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MILITARY CHIPS

The overall chip market may be slowing down, and the military electronics business may be entering the doldrums, but analysts expect sales of military chips to grow 9.3% per year through 1993. Just as personal computer users beef up their existing equipment by replacing memory chips with circuits with four times the capacity, the Pentagon is likely to upgrade its installed base of electronic weaponry.

Electronics (November, 1988).says, "Since the military will have less money to spend in general, industry insiders say improving current equipment with the insertion of new technology—faster and denser chips, for example—is wiser than developing all-new gear from scratch."

However, well publicized Pentagon programs to speed the military absorption of new chip technologies are only having a minor impact. Weapons makers are eschewing the products of the Very High Speed Integrated Circuit (VHSIC) program in favor of more established technologies. Not only is VHSIC more risky. But the initial costs of VHSIC technology are greater, despite projected long-term savings. **Electronics** reports that the three leading VHSIC suppliers—TRW, IBM, and Honeywell—are not selling many VHSIC chips.

Military-funded gallium arsenide (GaAs) development is also moving slowly, hindered by the high cost of the GaAs substrate and the expense of processing it. A blank four-inch GaAs wafer costs $3,000, compared to only $200 for a much larger state-of-the-art (six-inch) silicon wafer. The **San Jose Business Journal** (October 31, 1988) cites a market analyst at Integrated Circuit Engineering, "By 1990, people were expecting the market to reach $1 (billion) to $2 billion. Now it's estimated at $400 (million) to $450 million."

Meanwhile, corporate restructuring has recast the leadership of the military chip business, pushing Harris Corp. and National Semiconductor far ahead. Harris has just acquired most of General Electric's semiconductor business, including RCA Solid State, which specializes in radiation hardened chips, and Intersil. National absorbed the remains of Fairchild Semiconductor. And Advanced Micro Devices, the third largest supplier of military integrated circuits, upped its share by buying Monolithic Memories. Texas Instruments, which ranked first in 1986, slipped to fourth in 1988, despite a modest increase in military integrated circuit sales. (**Electronics**, October, 1988, citing Integrated Circuit Engineering)

Top Five U.S. Military IC Sellers—1988

Company	Military Chip Sales (Projected)
Harris Corp. (Intersil, RCA)	US$ 296,000,000
National Semiconductor (Fairchild)	265,000,000
Advanced Micro Devices (MMI)	175,000,000
Texas Instruments	170,000,000
Motorola	110,000,000

P.C. MARKET CONSOLIDATES

The three largest American producers of personal computers—IBM, Compaq, and Apple—are pulling away from the pack. They are increasing their share of the U.S. market and boosting profits. The two hundred other companies making personal computers, primarily clones of the IBM PC, for the U.S. market are having difficulty maintaining their sales levels. Many are losing money. **Business Week** (December 12, 1988) compares the big three to the GM, Ford, and Chrysler of Detroit's heyday.

The **Business Week** story lacks some of the data needed to make its case, but it reports that the three top firms now account for 66% of all personal computers sold through computer stores, compared to 61% in 1985. Including other non-store PC sales might make the big three appear even stronger, however, since all have major direct corporate and government sales efforts.

Producers of IBM clones, led by Compaq,

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have emerged as a major force in the PC market, particularly when measured by unit sales. However, only Compaq and a few firms with alternate sales channels have managed to build their market and profit positions. That's because clonemakers are followers who must buy chips sets and other technology from specialty outfits such as Chips and Technologies. Almost anyone can build a PC clone, so there are scores of companies attempting to make money by producing and selling cheap. In that environment, it's hard to build sales value and earnings.

IBM, Compaq, and Apple make most of their money off their high-end machines, particularly those, based upon 32-bit microprocessors, that are difficult to duplicate. Apple's Macintosh is based upon proprietary hardware and software, so it can't be copied. IBM has established industry standards by virtue of its size. (See the September, 1988 **Global Electronics.**) And Compaq actually built a computer based upon Intel's 80386 microprocessor before IBM.

Most other U.S.-owned PC-makers are having difficulties. For example, Wyse Technology's PC *business is barely profitable. The same is true for* AST Research. Tandon is losing money. And Kaypro may go into bankruptcy. Meanwhile, vaunted Japanese and South Korean firms with solid track records in chips, peripherals, and consumer electronics are proving vincible in the PC market.

A small group of PC suppliers, however, is circumventing the sales bottleneck of computer retail stores by going directly to their customers. Tandy sells computers through its own Radio Shack stores. Zenith sells to the government and through college bookstores. And Dell runs a mail-order computer business.

Within the arbitrarily defined PC business, the **Business Week** argument appears strong: as you move up the price and performance ladder, competition diminishes and profits increase. But why stop at high-end PC's, which compete against low-end scientific workstations made by Sun, DEC, and others? IBM probably still makes most of its money selling mainframes—the market where its dominance is greatest, but does the pattern apply in other lines of the computer business. Unless one can qualitatively distinguish PC's from the entire range of computer hardware, or extend the analysis further, the **Business Week** view may be nothing more than a short-term observation.

TOXICS UPDATE

• The Santa Clara County Inter-Governmental Council, made up of representatives from cities and other local agencies, has finally adopted a model ordinance for the storage and handling of toxic gases. The legislation now goes to Silicon Valley cities, which are expected to pass it within the next year. The model ordinance culminates years of study, primarily by the county's fire chiefs, and negotiations between the electronics industry, public officials, and environmentalists.

Once the ordinance is enacted in any jurisdiction, users of toxic gases such as arsine, phosphine, and chlorine within the jurisdiction will have from three to five years to install double-walled containers and other safety devices designed to prevent a deadly leak. The measure could cost several million dollars at any semiconductor wafer fabrication plant that does not already use such equipment.

The gas model ordinance resembles the underground storage legislation enacted earlier, but it triggered more opposition from high-tech industry. Silicon Valley is dotted with Superfund sites and other locations where hazardous chemicals have leaked from underground storage tanks—bringing companies an enormous clean-up bill and reams of bad publicity. But there has been no major leak of toxic gases. Some firms feel the measure is a costly way to reinforce what they consider a good safety record. Proponents, however, consider a leak inevitable unless rules are quickly enacted and

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enforced, given the recurring releases of other hazardous gases by Valley industry.

• One such release, of explosive silane gas, forced the evacuation of hundreds of people around Exar Corp. in Sunnyvale this October. Exar is a chip manufacturer. A cylinder of silane leaked, igniting upon contact with the atmosphere. Since a phosphine cylinder was nearby, firefighters decided to evacuate a half-mile area. Fortunately, all the silane burned without exploding. Four people were treated for minor injuries, and more than 100 workers went home with headaches. (**San Jose Mercury News**, October 18, 1988)

• Advanced Micro Devices (AMD), historically one of the most vociferous defenders of the semiconductor industry's safety record, has again assumed a "kill the messenger" posture. In August, the Silicon Valley Toxics Coalition released a list that it called the "Silicon Valley Dirty Dozen," based upon Environmental Protection Agency (EPA) statistics. AMD ranked first on the list, for it had reported releasing 2,745,000 pounds of hazardous materials in a year.

AMD angrily responded with a full-page ad in the **San Jose Mercury News**, accusing the Toxics Coalition of "polluting the truth." It turns out, however, that the Coalition's figures were in error because AMD had erred in filing its report to the EPA. It had totalled its total usage of hazardous chemicals, not releases into the environment. AMD submitted a correction to the EPA, but it never publicly apologized for its full page ad. (**Silicon Valley Toxics News**, Fall, 1988)

DEC IN THE VALLEY

Digital Equipment Corporation (DEC), one of the world's largest and most profitable computer makers, is based in Massachusetts. But its presence in Silicon Valley is growing. With its Valley headquarters in Santa Clara and key research labs in Palo Alto, DEC now employs more than 1,400 people in the Bay Area. It is moving 300 employees into a new office building in downtown Mountain View, and it is considering a "campus" in the Coyote Valley area of South San Jose. (**San Jose Business Journal**, October 31, 1988). The company must be planning to add more employees, if it can find them. It is unlikely that many of its current staff would forsake Palo Alto for the isolation of Coyote Valley.

JAPAN'S ENGINEERS AND SCIENTISTS

The top executives of high-tech firms in the U.S., in their campaigns for additional U.S. government subsidies, frequently claim that Japan has achieved high-tech leadership by training more engineers than the U.S. Japan dominates some high-tech market segments, and it's coming on strong in others, but its strength is all too often exaggerated.

In fact, Japan trails the U.S. in its total employment of scientists and engineers. Even when scientists and engineers are counted in proportion to the total workforces in the two countries, there are few categories where Japan is in the lead. ("The Science and Technology Resources of Japan: A Comparison with the United States," U.S. National Science Foundation, Surveys of Science Resources Series, NSF 88–318, June, 1988.)

Employed Nonacademic Engineers and Scientists—1985

	Japan	United States
Total	1,514,200	3,583,300
Per 10,000 in workforce	251	300
Engineers	1,124,300	2,190,400
Per 10,000 in workforce	187	183
Civil	485,400	313,300
Electrical/Electronic	233,100	528,100
Industrial & Mechanical	405,800	1,349,200
Scientists	389,900	1,393,000
Per 10,000 in workforce	65	117
Natural	67,100	652,300
Computer	320,500	420,900
Social	2,300	319,800

Japan clearly has a stronger relative position in engineering than the sciences. In quantitative terms, it has achieved absolute parity with the U.S. in engineering training. The NSF reports, "With population size just over one-half that of the United States, Japan in 1976 first exceeded the United States in the granting of first-degree [undergraduate] engineering degrees; it retained this lead through 1982, after which time the number of engineering degrees granted in the United States surpassed that of Japan. (In 1985, the United States conferred 9 percent more engineering degrees than Japan.)"

But even Japan's acknowledged accomplishments in engineering training must be viewed through a cultural prism. Engineering, in essence, includes more in Japan that in the U.S. The NSF found, "Analysis of the career histories of university graduates suggests that many of the graduates of Japan's engineering and agricultural courses assume jobs analagous to those taken on by U.S. science graduates.

The U.S. needs to provide more resources for education, including the training of high-tech professionals. But those professionals need not be engineers. And despite Japan's advances, there is no reason to panic about accomplishments in the U.S.

If our goal is to promote the commercial development of high-technology, then we should reduce the diversion of professionals into military work. In 1985, Japan spent less than one percent of its total R & D expenditures for military purposes, in contrast to the 30 percent military share of total R&D in the U.S. Japan spends 2.8% of its GNP on non-military R&D, compared to 1.9% in the U.S. But U.S. non-military R&D is still twice that of Japan.

MALAYSIA ALLOWS UNIONS

In September, the government of Malaysia, under pressure from, of all places, the United States, ended its fifteen-year ban on unions in the electronics industry. The government has long permitted workers in the "electrical" industry to organize, but it has defined semiconductor assembly, its largest export industry, as "electronics," a distinct field. It would not allow the Electrical Industry Workers Union to represent semiconductor workers. Now it is likely that a solid majority of those assemblers will join an industry-wide electronics union.

The government appeared to act in response to a petition by the AFL-CIO in the U.S. The AFL-CIO sought to deny Malaysia trade preferences under the Generalized System of Preferences (GSP). U.S. trade law now requires that countries observe fair labor standards to qualify for GSP.

This may be the first substantive consequence of the GSP labor standards provisions. It also represents a victory for progressives within the AFL-CIO, which has wasted a great deal of energy limiting America's meager imports from Communist and other left-leaning countries.

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