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SOFTWARE IS TAKING OVER

Official statistics often mask a key trend in high technology: the biggest growth is in software and design. The largest growth in value added, profits, and employment in recent years have come in those segments of the data processing and components industries that design chips and computers and develop the software to run them.

Silicon Valley's future still depends upon the chip, but the real action in the Valley is not the etching of silicon. Not only are 31 of the 100 largest software companies based in the Bay Area (**Soft-Letter,** cited in **San Jose Business Journal,** July 30, 1990), but the area's best known computer firms—such as Sun, H-P, and Apple—are also focused on software and design.

Federal and state labor statistics count Apple Computer as a manufacturing company, but Apple does no in-house manufacturing in Santa Clara County. It's major domestic production facility is in Fremont, in adjacent Alameda County, and its other factories are in Singapore and Ireland. Subcontractors and suppliers do a great deal of the production work that goes into Apple's machines.

Of the thousands of Apple employees at its home "campus" in Cupertino, many work in administration and sales, some design computer hardware, but the largest chunk, it appears, work in software. They write the programs, test them, document them, and help customers use them.

I (**Global Electronics** editor Lenny Siegel) am familiar with the business, for I moonlighted for a couple of years as an Apple contract technical writer, authoring users' manuals for Macintosh computers and peripheral equipment, and since then I've done odd writing jobs for a variety of small software houses in Silicon Valley.

One of the first products I documented at Apple was an external hard disk. Yet instead of spending hours going over the specification of the hardware or the intricacies of connecting multiple hard disks, my focus was on software. Not only did the hard disk require installation of its own "driver," but it was shipped with a group of utility programs designed to make it more useful.

Each time I worked on a new program, I not only worked with programmers, but with product managers, testers, and others in the technical writing team. Commercial software development, it turns out, is a labor intensive activity requiring workers with a variety of skills.

Working with a team designing system software, I learned how each product generation requires substantially more development and testing. In most cases, new software must be compatible with all earlier releases. This means it must either work directly with files produced with its predecessors, or it must convert them to the new format.

Similarly, it must work on old and new versions of the computer. This task is time-consuming enough for Apple, with a relatively small number of Macintosh versions in service, but firms producing software for the IBM-PC-compatible market face a more daunting task, since each generation of the PC comes in many brands and designs.

Finally, each new software package must work with other complementary programs. For example, a layout program must be able to use files from the latest word processors. (Despite the efforts of reputable software firms, many software products do not work well with every combination of hardware, software, or old file. This merely illustrates the magnitude of the task.)

Given the challenge of compatibility, it is not surprising that many new personal computer programs, of the type once designed by highly motivated and skilled individuals, now are invented and shepherded by comparatively large companies.

The same challenge faces the developers of new microprocessors and new mainframe computers, but there is one difference: PC workers—programmers, technical writers, etc.—usually have the resources to own the tools of their trade. While mainframe programmers and chip designers usually work in vast teams, approaching merely a fragment of the problem at hand, PC product developers can go it alone.

They must still hire out to firms with the capability to test and market their product, but they have the power to pick and choose their assignments and working conditions. Since mainframe software specialists and chip designers have many of the skills as microcomputer programmers, computer professionals on the

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whole have strong individual bargaining power. They need organization to defend their economic rights, but at this time collective bargaining would provide little benefit to most computer professionals.

Ironically, while Apple's technical writers are counted as part of the manufacturing workforce, I was counted, along with other contract employees, under business services. When I worked for software companies, all their employees were tabulated in the services category, just because they didn't have a branch that built hardware.

The inconsistency goes beyond data collection. For decades economists have considered durable goods production the heart of any industrial economy. Should software be considered a good? Or more important, can an economy succeed if a growing percentage of its workforce is engaged in chip design, system design, and software development and support?

Software production is strategic, for it makes possible the sale of a large quantity of hardware, other software, and services. It is an important source of skilled work—not just professionals employment. And it is a growing field. While a cresting software industry is incapable of propping up a weak national economy, it provides welcome relief to areas, such as Silicon Valley, where production employment has reached its peak.

GOING "FABLESS"

The high cost of building and operating a state-of-the-art wafer fabrication facility has not prevented Silicon Valley entrepreneurs from starting up innovative new semiconductor firms. Their solution: farm out production to a "silicon foundry."

Bernard Vonderschmitt, co-founder and president of Xilinx, writes, "If we study the last 15 semiconductor companies to go public, 10 did not have their own manufacturing at the time of their offering, and only one, Maxim, has subsequently purchased a fab.... The fabless semiconductors are an emerging group of U.S. companies whose primary value-added is in the software content and architecture of their products." (**San Jose Mercury News**, September 10, 1990) Xilinx is a leading producer of field programmable gate arrays, a type of application-specific integrated circuit.

Noting that fabless start-ups generally have a high rate of return, Vonderschmitt reviews several criteria that influence the decision to go fabless. He notes, "Xilinx, Cirrus Logic, Chips & Technologies, and Weitek can all use a standard manufacturing process, market a limited number of device types, and require sufficient wafer demand to make it worthwhile for a foundry. Moreover, the products they market can take advantage of state-of-the-art manufacturing processes. By using external sources, these companies avoid the risk of owning an obsolete fab."

SELLING SEMI-GAS

This Spring, Hercules Corp. announced plans to sell Semi-Gas, a Silicon Valley manufacturer of gas containment, purification, and delivery systems for semiconductor manufacturing, to Nippon Sanso, the leading Japanese producer of specialty chemicals, for $23 million. Almost immediately, the leadership of Sematech, the semiconductor manufacturing consortium, challenged the sale.

Sematech and its Congressional allies forced the interagency Committee on Foreign Investment in the United States (CFIUS), chaired by the Treasury Department, to investigate the sale, but in July President Bush ruled that the transfer would not pose a threat to U.S. national security.

CFIUS is charged with enforcing the 1988 Exon-Florio Amendment to the Defense Production Act, which gives the President authority to block or reverse foreign investments threatening to impair U.S. national security. (Before the passage of this law, CFIUS had a similar, but less precise charter.) The General Accounting Office reports, "As of February 1, 1990, only six proposed foreign investments were selected as warranting the complete CFIUS investigation process, out of a total of about 240 investments considered by CFIUS under the Exon-Florio Amendment. Of those six, the President blocked one investment—by ordering a Chinese firm to divest all of its

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interest in a U.S. aircraft parts manufacturer." ("Foreign Investment: Analyzing National Security Concerns," GAO/NSIAD-90-94, March, 1990)

While the Exon-Florio law does not precisely define "national security," it rests on the concept that certain foreign acquisitions might, in the long run, make it difficult for the U.S. military to obtain needed products or technologies. In most cases considered, such as the Semi-Gas sale, that is not the case. In fact, U.S.-owned firms are more concerned that their foreign competitors will reap more U.S. sales as a result of the takeover.

Furthermore, it is difficult to argue that U.S. allies cannot be trusted to supply militarily useful commercial technology to the U.S. at the same time that we are pushing hard for those allies to buy U.S. weapons systems. Secrecy is not the issue, since the handling of military secrets is governed by other laws and procedures.

The problem with the Semi-Gas purchase, from Sematech's point of view, was not really national security. Rather, Semi-Gas was a key Sematech supplier, jointly developing production technology with the Defense Department-backed consortium. Sematech is attempting to feed new technology to its U.S.-based members firms before Japanese-owned chipmakers obtain the knowhow, and the Semi-Gas sale threatened to open up massive leaks. Nippon Sanso promised to sign a non-disclosure agreement, but that did not satisfy Sematech, which by now has probably lined up a replacement supplier.

Many in high-tech industry question whether Semi-Gas was important enough for Sematech to have raised such a fuss. Alternate suppliers of chipmaking equipment and technology can be found. But that isn't the issue.

Instead, it is important to question how an R&D consortium such as Sematech can serve U.S. economic interests. There is really no way to keep new production technology in U.S. hands for long. Not only can foreign-owned companies buy U.S. firms, but they hire U.S. specialists from firms that remain under American control. Most major Japanese high-tech firms have technology and market-sharing agreements with Sematech members. While these agreements do not directly transfer the technologies being developed at Sematech, they open up conduits making it likely that any breakthroughs will be transmitted to Japan within a period of months. Furthermore, the U.S.-owned firms are not obligated to restrict application of Sematech technology to their U.S. facilities.

Government-backed consortia can be a sensible way to support technological development that individual firms cannot carry out on their own, but if the goal is to promote American business and American employment, then resources should go into educating the workforce and restoring our infrastructure. Those key factors of production are a lot less mobile than capital and technology.

Such a formula allows, of course, for foreign ownership and operation of high-tech labs and factories in the U.S. Unless those employers violate the rights of their American employees, suppliers, partners, and host communities, or unless they directly threaten U.S. security, there is no real justification to legislate against them.

Perhaps transnational corporate ownership works against the interests of all host countries, be they rich or poor, but it is unlikely that the members of Sematech, with their extensive overseas production facilities, would welcome consideration of two-sided investment protectionism.

One problem remains: Can Japan be forced to make inward investment as attractive in Japan as in the U.S? The U.S. has thrived historically because of its open borders, drawing ideas, culture, labor, and capital from all corners of the globe. Japan, on the other hand, is a much more closed society. It will take much more than treaties or legislation to give foreigners an equal footing in Japan.

NATIONAL SELLS OUT

In 1986-7, National Semiconductor campaigned effectively and successfully in Washington to prevent Fujitsu from taking over Fairchild Semiconductor, on the grounds that Japanese ownership represented a greater threat to U.S. security than its existing French owner—oil services company Schlumberger. Then National picked up Fairchild at fire sale prices.

Now, unable to wring a profit out of the remains of Fairchild, National is seeking a Japanese purchaser for one of Fairchild's most modern plant, a wafer-fabrication facility in Puyallup, Washington.

Perhaps, over the last few years, the technology embodied in Puyallup has lost its national security significance, but the argument against the Fujitsu purchase was not based upon its immediate impact, but rather upon its long-term affect on U.S. interests.

PLUS ÇA CHANGE, I.B.M. STILL OUTSELLS JAPAN, INC.

The Japanese-owned computer industry still does not live up to its impressive reputation. Once again, **Datamation** (June 15, 1990) magazine's annual survey of the world's largest purveyors of information technology shows that a single U.S.-

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owned company, I.B.M., outsells all 18 Japanese-owned firms in the Datamation 100. In 1989, IBM's information system and service (IS) revenues reached US$60,804 million, up 10.5% from 1988. The 18 Japanese firms, including Nihon Unisys, totalled US$57,866.5 million in computer-related sales, compared toUS$53,528.0 million for 16 companies the previous year. (See **Global Electronics** No. 94)

Digital Equipment Corp. remains the world's second largest computer firm, with its IS revenues rising to $12,936.7 million in 1989. The two top Japanese IS firms, NEC and Fujitsu, follow with US$11,480.4 million and US$11,378.9 million, respectively.

Remember, **Datamation** ranks firms based upon their IS sales alone. Many companies in the top 100, such as Hitachi, Matsushita, AT&T, and General Electric, post sales well above their computer-related totals.

A CLEANER WAY TO MAKE CIRCUIT BOARDS

Dragon Circuits, a small Silicon Valley manufacturer of printed circuit boards, has reportedly developed an environmentally sensitive way to fabricate its boards. The Santa Clara company has developed a closed-loop manufacturing process, as well as a venting system that reduces air emissions.

The process of printing complex patterns of heavy metals on PC boards is historically a major source of wastewater pollution in high-tech areas. If you want to find a list of PC board-makers, you just check the list of operations cited for Clean Water Act violations.

Faced, with persistent monitoring and enforcement, many firms have increased their internal pre-treatment operations or diluted their releases with large volumes of water. Neither method is an adequate solution. Chemical pre-treatment, generates a stable sludge that must be trucked to hazardous waste landfills. Furthermore, the standards that regulators follow take into account the difficulty and cost of reducing releases. In the almost stagnant, shallow southern end of the San Francisco Bay, heavy metal concentrations are rising, despite strong programs to control releases.

In the long run, it would make sense to figure out ways to make PC-boards without using and losing so much toxic heavy metal, but Dragon Circuits has taken a big step forward. Dragon's system recycles almost all of the water used in its plating system. It uses an ion-exchange resin to remove metals from the water before transporting it back to the beginning of the loop. "When the filtration units are full, the company will recycle the waste metals via an 'electro-whinning' process to create a heavy metal byproduct," reports the **San Jose Business Journal** (September 17, 1990).

Ironically, Brad Bergantz, one of the founders of Dragon Circuits, actually spent a year in jail for violating hazardous waste laws at his previous company, Golden State Circuits. It is possible that the full weight of the law led to this breakthrough, but Bergantz claims that he was working on the closed-loop process before he started having problems with the law.

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