately 20 percent of industry sales (in dollars) are through distributors. In 1973 distributors overbought for the same reasons as the OEM's. In addition, millions of dollars worth of IC's were shipped to distributors by manufacturers whose product controls were inadequate and who were producing out of mix (i.e., production mix and sales mix were unmatched) and shipping the surplus to distributors. In the third quarter, distributors began to rectify this problem, which had been exacerbated by high interest rates in early 1974. The result of this readjustment is that in the second half of 1974 the distributor sector should account for about only 10 percent of industry volume, resulting in a $65 million reduction in factory IC sales.
- Leveling of OEM demand - The demands in several important demand sectors--especially consumer and EDP--are expected to level beginning in the fourth quarter of 1974.

- Price attrition - Price attrition in several product segments will cause dollar markets to level or decrease in spite of rising unit sales. For example, in 1975 some MOS RAM's may double in unit sales but rapidly falling prices may cause a net decrease in dollar sales.

- Foreign markets - Contacts in Europe and Japan indicate a pronounced reduction in business starting in the third quarter of 1974. While we are not able to quantify the impact precisely at this time, we believe that foreign sales of U.S. companies will experience a significant decline.

Key Factors For Success in 1976

We believe several criteria will determine the relative ability of IC manufacturers to participate in industry growth in 1976.

- Vertical integration - A number of markets in which the final product contains a high content of solid state devices are expected to offer profitable opportunities for vertical integration for a limited number of companies. These markets include personal calculators, watches, clocks, point-of-sale devices, and microcomputers, among others.

- High yields in state-of-the-art processes such as N-MOS silicon gate, C-MOS, Schottky TTL.

- Product positioning - Successful companies will have to choose individual products very carefully, with these criteria:

  1. Volume (commodity) markets, but with high growth and good margins.

  2. A product spread over several markets and several technologies.

- Uniqueness - With the market becoming both large and broad, the 1976 winners will almost certainly have to dominate--as opposed to merely participate in--smaller segments. In such areas as power semiconductors, microwave semiconductors, microprocessors, CMOS, RAM's, FET's and others we believe dominance will imply plant margins of 45 percent or higher.

- Capitalization - Only those companies which have sufficient net worth and return on equity, combined with secure debt arrangements, will likely be able to make necessary and timely receivables, equipment, and plant investments assure necessary staff and have sufficient working capital to meet short term needs. In other words, they must have cash for growth.

- Control - Successful companies will need tight controls in production, processing, finance, marketing, inventory, etc. and discipline in the use of scarce resources--such as engineers, capacity, and cash.