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Electronics®

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DOWNSIZING: IS LEANER ALWAYS MEANER?

PAGE 30

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CIRCLE 178

Electronics

EDITOR
Jonah McLeod
MANAGING EDITOR
Howard Wolff
SENIOR EDITOR
Lawrence Curran
EDITOR-AT-LARGE
Samuel Weber
914-428-3595
ASSISTANT MANAGING EDITOR
Jacqueline Damian
DEPARTMENT EDITORS
Communications:
Jack Shandle
201-393-6228
System Technology:
(San Jose) **Jonah McLeod**
408-441-0550
EDITORIAL PRODUCTION MANAGER
April Messina
ASSOCIATE ART DIRECTOR
Tony Vitolo
STAFF ARTIST/DESIGNER
Anthony White

BUREAUS
Boston: **Lawrence Curran, Manager**
508-441-1113
Midwest Correspondent: **Francis J. Lavoie**
Mid-Atlantic: **Jack Shandle, Manager**
201-393-6228
Frankfurt: **John Gosch, Manager**
011-49-61-71-53834
France Correspondent: **Andrew Rosenbaum**
011-331-4236-1867
Italy Correspondent: **Andrew Rosenbaum**
011-331-4236-1867
Japan: **Shin Kusunoki, Consultant, Nomura Research Institute**
011-81-45-336-7064
UK Correspondent: **Peter Fletcher**
011-443-226-64355
Electronics Index: **Mark Parr**

VICE PRESIDENT-EDITORIAL
Perry Pascarella
GROUP ART DIRECTOR
Peter Jeziorski
EDITORIAL ADMINISTRATION
Bradie S. Guerrero, Tina A. Montone

Director of Circulation: **Bruce Sprague**
Manager of Circulation: **Bob Clark**

Production Manager
Doris Carter
(201) 393-6259
FAX: (201) 393-0410
Order Entry
Beverly Desbiens

PUBLISHER
John G. French
617-890-0891

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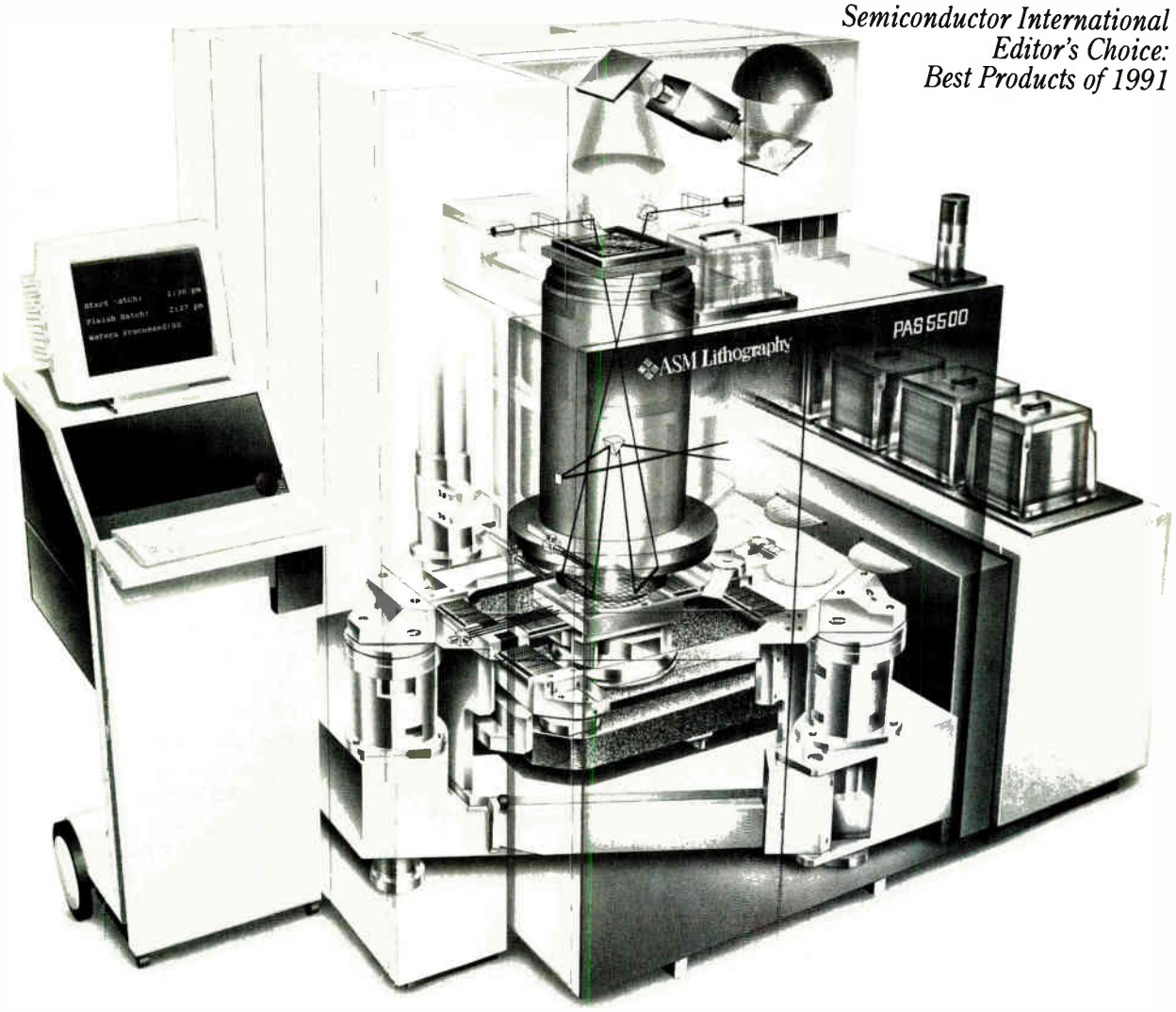

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CIRCLE 181

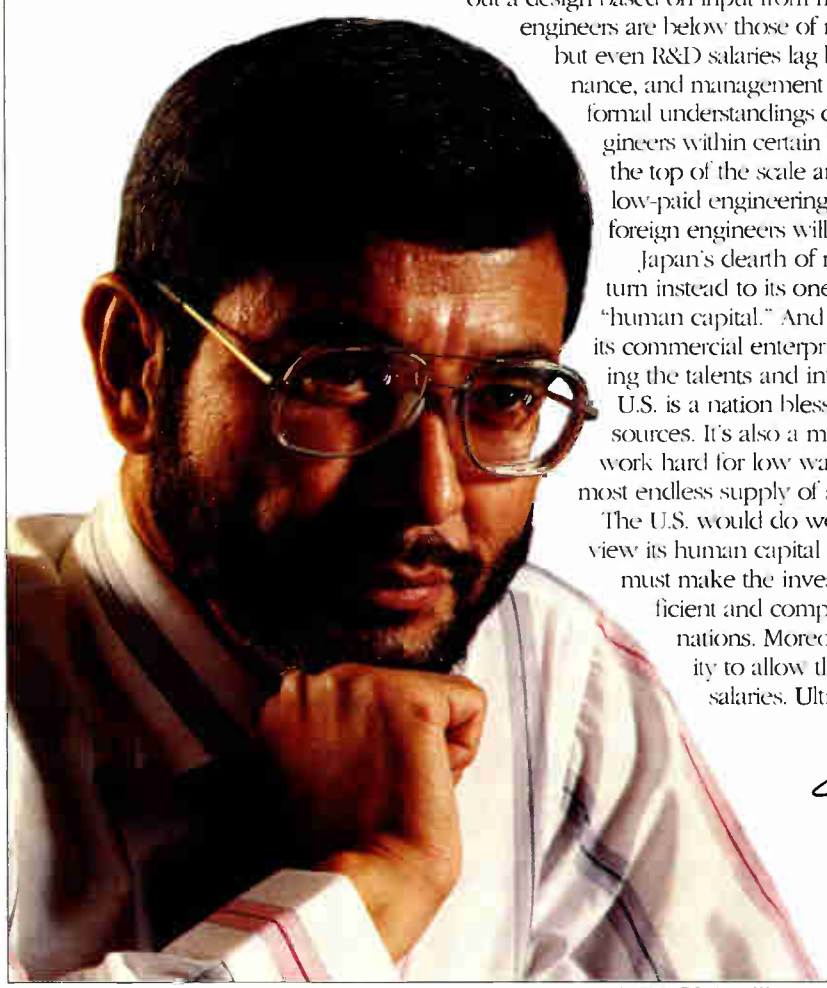
AT RISK: THE HUMAN FACTOR

There is one aspect of Japanese culture that the U.S. should take to heart: that nation's respect for a person regardless of his station in life. The Japanese manufacturing worker and engineer are as much esteemed for their contributions to a company's well-being as the corporate executive. The image of Akio Morita clothed in Sony Corp. coveralls and conversing with members of his assembly line is much more a reality than U.S. managers are willing to believe.

In America, professions are colored by popular myths. Factory workers are blue collar, office workers are white collar, and engineers are nerds. This stratification is at the heart of the U.S. inability to compete effectively in a worldwide market economy. Workers are seen as variable costs that can be discarded in tight times, hired in good times. A nation prospers and grows on the talents of its engineers and builders. But John Densler, assistant professor of management and aviation science at Bridgewater State College in Massachusetts, says the best and brightest U.S. minds are not going into engineering but into such glitzy, lucrative fields as finance, marketing, and management. He wonders how this nation can expect to prosper if it does not encourage the next generation of builders.

The high-water mark for U.S. engineers was in the aftermath of World War II. A grateful nation spent enormous sums educating returning soldiers, many of whom chose to become engineers. And the incredible wealth created in the 1950s and 1960s can be directly attributed to this investment. The U.S. engineered a highway system that was then the envy of the world. It achieved goals in aviation and space that put the first man on the moon. It laid the foundation for the revolution in microelectronics. But America has failed to sustain the level of investment needed to ensure a steady stream of talented new engineers to be the builders of tomorrow.

In addition, business has taken engineers for granted, treating them as human machines who churn out a design based on input from marketing. Salaries for manufacturing engineers are below those of research-and-development engineers, but even R&D salaries lag behind those paid for marketing, finance, and management jobs inside most U.S. corporations. Informal understandings conspire to fix the salary scales for engineers within certain bounds, so experienced engineers hit the top of the scale and can expect to rise no higher. To fill low-paid engineering positions, companies actively recruit foreign engineers willing to work for lower wages.

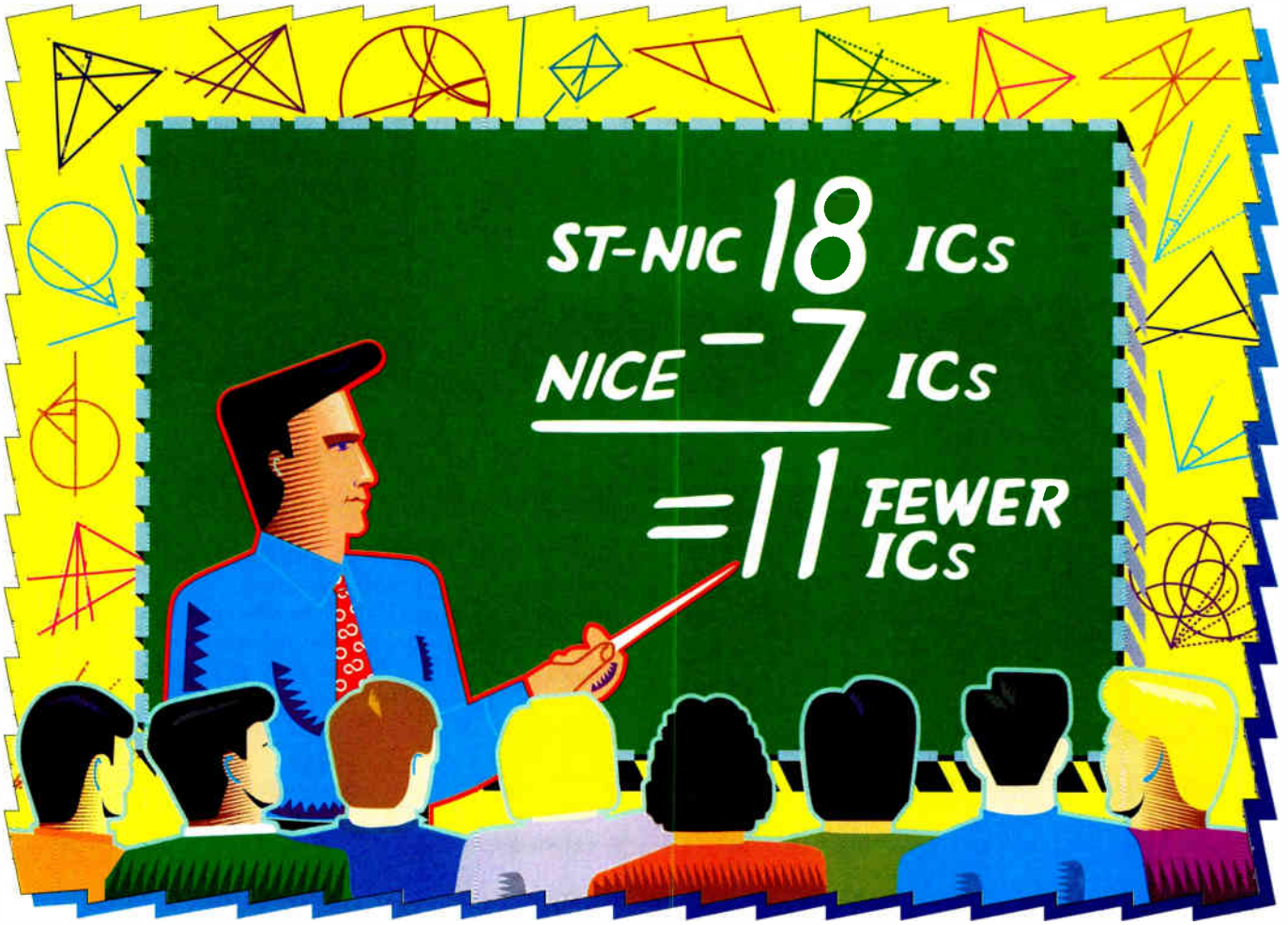


Japan's dearth of natural resources leads that nation to turn instead to its one renewable resource: its people, its "human capital." And both the Japanese government and its commercial enterprises have invested heavily in cultivating the talents and intellect of its people. By contrast, the U.S. is a nation blessed with an abundance of natural resources. It's also a mecca for talented immigrants willing to work hard for low wages, and so has always enjoyed an almost endless supply of skilled labor.

The U.S. would do well to take Japan's lead and begin to view its human capital as a renewable natural resource. It must make the investment needed to make workers as efficient and competitive, if not more so, than in other nations. Moreover, business has a special responsibility to allow the free market to work for employee salaries. Ultimately, you get what you pay for. ❑

Jonah McLeod

JONAH McLEOD
EDITOR



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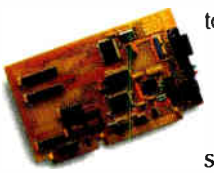

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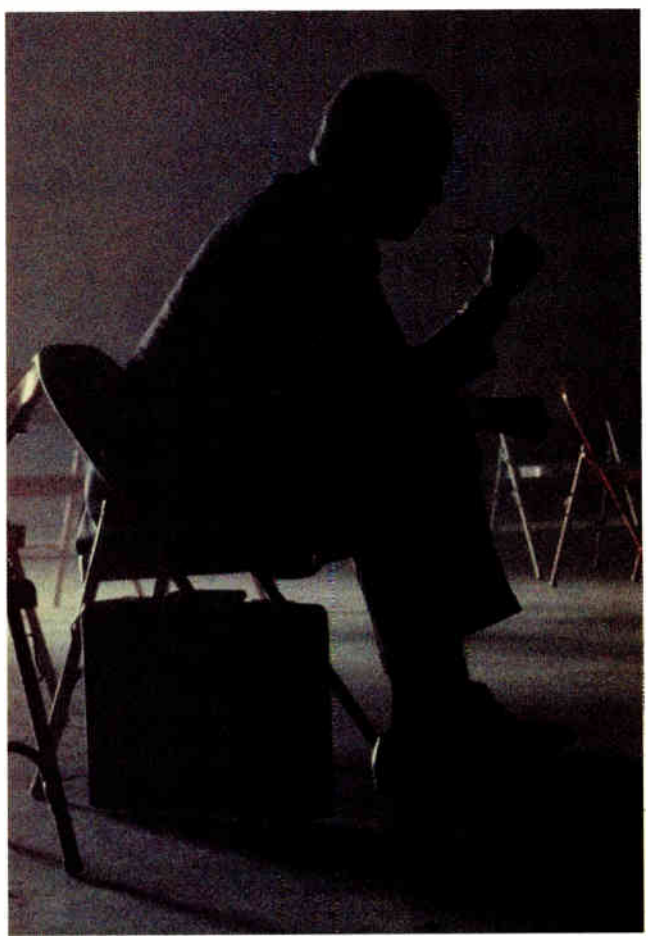

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DEPARTMENTS

NEWS ROUNDUP

WORLDWIDE NEWS

COMMENTARY

Jesse H. Neal
Editorial Achievement Awards

1956 Merit, 1965 First
1975 Merit, 1976 Merit
1977 First, 1978 First
1988 Merit, 1990 Merit

Companies covered in this issue, indexed to the first page of the article in which each is mentioned.

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CIRCLE 227

EXCEEDING EXPECTATIONS. HARRIS REDEDICATES ITSELF TO CUSTOMER SATISFACTION.

An interview with Jay A. Davis, V.P., General Manager, Military & Aerospace Division, Harris Semiconductor.

QUESTION: Harris Semiconductor reorganized recently, primarily to improve customer service. How does this reorganization help your Military & Aerospace Division?
DAVIS: Before I answer your question, let me correct something. We don't talk about "customer service." The word "service" implies that a task has been completed. So instead of service, Harris Military & Aerospace Division is pledging satisfaction to customers. Customer satisfaction is an ongoing process that our people are engaged in each and every working day.

Our reorganization now permits the Military & Aerospace Division to have management over all phases of the business. From start to finish; from concept and design to delivery. The employees in this division have rededicated themselves to consistently satisfying the requirements and value expectations of our internal and external customers. In fact, our goal is to exceed customer expectations in every single transaction.

QUESTION: You speak very confidently about employees "buying in" to Harris' renewed emphasis on customer satisfaction. How can you be sure that's what's happening?
DAVIS: I'm sure the employees of Military & Aerospace are buying in because I'm seeing the results of that buy in. Our people understand that the old ways won't cut it anymore. I'm seeing this in all our transactions—from the way people handle telephone calls to the way they pack product for shipment. Our people have a sense of pride in doing their jobs well.

But I think the biggest changes can be seen in the quality of management and the management of quality. Harris products have always done what they were supposed to do. So that type of quality management has never been an issue. What I'm talking about is the quality of management decisions. Today, our managers are making their decisions on the basis of continuous improvement and customer satisfaction. There's a new vibrance and vitality in the organization, and it's coming from the top down as well as from the bottom up. Our managers are dedicated to leading the way in the area of customer satisfaction.

QUESTION: What are Harris Semiconductor's Military and Aerospace Division's program credentials? Did you, for instance, have any products involved in Desert Storm?
DAVIS: Our products had a visible presence in Desert Storm. We were involved in the TOW missile, that's the tube-launched, optically-tracked, wire-guided antitank missile. We also had products in the AMRAAM, the F-15 and F-16 aircraft, the Hellfire missile, and the GPS Global Positioning System equipment.

QUESTION: What about space products? What Harris Semiconductor products find their way into recognizable space programs?
DAVIS: We have excellent credentials here, too. Among other programs, we have products in the DSP, Milstar, Galileo, the Mars Observer, the Shuttle, Landsat, Eutelsat, Insat, Voyager, Tiros, Intelsat, and Inmarsat, to mention only a few. Our marketing strategy is to focus on military and space markets with both application-specific and standard space-level products. We're also committed to adding value for our customers through delivery, design, reliability and process technology. Our applications focus is on high-performance, specialized functions and hostile environments. That's why we're so well represented in these programs.

QUESTION: What about new products?
DAVIS: We are absolutely in a leadership position. Our new 64K rad-hard static RAM is the only producible rad-hard device of its type on the market today. We offer a new TSOS4 rad-hard silicon compiler that's finding application in a lot of upgrades on strategic systems, such as small ICBMs. Our long-range strategy is to transition from the SOS process to SOI, silicon-on-insulator. It's a more bulk-oriented process that uses implantation and EPI to create the isolated layer. We also have an SOI RH 256K static RAM, designed and proven functional, and we've completed initial radiation testing. Incidentally, I also foresee that a lot of this purely military business will transition into products primarily for global surveillance. That's a transition we're prepared for.

QUESTION: What are your plans for the future of the Military & Aerospace Division, particularly as regards improved delivery and customer-designed products?
DAVIS: Thanks to one of our TQM (Total Quality Management) teams, we've made significant improvements in delivery performance and it continues to get better. However, we still have a major challenge to attain better than 95% in delivery performance.

In the field of customer-designed products, we have in place a Fastrack™ customer design program that's already shown some remarkable results. In one instance, a customer who wanted an HDI-1000 tile array worked with us via Fastrack. Our first contact with them was in early June and we delivered the parts on August 15th! Exactly 10 weeks from customer contact to working silicon. Needless to say, that was a very satisfied customer.

We're making customer satisfaction a way of life. We're fully committed to the space business, in the U.S. as well as Europe and the Asian markets. And to the analog customer-based design system. Those commitments thread through the entire organization, too. Long term.

You see, we know the future is here, right now. And we're ready for it.

LETTER FROM

TOKYO

PROFITS ARE DOWN 20% TO 40%, AND CAUTION IS THE WATCHWORD

RECESSION IS FELT IN JAPAN, TOO

BY STUART M. DAMBROT

It's even happening in Japan. After years of uninterrupted expansion, Japan has finally been touched by recession. Though the effects of the slump are less pronounced than in the U.S., growth has dropped to 3% a year, the lowest in recent times, and the world's newest economic superpower is facing changes in both the domestic and international arenas. Not surprisingly, the country's electronics manufacturers lie at the center of this drama.

The issue is not merely reduced profits and the resulting modification of expansion and investment strategies, though those developments are significant. "With profits down 20% to 40%, almost all major firms have revised their investment plans," notes John Stern, Tokyo-based vice president of the American Electronics Association. "The demand for 4-Mbit DRAMs is drying up, and there are terrific price wars in the market for video cassette recorders, video cameras, and other home video equipment."

In fact, Stern notes, referring to Japan's historically rigid pricing and distribution structures, "the longstanding taboo on discounting seems to be crumbling."

What's happening, he explains, is that manufacturers are bringing out new models every three months and giving 30% to 50% discounts on the "old" models. This strategy works in Japan, where the passion for new electronics equipment, coupled with the absence of a used-equipment market, often leads to six-month-old consumer gear finding its way to the trash heap.

Agreeing is Darrel Whitten, director of research at Prudential Securities (Japan) Ltd. in Tokyo. "The audiovisual sector is in the doldrums, resultingly partly from a disappointing Christmas season in the U.S.," he says. "There is a large two-digit decline in video and compact-disk equipment, while television market growth is basically flat."

Also, the silicon cycle may be changing, says Whitten. "This year was supposed to be a takeoff year" for 4-Mbit dynamic random-access memories, "but 4-Mbit chips may have a shortened cycle," Whitten says. If so, that would result in "an emphasis on incremental increases in operating ratios and on profit per chip, as opposed to volumes and market share," he says.

Business remains brisk for this calligrapher writing epigrams for visitors to a shrine in Kyoto.

Finally, observes Whitten, "PC sales are showing low one-digit growth—downsizing and open architectures are catching on more slowly in Japan due to the historically greater dependence upon mainframes and large-scale systems development."

The AEA's Stern says Japan is several years behind the U.S. in both local-area networks and downsizing, citing "the tendency for users to be locked into one company's computer products." That results from either a proprietary operating system architecture or enmeshment in the complex *keiretsu*-based distribution system that often acts as a barrier to entry for non-Japanese firms.

However, Stern says, "Now that networking is clearly an up-and-coming trend, many Japanese companies are quick to put networking capabilities into notebook computers; in the U.S., this often requires add-on boards." The bottom line, Stern concludes: "They're catching up quickly."

Even the typically reticent Japanese acknowledge the difficulties they now face. "The slowdown of the U.S. economy has lasted longer than anticipated, and the computer industry there has not been in very good condition," laments Kanji Sugihara, general manager of NEC Corp.'s Corporate Planning Division at Tokyo headquarters. "This has badly affected the [Japanese] semiconductor industry, and the electronics industry has therefore started to review its plans for investment more carefully. In fact, some firms have already begun scaling back."

Sugihara adds that as in the U.S., a "negative consumer spending attitude has made it even more difficult for the consumer electronics industry to recover."

Sugihara doesn't anticipate any drastic changes in NEC's commitment to research and development or to investment spending. "Even so, we cannot help examining next year's planning

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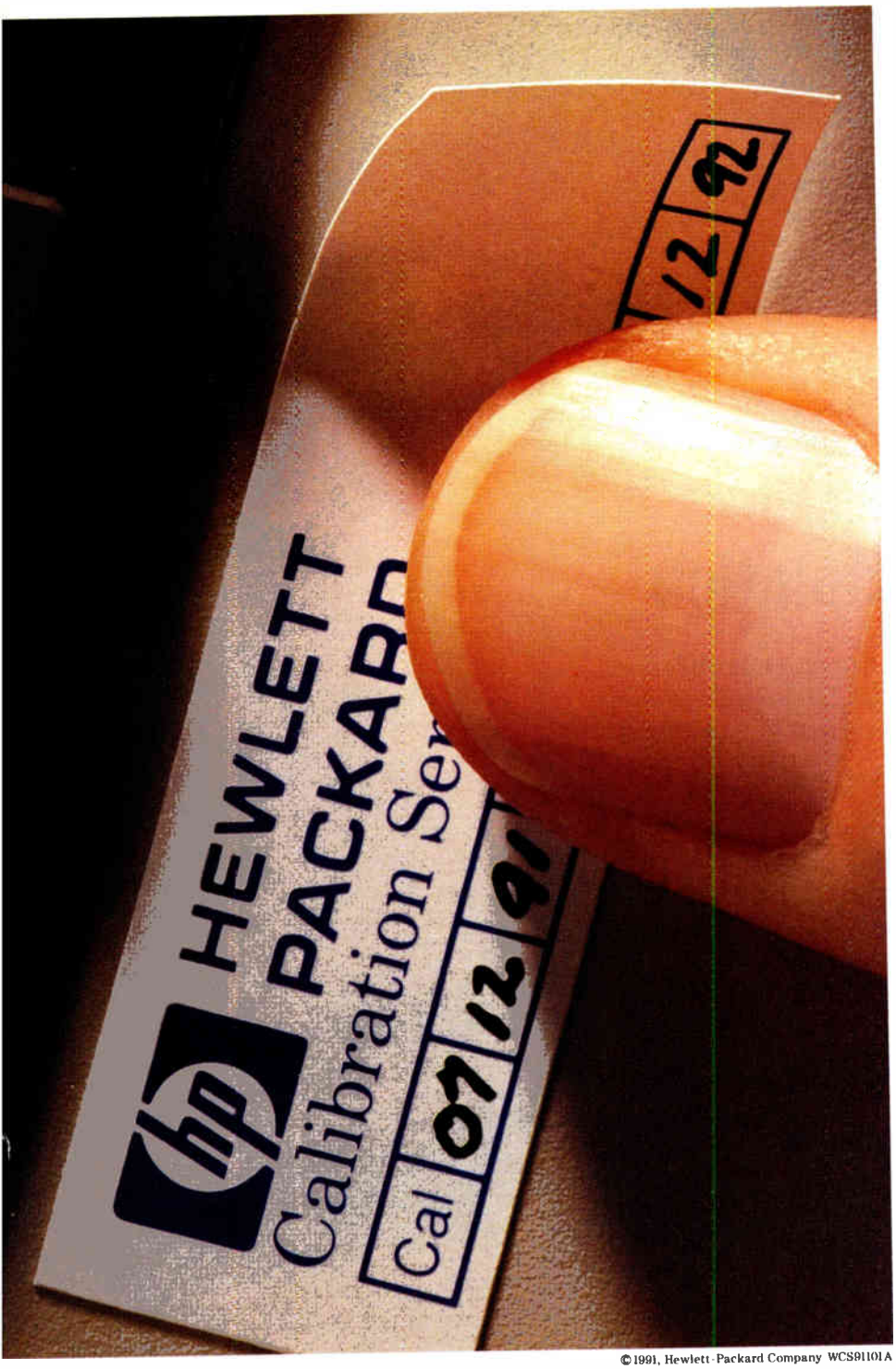

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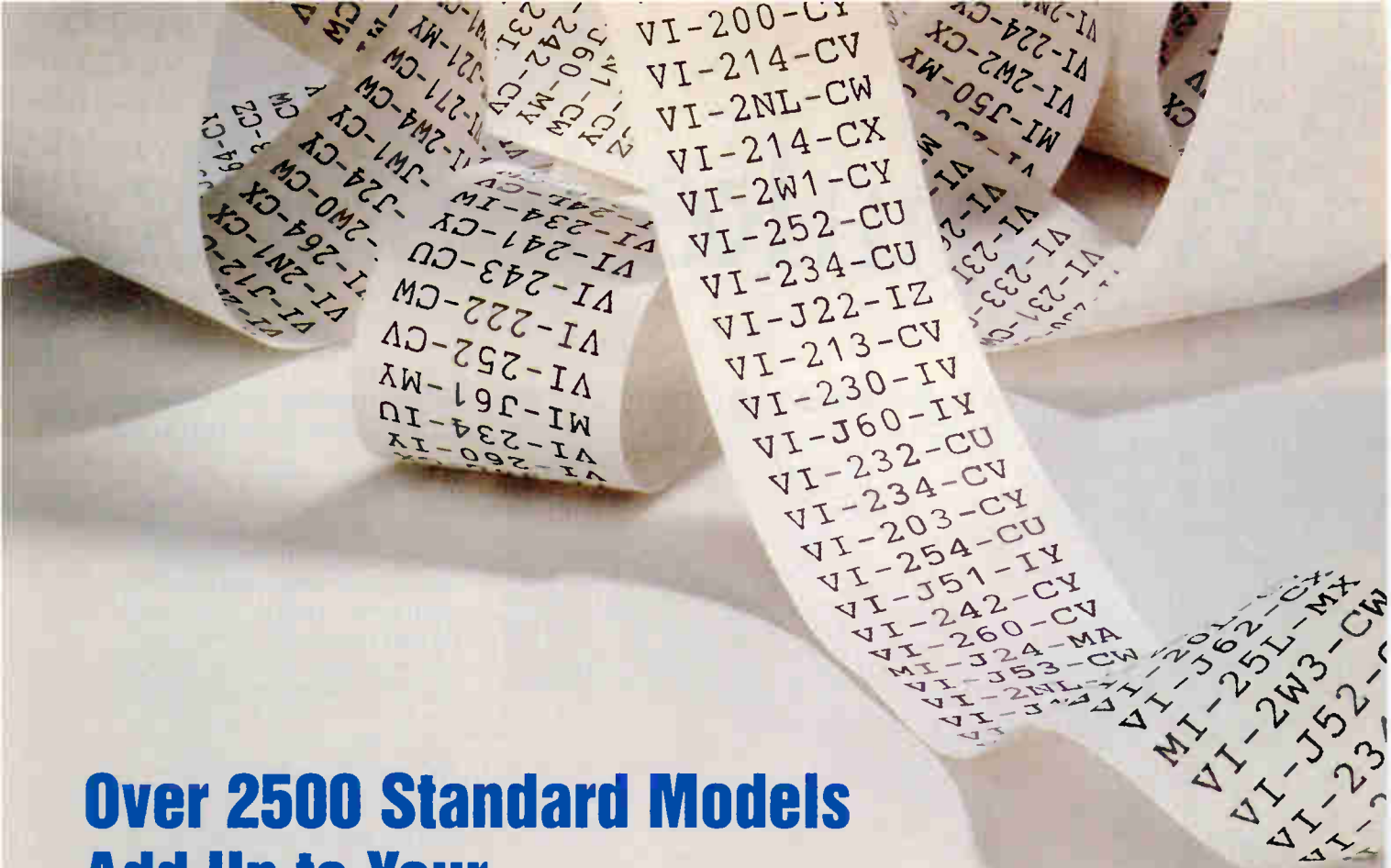

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CIRCLE 191

and executing those plans with the utmost caution," he says. More specifically, he says that because Japanese companies are refraining from investing in corporate network systems, NEC's telecommunications business is in "a difficult position."

Furthermore, although NEC isn't planning to change its capital-investment schedule, the company's equipment budget "will have to be carefully investigated." As for the computer industry, Sugihara admits that "the computer business in the United States is very difficult," but claims that "the computer market in Japan has not been affected as much by the current economic stagnation" as it has abroad.

JAPANESE COMPANIES ARE NOW SHOWING A NEW EMPHASIS ON PROFITABILITY—MORE LIKE IN THE U.S.

The result of all these developments, Sugihara continues, is that "the corporate mind has become more conservative and the Japanese economy has entered into an adjustment stage starting in the second half of 1991. However, we see the gradual improvement of the current conditions after the second half of this year."

Things are pretty much the same elsewhere. At Tokyo-based Fujitsu Ltd., board director Keizou Fukagawa comments that "the recession in the U.S. has made managers more cautious in making capital expenditures." Echoing NEC's Sugihara, Fukagawa says that while Japan's domestic economy has slowed, "investment into information systems has not fallen off, and the trend toward investment for streamlining remains strong." The chip business has taken the hardest hit, he says. "Our semiconductor business has been severely affected by sluggish demand and lower prices, mainly due to the depressed computer market in the U.S."

Computers and memory chips "have been the wheel of the Japanese electronics industry, especially in terms of profitability," says an economist at Toshiba Corp., also in Tokyo, who asked not to be quoted by name. "Low performance in these fields leads to low profitability. Therefore, in our semiconductor business, Toshiba has been pursuing the policy of well-balanced management" in logic, memories, bipolar technology, and discrete devices. "This has prevented Toshiba from having depressed overall semiconductor sales," the economist says.

Another factor affecting Japan's electronics firms is strictly financial, notes Whitten of Prudential. "There are quite a few convertible bonds coming due over the next two years, many of which are held by the electronics firms." Moreover, the AEA's Stern adds, "there are a lot of bad loans in circulation, and banks have instructions not to lend to real estate and nonbank finance companies." As a result, these previously powerful firms are unable or unwilling to buy new equipment.

The common thread running through these trends is that Japan is slowly becoming Westernized in its approach to profitability and investment. "Japan's electronics firms are evidencing a new emphasis on profitability—more like in the U.S.," says Whitten. "They're in a self-defeating cycle where increased limits to domestic growth push expansion, which then results in trade friction" of the sort that brought President Bush to Japan last month.

This development may benefit the U.S., says Stern, discussing a recently concluded bilateral computer agreement which could open up the Japanese market for U.S. products—personal computers, workstations, mainframes, minisupercomputers, peripherals, software, and services—to the tune of $5 billion (see p. 19). "The agreement covers all problem areas the AEA has identified in Japan's computer procurement practices, such as ending the use of Japan's domestic government as a reserve computer market," he says.

Paradoxically, then, the Japanese economic slowdown may spell good news on at least one front: it could end up benefiting both that nation and the U.S. in their efforts to become mutually satisfied trade partners. ❑

INTEL PASSES MOTOROLA

Intel Corp., spurred by hot microprocessor sales, has dislodged Motorola Inc. from first place among U.S. chip suppliers. That's the preliminary 1991 indication from Dataquest Inc., the San Jose, Calif., market research firm.

At the same time, Intel's 28% revenue growth—from $3.17 billion in 1990 to $4.06 billion last year—enabled the Santa Clara, Calif., company to place fourth in worldwide semiconductor sales, up one notch from its 1990 finish. Intel trails the Japanese big three of NEC, Toshiba, and Hitachi. Motorola slipped a notch as its semiconductor revenues grew from $3.69 billion in 1990 to $3.91, says Dataquest. In fact, Intel's growth rate outpaced that of every other company in the top 10. In addition, the company now plans a 35% price cut in microprocessors and plans to increase spending for capital equipment and R&D.

Other findings from Dataquest: worldwide semiconductor sales grew 11.5% last year, a little less than the 15% Dataquest forecast [*Electronics*, January 1991, p. 70]; MOS microcomponents, mainly microprocessors, were the biggest contributors to the boost, with 22% sales growth. ❑

WORLDWIDE SEMICONDUCTOR RANKINGS

1991 RANK	1990 RANK		REVENUE ($ MILLIONS) 1990	REVENUE ($ MILLIONS) 1991	MARKET SHARE (%)
1	1	NEC	4,898	5,547	8.5
2	2	Toshiba	4,843	5,337	8.2
3	3	Hitachi	3,893	4,351	6.7
4	5	Intel	3,171	4,059	6.3
5	4	Motorola	3,694	3,915	6.0
6	6	Fujitsu	2,880	3,111	4.8
7	7	Texas Instruments	2,574	2,753	4.2
8	8	Mitsubishi	2,319	2,568	4.0
9	10	Matsushita	1,942	2,421	3.7
10	9	Philips	2,011	2,072	3.2

SOURCE: DATAQUEST INC.

REUSE IT OR LOSE IT, ELECTRONICS MANUFACTURERS ARE TOLD

Reducing toxics used in manufacturing isn't the only front in the battle to make the electronics industry environmentally friendly [*Electronics*, December 1991, p. 42]. Also moving forward is a packaging initiative involving some 50 firms. The aim: to "develop an environmentally responsible packaging strategy for the industry," says Paul Russell, corporate packaging engineer at Hewlett-Packard Co., who heads a task force working to establish standards on materials (including recycled content), reusable containers, and consumer-return systems. "If we're not proactive, legislation will make us reactive."

Indeed, says Russell, Massachusetts already has a law that says packages must be made of 25% recycled materials, and at least five other states are considering similar legislation. Internationally, Germany on Dec. 1 ruled that all retailers must accept from consumers the containers in which their products were shipped.

"It's the wave of the future," says Russell, who predicts that such laws will soon extend to the contents of those packages, too. In fact, the German law contains a provision forcing manufacturers to take back old equipment returned by consumers for reuse or recycling. It would go into effect in 1994.

Russell says his group—which includes representatives from most U.S. computer makers and is working under the aegis of the Institute of Packaging Professionals—is looking into schemes for such consumer returns. HP and IBM Corp. have launched an experimental project with United Parcel Service to recover obsolete products, he says. The idea is to regrind the plastics, recycle the precious metals from pc boards—and trim the amount of trash going into overcrowded landfills. ❑

PASS IT ON: MICROMECHANICS

Some conferences can be said to have a wetted finger to the wind the better to detect the first signs of technological stirrings; but the International Solid State Circuits Conference is better described as a generator of innovative breezes. So trend-spotters who are patrolling the corridors of the San Francisco Hilton as the ISSCC's latest version opened its Feb. 19-21 run can anticipate finding at least one strong possibility: micromechanics.

Spotlighted at the first day's plenary session, micromechanisms were decribed by Henry Guckel of the University of Wisconsin, Madison, as "assemblies of micromechanical components that are controlled by microelectronic circuits." The beauty of the devices is that they can move fast because of their low mass, and they can position accurately with proper feedback. Not only that, but the micromechanisms can be driven electrostatically—using high-voltage, high-speed CMOS—or excited magnetically.

In Japan, the Agency of Industrial Science and Technology has taken notice of the technology. The agency, part of the powerful MITI—the Ministry of International Trade and Industry—plans to set up an organization to oversee development of micromachines.

Potential commercial applications range from magnetic read heads, robot arms, and atomic-force microscope positioners to microsurgery tools. But before that happens, says Guckel, work must be done to develop control electronics to produce more complex systems. ❑

Oh no. Please, not now. Not with manufacturing release next week.

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And my performance review comes up next month. Maybe they'll just forget about all this, right? Yeah. Sure.

THE PROTOTYPE DOESN'T WORK.

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CIRCLE 223

TO WATCH

HP WORKSTATIONS COST UNDER $5,000

When the Apollo Systems Division of Hewlett-Packard Co. unveiled its Series 700 workstations last May, some analysts questioned how quickly the Chelmsford, Mass., operation would be able to offer a true low-end entry. That question was answered with the January debut of the model 705, which is believed to be the market's lowest-priced Unix-based reduced-instruction-set-computing machine.

The 705 executes 35 million instructions/s, 8 million double-precision floating-point operations/s, and 34 Specmarks in a diskless, 8-Mbyte configuration with a 19-in. gray-scale screen. It sells for $4,990—which is just $5 less than the Sun Microsystems Inc. ELC, a 20.1-mips model. HP is also offering 16- and 19-in. color monitors for its workstations.

At the same time, HP announced its model 710, which delivers 57.9 mips, 12.2 megaflops, and 49.7 Specmarks in a 16-Mbyte, 19-inch gray-scale diskless version for $9,490. HP says the 710 will compete, among others, against the Sun IPX, which offers 24.6 mips and sells for $11,995 when comparably configured. ❑

HP's new 705 Unix workstation comes with a 19-in. gray-scale, or, 16- or 19-in. color monitor.

OAK'S SUPER VGA CHIP IS FOR MOTHERBOARD

A Super VGA graphics chip specifically designed for mounting on a personal-computer motherboard boosts display performance of Windows applications up to five times, compared to add-on board products.

Most of the performance delivered by Oak Technology Inc.'s OTI-087 can be traced to its direct communication with the microprocessor over a 32-bit local bus instead of the system bus, says the Sunnyvale, Calif., firm.

The chip also incorporates hard-wired functions such as a 64-by-64, 2-bits-per-pixel bit-mapped cursor. In addition, cache is used for zero-wait-state bit-block transfers. The 32-bit chip supports 24-bit color. Available now in sample quantities, it is priced at $31 each in quantities of 1,000. ❑

MULTIMEDIA-ENHANCED SOFTWARE SOLVES LABORATORY PROBLEM

Desktop visualization of signal-analysis applications can be inexpensively shared with other work-group members using Spectral Innovations Inc.'s Signal Analyzer/QT software package.

Although data visualization is possible with existing signal-analysis packages, all require a digital-signal-processor-based accelerator card. Spectral Innovations lets users record 3-d data on disk—along with voice annotations—for playback on Apple Macintoshes without a hardware accelerator.

The Santa Clara, Calif., company does it by supporting Apple's QuickTime multimedia extensions to the Mac's operating system. The originator of the multimedia data still needs a DSP hardware accelerator for the Mac, however, and Spectral Innovations offers the 30-megaflops MacDSP3210. Available now, Signal Analyzer/QT is priced at $500; the accelerator, about $3,500.

VITESSE DELIVERS 350,000-GATE GaAs ASIC

Gallium-arsenide chip density has reached the 350,000-gate plateau with Vitesse Semiconductor Corp.'s VGFX350K.

Fabricated in the Camarillo, Calif., company's 0.6-µm H-GaAs III process, the application-specific IC integrates two 44-Kbit custom blocks of on-chip static RAM, two custom five-port register files, and over 200,000 raw gates. The chip has about the same number of transistors as high-end processors such as Intel Corp.'s 80486.

Vitesse's FX ASIC family uses a sea-of-gates architecture with four-layer routing and offers 60-ps delay times. The VGFX350K has 378 ECL input/output signal buffers and is packaged in a plastic 557-pin pin-grid array. It dissipates a maximum of 44 W. Its SRAM and register files have access times of 3.5 ns and consume less than 4 W. ❑

LCD TEST GEAR BOOSTS YIELDS

Manufacturers of active-matrix, thin-film-transistor LCDs will be able to increase yields with the GTS-1 test system developed by GenRad Inc., Concord, Mass., and Tokyo Electron Ltd.

Besides providing the diagnostic information required to repair TFT LCD substrates, the system offers extensive measurement capabilities for process control and the design characterization of substrates. Deliveries to major LCD manufacturers will begin before the end of the second quarter. ❑

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CIRCLE 211

COMPUTING AND COMMUNICATIONS COULD BE IN FOR MORE CASH—AND AN OPENING TO JAPAN

SURPRISE! GOOD NEWS

BY JACK SHANDLE

COMPUTERS

A recession-buffeted computer industry leaped eagerly on a few morsels of good news at the start of the new year. First, the White House decided to ask for a whopping increase in funds for high-performance computing and communications projects. Then the U.S. and Japan agreed that foreign information-technology products should have increased access to Japan's government market.

There is a growing consensus in Washington that government and the electronics industry can work together. That has led to a boost for the computer-communications marriage in the budget submitted by the White House for the fiscal year starting Oct. 1—a 24% increase over this year's allocation.

And even as the nation focused on auto trade friction with Japan, the computer industry rejoiced at its new opening to Tokyo's public-sector market. "We look forward to . . . fair and open market access," says John Sculley, chief executive officer of Apple Computer Inc. and chairman of the Computer Systems Policy Project. That group, made up of the chief executives of the 12 largest computer companies in the U.S., had found that while foreign computer manufacturers have 41% of Japan's private-sector market, the foreign mainframe share of the government market is only 0.4%.

Back on the budget front, the Administration's request went to the Congress last month; still to come is the political process from which a final spending blueprint emerges. Still, the White House, Congress, and industry representatives are uniformly optimistic. Driving that mood is the growing feeling that the nation's gigabit/s "data superhighways" should be universally available at a reasonable cost and not reserved for research laboratories.

The Bush budget requests $800 million, a $145 million increase over fiscal 1992's total for research spending on a conglomeration of programs grouped together as the High-Performance Computing and Communications Initiative (HPCCI). The biggest individual winner would be the nation's high-performance network (see p. 40), where spending would grow by 36%, says Robert Grady, deputy director of the Office of Management and Budget. Another winner is the National Institutes of Health, which would get 18% more for research into the delivery of health and human services by using high-performance communications and computing.

Observers in Washington read the NIH increase as a significant shift by the Bush Administration away from a "big science" orientation—which emphasizes large-scale supercomputer projects—toward a data-packets-for-the-people approach to the high-speed communications infrastructure of the future. One Senate insider says that in early versions of the High Performance Computing and Communications Act, sections that recommended research into human-services applications were deleted at the Administration's request.

What's more, it appears that the computer industry has won a major point. The CSPP insists on a broader, people-oriented focus for the super network as a prerequisite for industry support and participation. Each time it met with OMB Director Richard Darman last year, it lobbied to bring more federal

HOW MUCH GOES WHERE

BUDGET AUTHORITY FOR HIGH-PERFORMANCE COMPUTING AND COMMUNICATIONS ($ MILLIONS)

	1991 Actual	1992 Requested	1992 Enacted
TOTAL	**516**	**669**	**657**
By Program Component			
High-performance computing systems	117	154	153
Advanced software technology and algorithms	230	285	279
National research and education network	65	95	93
Basic research and human resources	104	135	132
By Agency			
Defense	183	232	232
National Science Foundation	169	213	201
Energy	65	93	92
National Aeronautics and Space Administration	58	72	72
Health and Human Services	36	41	41
National Oceanic and Atmospheric Administration	1	10	10
Environmental Protection Agency	1	5	5
National Institute of Standards and Technology	2	3	3

SOURCE: OFFICE OF MANAGEMENT & BUDGET

departments—such as the NIH and the Library of Congress—into planning the program, says Ken Kay, executive director of the computer group.

Now the OMB's Grady says, "We share CSPP's vision of enlarging the program's scope. We also share CSPP's notion that the government's part of the program needs more strength in its management so that we can have a coherent policy and speak with one voice. We are working on that in several ways with CSPP."

But threatening progress is the ever-present specter of the bureaucracy and the complexities of implementing public policy in the U.S. "You are trying to get a lot of [federal] agencies with different missions to cooperate," says the Senate insider, "and this is always tough."

Within the CSPP, the chief technologists of its member companies had a strong voice in forming the group's policy and identifying potential roadblocks. For example, John Armstrong, IBM Corp.'s vice president for science and technology, points out that in order to deliver maximum return from a high-speed backbone network, the rest of the network—local lines—must be upgraded. That brings state utility commissions into the process, he says. "How rapidly are we tariffing—and making available digital communication at the end of the tree?" Armstrong asks.

Not surprisingly, the chief technologists agree that a properly deployed gigabit/s net can enhance U.S. competitiveness. "It translates into faster time to market for U.S. companies," says Joel Birnbaum, vice president of research and development for Hewlett-Packard Co. in Palo Alto, Calif. By using high-speed links to supercomputers, individual companies can bypass the "lengthy and expensive prototyping" now required for computer-system design, he says. Precompetitive research—the touchstone of government-industry cooperation—can also be shared.

In fact, precompetitive research is needed to build the network itself, says Tom Gannon, director of technology planning and development at Digital Equipment Corp. in Maynard, Mass. Someone must determine if "standard network protocols and algorithms are adequate to exchange the volume of information at high speed that we foresee," he says. Research is also needed to understand how people could work together more efficiently when they are geographically dispersed, he says. ❑

KENDALL SQUARE BANKS ON ITS TECHNOLOGY AS WELL AS SOME PATIENT CAPITAL

CATCHING THE WAVE

BY LAWRENCE CURRAN

COMPANIES

Is there an opportunity for a new company to succeed in the parallel-processing supercomputer business? Henry Burkhardt III believes there is. Burkhardt is chairman, president, and chief executive officer at Kendall Square Research Corp. The Waltham, Mass., firm will soon launch its first product—a highly parallel computer system featuring home-grown logic, a novel cache-memory scheme, and a conventional shared-memory software-development environment.

Burkhardt is relying on both the technical innovation embodied in the 64-bit, reduced-instruction-set-computing KSR1 system, and on the patience of Kendall Square's financial backers to help the five-year-old company catch the crest of a wave of demand for highly parallel supercomputers.

Burkhardt is no stranger to the computer business. At age 23 he was a cofounder of Data General Corp. in Westboro, Mass. Later, he helped found Encore Computer Corp.

Apparently his track record and vision for Kendall Square were convincing enough to help it attract $60 million in financing to date. Of that, Burkhardt says, "Our backers are not the common kind," who get in and out quickly. "They're committed to quite substantial funding over an extended period."

Charles Casale, president of the Aberdeen Group, a Boston market research and consulting firm, has long been impressed with Burkhardt's ability to raise money. Casale was part of the management team at Encore, and points out that Burkhardt "was the key driver in raising money. He's one of the most brilliant and creative people I've ever met," Casale adds.

"He's raised a lot of money for KSR and has shipped at least four systems even before announcing the product. They got the customers first before doing the high-profile marketing. That's a smart strategy. They appear to be taking the long view, and I give them a better than even chance of succeeding," Casale concludes.

Burkhardt used a big chunk of the early seed money to build a design team that has developed the four-chip CMOS processor used in the KSR1. The chips are being manufactured by Sharp Corp. in Japan.

The KSR1's processor devices have a 20-MHz clock speed and execute 160 million instructions/s, or 320 million floating-point operations/s, in an eight-processor cluster. Burkhardt envisions systems with as many as 1,088 processors, delivering more than 21,000 mips and 43,000 megaflops. Such a system's price would be as much as $30 million, but a 16-processor configuration sells for $975,000. Burkhardt says the closest competitive system from IBM Corp., an ES/9000 model 620, sells for $8.5 million and delivers about 80 mips vs. 320 for the KSR1-16.

The company uses the term Allcache to describe the KSR1's memory architecture. Each processor has a very large, 32-Mbyte local cache memory. That compares with more conventional 256-Kbyte to 1-Mbyte caches. And that's all the memory there is; no permanent physical location exists for an address. Instead, addresses are distributed and shared based on processor need and access patterns.

In operation, when addresses are requested by a processor through the execution of a load, store, or branch instruction, if the data isn't in local cache, the processor's scan engine finds it and transfers both the data and its address into local cache. This reduces latency or seek time and also avoids communications congestion in the system. To a software application developer, memory can be regarded as a single resource, providing as much as 1 terabyte of virtual address space per process.

The Allcache scheme also allows the use of software standards. The KSR OS operating system is a variation of the Open Software Foundation's OSF/1 Unix, which runs symmetrically on all

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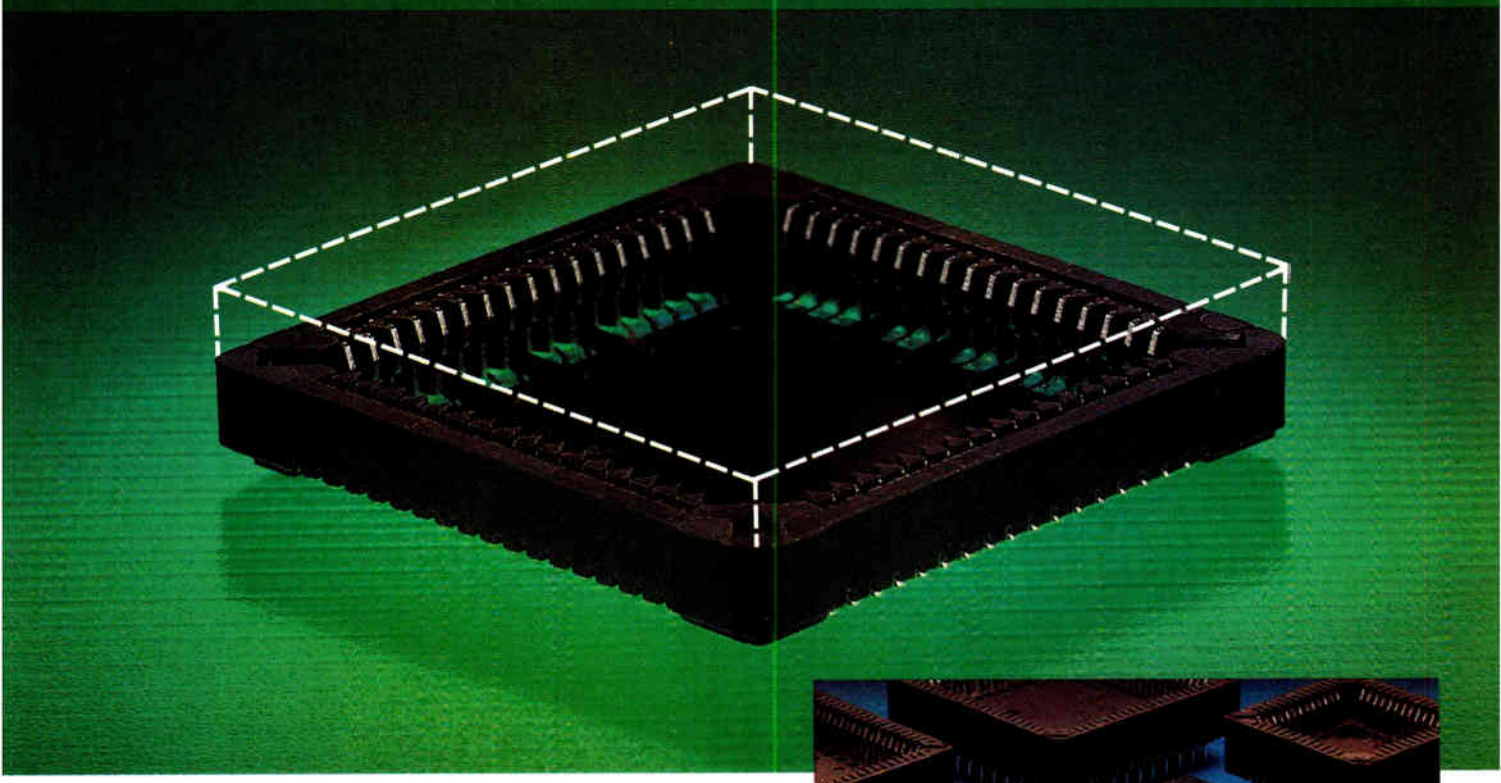

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CIRCLE 192

processors. Burkhardt says that unlike some existing supercomputers, his system will meet commercial and technical production requirements.

Debra Goldfarb, manager of high-performance computing at International Data Corp. in Framingham, Mass., says that if the Allcache scheme works as well as KSR says it will, "they will have changed the scope of massively parallel processing" by enabling it to take off in commercial as well as technical applications.

Burkhardt sees the KSR1 addressing a market that consists of about 500 users of high-performance general-purpose computers. They include government laboratories and scientific organizations running numerically intensive technical applications, as well as commercial firms with large data-base applications, such as transportation-reservation systems. KSR shipped four systems in 1991, one with 16 processors. ❑

MERGER IN JEOPARDY

BIG DEAL? MAYBE NOT

BY ANDREW ROSENBAUM

CAPITAL

There may be less than meets the eye in the move by the French government to group some of its state-owned electronics businesses into a conglomerate. The action has been greeted skeptically by industry watchers and may, in fact, be forbidden by the European Community.

France is trying to create a "high-technology giant," in the words of Prime Minister Edith Cresson, "one that will be able to compete with Japanese companies like Toshiba" on its own terms. So the French government intends to merge Thomson Consumer Electronics and SGS-Thomson Microelectronics, the French-Italian semiconductor manufacturer, with the national atomic energy agency Commissariat a l'Energie (CEA).

Skeptical industry analysts point to the lack of synergy between the electronics firms and the nuclear energy agency. Though the CEA operates a subsidiary devoted to related computer technology, the lack of any possible relationship between the various partners shocked the industrial community in Europe. "This is simply a way for the cash-rich CEA to subsidize the ailing Thomson units," says one expert.

Whether or not the move is economically feasible, it will have to be approved by the EC. The EC Commission is still trying to decide whether the subsidies paid to Bull last year are justifiable; it will thus be equally difficult for the EC's governing body to determine whether or not the proposed group is just a disguised form of government subsidy.

The merger is defended by Thomson president Alain Gomez as a marriage of the strong to the weak. "It's important to be able to put together activities with strong growth and heavy investment needs, which undergo intense competition, with more mature, lower-growth activities that have resources," he says. "It's the marriage of cash cows with those that need funds." ❑

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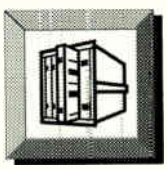

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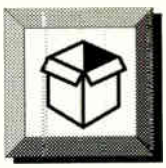

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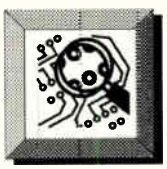

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CIRCLE 190

A BIG LEAP FOR THE EAST

Germany's five eastern states, which joined the country after Communism's demise in 1990, are leapfrogging from the back to a front-running position in communications. Well ahead of the rest of the world, Germany's new states will get a glass-fiber network running right up to private homes.

The new FTTH—for fiber-to-the-home—network will handle services such as telephone, facsimile, TV, radio, and future broadband multimedia. The network also permits PC-based video processing and fast access to external data banks.

Providing the network is the Telekom Division of the Bundespost, the German communications authority; installation will be by both domestic and foreign communication houses. By 1995, Telekom expects 1.2 million households in eastern Germany to be connected.

The work is spurred not so much by demand but the state of eastern Germany's communications infrastructure, which was left in shambles after 40 years of Communist rule. It must be built up virtually from zero, with considerable digging required. Telekom officials figure it will be cheaper to lay glass-fiber cables now than to dig a second time when there's a bigger demand for new services. The network's first link is now being tested in Leipzig.

A fiber net for eastern Germany will mean access to leading-edge technologies.

Even though international standards for glass-fiber networks haven't been drawn up yet, Telekom officials say it makes sense to go ahead with the project now. For one thing, eastern Germany offers the authority a good chance to gain operational experience; for another, the project gives participating companies the opportunity to acquire early know-how in FTTH technology. Minimum standards will be devised by Telekom by April so that the equipment-procurement phase can get under way. ❑

PHILIPS AND SGS-THOMSON TO COOPERATE IN VLSI TECHNOLOGY

It wasn't the super-alliance that European Community officials had hoped for, but the cooperative deal recently announced by Philips Semiconductors International of the Netherlands and the Italian-French components combine SGS-Thomson Microelectronics is significant enough. Industry observers had speculated that Germany's Siemens AG would be part of the new combine, the third party in a grand European alliance that would bring together the continent's big three in semiconductors, an alliance EC authorities favor. But Siemens apparently has other things on its mind, one being the restructuring of its loss-ridden Semiconductor Division. Also, the Munich-based company is linked with IBM Corp. in memories. Be that as it may, to put themselves in a better competitive position in world markets, Philips and SGS will cooperate in developing advanced CMOS logic processes below 0.7 µm, as well as design rules and libraries. The first joint project will be a 0.5-µm CMOS process on 8-in. wafers. It is to be completed by the end of 1993.

The work will take place at SGS's new R&D Center in Italy and at CNET, the French telecommunication research institute at Crolles, near Grenoble, France. ❑

SIEMENS AND IBM MAKE HAY WITH THEIR DRAM PROJECTS

Even as Siemens AG disappointed industry insiders by opting out of what would have been an alliance of Europe's big three semiconductor makers (see below), the Munich company was in the news elsewhere. A milestone of the Siemens-IBM Corp. memory alliance, the prototype of a 64-Mbit DRAM, was announced at the end of 1991. The achievement appears to position the two out front in the race with Japanese chip makers to market a 64-Mbit DRAM.

The two companies are also on target with joint production of 16-Mbit dynamic random-access memories at IBM's factory in Corbeil-Essonnes, France [*Electronics* August 1991, p. 33]. With production equipment in place and tested, the first 8-in. wafers went through their paces at the end of 1991. First chips are expected in the spring and the data measured on these samples will serve to fine-tune the production lines so that by year-end 16-Mbit DRAMs will be available in large quantities.

The first product will be a memory laid out as 4 Mbits by 4 bits. It will feature access times between 50 and 70 ns and come in a 400-mil-wide SOJ plastic package with 24 or 28 pins. The chip—it uses 0.5-µm structures—will incorporate some 35 million elements on a 137 mm^2 area. In 1993, other types will follow, among them byte-oriented memories (2 Mbits by 8 bits and 1 Mbit by 16 bits) as well as devices housed in a TSOPII package. ❑

'AGILE MANUFACTURING' CAN REVIVE U.S. COMPETITIVENESS, INDUSTRY STUDY SAYS

A MODEST PROPOSAL

BY JACQUELINE DAMIAN

MANUFACTURING

By now, Congress is accustomed to hearing Cassandra-like predictions about the decline of U.S. manufacturing. Amid the onslaught of reports from the Office of Technology Assessment, the National Advisory Committee on Semiconductors, and others, is there anything left to be said? Executives from a variety of industries working under the auspices of Lehigh University's Iacocca Institute think there is.

Representatives of that task force will appear before Congress Feb. 27 to lay out a visionary action plan aimed at nothing less than reinventing American manufacturing. The U.S. must rapidly move from mass production to "agile manufacturing," says the ad hoc group, which compiled its vision in the report "21st Century Manufacturing Enterprise Strategy: An Industry-Led View."

Agile manufacturing is "a concept and a culture change and a way of doing business," says Rusty Patterson, a manager at Texas Instruments Inc.'s Defense Systems and Electronics Group in Dallas and one of the Lehigh team members. "It is the next infrastructure that's going to happen," he says. "It's just a matter of whether or not we [the U.S.] care to play. If we don't, Japan and Europe will."

In fact, agile manufacturing—which is marked by fast product turnaround and quickly moving market windows—plays to U.S. entrepreneurial and cultural strengths, says Roger N. Nagel, operations director at the Iacocca Institute, in Bethlehem, Pa. "Japan is a monocultural society and we're a multicultural society," he says, and the ability to work across industrial and cultural lines "is an important strength to build on." The dawn of agile manufacturing thus represents a unique opportunity for the U.S. to reclaim industrial dominance, says TI's Patterson—"probably the last opportunity we're going to have."

The sweeping Lehigh report posits a future in which agile manufacturers dominate the industrial world. Unlike the mass-producers of today, agile manufacturers will build to order highly customized, reconfigurable products—an individualized car that can be upgraded later if the driver wants to add bells and whistles; a small batch of specialized semiconductors priced the same as larger lots; or a computing/communications machine programmed to a user's specs and shipped 24 hours after he orders.

Such service will be possible thanks to highly flexible robotic assembly lines that can be swiftly reprogrammed for new tasks. To speed production and aid cooperation, factories will be linked by a broadband communications clearinghouse, the "Factory America Network," that will enable them to locate suppliers and designers, and to share information, at a keystroke. The network will also facilitate the rapid formation of "virtual companies"—joint ventures among multiple corporate units working cooperatively to seize a market opportunity. Management will be decentralized—"self-managed work teams" will be the rule, not the exception, says Patterson—and information will flow freely among R&D, shop floor, and boardroom.

The Lehigh outline may seem at first blush like pie in the sky. But the executives who forged the report are quick to point out that elements of agile manufacturing already exist. "There needs to be no technological breakthrough in [factory] equipment for agile manufacturing to happen," says panel member Ted Woods, vice president of operations at Motorola Inc.'s Government Electronics Group in Scottsdale, Ariz.

Robotics and expert systems are here, he says, and plans for an industrial broadband network are being discussed by industry groups and by the Pentagon, which commissioned the Lehigh study. In terms of the cultural changes that agile manufacturing demands, Woods notes that more and more electronics companies are joining forces in teaming arrangements not unlike the virtual companies proposed in the report.

But even with some of its ducks in a row, the U.S. could miss the window on agile manufacturing unless industry acts fast and enlists the support of government and academe, the report warns. To that end, the Iacocca Institute is recruiting top U.S. CEOs to the cause, some of whom will help deliver the presentation to Congress. Meanwhile, the Lehigh team members—who come from 15 U.S. companies including IBM Corp. and AT&T Co.—have formed 17 committees to try and get the cooperative ball rolling in such areas as environmentalism and broadband networking, says Patterson. "Industry should take the lead," he says. "If we keep waiting for somebody—some huge bureaucracy—to solve our problems, it's not going to happen." ❑

AGILE MANUFACTURERS WILL...

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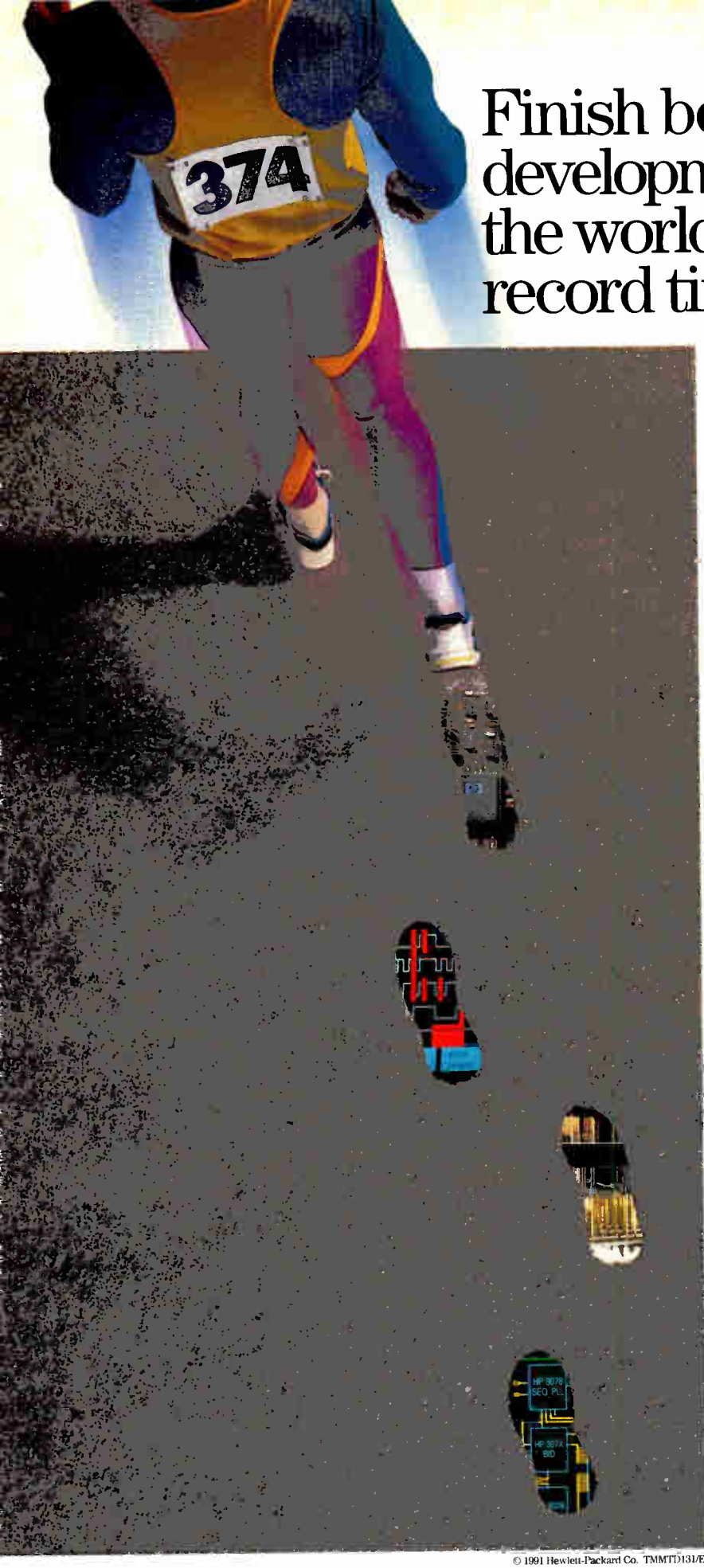
...group as "virtual companies" to seize fast-moving market windows

...deliver customized, upgradable products

...use easily reconfigured factory equipment, expert systems for fast turnaround



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CIRCLE 187

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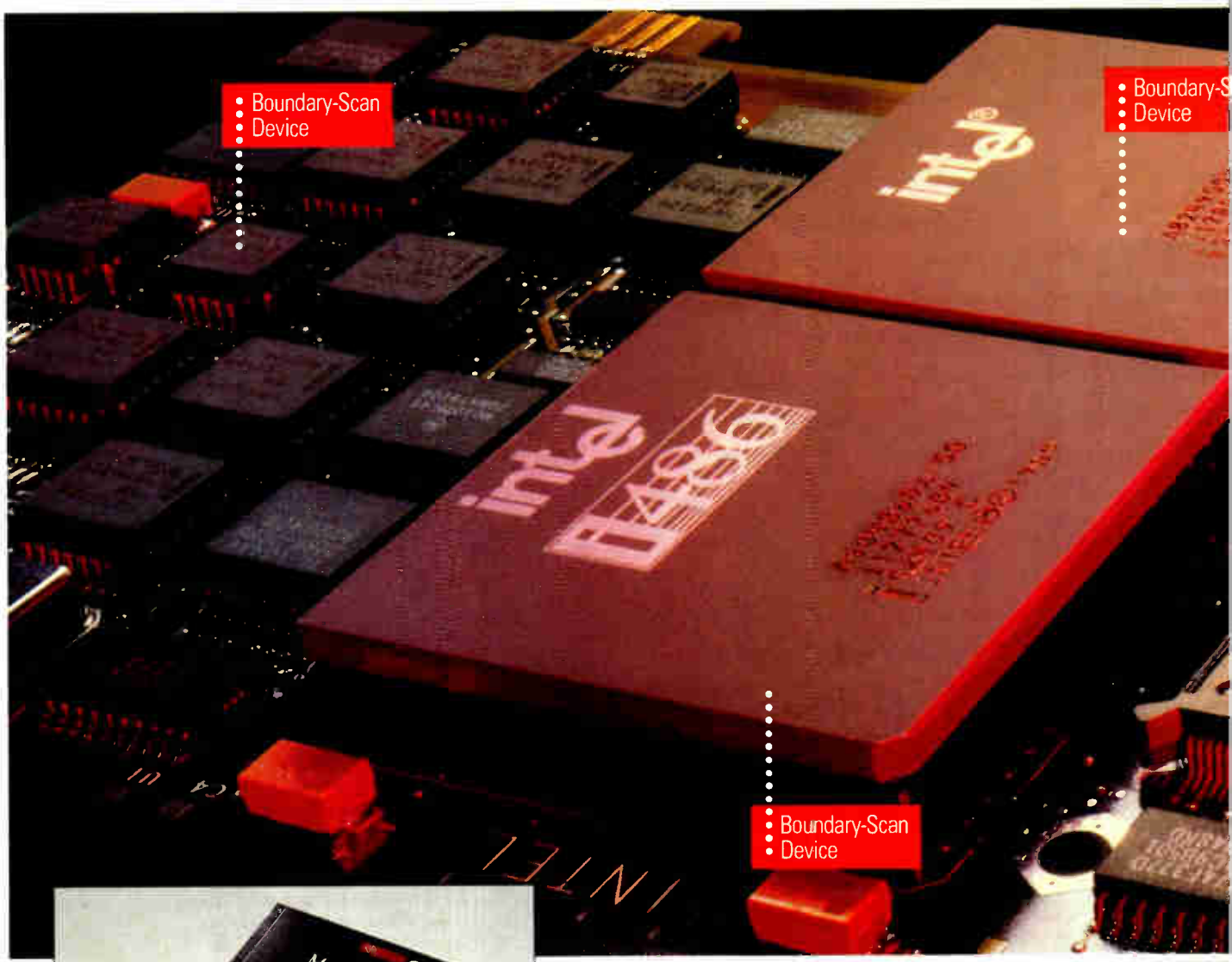

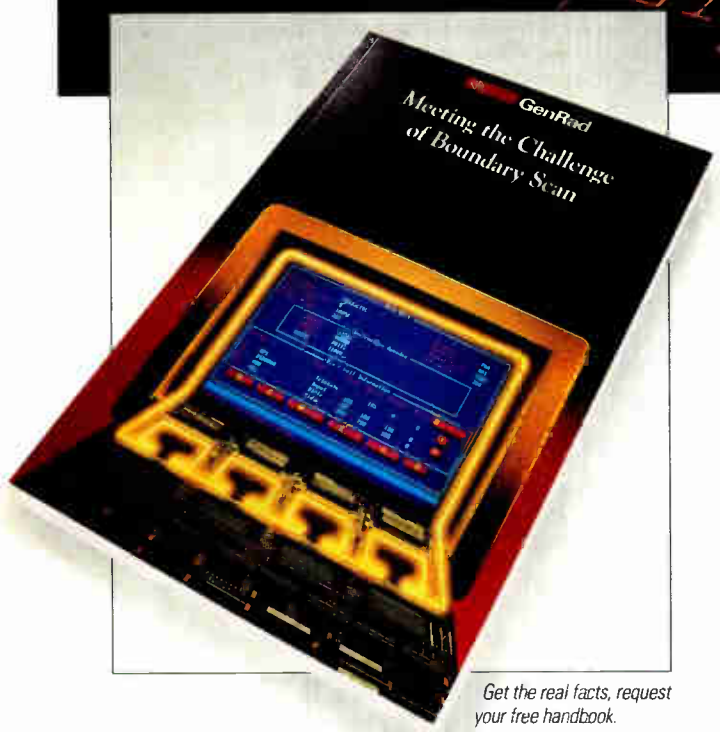

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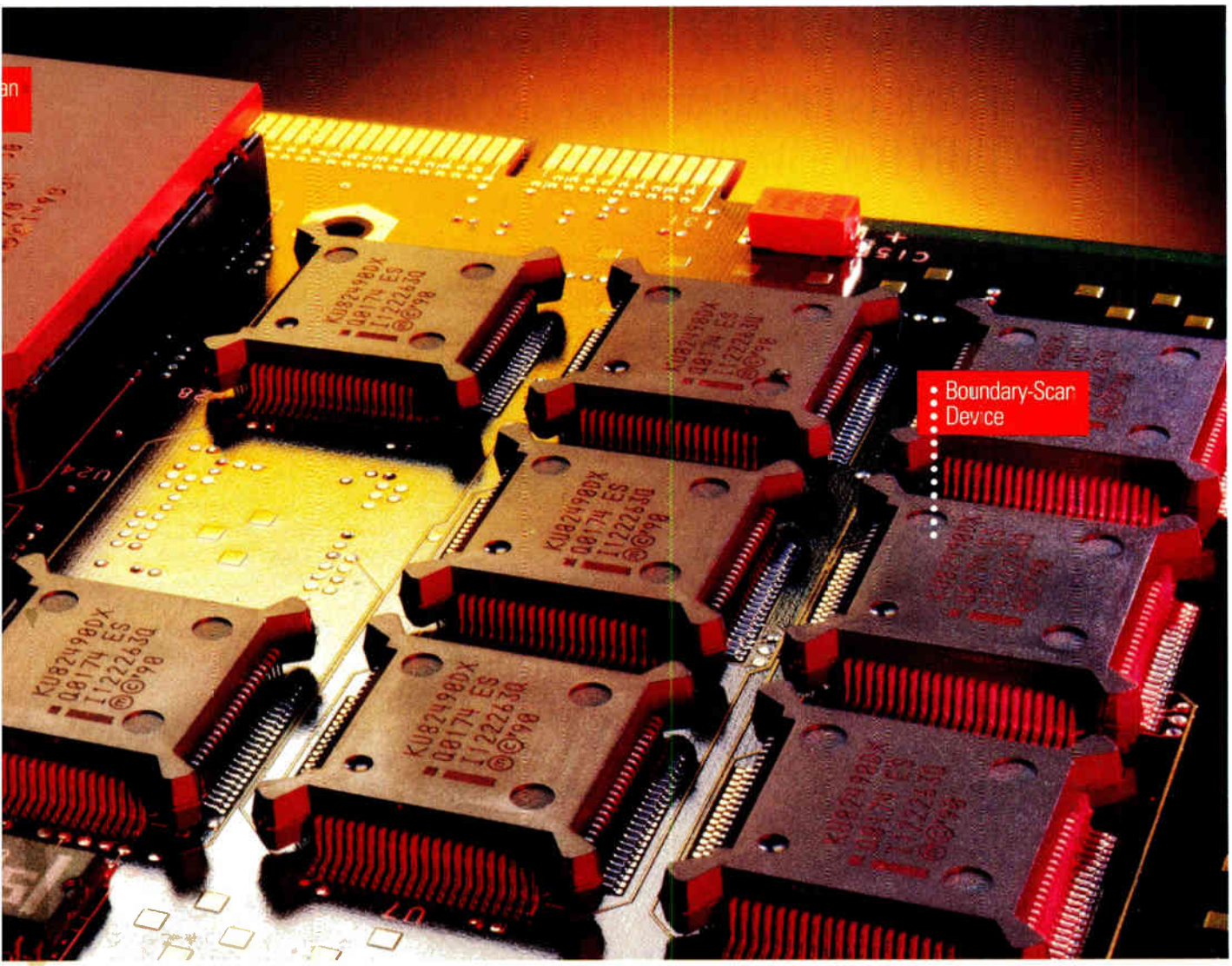

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A New Way of Thinking

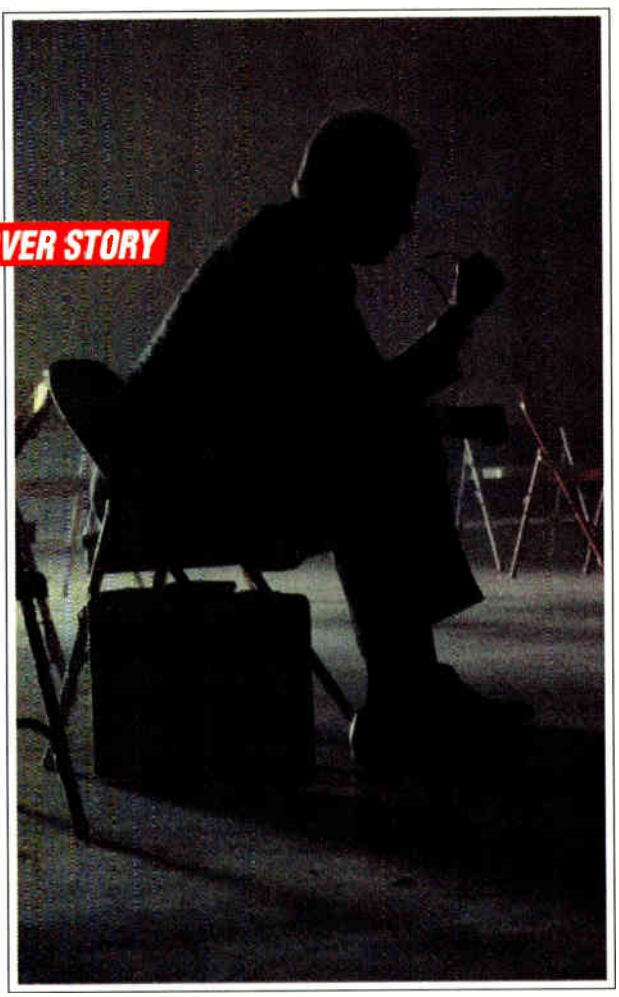
CIRCLE 235

THE INDUSTRY GETS A '90s

'LEANER AND MEANER' IS THE RALLYING CRY AS COMPANIES SLASH JOBS, BOOST PRODUCTIVITY IN A WAVE OF DOWNSIZING

BY SAMUEL WEBER

COVER STORY



When IBM Corp. announced a major restructuring late last year, coupled with a plan to eliminate 20,000 jobs, it was only the most prominent example of an electronics industry trend that began in 1989 and has been gathering momentum ever since. With a rallying cry of "leaner and meaner," company after company has pared employment rolls and reorganized the way it does business—cutting overhead, eliminating frills, improving productivity, and riding herd on the accountability of managers. In many instances, companies are shedding activities that don't match with the organization's core skills to focus instead on narrower areas of corporate competency.

It's called downsizing, a doctrine that U.S. firms have taken up with an almost religious zeal as the means to gain ground in the intensely competitive '90s. "I think it's a catchup for the electronics industry to the rest of industrial America," says Matthew Crugnale, a market analyst in Palo Alto, Calif. "I think downsizing has been going on in other industries for some time, and now the electronics industry, one of the largest in the world, is joining their ranks."

The downsizing wave has resulted in a loss of 190,000 U.S. jobs (not counting the latest cuts announced at the end of 1991) since the industry hit its 2.6 million employment peak in 1989, according to the American Electronics Association, an industry trade group. Some 60,000 jobs were lost in the first three quarters of 1991 alone, the AEA says.

Employment dipped 3.6% to 2.41 million last September, the latest date for which figures are available, from the year before. The loss would be an even greater 5.8% if the only growth segment—software were excluded. "We are alarmed at the plunge in U.S. high-tech employment," says John F. Mancini, vice president for domestic policy at the AEA.

Part of the job loss can be attributed to the ongoing recession, but something deeper underlies the cuts: a sense that the industry must reshape itself in a permanent contraction in light of the ever more competitive global environment. The boom years are over, says analyst Crugnale.

"This industry is geared for double-digit growth in how it thinks, how it plans, and how it facilitates," he says. "People in this business thought they were exempt from the laws of economics. Now we've had a couple of years of single-digit growth, and it will probably stay that way."

Like any massive change, downsizing brings pain—especially to laid-off workers, many of whom are in the professional ranks (see p. 32)—and promise as well. Amid what sounds like a dirge as companies announce they're letting go of thousands upon thousands of employees, some firms—including Hewlett-Packard, National Semiconductor, and Texas Instruments—are reporting better profitability and more nimble structures as a result of their reorganizations. IBM is hoping for the same.

"Companies waste a lot of effort doing things they don't need to do," says Crugnale, "so there will probably be more concentration on things that really need to be done. Basically, you stop doing things that aren't important and farm those things out. Sometimes you outsource the entire product." One niche that benefits is contract manufacturing (see p. 36).

But nagging questions remain. When does "leaner and meaner" become downright anorexic? Is the restructuring just a reaction to today's hard times, and will companies shedding business units, manufacturing capacity, and personnel be caught short when recovery finally hits? Will a new cycle of boom and bust be triggered?

National Semiconductor Corp.'s Don Beadle, for one, doesn't think so. "We were at the low 60% level of manufacturing utilization when we started our restructuring [in 1990]," says Beadle, who is senior vice president of the international business group at the Santa

FACELIFT

Clara, Calif., chip maker. "When we finish, our target is to have 90% utilization at today's efficiencies. We don't think that even with a strong market there is any way we'll need more than 90%."

That attitude stems from a basic assumption that the industry will never again experience a gold rush akin to that of the 1980s, when the personal computer mania fueled heady growth. "I don't see any product that people are working on coming on the market that is going to drive things the way the PC did in the mid-'80s," says Beadle.

In an age of diminished expectations, some of the niceties of corporate life will inevitably fall by the wayside. "One of the things that's fallen off the truck is training," says analyst Crugnale. "Very few companies still do it. More and more they depend on knocking off other companies' good people." Also, he says, "engineering is less of a prestige job. Engineers don't have backup and support anymore; they have to answer their own phones, write a memo, or do their own testing, where they used to have help."

But questions of work climate or employee preparedness take a backseat to more pressing problems of profit margins and productivity. In fact, says Crugnale, "productivity in this industry hasn't been very good," and the reorganization plans now under way are setting about to fix that. "The facts of life are that most U.S. companies are not getting the billings per person they need to be competitive," says Joe Zimmerman, vice president and manager of corporate services at Texas Instruments Inc. in Dallas. "We've got to figure out a way to get the people we have producing more revenue."

TI's solution is to streamline its organization and business procedures in an effort to improve efficiency and conserve costs. One way is by trimming staff. Since January 1990, through both voluntary and involuntary programs, TI has cut 7,500 employees, mostly in the Defense Group. An additional reduction of 500 in TI's European workforce will be completed in the first quarter of 1992, and another 450 jobs will be slashed when the company closes its Colorado Springs, Colo., electronic-warfare facility by the end of the year.

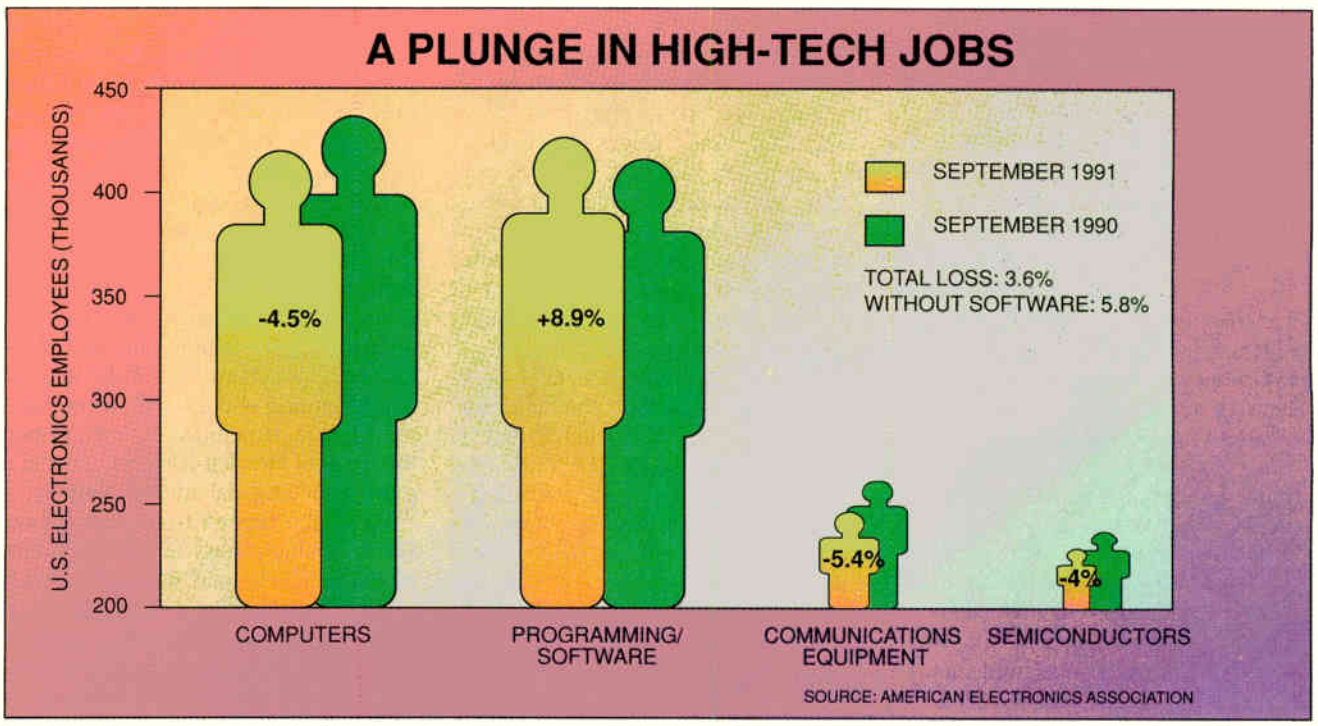
Equally important, says Zimmerman, is a systematic program to control logistics. "Logistics—defined as the movement and flow of assets through distribution, warehousing, freight handling, material movement, and inventory management—is an area that in most companies is done very inefficiently," he says. "It's usually done at the local level by the local plant manager."

By benchmarking several companies, Zimmerman says, TI found that the annual cost of the logistics process is 10% to 11% of revenue. It should be 6% to 7%, he says. The companies TI studied found that by streamlining this process, "they could take out about 40% of their inventory." Since TI's inventory is about $1.5 billion, Zimmerman points out, a cut of that magnitude would have a big effect on the cost of money and the balance sheet.

"We've put together a team to study this, and their preliminary report shows that we can effect substantial savings," Zimmerman says. TI figures that "we can take out about $30 million of cost next year just by streamlining the process around the world."

Streamlining means going to corporate agreements on trade contracts, redoing business procedures on a global rather than a local basis, consolidating distribution centers in Europe and the U.S., and dealing with only one or two freight handlers around the world instead of 10, Zimmerman says.

"In some cases, we found that some products in inventory just weren't moving, and they represent a big portion of our inventory but only a small portion of our revenue." TI figures that simply by adhering to strict just-in-time delivery and culling slow-moving parts out of inventory it can save "over $100 million,"



'ENGINEERS HAVE TO ADAPT'

When Fred Martin lost his job last March, one realization came crashing home. Corporate downsizing carries a special risk for professionals who move from job to job as defense contracts ebb and flow through the Silicon Valley, Long Island, Boston's Route 128, or any other high-tech pit stop in the U.S. The reality is that engineers and engineering managers can be employed for most of their working lives and still collect a relative pittance of a pension when they retire.

Martin logged 10 years at GTE Government Systems Division, Mountain View, Calif., before the pink slip arrived at age 59. He will get about one-third the pension he would have earned if he had retired at 65. "The weakness of the process is that pension benefits are tied to the employer rather than the employee," he says. Martin is looking for a solution from the IEEE. So far, that professional group has not found one.

LAID-OFF ENGINEER FRED MARTIN

The big shock for Joe Neri of Stony Brook, N.Y., was not being able to find another job. Neri, 57, had worked for General Instruments Inc. on Long Island for almost 20 years when an investment group bought out the company and started pruning unprofitable businesses. "It was the first time I was ever laid off," says Neri.

A manufacturing manager, Neri believed his skills could be easily transferred outside electronics, if need be. "It's not that my talents were not wanted, but most companies were already downsizing and it did not help that I was in charge of the military end of our business." Neri is doing the standard job-hunting routine, including networking, but he thinks his best shot is as an entrepreneur.

Through the Center for Practical Solutions, a Hauppauge, N.Y., nonprofit corporation that helps engineering professionals look for jobs, Neri found a couple of like-minded engineers. "We are developing a product and we are looking to go into business for ourselves."

It is not surprising that Neri and Martin both worked in the defense industry. The contraction now under way, which was exacerbated by the recession, gives former "defense establishment" employees a "loser" image in the eyes of prospective employers, some say. "They have to change the way they come across," says Fausto Molinet, a laid-off defense professional himself who is now involved in the Boston Area Job Fair Cooperative.

"A lot of older guys are getting hit," he says, "but they have to realize that when they come to a job interview in a polyester suit, 20-year-old glasses, and old ways of thinking, that they are just not attractive to a 30-year-old entrepreneur dressed in an Armani suit."

Molinet, 51, had to make "some lifestyle cutbacks" after being laid off from Litton ITEK Optical in Lexington, Mass., last June. His wife is working more hours as he builds a consulting business in total quality management—the last position he held at Litton.

Fundamental changes are shaking the economy, he says. "The Soviet Union has folded but—like it or not—its threat provided a lot of the energy that drove our economy for the past 40 years. What arises will certainly be different. It may be good, though, and engineers have to adapt."

Because they tend to have nest eggs and other options, the suffering imposed on many engineering professionals is not enormous. But the growing legion of unemployed professionals represents a staggering waste of talent and expertise. "When companies tighten their belts, the first thing they cut is R&D," says Neri. "We are going to lose even more of our technology edge." —*Jack Shandle*

says Zimmerman. TI is also making radical changes in its purchasing procedures. According to Zimmerman, TI buys about $3.5 billion worth of goods each year from more than 25,000 suppliers. In the last few years, it has been training managers and engineers to rethink the purchasing process. "We're saying, 'Let's think about the most effective way to buy, alternative ways of designing your product at the lowest cost,'" Zimmerman says.

The procedure is streamlined by an automated information system that tells TI purchasing people around the globe "where we can get the best price, quality, and delivery. With this electronic system, we get the purchaser out of the transaction process into the strategic process—finding the best supplier and the best deal," he says. TI is also negotiating global rather than local contracts, says Zimmerman, "applying our total purchasing leverage against those contracts.

"We expect by next year we will have saved about $45 million just from a half dozen contracts," Zimmerman says. Significantly, this kind of automated purchasing can be handled by fewer people who "work on more strategic tasks, tasks with more value added, rather than grunt work," he says. TI's philosophy is that "we're not downsizing people—we're upsizing productivity."

On another front, TI is contracting out services that used to be performed internally. The company now arranges all corporate travel through American Express. Copy centers have been turned over to Xerox Corp.—TI pays by the sheet, while Xerox maintains and supplies the equipment. Printed-circuit boards are manufactured outside as well.

Such aggressive cost management, some say, is the only way to cope in an industrial environment as competitive as today's. A company can't count on improving gross margins significantly—even with good products and improved manufacturing—so its only recourse is to get cost structures in line, Robert Wayman of Hewlett-Packard Co. told a meeting of financial analysts recently.

Since the biggest fixed cost is jobs, HP is looking closely at managing employment levels, said Wayman, who is senior vice president and chief financial officer at the Palo Alto company. Long known for its benign employee practices, HP will have pared 3,300 jobs by

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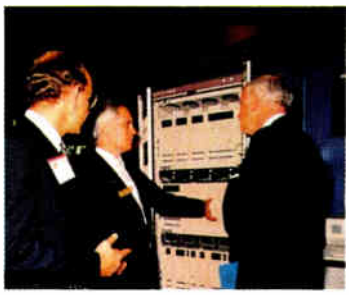

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midyear from a payroll of 92,200 in October 1990. The cuts were made through attrition, voluntary early retirement, and hiring controls.

Besides cutting jobs, HP's reorganization, begun three years ago, aims to create increased accountability and better alignment with market opportunities, chairman and CEO John Young told the financial analysts. The restructuring eliminated two layers of management in the computer business and two in field sales, resulting in faster decision making and less bureaucracy, Young said. With these and other changes, Young said that using 1987 as a base (and not counting special charges for the reductions in staff), HP's revenue per person has grown 50% over the last three years.

Indeed, HP isn't the only company to get results from downsizing. National Semiconductor expects that the first quarterly returns after its restructuring will show a 29% gross margin, up from the current 24%, says Beadle; the goal is 40% in five years. The company posted a $5.9 million net earnings in the second quarter of its 1992 fiscal year, not a bonanza but up from $3.5 million in the same period last year.

National launched its new, slimmed-down look in the period surrounding the retirement of company founder Charles E. Sporck. Struggling to reverse a decline in fortunes over the past few years, the company made some drastic changes in structure and strategy during the time when Sporck was passing on the torch to Gilbert F. Amelio, the new president and CEO. The strategy has been implemented in three major steps, says Beadle.

First, in the summer of 1990, National exited the fast static RAM business and sold off its Puyallup, Wash., fab, taking a restructuring charge in the process. That resulted in a cut of 2,000 employees. Next, Amelio reorganized the company into two businesses: standard products (logic and linear devices); and an advanced technology organization dubbed the Communications and Computing Group. This resulted in another loss of 800 to 1,000 jobs.

At the same time, Beadle says, National decentralized its vaunted manufacturing organization. "As a result, each group president now has total responsibility from design of product all the way through manufacturing and sales."

The standard products, Beadle points out, are characterized by relatively low growth and margins, lower selling costs, and fewer research and development centers. The advanced technology group has higher margins, so higher R&D expenditure is affordable, he says.

Finally, National slashed another 800 jobs in the final quarter of 1991 when it reviewed its manufacturing assets, restructuring and retiring older facilities. Now, Beadle says, "We have already brought our break-even to under $400 million per quarter, which is about our current sale rate. So we feel very confident that we can weather this storm and are poised for good financial performance when the market recovers."

Just as National is concentrating on core competencies, so is Mentor Graphics Corp., the Wilsonville, Ore., leader in electronic design automation. "We're looking at everything we're doing," says Tom Bruggere, chairman and CEO, "and shedding everything that is not optimum." Mentor's continuing net losses in 1991—largely due to the delay in shipping its much anticipated Release 8.0 and Falcon Framework—led to a major restructuring instituted last August.

Mentor cut personnel 15% to about 2,500; sold off its documentation tools company, Context Corp.; and exited the hardware service business. Also dropped was the development of mechanical computer-aided design tools and efforts in computer-aided software engineering. The restructuring resulted in a one-time charge of $27.2 million in the third quarter.

Bruggere is optimistic that these steps will boost Mentor's 1992 earnings and believes that the merger of major rivals Valid Logic Systems Inc. and Cadence Design Systems Inc., both in San Jose, Calif., will help. "We now have only one major competitor worldwide instead of two. They have to worry about integrating two companies and two sales organizations. We think this gives us an opportunity."

The difficulties of merging two companies is well known to Harris Semiconductor of Melbourne, Fla. The company began staggering when the recession arrived at the same time it was digesting the General Electric Solid State business, acquired in 1988. The pressure caused by the slowdown coupled with the costs of consolidating plants, product lines, and sales and distribution operations led Harris to downsize.

In the past year, jobs have been slashed 30%, from 13,000 worldwide to about 9,000. Manufacturing capacity was reduced by closing a wafer fab in Santa Clara and moving that capability to a more efficient facility in Findlay, Ohio. Similarly, test and assembly facilities were closed in Taiwan and transferred to Singapore and Malaysia.

All told, Harris has cut the number of divisions from five to two, says Phillip W. Farmer, executive vice president. "We now have a third fewer vice presidents," he told the New York Society of Security Analysts in November, "half the number of directors, and we've substantially reduced the manager-level positions." The result, Farmer said, is a flatter, more responsive organization that is "more focused on our customers and their requirements."

Downsizing, by all accounts, is here to stay as the U.S. electronics industry faces the 1990s. But the movement is creating a business that's radically different from the expansive, freewheeling industry that existed during its long-gone glory days. "Will there ever again be that nice feeling about working in this business?" asks a wistful Crugnale, who once held marketing jobs at GE and Beckman Instruments. "It used to be fun to work in electronics. Now it's just another business." ❑

HARD TIMES, GOOD TIMES

With U.S. electronics companies slashing their manufacturing operations and outsourcing services, one sector of the industry that is reaping the rewards is contract manufacturing. This service has grown 19% a year in the past five years, according to a recent study by the Institute for Interconnecting and Packaging Electronic Circuits of Lincolnwood, Ill.

A major reason for the rise, the study says, is the poor economy. OEMs tend to outsource more services during bad times to reduce overhead and gain efficiency in certain operations. The study also indicates a significant rise in turnkey programs, where contractors take over a complete process from buying to building.—*S.W.*

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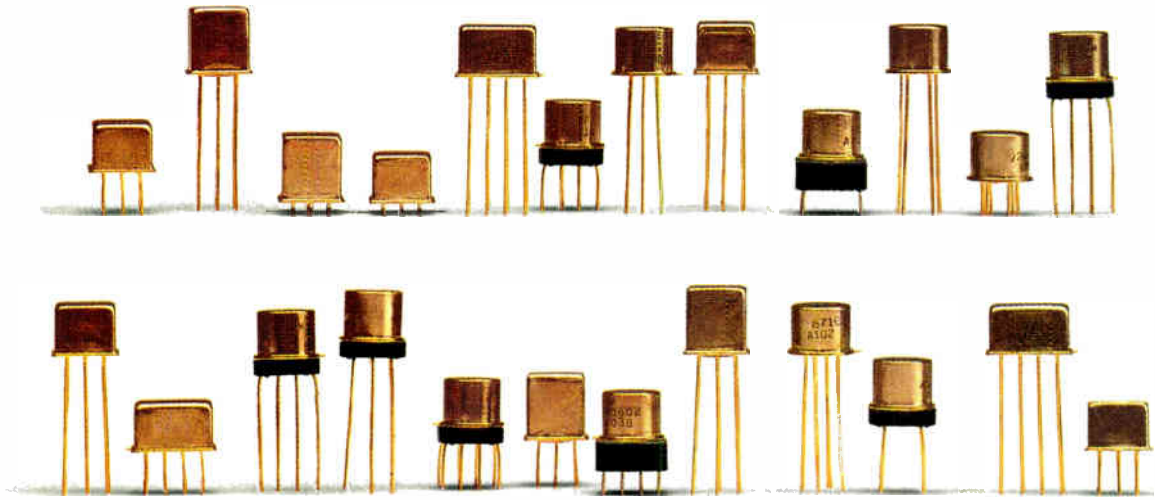

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CIRCLE 196

DEC'S BIG GAMBLE ON A NEW RISC

A 200-MHz CPU IS THE FIRST IN A FAMILY THAT WILL POWER EVERYTHING FROM PALMTOPS TO SUPERCOMPUTERS

BY LAWRENCE CURRAN

SEMICONDUCTORS

Several years ago, industry wags tried to hang the nickname "Silicon Mountain" on the wafer-fab facility Digital Equipment Corp. built on a hill overlooking Hudson, Mass. Implicit in the humor was the question, "How can this conservative East Coast computer firm hope to rival the semiconductor expertise resident in Silicon Valley?"

Perhaps those who chortled should take another look: Digital is routinely producing 83-MHz CMOS microprocessors in Hudson now and is measuring clock rates as high as 200 MHz in chips that will implement systems in its so-called Alpha architecture. Those machines won't be on the market until late this year or early next. But enough Alpha chips have been produced to give the company confidence that 200 MHz is no barrier for these reduced-instruction-set-computing devices. In fact, Digital is considering making the chips available on the merchant market—by licensing arrangements or direct sale.

Alpha is a code name for a computer architecture and future product family that embodies a big gamble for Digital. This RISC scheme—which has been in development for more than three years and is intended to last for 25—will eventually succeed the highly successful VAX architecture, which has contributed the lion's share of Digital's revenue since the VAX-11/780 made its debut in 1977. "DEC's future as a preeminent vendor hinges on Alpha," says Terry Shannon, president of Gander Resources, an Ashland, Mass., research firm. "They're betting their business on this program, and I see no reason why they won't be very successful."

The company is just beginning to provide details about the architecture. It is conducting six "roundtable" briefings for the press and analysts to get the word out and to make clear Digital's commitment—an important indicator of how crucial Alpha is to Digital. These moves represent an "opening of the kimono" by a company that historically works very hard to prevent leaks about new products or technology directions.

Alpha is a true 64-bit open architecture designed to run multiple operating systems on successive generations of RISC microprocessors that will be built into a range of systems from palmtops to supercomputers. Alpha will support everything from uniprocessors to massively parallel systems, Digital says.

Importantly, Digital says the Alpha architecture will have no operating system bias: the company is bending over backward to assure customers that it will run any operating system they're using. To reassure those now using Digital's proprietary VAX VMS or its Ultrix version of Unix, the company says today's software is binary-compatible with the Alpha architecture; it will run on the Alpha family after a simple recompilation. To demonstrate that, Digital has built at least 50 Alpha systems and ported more than 7 million lines of code. "We've built a software factory that takes in VMS code and outputs Alpha code," says Jean Proulx, group development manager in Digital's VMS Advanced Systems Group.

As for Unix, Digital's goal is to deliver "one common Unix implementation based on [the Open Software Foundation's] OSF/1," says Steve Jenkins, senior group manager in the company's Alpha OSF/1 Software Group. That means consolidating AT&T System V, Berkeley, OSF, and Ultrix into Alpha OSF/1, which will be the first 64-bit OSF/1 operating system, he says.

The thumbnail sketch of Alpha's future actually represents a singular view of how to use RISC, which to date has found its way mainly into Unix work-

stations. "The early RISC chips were for point products, primarily workstations, not for an entire product family," says Charles Casale, president of the Aberdeen Group, a Boston-based market research firm. But Casale believes the old RISC approach is too narrow. "You need a new architecture to span the breadth of products Digital is planning," he says.

Digital won't say precisely which class of Alpha system will be the first to hit the streets. Most analysts expect to see both workstations and some high-end machines—at least in the high-performance minicomputer category—among the early entries. Although Casale, based on the initial Alpha briefing, "didn't come away with a strong sense that this is a world-class architecture," Gander analyst Shannon is more bullish. "If they can deliver on Alpha's promises, it will be one hell of an accomplishment," says Shannon, who for several years was director of the DEC Advisory Service at International Data Corp., the Framingham, Mass., market research firm.

Those promises, he notes, include establishing the architecture as an industry standard, having it endure well into the next century, and making it scalable a thousand-fold in performance—over the planned palmtop-to-supercomputer product span. "I like that 25-year planning horizon," says Casale. "The IBM 360 lasted that long, and Digital is still building PDP-11s," which were introduced in the early 1970s.

The VAX lifeline keeps getting longer, too. VAX will still be sold long after 2000, says Richard Sites, a Digital senior consulting engineer who is co-architect of Alpha. But the company is convinced that a 64-bit scheme is needed now. "You run out of address space at 32 bits," says Sites. "You can't go much beyond the year 2000 with 32-bit address space; 32-bit integers won't be enough to hold the addresses of file spaces." Further, numerically intensive applications, such as atmospheric modeling, "don't provide enough precision with 32-bit integers," he says.

Alpha's clout largely hangs on Digital's semiconductor expertise. "Now that they have chips up and running, they're extremely confident of Alpha's success," says analyst Shannon.

But these central processing units might not be quite as sensational as they sound, says Ed Kelly, senior staff engineer at key competitor Sun Microsystems Inc. in Mountain View, Calif. The eye-popping numbers cited for the Alpha chips—200 MHz leading to 400 million instructions/s in a system—represent peak performance, Kelly says. "The technology is pretty aggressive, but there's a big difference between peak and sustained performance."

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IBM Power	42 MHz
Sparc	40 MHz

Kelly says the Alpha circuit design, as indicated in abstracts submitted for this month's International Solid State Circuits Conference in San Francisco, shows "they've opted to go very fast—but that takes more cycles to do things like loads. I suspect the sustained performance will be more like 100 mips/100 Specmarks when they ship late this year or early '93." Kelly says both Sun and Hewlett-Packard Co. will have systems with similar performance by then.

Meanwhile, back at Silicon Mountain, Digital has spent the past 10 years putting together what Sites calls "the best microprocessor design team in the industry." The designers came up with process and circuit-design features that contribute greatly to the Alpha chips' superfast clock cycles, says Richard Hollingsworth, manager of advanced chip development in the Semiconductor Manufacturing and Technology operation. One is the thickness of the devices' top, or third, metal layer and of the dielectric layer below it, which isolates the top layer from the other two. Both layers are unusually thick—2.0 μm, he says. Typically, the top layer in microprocessors is around 0.7 μm.

But the thicker oxide provides better isolation against coupling capacitance, or noise, between the metal layers, says Hollingsworth. And the thick top metal layer fosters very low resistance, contributing to greater speed. Another advantage is the small gate area of the CMOS transistors, which have an effective channel length of 0.5 μm—substantially shorter than usual. This also contributes to speed, he says.

The Hudson facility was originally conceived as providing a strategic backup for semiconductors purchased on the merchant market, Hollingsworth says. It was moved in 1979 from a much smaller building to the current site, which once housed two 4-in.-diameter wafer-fab lines.

Since then, Digital has built a broad range of MicroVAX, VAX, and Alpha CPUs and peripheral chips in Hudson, which now runs 5- and 6-in. wafers in a process Digital calls CMOS-4. It is being used in volume production of the 83-MHz complex-instruction-set NVAX microprocessor used in the recently announced VAX 6000 model 600 family [*Electronics*, December 1991, p. 27 as well as in the Alpha microprocessors. Hudson is augmented by another CMOS facility in South Queensbury, Scotland, which is "just bringing up CMOS-4" to fabricate both of those devices.

Both CMOS-4 and its predecessor, CMOS-3, are 3.3-V processes, compared to 5 V for most other CMOS techniques. The lower power consumption makes for more easily cooled systems powered by these devices, Hollingsworth says. "I know of no one who can match these capabilities in a production process anywhere in the world, even for dynamic random-access memories," he says.

Impressive as that is, Sites says that world-class microprocessor design and fabrication by themselves won't get Digital the scalability—the big boost in performance—that will be required of Alpha. "Over the last 10 years," he observes, "computing performance has improved by a factor of 100. It's very likely that a 25-year architecture will have to scale over a performance range of 1,000. Performance gains in the next century will not be achieved through CPU clock speed alone."

Besides speed, Sites contends that a 21st century architecture must be able to take advantage of two other dimensions of performance: multi-issue instruction (superscalar, as in RISC); and multiple processors, including massively parallel processing. And there can be no bias in the architecture for any existing operating systems, computer language, or style of computing. In Sites's view, Alpha meets all those requirements. ❑

CAN DATA SUPERHIGHWAYS PUT THE U.S. IN HIGH GEAR?

IN THE BEGINNING, GIGABIT NETS WILL LINK RESEARCH CENTERS, BUT 'DATA PACKETS FOR THE PEOPLE' ARE ON THE HORIZON

BY JACK SHANDLE

NETWORKS

An industry/government partnership to build a high-performance communications infrastructure has taken its first tentative step. The High Performance Computing and Communications Act signed by President Bush last December calls for spending $1 billion over the next five years for research into a gigabit-per-second network connecting the nation's research centers. Significantly, national defense was not the bill's primary justification on Capitol Hill or in the White House.

The bill's architect, Sen. Albert Gore (D., Tenn.), likens the proposed National Research and Education Network (NREN) to the interstate highway system inaugurated in the 1950s. What that did for the economy in the 1960s, he predicts, data superhighways can do for U.S. global competitiveness today. "Like the interstate freeway system, the network will require leadership by the federal government," says Gore.

'Like the interstate freeway system, the network will require leadership by the federal government. The government can serve as a catalyst.'

SEN. ALBERT GORE (D., TENN.)

Some heavy-hitters in the corporate world—IBM Corp., for example—are deeply committed to high-speed networks. And for small companies and even start-ups, the technology discontinuity inherent in a public-policy-backed move from copper to fiber portends a new vein of gold ready to be mined. After all, government-funded research for the Arpanet national network spawned Sun Microsystems Inc., the Mountain View, Calif., workstation powerhouse. Who says it can't happen again?

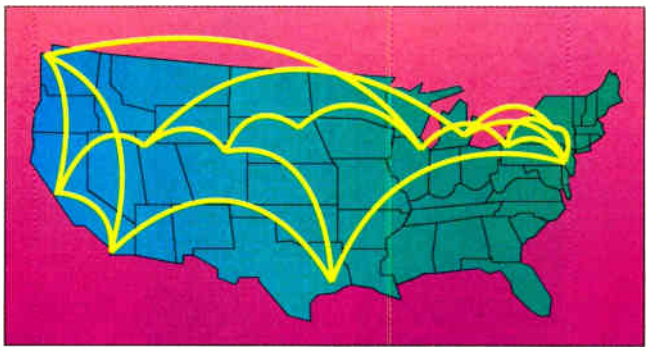
Little-known semiconductor houses like Applied Micro Circuits Corp. of San Diego have staked early claims in equally little-known technologies such as Sonet, HPPI, and FiberChannel. Similarly, leading-edge networking companies such as Cisco Systems, Menlo Park, Calif., have declared NREN a key part of their corporate strategies.

Whether they know it now or not, virtually any computer or communications house has a stake in connecting to the data superhighway. Besides business opportunities, the network probably means better research , development, and manufacturing. Gore, for one, envisions a "national co-laboratory" linking teams at different locations. Engineers in private companies could enlist design help from scientists in universities and national labs. Once a design is finished, it could be instantly transmitted to the manufacturer over the network, says Gore.

There are, however, some significant barriers to be hurdled before the network can really contribute to the global competitiveness of U.S. business. The first is funding. Although appropriations in the 1992 fiscal year will nearly match the amounts called for in the act, keeping the project fully funded through 1996 will be a major political challenge for the electronics industry and others that will benefit from the network, say Washington insiders. Even if funding continues at target levels, however, many industry observers believe changes are needed in the network's operating structure if the network's "global competitiveness" goal is to be met.

The Computer Systems Policy Project, a group of senior executives from a

dozen large U.S. computer companies, has some clear ideas on NREN's governance and goals. For starters, there's an interest in building grassroots support, says CSPP Executive Director Kenneth Kay, a Washington attorney. The project's members—among them Apple's John Sculley, Hewlett-Packard's John Young, IBM's John Akers, DEC's Ken Olsen, Cray's John Rollwagen, and Sun's Scott MacNealy—apparently fear the priority status NREN now enjoys in Washington could dry up at budget time if the man in the street is not on the bandwagon. To remedy this, CSPP has formulated several "Grand Applications"—ways the network can directly benefit people's lives. Released last December, the five application areas are education, medicine, manufacturing, distributed data bases, senior citizens, and the disabled. The computer company executives have suggested funding the project by reallocating existing federal research dollars—not by adding another line to the federal budget. Only about 2% of federal R&D dollars are allocated to computer science, says David Nagel, Apple Computer Inc.'s chief technologist, so a small shift in priorites could easily mean a massive infusion for iniatives such as NREN.



UNITED BRAIN TRUST

The proposed National Research and Education Network would link research centers at 1 Gbit/s.

CSPP also wants the network's governance to be changed from a loose confederation of government departments to a more focused organization with specific goals. NREN defines a good starting point, says Kay, but is too limited to be entirely useful to the business community. In the CSPP's strategy to find the right synergy between government and business, the supercomputing project goes hand in glove with Cooperative Research and Development Agreements, which put the intellectual power of the National Research Laboratories to work for business [*Electronics*, November 1991, p. 45].

The primary result of legislation passed last year, CRADAs let large and small companies alike plug into the National Laboratory system for early-stage technology development. A network that can transmit high-resolution images for real-time video conferencing, and let researchers share supercomputer resources and enormous data bases, would clearly expedite a CRADA be-

'PROCESSING IS THE BOTTLENECK'

Three years ago, researchers at IBM Corp.'s Thomas J. Watson Research Center in Yorktown Heights, N.Y., concluded that the relationship between computing and communications was undergoing a fundamental change that would eventually invalidate many assumptions of today's network architectures.

"One of the key assumptions," says Alan Baratz, director of IBM's High Performance Computing and Communications Laboratory, "was that network bandwidth is a scarce resource. As a result, we do a lot of processing to conserve bandwidth, such as data compression and error detection and correction. But in the new world, computing is the scarce resource, not bandwidth." Two years down the road, for example, an engine crunching 200 million instructions/s will struggle to fill a 600-Mbit/s Sonet line. The reason: the migration from copper to fiber for transmission.

To deal with this technology discontinuity—in which "processing is starting to become the bottleneck"—Baratz and his group have devised a new network architecture. It is one of several being evaluated by the Corporation for National Research Initiatives (CNRI), Reston, Va., under grants from the National Science Foundation and the Defense Advanced Research Projects Agency. CNRI is setting up five gigabit-network test beds across the nation. Early this year, IBM's network architecture will be deployed in the Aurora test bed, which links the facilities at the Massachusetts Institute of Technology, IBM, Bellcore, and the University of Pennsylvania. AuroraNet consists of eight 1.2-Gbit/s links and a 6-Gbit/s backbone capable of switching 10 million packets/s.

Besides the changing relationship between computing and bandwidth, the switching architecture requires the real-time response traditionally associated with circuit-switched networks, says Baratz. Otherwise, it would not support new applications such as video and imaging. "To keep the pipes full, we have to reduce reliance on general-purpose processing."

Thanks to the almost noiseless transmission characteristics of fiber, moving processing functions such as error detection and correction to the network periphery is not difficult. Tougher is moving flow and congestion control. IBM's solution is average-rate flow control, whereby the architecture determines an average rate for a session and tries to restrict network access to that level. "It is halfway between packet switching and circuit switching," says Baratz. "We try not to let traffic into the network unless we are sure it will not cause congestion."

Routing a packet across the network has typically involved significant processing because the packet is interrogated at each node to see where it will be sent next. But since bandwidth efficiency is not a priority, IBM has borrowed source routing from local-area networking—and gotten throughput dividends in return. Its first prototype, a switching node capable of handling up to eight 100-Mbit/s links, could switch more than a million packets/s, compared with the traditional telecom T3 switching node, which runs at 45 Mbits/s and switches just 40,000 packets/s.—*J.S.*

JAPAN LAGS, BUT MAYBE NOT FOR LONG

Government-supported high-speed computer networks have not taken hold in Japan. Only the Science Information Network runs at speeds as high as 1.5 Mbits/s. Others operate at 193 Kbits/s or less, according to the U.S. General Accounting Office's study of networks in Europe, Japan, and the U.S.

However, the disparity may not last long. Nippon Telephone and Telegraph, Japan's national carrier, will invest about $250 billion for a nationwide deployment of broadband ISDN by 2015. The network will permit several new applications. At a high-definition TV symposium in the U.S. last year, for example, NTT officials outlined a TV-on-demand scenario in which an entire week of programming would be stored in a terabyte data base. Users would dial a code to download the show they want to see. Other advances envisioned by NTT include 3-d video communications and automatic translations.

Fujitsu's prototype workstation delivers video over a gigabit net.

A Japanese firm reached a milestone in high-speed switching last October, when Fujitsu Ltd. announced it had successfully tested the world's fastest asynchronous transfer mode switch module: 40 Gbits/s. Fujitsu's prototype Multimedia-Oriented Super Terminal workstation—Monster, for short—takes advantage of gigibit nets to deliver video. It finds text, images, and full-motion video in remote data bases.—*J.S.*

tween corporate technologists on one coast and national lab scientists on another. Which leads to the CSPP's final concern: that the NREN—a gigabit network linking national labs, universities, and corporate research centers—should not be considered the final goal, but the beginning of a high-speed communications infrastructure.

Although a $1 billion infusion of federal dollars would be a boon to the data superhighway, there is plenty of action in high-speed networking in the private sector already. Three years ago, the National Science Foundation began to disengage itself from running NSFnet, a 1.5-Mbit/s network that succeeded the original Arpanet. Its policy of privatization led to the formation of Advanced Networks and Services Inc. (ANS), a nonprofit corporation based in Elmsford, N.Y. ANS administers a commercial, 45-Mbit/s backbone network that includes NSFnet as one of its customers.

That effort became part of the Internet, which links NFSnet and ANSnet as well as government, university, and private networks—3,000 in all. Just 18 months ago, that number was 1,800 and it is still growing exponentially, says Phil Gross, ANS's vice president of technology. "We have over 30,000 network numbers assigned [to be part of Internet, a network needs an address], and I think we will hit 5,000 networks real soon," he says. "Just establishing the routing between nets is an enormous technical challenge." ANS is looking beyond 45 Mbits/s into a 622-Mbit/s environment, he says, which it hopes to deploy in the next 24 months. ANS is not involved with NREN now, but is clearly following a converging path.

Technology aside, there is disagreement over how NREN will be implemented. Some conceive of it as a Big Science network for research such as supercolliders and the Hubble space telescope. Others envision "data packets for the people." In education, "the K-through-12 people have gotten involved in the debate in a big way," says Gross.

Meanwhile, standards activity is under way on gigabit nets, including the High Performance Peripheral Interface (HPPI) for connections between supercomputers and other systems, the Synchronous Optical Network (Sonet) for telecommunications, and FutureBus for systems vendors. "In the near term, this will put the technology foundations in place," says Mark Friedmann, vice president of network products at Applied Micro Circuits. Standards will drive component development, especially ICs, lasers, and photodiodes, he adds.

Applied Micro Circuits, which specializes in biCMOS and bipolar processes, is designing chip sets for both Sonet and HPPI, says Friedmann. HPPI protocols describe a simple, high-speed pipe between computers at distances of 25 m or less. Fiberchannel, an HPPI superset, is good up to 10 km. Beyond that, Sonet takes over, perhaps in the form of broadband ISDN, perhaps as asynchronous transfer mode. (ATM is a communications protocol, often referred to as cell relay, which transmits voice, data, image, and video on a single, very high-bandwidth communications circuit.)

The company recently signed a development agreement with Pacific Microelectronics Centre, Burnaby, Canada, for Sonet chips. Sonet is a multitier protocol that includes 155 Mbits/s (STS-3), 622 Mbits/s (STS-12), and 2.5 Gbits/s (STS-48). And Futurebus may indeed be the bus of the future, Friedman adds: its 64-bit words and 100 million transfers/s add up to a data rate of 6.4 Gbits/s. "We are beginning to see tremendous interest in the workstation community," he says. "They are even talking about having attachments to medium-performance workstations and high-performance PCs."

The opportunities will be just as great in wide-area networking. "NREN's size requires different forms of technology to manage, administer, and operate it," says Ed Kozel, director of business development for Cisco Systems, a designer of routers. Cisco considers it a strategic advantage to participate in tests for NSFnet. Large corporations that want to network 40,000 or 60,000 workstations will be running into the same technical problems in two or three years, he says. ⌟

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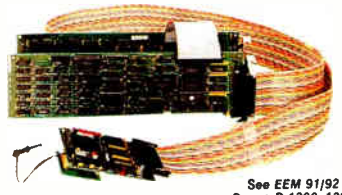

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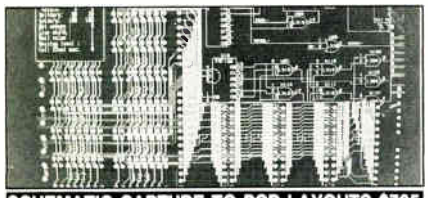

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SPEAKS OUT

TIME AND THE PRODUCT PLAN

New products are the lifeblood of any company, but the headlong race to get the next product to market often creates conflicts between the company's engineering and marketing departments. All too often, the result is a mediocre product. An old adage holds that timing is everything. To listen to electronics companies' new-product plans, one could easily reach the conclusion that it is the only thing. Time to market; engineering development timing; product life cycles. All of these play roles in product planning, but frequently, time constraints are in conflict: marketing and engineering are not in sync.

Today, electronics companies are expected to introduce new products on some regular schedule. This perceived requirement may be related to a key industry trade show or sales window—events that may be six months or a year away. Few, if any, engineering programs can develop important new products by clockwork, especially on a short-term schedule. And few marketing planners can accurately forecast product specs three to four years in advance when that means guessing at a competitive scenario six to eight product generations ahead of today's offerings.

In the computer industry, the result of this dilemma has been the introduction of a plethora of products that are, quite simply, unimportant. I'm told, for example, that approximately 1,600 different 80x86 computer models were exhibited or introduced at last November's Comdex show in Las Vegas. How is a company to differentiate its machine from the other 1,599? And does the world really need 1,600 variations on the x86 theme? Clearly, product planning has taken on new complexity, and should be reexamined.

What are the realities? First, companies do need new products. Although many customers complain that the rate of change in product introductions makes it difficult for them to set corporate buying standards, salespeople wear out their welcome if they make the same presentation over and over without talking about something new.

Second, important new products require two or three years to engineer. This opinion is prompted by having observed scores of business plans presented by excellent engineering teams wanting to start a new company. Working on nothing but their first product without interruptions, these teams normally take two or three years to produce something that's really new and innovative.

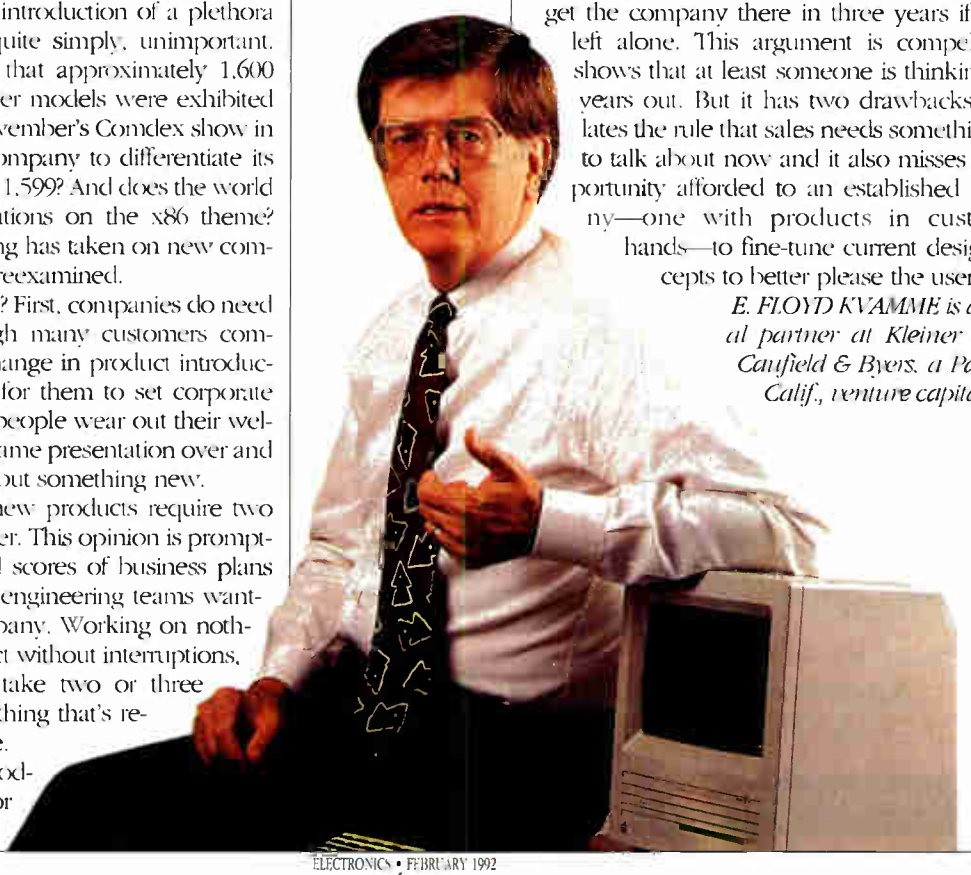
Third, important products, be they software or hardware, are either modular or are platforms that have expansion capabilities built in. I can't think of many examples of successful "point" products that did not offer growth through either module swapping or, for example, peripheral expansion. These products were designed with a life cycle in mind.

IT'S A BAD SIGN IF 70% OF R&D GOES FOR THIS YEAR'S OFFERING.

Product plans, then, must take a longer view—at least as long as it would take to engineer the important next product, namely two to three years. After a company's first products are on the market, the mandatory "new" products introduced at the next show should be enhanced or expanded versions of the originals. In the steady state, some members of the development and marketing teams are working on the products for the upcoming show while the others are planning for an introduction 12 to 24 months downstream.

A rough development/marketing health monitor might suggest that if more than 70% of the development effort is devoted to this year's introductions, the future may not be too bright. And if this condition has existed for some time, the products in development may not be important ones.

Some engineers might ask why they should bother with interim add-ons to last-generation technology when they've seen the future and can get the company there in three years if they're left alone. This argument is compelling—it shows that at least someone is thinking three years out. But it has two drawbacks: it violates the rule that sales needs something new to talk about now and it also misses the opportunity afforded to an established company—one with products in customers' hands—to fine-tune current design concepts to better please the users.



E. FLOYD KVAMME is a general partner at Kleiner Perkins Caufield & Byers, a Palo Alto, Calif., venture capital firm.

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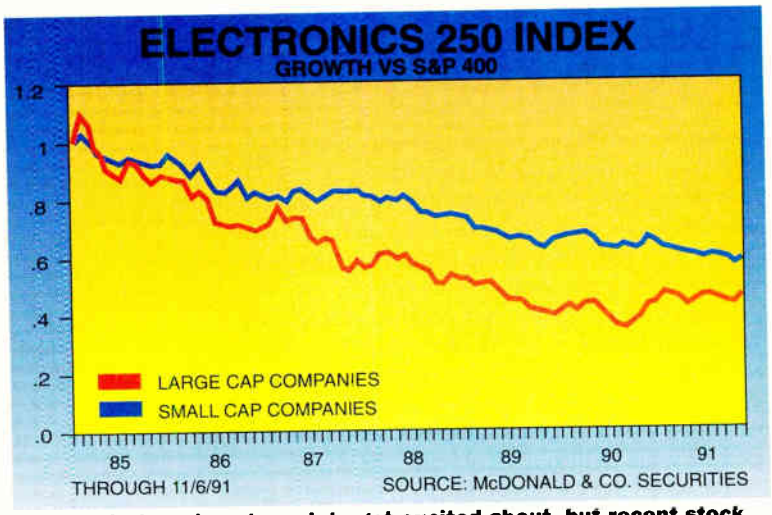
NEW YEAR STARTS WITH STRONG ORDERS IN SOME SECTORS



Overall, there is not much to get excited about, but recent stock market activity foreshadows some improvement.

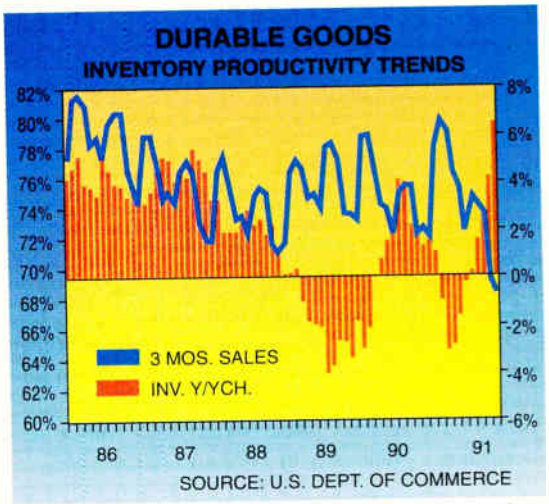
The new year is off to a slow start, but momentum appears to be modestly positive overall. The stock market has spiraled to new highs, and although attention has begun to refocus on cyclical stocks, in past economic cycles the market has typically been an excellent leading indicator for growth trends. So while some of the strength in cyclicals is due to rotation of money away from other sectors such as food and drugs, order patterns do suggest some improvement in overall earnings prospects over the next six to nine months.

New orders have been particularly strong for communications equipment, motor vehicles, electrical equipment, and electronic components. However, orders for computers and office equipment continue to lag due to persistent price erosion, the shift to less expensive decentralized computing systems, and software advances that make it easier to modernize older equipment. Electronics component demand appears to be showing signs of renewed growth, in part due to weak earlier performance.

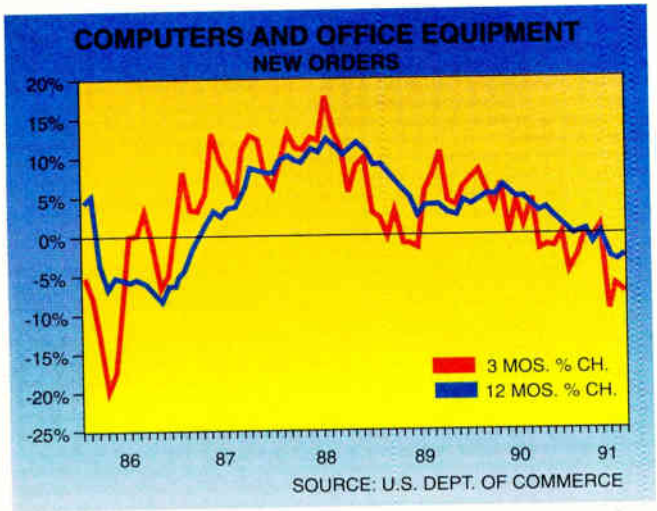
Overall orders for durable equipment appear fairly sluggish on a year-to-year basis, but the trend shows promise. Durable inventory productivity is also continuing to accelerate. While this does not bode well for near-term production, it does set the stage for accelerated production trends once positive demand patterns have been reestablished.

The President will have presented his economic growth package by the time this article appears, but you can expect the Congress to avoid any initiatives because cooperation with the Administration would help the Republicans in the fall. So 1992 economic trends will continue to depend primarily on Federal Reserve action. If President Bush is reelected, tax cuts and/or investment incentives could be enacted next year. ❑

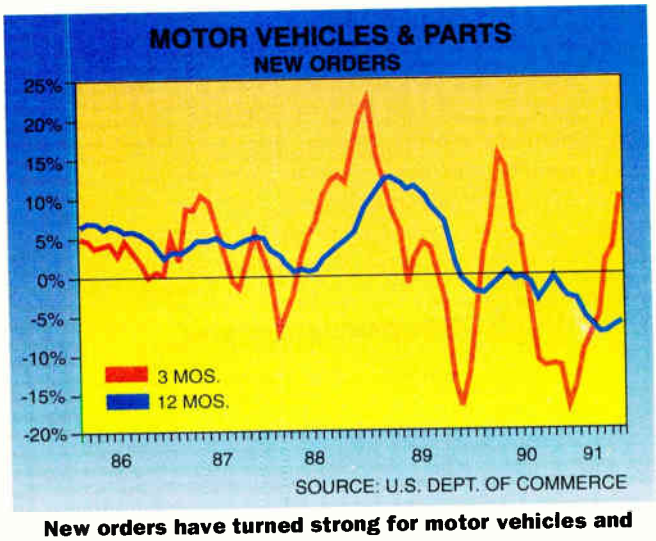
By Mark Parr, McDonald Securities Inc., Cleveland (216 443-2379)



Durable equipment trends are showing promise as inventory productivity accelerates.



Computers and office equipment orders are slow due to continued price erosion, among other factors.



New orders have turned strong for motor vehicles and parts among other sectors of the industry.

MIKE EVANS

LAST WORD

THERE ARE ASSETS—AND REAL ASSETS

Both assets have outstanding long-term performance records. One of them has increased in value 48 out of the last 50 years—but it has declined the past two years. As a result, prices are lower than they have been for 15 years, relative to income.

The other asset has a much more volatile price record. It has fallen 14 out of the last 50 years—sometimes as much as 40% in one year. It has recently risen in price to the point where, relative to earnings, it is at a peak value not seen over the past 62 years. Which asset should you buy?

Based on the cliche of "buy low, sell high," the answer should be obvious. Yet that is precisely the opposite of what most investors are now doing.

The two assets are, of course, real estate and the stock market. Yes, real estate prices have fallen over the past two years in many sections of the country. But as a result, the affordability of homes is at a 15-year high.

Stock prices, on the other hand, soared following the Dec. 20 discount rate cut, pushing the price/earnings (P/E) ratio for the S&P 500 to a record 23.4 and eclipsing the previous peaks in late 1961, early 1973, and mid-1987. The only time the P/E ratio was ever higher was in 1929.

Meanwhile, real estate languishes.

Understandably, no one wants to buy a house if it will be cheaper next year. But except for California, where the decline just started, housing prices have reached their trough, and will be rebounding significantly in 1992 and future years.

Over the long run, housing prices generally rise at the same rate as family income, or about 7% per year. That doesn't sound very exciting, although it does beat the current 3.5%-to-4% yield on money market funds. However, very few people buy a house for cash: the usual deal is an 80% mortgage. That way, your invested capital grows at about 15% per year. Sure, you have to make the mortgage payments, but you have to live somewhere and the after-tax equivalent of the payments usually won't be any higher than rent.

Short-term interest rates are just about as low as they can go. That doesn't preclude another 0.5% drop, but with the discount rate at 3.5% and inflation at 4%, the Fed will be hesitant to cut rates much further. That means mortgage rates are also near their trough, so the time to buy is now.

However, that's not what most investors are doing: they are taking their cash out of money market funds and buying bonds and stocks. That's a bad idea—because both of these are going to head lower before the year is out. A lot lower.

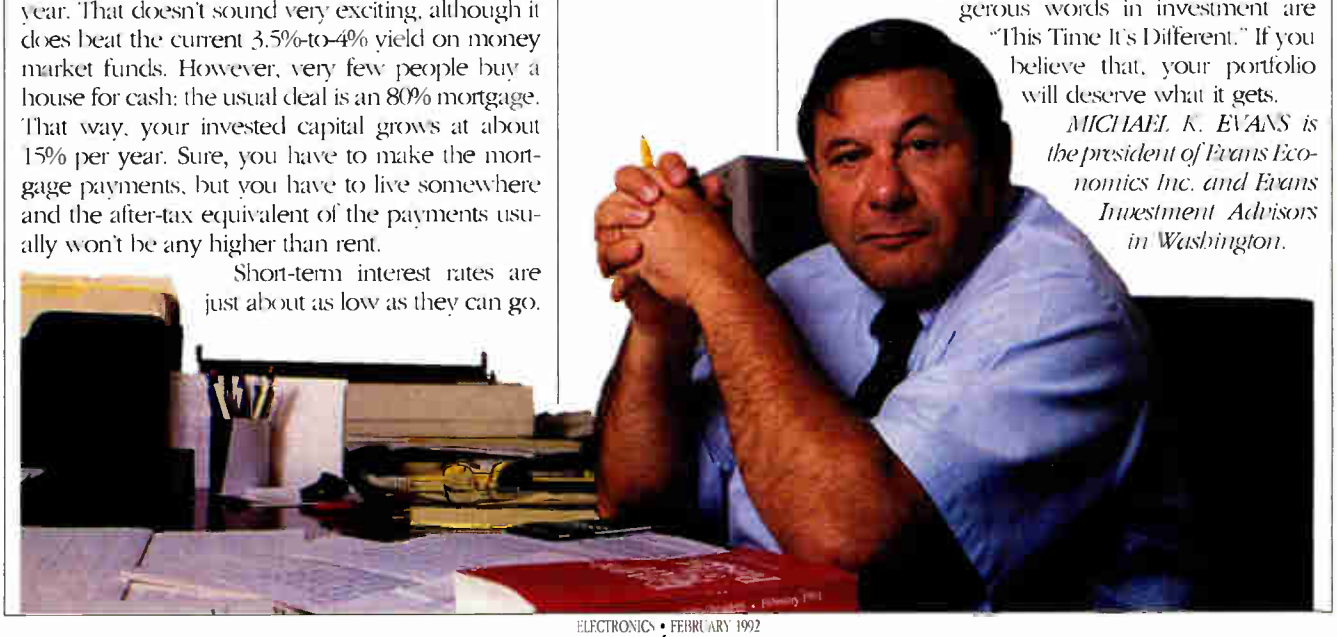
To review history briefly, the three times in the post World War II era that the P/E ratio has been above 20, stock prices have declined 30%, 20%, and 50% soon afterwards. Not to mention the 90% decline from 1929 through 1932.

With 4% inflation I estimate that the equilibrium P/E ratio is about 16, compared to almost 24 currently. Granted, the "E" in the ratio is depressed by the recession, but profits can't rise 50% this year. The consensus forecast currently calls for a 31% gain in earnings per share in 1992, but on the average the consensus view at the beginning of the year overstates profits by 12%. That suggests the gain is more likely to be under 20%. My own estimate is 10%, because I think the recovery won't start until midyear. But either way—10% or 20%—the market is way overvalued: 30% or 40%.

PEOPLE ARE SWITCHING TO BONDS AND STOCKS RATHER THAN REAL ESTATE. BUT WHY?

Finally, there are those who claim that earnings don't count any more. Also, they claim that so many recent dips have been followed by rebounds that investors have learned to buy on weakness, not sell. In other words, the rules have changed. John Templeton, one of the all-time canniest investors, once stated that the four most dangerous words in investment are "This Time It's Different." If you believe that, your portfolio will deserve what it gets.

MICHAEL K. EVANS is the president of Evans Economics Inc. and Evans Investment Advisors in Washington.



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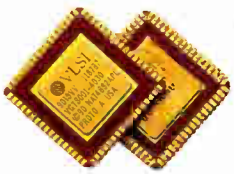

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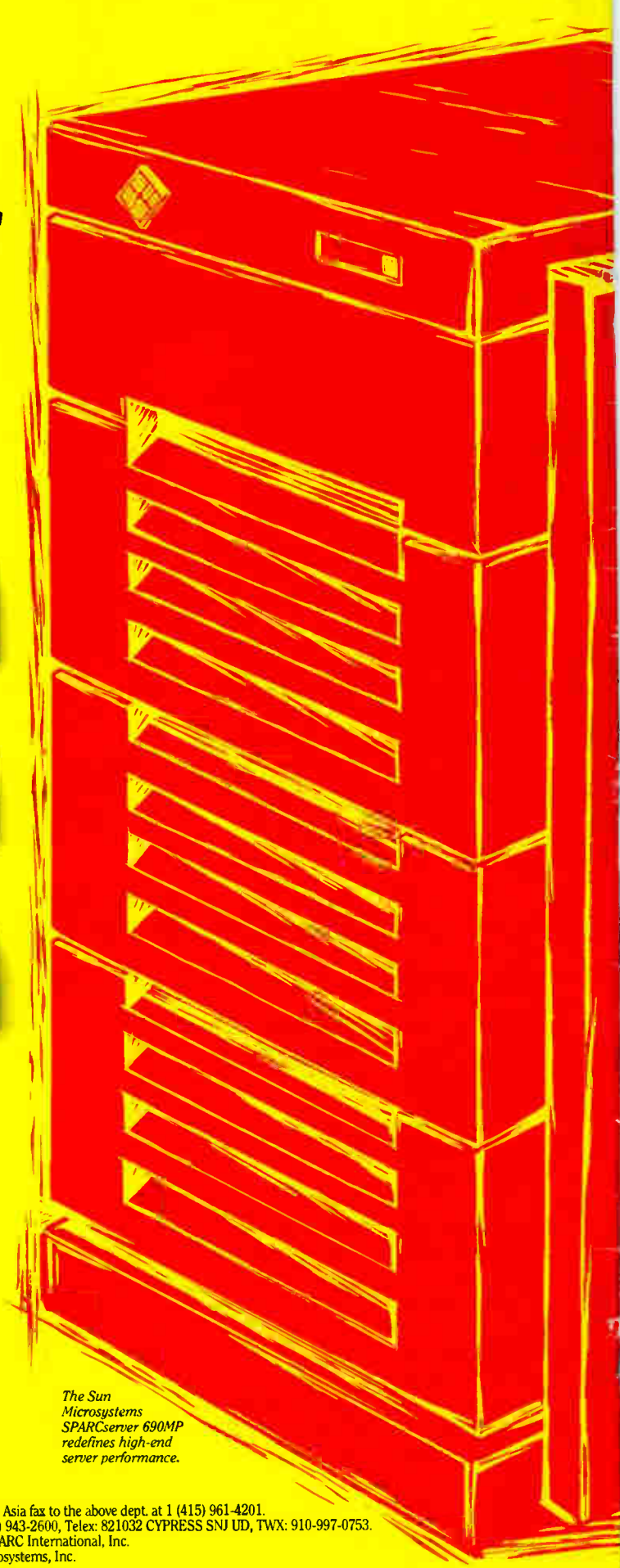

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