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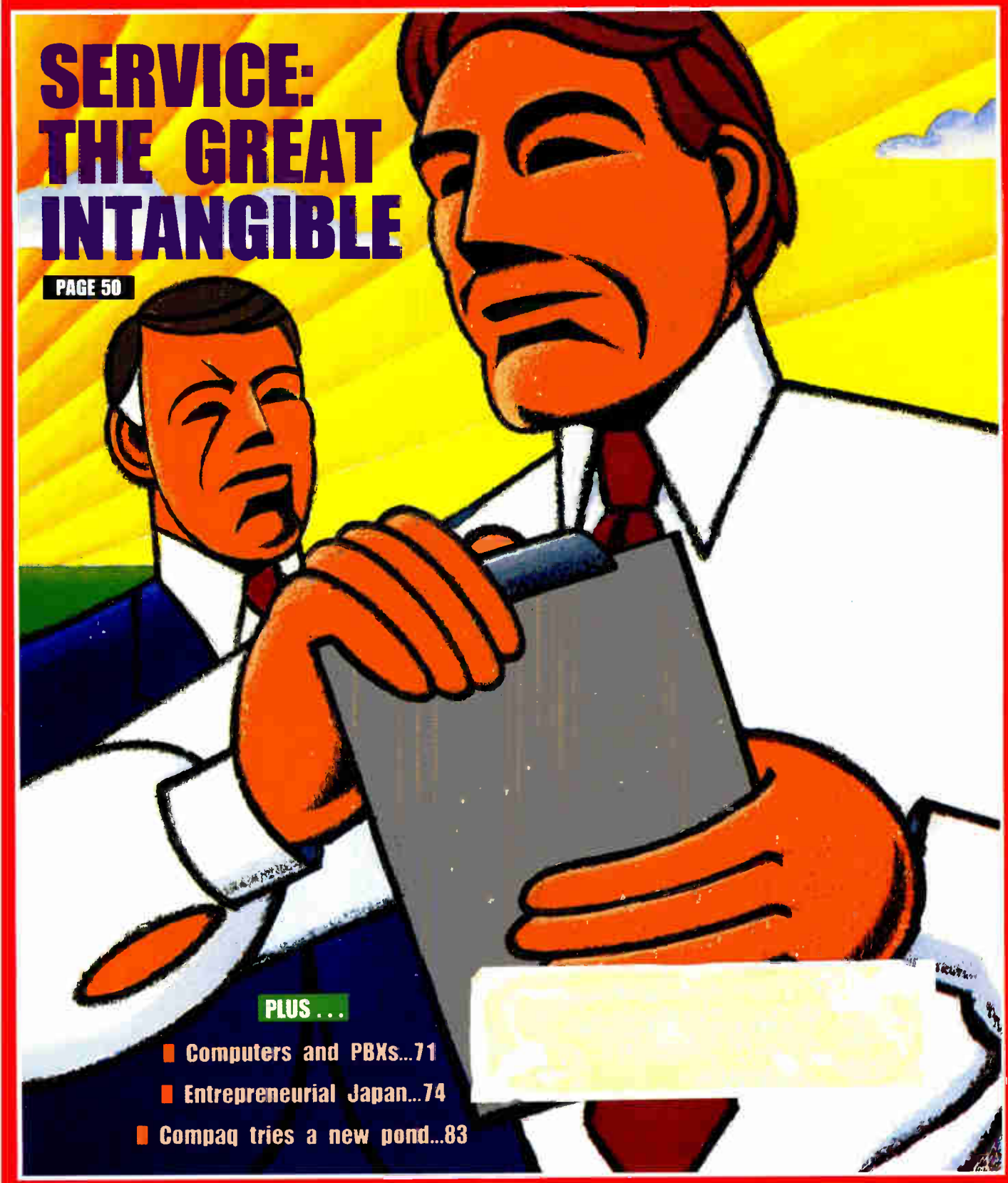
JULY 1990

Electronics

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT



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THE END OF AN ERA

What more can be said of the late Robert Noyce, president of Sematech, founder of Intel Corp., holder of original patents on the integrated circuit, author, statesman, athlete, husband, father? He was a Renaissance man in a modern age that encourages specialization, not diversification: he excelled at everything he undertook.

But beyond the passing of a multitalented man, the death of Robert Noyce on June 3 marks the end of an era. In the new age that's succeeding it, the once resplendent U. S. technology base and educational system are increasingly being relegated to second-tier status. The U. S. population is increasingly ignorant of math and science, and few steps are being taken to improve that knowledge. Its technology base—once heavily supported by imaginative administrations that set goals like reaching the moon in a decade—is being depleted by an indifferent leadership, just as ignorant of math and science as the rest of the population.

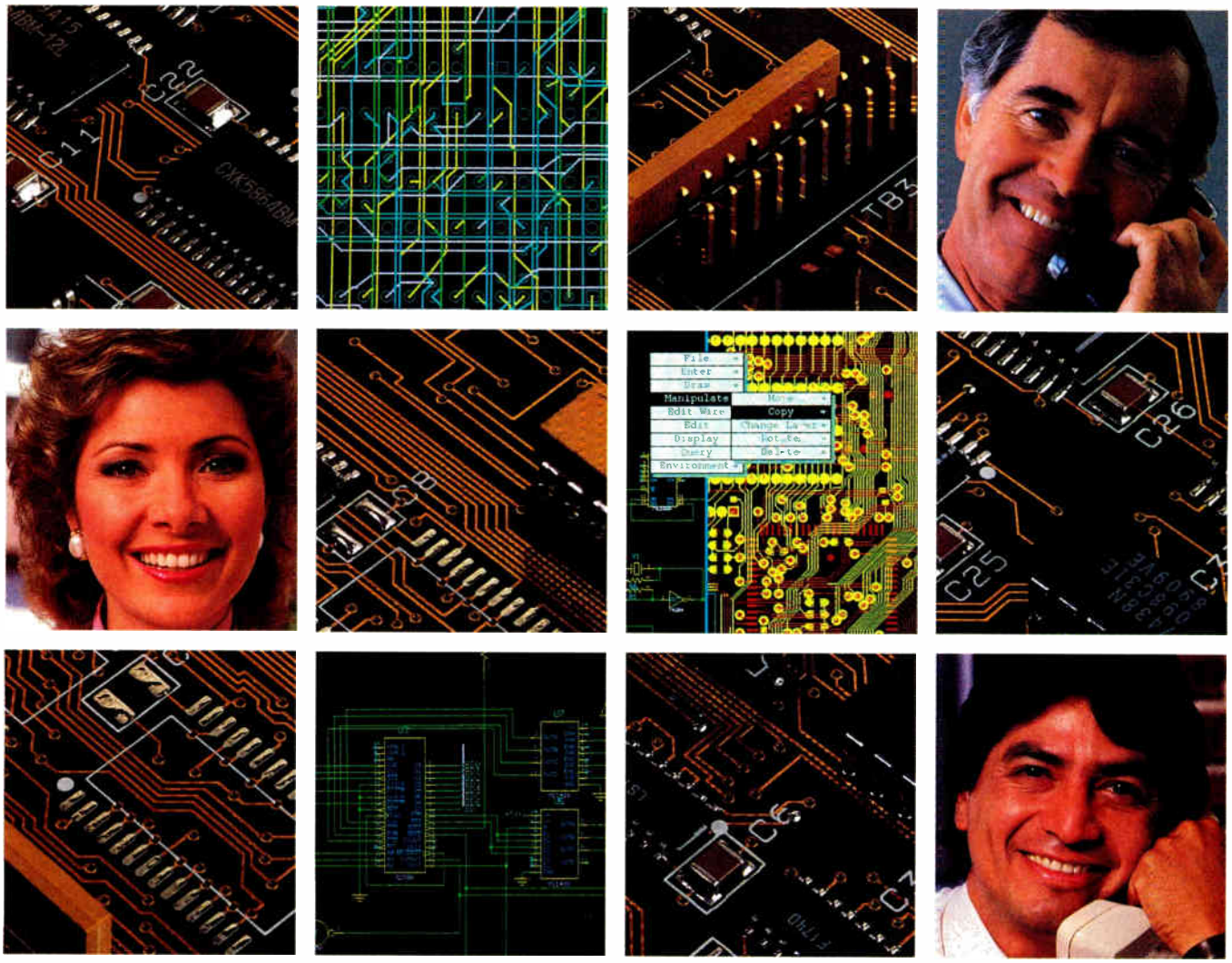
A nation is known by the ingenuity of its great minds. But today's educational system, decimated by politicians willing to mortgage the future for military might, seems ill-equipped to supply them. Think of the waste in human capital this policy has wrought. Think of how many more Robert Noyces could have been nurtured to their full potential had this nation chosen to value intellectual achievement as much as military machinery.

In a world preparing for the arrival of the 21th century, the industrial revolution has been won and we are in the midst of the information age. In such an age, state-of-the-art technology is essential for any nation to maintain worldwide economic competitiveness. But our national leadership balks at actively taking the next step, waiting instead for the unseen hand of competition to chart the course of its industry. Robert Noyce leaves a nation much less self-assured, much less willing to mount great enterprise than the one he entered 62 years ago.

Once an epicenter drawing eager, intelligent individuals who flocked here to seek their fortunes, America no longer has so strong a magnetic pull. Other nations have centers of excellence that pull talent as strongly: U. S. companies go to Japan for semiconductor technology, Europe is increasingly becoming the center of telecommunications technology, and superconductivity is being developed concurrently throughout the world.

East Asia, Europe, the USSR, and Eastern Europe all have established national goals to engender high-technology industries. What is the U. S. response? To fail to establish a policy that engenders educational excellence and technological development would be a self-destructive act, the equivalent of failing to underwrite the development of a rail system a century ago. It seems incumbent on those who knew Robert Noyce and admired what he stood for to redouble their efforts to change the course of this nation, to alert its leadership to their shortsighted vision of the future. And if this effort is not enough, then perhaps it is time to replace that leadership with one of greater imagination and vision.

JONAH McLEOD
EDITOR



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Electronics

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FEATURES

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

LETTER FROM

TOKYO

CONSUMER DISCONTENT, CREDIT BUYING, HIGHER INTEREST RATES ARRIVE

CRACKS IN THE JAPANESE SHELL

BY HOWARD WOLFF

THINGS ARE CHANGING in Japan. Of course, change is glacial and sometimes imperceptible in this most subtle of cultures, but the signs are there. Consider these hairline cracks in the shell:

- Japanese consumers, perceiving a declining standard of living, are voicing discontent.
- Younger Japanese are discovering the delight of the credit card.
- The traditionally high savings rate of the general population is expected to drop in the next five years.
- Increasing interest rates coupled with a labor shortage are changing the business climate.

Japan watchers are keeping an eye on those factors as possible harbingers of what's ahead as the century winds down. And for the competitors seeking cultural parity, the new attitudes are important clues.

Discontent is rare in Japanese society, where individuality is discouraged. One is considered a member of a team and is expected to sublimate personal desires for the good of all. As one middle manager puts it, "No individual Japanese would defy the government—or the management."

But the report about a declining living standard from the government's Economic Planning Agency goes counter to that philosophy. The agency links the perception to a feeling that the economy is turning downward at a time when Japan is struggling with its role as a global superpower.

Also, the survey was taken "when worries of the nation's economic outlook were at their peak following huge losses suffered by the stock and currency markets. This also has played a role in the drop of the index measuring consumer confidence," says an official of the agency.

That's true, but even the powerful Ministry of International Trade and Industry, mighty MITI, is getting into the act. It wants the government and corporations to change Japanese society so that more emphasis is placed on quality of life than on efficiency. MITI is calling for a dramatic shift that would see more of the nation's wealth used to improve people's daily lives.

Events in Japan may foreshadow basic change, but at Panasonic's exhibition it was strictly big business as usual.

Some Japanese aren't waiting. One trend among young professionals that is alarming their elders is credit-card use. "They rent two-room apartments, then fill them with big-screen TVs and other gadgets bought on credit," says a 30-year-old economist.

That trend, coupled with the growing proportion of older people in the population, inevitably results in less money in the bank. That is worrisome to many in Japan because the high rate of savings has enabled the nation to build huge financial resources, a major building block in its economic growth. "The next five years may be fine," says Makoto Utsumi, a vice finance minister, "but nobody knows what will happen after that."

At the same time, rising interest rates are drying up the capital market for small businesses as money is drawn to safer, more lucrative investments. For example, with the yield on 10-year Japanese government bonds at 7.3%, up from 4.2% at the end of 1988, why look further for a good investment?

Then there's the labor shortage. University graduates are heading for the big, well-established companies at a time when each grad receives an average of three job offers. That leaves the smaller firms, among them those from the U. S., struggling to staff up.

Nevertheless, it's a mistake to assume that the Japanese juggernaut is slowing. The big companies whose names have become household words can still crush competitors with marketing on a grand scale.

For example, the $40 billion Matsushita Electric Industrial Co. recently took over the spanking new Japan Convention Center outside Tokyo for a week to throw an invitation-only party for itself and about 25,000 of its closest friends. The format was a slick exhibition, a paean to Matsushita/Panasonic in which about 600 products and prototypes were arrayed for competitors, customers, and other interested folk—some of them flown in from overseas for the occasion.

The extravaganza cost $5 million, says a company spokesman. The return? "We expect it to result in $450 million worth of additional business," he says.

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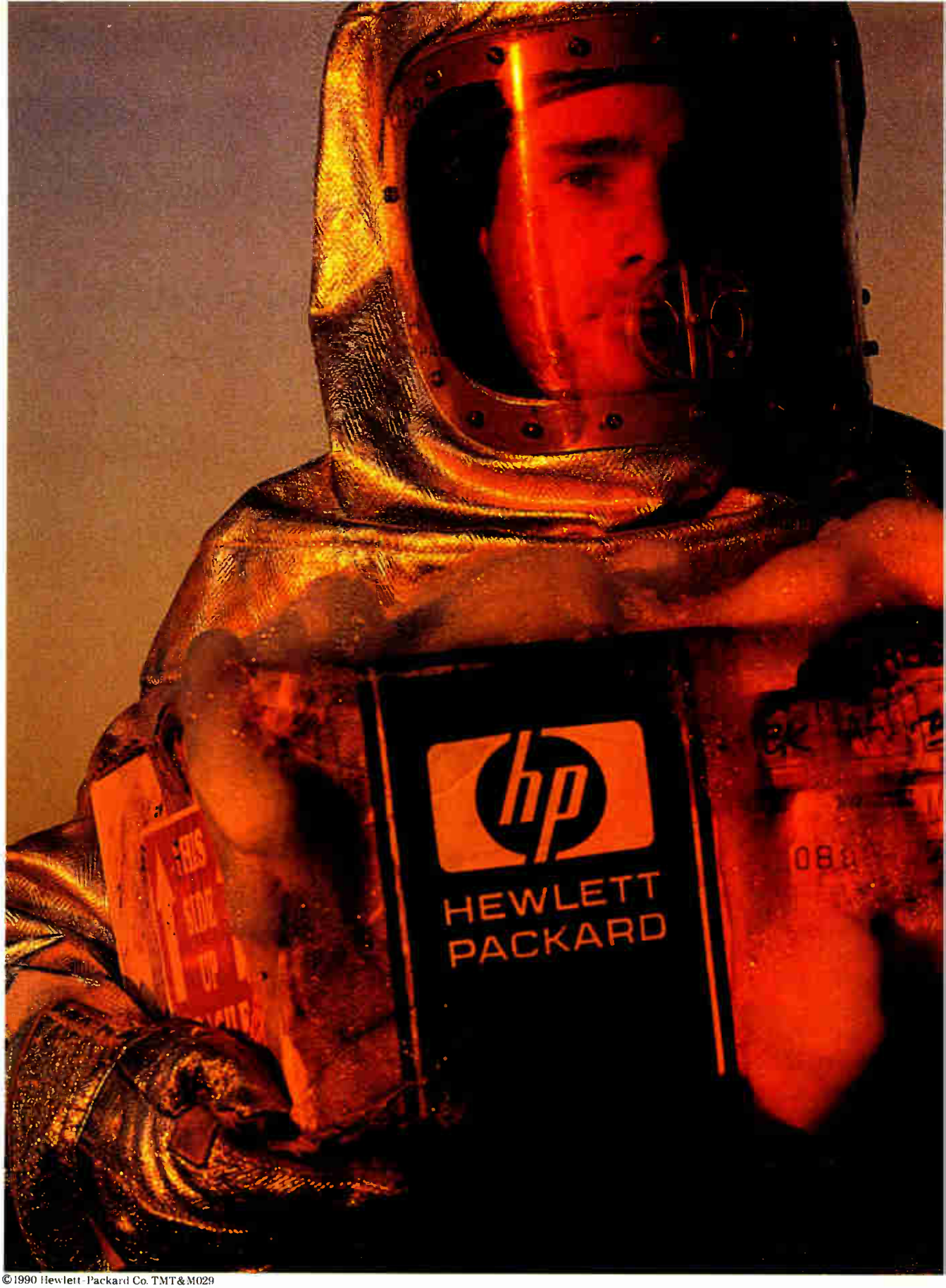

Did you hear about the optical attenuator that fell from the sky?

It hit the ground running.

"Roger, Falcon 20, you're cleared for landing. Braking action advisory. Ice on the runway." The veteran pilot of the cargo plane had landed at Link Field before, but the tower's report was a cold reminder that the airstrip ended in a 75-foot cliff.

On touchdown, the jet skidded out of control. Within seconds, it shot off the cliff like a ski jumper and tumbled down the steep embankment, cargo flying in all directions.

Minutes later, rescue teams were helping the pilot and co-pilot from the wreckage. The pungent smell of jet fuel filled the air, so crews sprayed fire-retardant foam on everything. Including an HP optical attenuator which was on its way to a customer.

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HEWLETT PACKARD

CIRCLE 178

Tiny Glitches Lead to Giant Wobbles

We take it for granted that the Earth rotates stably on its axis and that the stars are fixed in the sky above us.

Yet, Hipparchus discovered more than two millennia ago that there were very slight discrepancies in the measured positions of stars over the years. Compelled to look further, he found the difference to be greater than what could be attributed to error and analyzed it.

Hipparchus

Hipparchus realized that the position of the stars was actually shifting at a constant rate, year after year. This was later shown to be caused by the Earth slowly wobbling like a top as it turned on its axis.

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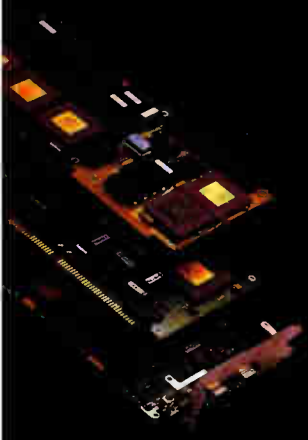
INSIGHT!

Competitive Advantage



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CIRCLE 207

SANYO THINKS ITS CELLS WILL FLY

When a company is sinking more than $13 million a year into solar cell R&D, and has come up with a way to make arrays of amorphous silicon cells extremely flexible, it wants to demonstrate the commercial value of its work. In the case of Sanyo Corp., the opportunity is coming with the flight of an ultralight, solar-powered aircraft from San Diego, Calif., to Kitty Hawk, N. C.—2,000 miles in all. The trip is expected to take seven days.

The horizontal surfaces of the plane, called SunSeeker, will be covered with arrays of Sanyo's Amorton amorphous cells. Energy will be stored in nickel-cadmium batteries aboard the craft.

Arrayed on the wing of the ultralight aircraft SunSeeker are the Sanyo amorphous solar cells.

A Sanyo spokesman says that the project marks the first time that amorphous solar cells have been applied to a thin, transparent film. This makes them very efficient for their weight. In fact, conversion efficiency is just 5%, versus 7% for glass versions, but "conversion of 200 mW per gram makes it the most efficient energy source in the world," says Yashio Kishi, general manager of Sanyo's Functional Materials Development Center in Tokyo. What's more, he says, amorphous cells consume less energy to manufacture, use less material, can be used over large areas, and are flexible enough to be applied to virtually any shape surface.

The present conversion efficiency is sufficient for commercial use, says Kishi, but today's cost of materials is still too high. Nevertheless, commercial use is a year or two away, says Kishi; the first application probably will be a portable power source. The company also envisions Amorton-powered camping equipment, auto air-conditioners, and entertainment equipment.

And for the blue-sky future, Kishi points out that if solar cells were spread over 4% of the earth's area, they could supply all the power that the world's population would need. For those keeping score, that's the equivalent of 1.4 X 10^{10} kiloliters of oil yearly.

AMP LENDS ITS MUSCLE TO 'PAPERLESS DOCUMENTATION'

AMP Inc.'s decision to deliver 2-d and 3-d graphical models of its line of connectors on compact-disk read-only memories compatible with Mentor Graphics Corp. workstations perches the Harrisburg, Pa., connector giant squarely at the cutting edge of its industry. It also gives Mentor, the Beaverton, Ore., design-tool vendor, a headstart in a new market niche: automating the design of system-level cabling and wire harnesses.

But the implications go even further for Mentor Graphics. Having a $2.8 billion company like AMP weigh in on the side of electronic delivery helps validate the "paperless documentation" strategies announced earlier this year by Mentor, Hewlett-Packard, and IBM. And as CD-ROM drives become more commonplace, the barriers for other storage-hungry technologies, such as multimedia [*Electronics*, February 1990, p. 48], inevitably will drop to the point where they can become practical enough for widespread commercial utilization.

AMP's adoption of the Mentor software also helps to spotlight one of the major lingering problems that are associated with use of CD-ROM. The lack of an industry standard for hypertext software means the CD-ROM connector libraries can be used efficiently only with Mentor's Cable Station design tool.

CONGRESS TAKES ON BUSH IN HIGH-TECH FUNDS BATTLE

Battle lines between the Bush Administration and Congress on a national agenda for the electronics industry are growing sharper. On one front, the Commerce Department has reported again that the U. S. is losing technology ground, but refuses to waver from its hands-off-the-industry policy. On the high-definition-TV front, congressional Democrats are introducing legislation that would create an HDTV strategy commission.

The Commerce Department's report concludes that Japan could pass the U. S. in total electronics production by 1994, but nevertheless suggests only long-term solutions. These include adopting a permanent research-and-development tax credit, remolding antitrust policy to fit a global economy, and acting against unfair trade barriers abroad.

The Democrats' package earmarks $50 million of the Pentagon's budget specifically for HDTV, $200 million for small companies doing high-tech research, and $100 million to create a new Commerce Department program for advanced technologies such as HDTV.

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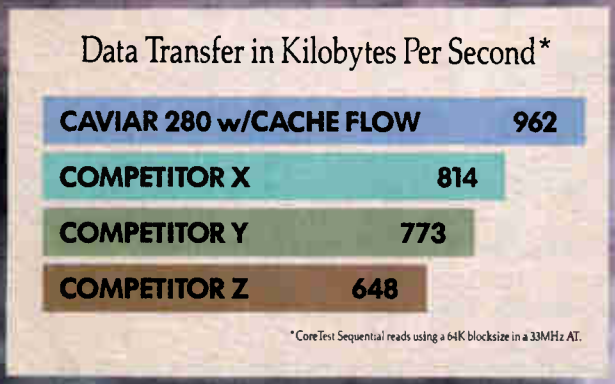

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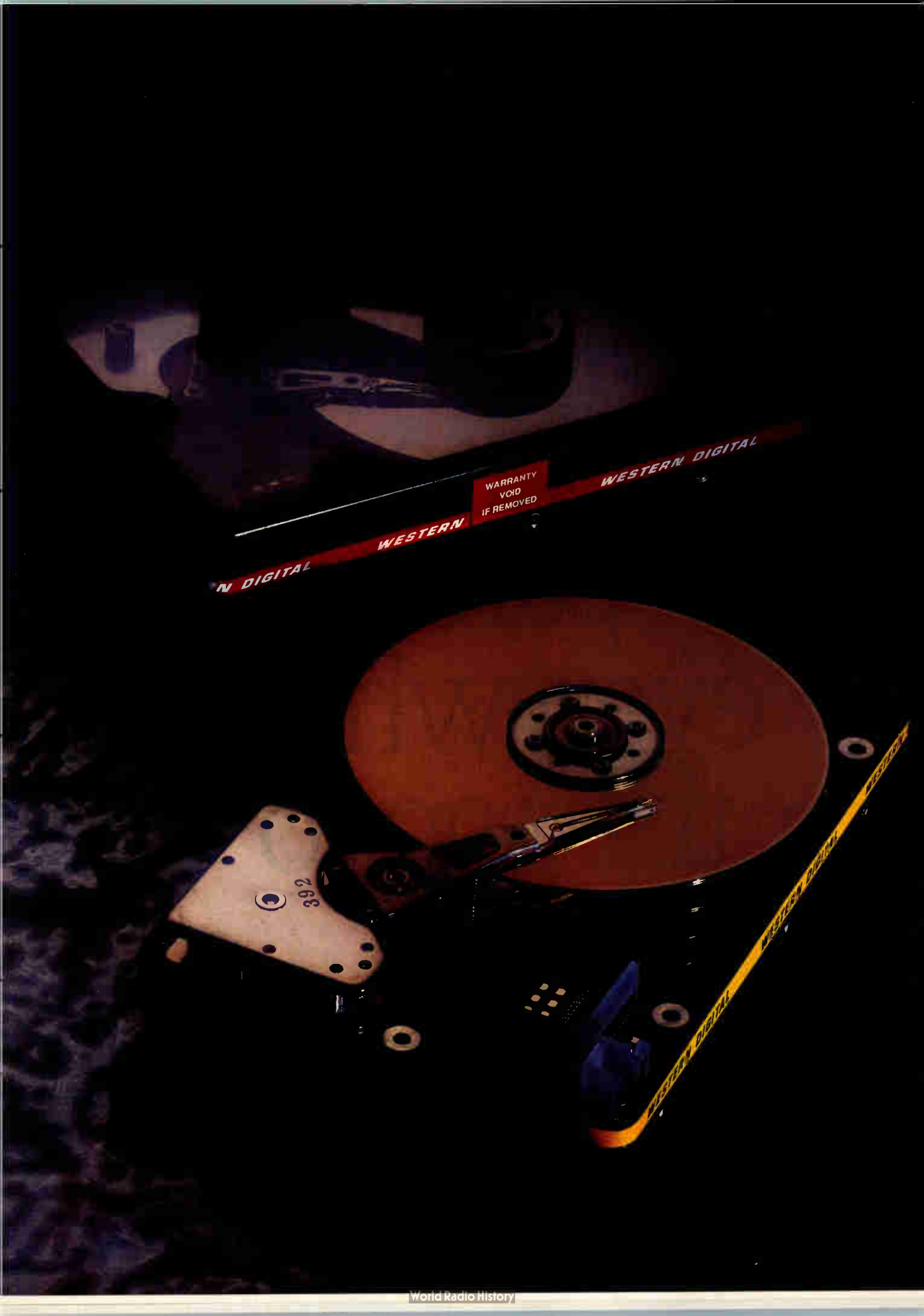

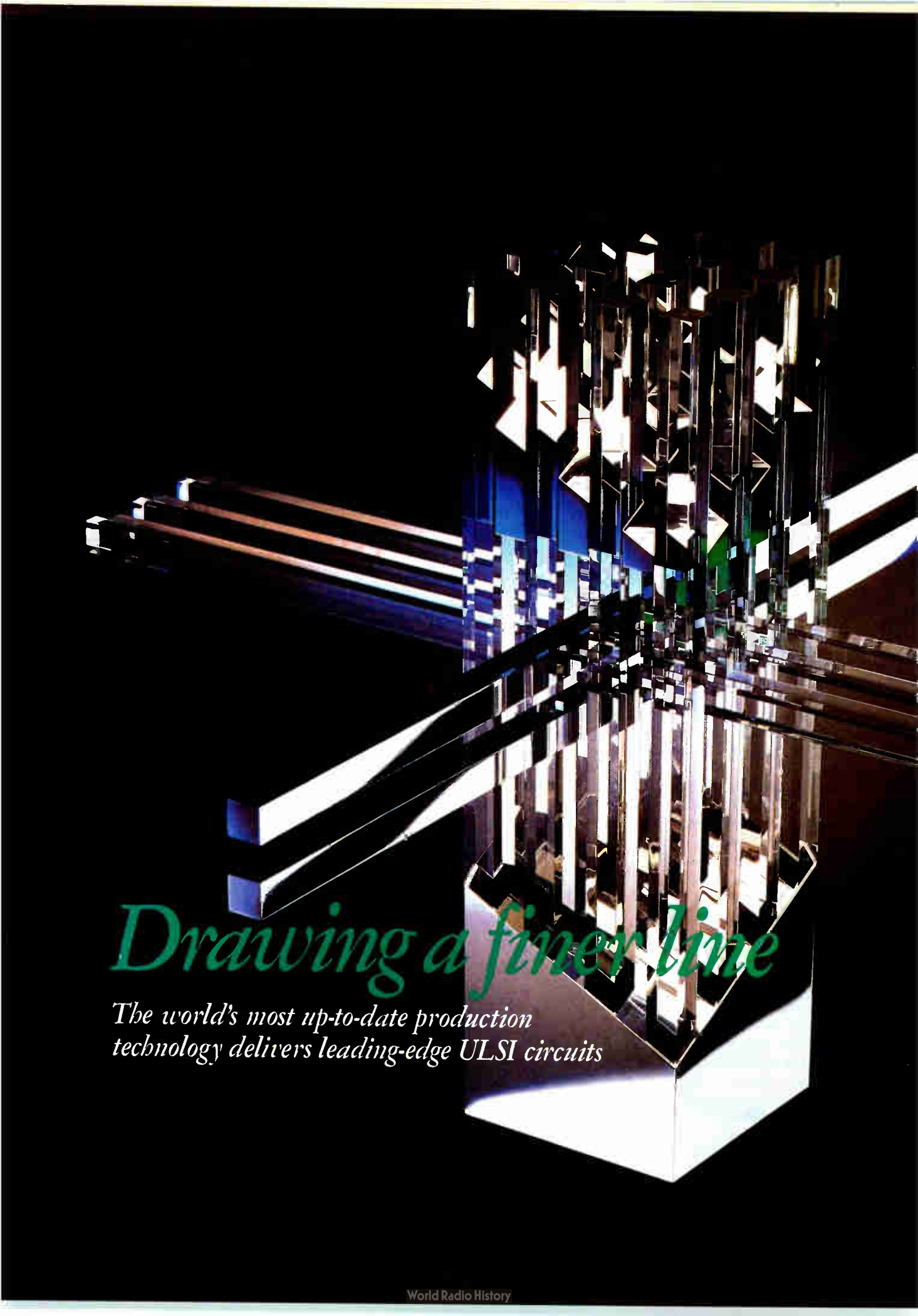

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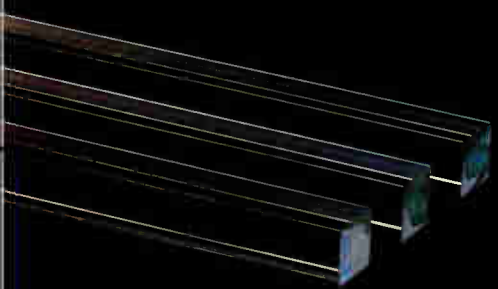

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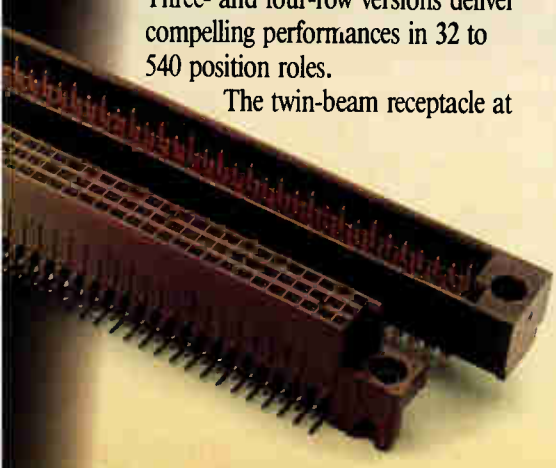

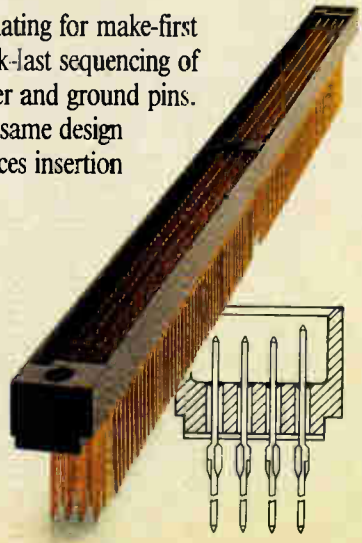

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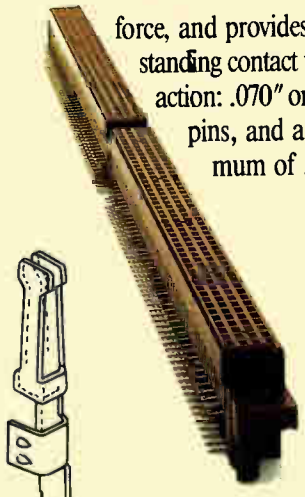

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AMP Interconnecting ideas

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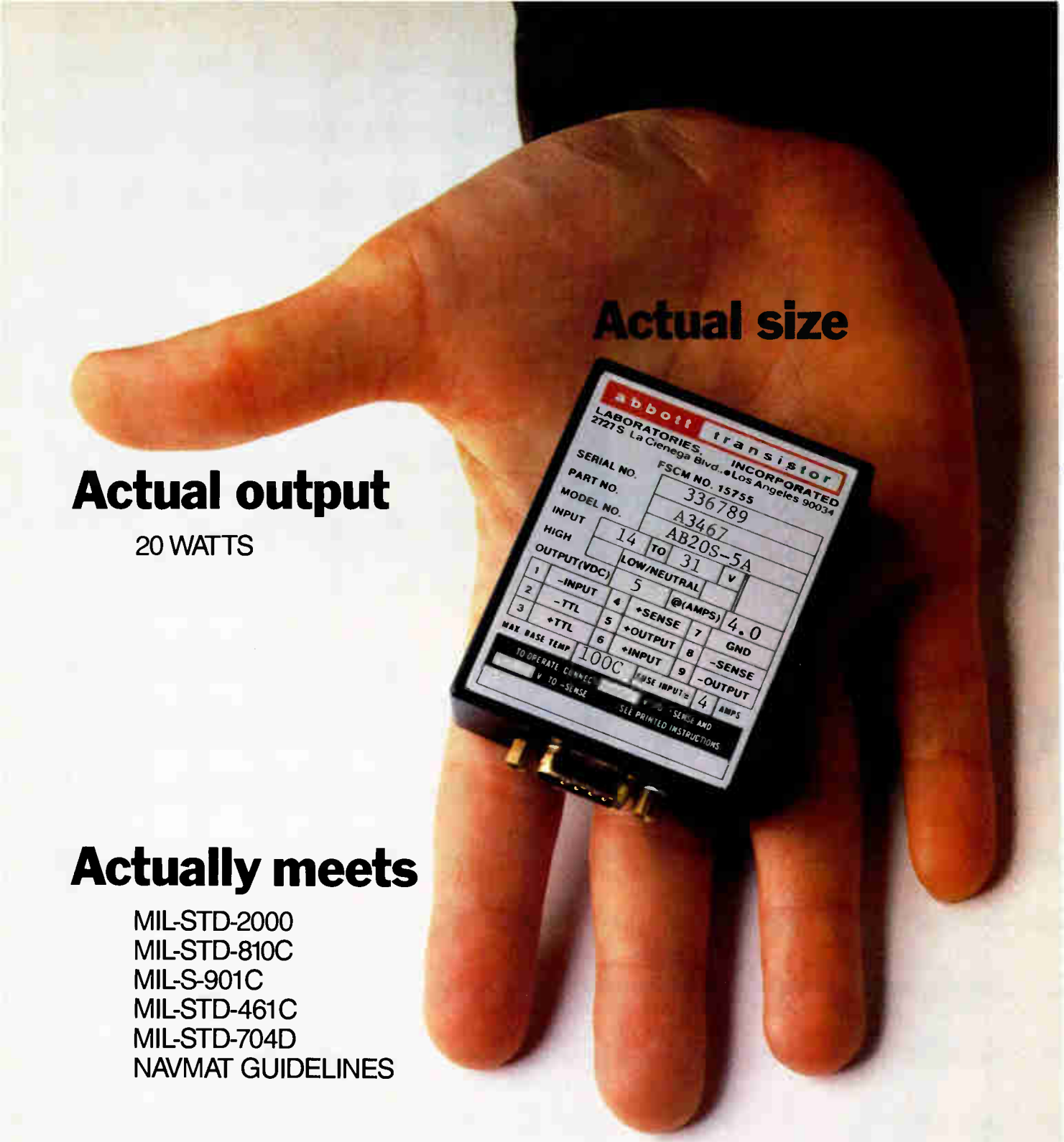

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CIRCLE 203

IBM, HEEDING THE COMPLAINTS, IS CHANGING ITS HAUGHTY WAYS

THE NEW BIG BLUE

BY LOUISE KEHOE

THERE'S A "NEW" COMPUter company in town, and by its own proclamation, it's dedicating itself to customer service. "The new IBM is customer-driven," declares Jack Kuehler, president of the $63 billion computer giant. IBM Corp. has begun a metamorphosis, he says. From here on in, "IBM's direction will be set by the needs of its customers," rather than by the advance of information-processing technology.

The change in direction comes at a time when a new passion is sweeping the electronics industry: customer service. It is changing the way many companies do business (see p. 50).

For Big Blue, customer service has become far more than a corporate slogan. Meeting the needs of its customers—from individual computer users to industry groups—has become the central tenet of a far-reaching plan to transform the corporation. Ultimately, IBM aims to emerge as a leaner, more responsive company focused on "solution selling" and measuring its success in terms of customer satisfaction as well as increased market share and sales.

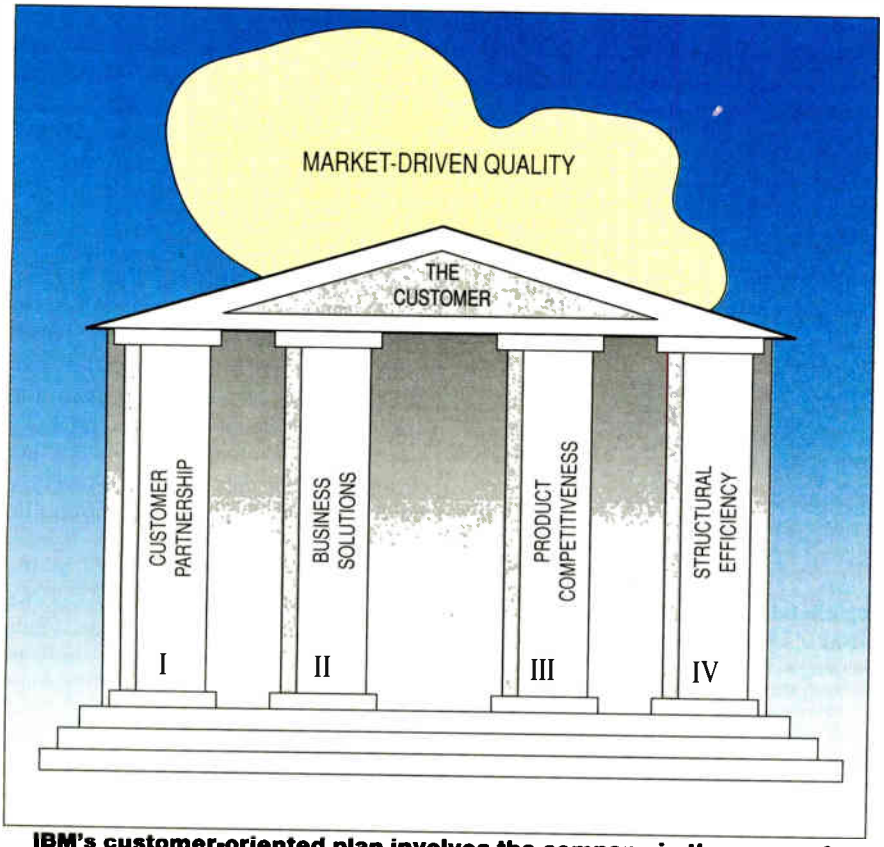
As part of the new service doctrine, the company, headquartered in Armonk, N. Y., will now incorporate third-party hardware and software into products to create turnkey solutions for particular clients. And it's heavily involved in systems integration [*Electronics*, April 1990, p. 85] and in facilities management, including a unique deal with Eastman Kodak Co. which has Big Blue working side by side with rival Digital Equipment Corp.

The impetus for change is coming from the top, fueled by the computer-industry slowdown and by customer grumbling. It all began three years ago, when chairman John Akers initiated a broad analysis of IBM's business after it became apparent that the buoyant growth of the early 1980s was over. He drew in more than 100 of the company's major customers.

"They were brutally honest," recalls Douglas Sweeny, chief corporate strategist and a close aide to Akers. IBM learned that its customers were far from satisfied. They complained that applications software was lacking, that software development tools were inadequate, that integration of IBM's different computer product lines was difficult, and that systems were hard to use. Most significantly, IBM found that corporate computer users were questioning the real value of information technology in improving productivity.

Faced with this stark evidence, IBM adopted, in January 1988, a new "market-driven" strategic plan. Shattering the complacency of senior IBM managers, Akers told them, "We are the biggest, but not the best" in the computer industry. IBM's first point of attack was to reduce the bureaucracy: the corporate staff has been cut drastically, from about 7,000 two years ago to just 1,800. Thousands of former administrators have been moved into the field. The upshot is that "within the U. S. marketing organization, more and more accountability, autonomy, and authority are moving down to area managers, and a lot of that is passing right through to the sales branches," says Sweeny.

IBM has also created a new "line-of-business" structure with divisions focused on several significant industry sectors and responsible for building up applications-software bases and creating what IBM calls "business solutions." "Our objective is to be close to the customer, to understand his requirements, and to be much more responsive to them in terms of meeting those requirements," says Marvin



IBM's customer-oriented plan involves the company in the areas of systems integration, third-party solutions, and facilities management.

Mann, president of the Services Industries Sector, one of five industry-specific groups. And since the dearth of applications software has long been a customer complaint, IBM is increasingly turning to third parties for solutions. "We cannot do everything alone," Kuehler says.

All these efforts have made an impact on customers. "They [IBM] are far less arrogant than they used to be three or four years ago," says Carmine Vano, vice president at Bankers Trust Co., New York. The company is far more responsive as well, he adds. "They have slimmed down their bureaucracy," says Vano, "but they still have a long way to go, they still have too many layers of management between the customer and the chairman."

IBM acknowledges that it is only part of the way home. As the company embarks upon Round Three of its transformation plan, it is attempting to directly renew its focus on the customer, says Sweeny. One way of bringing the giant corporation closer to the customer is making changes in the sales and marketing setup. Sales managers are being given the opportunity to form close, long-term relationships with major customers, instead of being "promoted" to new territories or accounts every couple of years. IBM is also adjusting its training schemes and incentives to reward specialist salespeople. "They have got to be more like business consultants," says Sweeny.

Service is a top priority for today's computer buyers, says William Zachmann, president of Canopus Research, a Duxbury, Mass., consulting firm for the computer industry. Good service more and more is becoming a vendor-selection criterion used by potential customers, he says. "All of the traditional vendors have pushed that sort of thing," Zachmann says. "Service has become a big focus of attention lately, so vendors are putting more public emphasis on it"

The game plan has been worked out. Now Akers is urging IBM executives to "pick up the pace" of change. "We need to have a greater sense of urgency," he told them at IBM's annual strategy meeting this spring. E

Additional reporting by Laurence Curran

VOICE RECOGNITION

GIVE AND TAKE
A MACHINE TALKS BACK

BY JOHN GOSCH

A MACHINE THAT NOT only listens to continuous human speech and talks back in complete sentences, but also enters into a dialogue with the speaker? That's not science fiction but is close to reality—at least as a demonstration model of a database inquiry system.

With that development, researchers at Philips International NV in the Netherlands and Siemens AG in West Germany have fulfilled a promise made three years ago: to come up with a system that, at close to real time, responds to a spoken input, asks counter-questions, and is speaker-adaptive, which means it understands anyone who speaks to it. The result is the Spicos 2 system, successor to Spicos 1 [*Electronics,* April 30, 1987, p. 39].

Besides combining speech recognition and speech synthesis with a dialogue facility, Spicos 2 works on the basis of its knowledge of sentence and word meanings. For example, the system does not corrupt the word Worcester with incorrect stress and vowels. It also correctly emphasizes a word, as in "not this but *that.*"

The system is a truly across-the-border cooperative development effort, with researchers in three countries participating. Involved are scientists at the Institute for Perception Research (IPO), a laboratory shared by the Philips Research Laboratories and the University of Technology, both in Eindhoven, the Netherlands.

Also taking part are experts at the Siemens Corporate R&D Laboratories in Munich and at Philips research labs in Hamburg, West Germany, and in Brussels, Belgium. These companies have given the system its name—Spicos derives from Siemens Philips IPO Continuous Speech.

"If Spicos 2 is compared with developments in this field elsewhere in the world, the system is in the forefront,

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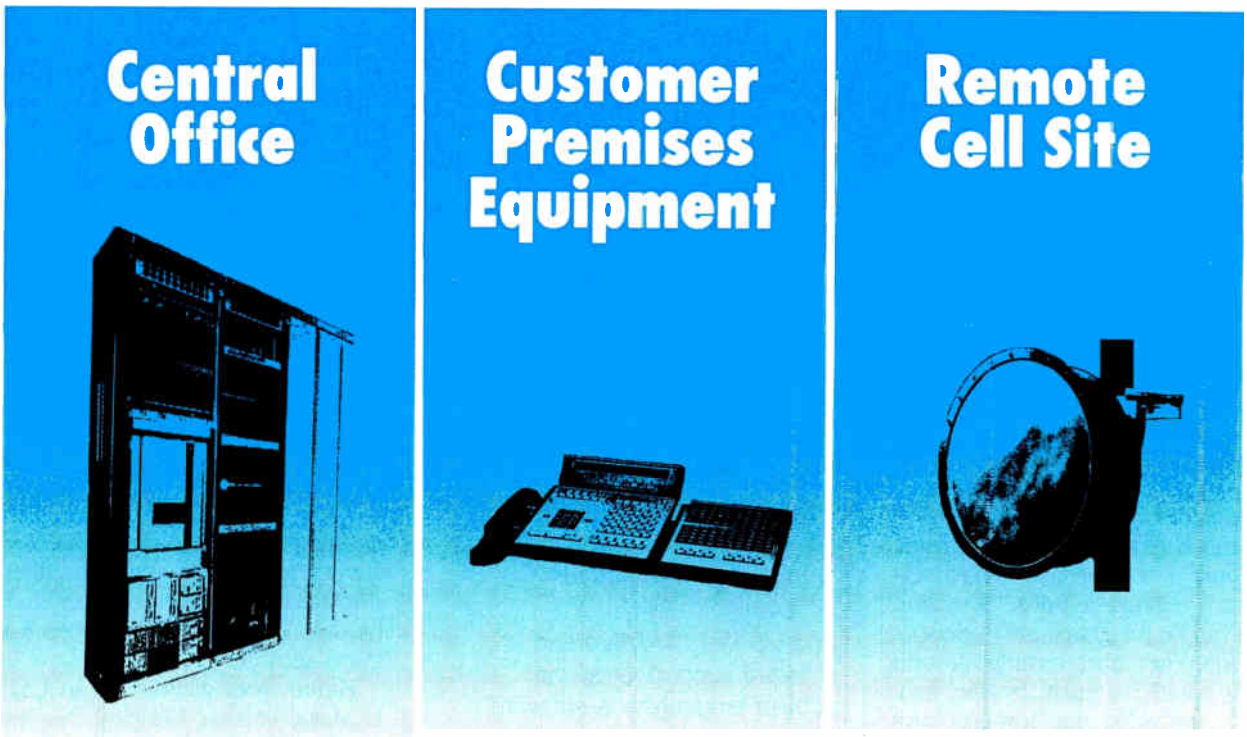

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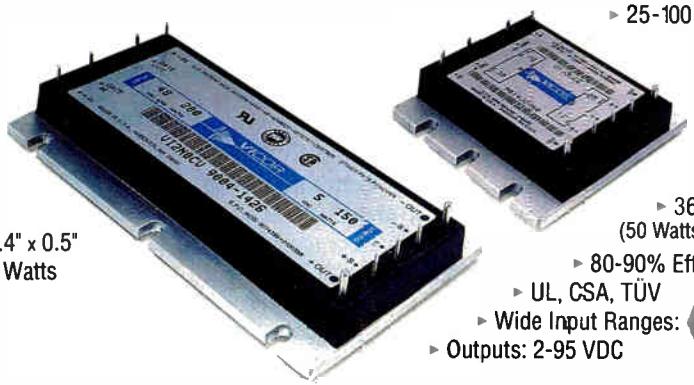

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CIRCLE 195

and in certain respects can even be called unique," says Don Bouwhuis, a chief scientist at Philips and head of the project's dialogue part at IPO. "In future research we still must consider the human factors: does the system meet the user's wishes."

In addition to that, Spicos calls for much more work before it will become a commercial system selling at a reasonable price. "A version that can be integrated into a personal computer and costing around $600 could be ready by the mid-1990s, provided that low-cost processor chips with a computing power of 50 million to 100 million instructions/s are available by then," says Harald Höge, manager of the project's 16-person team at Siemens in Munich.

At present, the Philips and Siemens researchers are working to complete Spicos 2—demonstration models could be ready around midyear, Höge says. Compared to Spicos 1, the new system offers a big improvement in functionality. The prime addition is the dialogue handler, enabling the user to engage in a conversation about the question that was asked to clarify his intentions.

In contrast to its predecessor, Spicos 2 is no longer speaker-dependent only. It's speaker-adaptive too. After two defined sentences, each with five to seven words and containing certain vocal characteristics, are spoken into it, the system adapts itself to the speaker's voice and recognizes it reasonably well. Its voice-recognition capability improves the more the user speaks into the machine. The system also understands other speakers' voices after a two-sentence training period.

Guided by a language model, Spicos 2 recognizes only grammatically correct sentences. This is unlike the speech recognition equipment based purely on acoustic evidence and easily producing a sequence of words without meaning and logic.

Spicos 2 also brings a tenfold improvement in system response—that is, the time it takes to analyze each word in a query, go through its files, and come up with an answer. While Spicos 1 responded in about 100 times real time, or 300 s, for Spicos 2 it's only 10 times real time, or 30 s. (Real-time response for most humans is considered to be about 200 ms plus the time it takes to utter the words.)

The system's vocabulary size of 1,150 words may seem rather small. But even so, it allows its language model to cope with a staggering 1 trillion different five-to-seven-word questions. The present vocabulary contains words used mainly in an engineering office environment. The current system's working language is German.

A dialogue in a conventional speech- recognition system is simply a question posed by the speaker and an answer from the machine. It then stops. Spicos 2, however, in true dialogue fashion, reacts to questions in much the same way as humans do when they communicate with one another.

For example, if a user discusses Johnson and Mayer with the system and then asks, "Did he attend meetings on the dialogue system?," Spicos 2 does not know who is meant by "he." So the system asks "Whom do you mean by 'he,' Johnson or Mayer?" The speaker then replies, clarifying his intention.

Thus, the system is capable not only of dialogue but also of interactive elimination of double meanings. Another feature is that the user can refer to earlier questions in the dialogue. All this calls for a large measure of system intelligence, of which knowledge of grammar and the meanings of words are only two aspects.

At the present state of development, Spicos 2 consists of three workstations—one from Texas Instruments Inc. and two from Sun Microsystems Inc.—using special Siemens-developed hardware such as application-specific ICs. In addition to spoken inputs and outputs, it accepts written inputs and delivers written outputs.

A question spoken into the machine first passes through the speech recognition section. It is then sent in coded form to the dialogue section. Typed questions enter this section directly. An answer from the system can either be displayed on a screen or given audibly by a loudspeaker via the speech synthesis section.

Future work will aim at an English-language version, bringing the system response to straight real time, and making it truly speaker-adaptive so that the system can work with anybody's voice without training. E

OLDER PCs GET A NEW LEASE ON LIFE AS WINDOWS 3.0 MAKES ITS DEBUT

A SQUEEZE ON APPLE

BY LAWRENCE CURRAN

Windows 3.0 gives graphical muscle to a potential 30 million older PCs.

THE GLARE OF the spotlight is focused on Apple Computer Inc., Cupertino, Calif., and its expected response while the computer industry's applause still echoes for Microsoft Corp.'s long-awaited Microsoft Windows graphical environment version 3.0.

Windows 3.0 is software that converts a garden-variety keyboard-character-based personal computer into a much more versatile graphical machine.

Introduction of the $149 package by the Redmond, Wash., software giant puts icons for simpler application execution at the disposal of users of almost 30 million older 286- and 386-based personal computers that run the MS-DOS operating system, substantially extending their life.

Until now, many personal computer users have been willing to pay the higher price for an Apple Macintosh because it's easier to use than lower-priced MS-DOS-based IBM Corp. PCs and their clones. But the immediate availability of Windows 3.0 also neutralizes the ease-of-use argument for the Macintosh graphical interface vs. the more cumbersome commands required to use MS-DOS machines.

For those more comfortable using a mouse, Microsoft is also offering 3.0 with its 400 Series Microsoft Mouse as a $225 package that should further enhance the appeal of 3.0 in competition with the Macintosh. A $50 upgrade to version 3.0 is available to users of Microsoft Windows 1.x, 2.x, Windows/286, and Windows/386.

Tom Willmott, a vice president and computer industry analyst at the Aberdeen Group, a Boston market research firm, points out that Windows 3.0 "extends the life of a huge number of installed 286 and 386 workstations and PCs—perhaps 27 million of them. This gives those users the option of upgrading with a graphical user interface to a true multitasking system for a lot less money than they'd have to pay" for a system with 8 Mbytes of memory to run the OS/2 operating system with Presentation Manager.

Willmott adds that Apple will have to respond with a lower-priced, higher-performance computer: "There's no room for another $7,500 Macintosh built around the 68020," he says.

Microsoft's target entry-level system for Windows 3.0 is a PC with 1 Mbyte of memory. A PC must have MS-DOS version 3.0 to be able to run Windows 3.0. The software includes a new memory-management scheme that enables any application program to run faster than under earlier Windows versions, and also overcomes the 640-Kbyte limitation of DOS machines.

Windows 3.0 can accommodate any of the more than 700 applications that run under earlier versions, and more than 30 vendors of IBM-compatible PCs have announced they will offer the package with their computers.

Version 3.0 also supports broad PC networking by including standardized interface software to device drivers for a wide range of networks, among them Microsoft Networks and LAN Manager, IBM's LAN Server, Novell Inc.'s NetWare, and Banyan Systems Inc.'s Vines.

THAT'S THE PROMISE OF CLIVE SINCLAIR AND HIS 'HYPER-RISC' PROCESSOR

PARALLELISM FOR ALL?

BY PETER FLETCHER

CLIVE SINCLAIR IS AT IT again. The indefatigable Sir Clive now says he is going to "bring parallel computing within reach of everyone" with a radical processor chip from Sinclair Research Ltd. of London.

Sir Clive says the design objectives include processing 200 million instructions per second, and emulation of any standard processor—including those from Intel Corp. and Motorola Inc.

"There are single-processor computers and there are parallel arrays," he says. "Our new chip is designed to do both." He classifies it as a "hyper-RISC" processor. A feature is "Transputer-like" communications ports that will allow any number of the chips to run in parallel.

"It's a full custom chip, not a gate array, with a lot of new technology. It has custom RAM and custom ROM, and both are far faster than anything that has been done before," says Sir Clive.

"Its basically a 32-bit chip," he explains. "We have put a lot of work into making fast adders and other processing elements, and especially on-chip RAM. We designed it to have a 3-to-4-ns access time. The chip handles its own memory management," Sir Clive says, "and has on-chip video drive and input-output circuits, so it's truly a one-chip solution."

Sir Clive says that "various tricks" allow efficient use of external RAM: "It accesses external memory in page mode. That way it can address multiple banks of memory using just 32 pins and there is no limit on the amount of memory it can handle," he states.

The technique also provides very fast access to program instructions, Sir Clive says. "We can pull off instructions very, very fast because they are only 8 bits long and we can queue them on the chip. Also on the chip we have a very-high-speed ROM for subroutines that can store macros." This on-chip ROM code is what will give its emulation capability, Sir Clive says—the chip could be set up to use the same instruction code as industry-standard CPUs. "We will do with software what others do with hardware," he asserts.

Other features used to increase speed, hold power down, and keep the chip within a 300-by-300-mils die area include the use of "stacked, balanced logic." The design uses logic swings of just 100 mV and claims an equivalent switching speed of 100 ps, although that is achieved by stacking multiple instructions in ROM.

"And on top of that we are using self-timing. It's self-clocking and it runs at its own speed. When it talks to the outside world it's clocked, but internally it runs as fast as it can. And that is a considerable advantage. Normally you design for the slowest possible gate so everything else runs a lot slower than it could do."

Key technology for the device is a 1.0-μm version of the collector diffusion isolation (CDI) low-power bipolar process developed at the Manchester, UK, laboratories of Plessey Semiconductors—work that was started by Ferranti Electronic Components Ltd. before its 1987 merger with Plessey.

"We could not make this chip with CMOS because the charge and discharge times are too high to get the speed and the power consumption would be far higher than the bipolar device," says Sir Clive. "So this really does have a huge advantage over CMOS. Plus, of course, there are far fewer mask layers in the process—the minimum is five for CDI but of course there are several metal layers so its around nine—still very low compared with modern CMOS, perhaps half the number."

No introduction date has been set because the chip, now in first silicon, must go through a few more silicon iterations. However, Sir Clive says he intends to offer the design for licensing and the device for general sale. What Sinclair Research intends to use it for is a closely guarded secret—but the hints are that it is a mass-market personal computer application.

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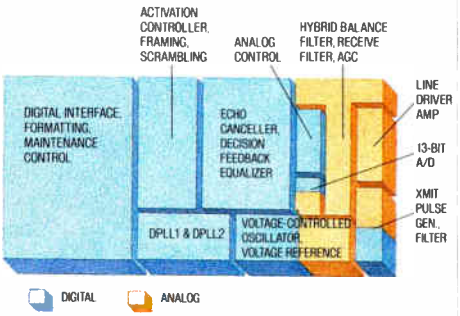

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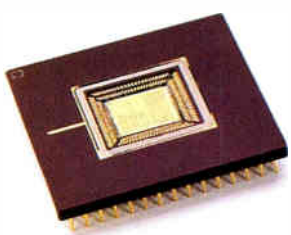
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continued next page

National Semiconductor

The challenge of integrating analog and digital functions onto the same chip.

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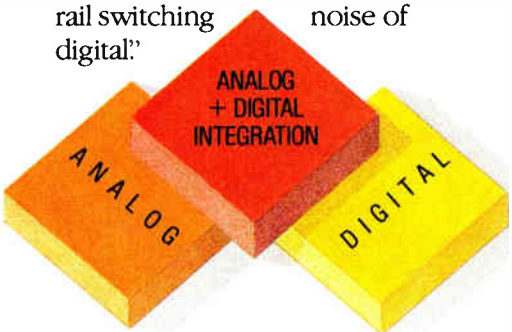
"And the way to achieve higher levels of performance is through higher levels of integration. Which, at the chip level, ultimately demands that analog and digital functions be pulled together onto the same substrate."

"And this is like trying to merge two incompatible universes."

"Digital's goal is smaller, faster, denser. The world turns on lithography. It lives for the shrink."

"Analog, on the other hand, is concerned with precision, linearity, dynamic range, bandwidth, phase shift, component matching, microvoltage sensitivity. And it simply can't tolerate the clanging rail-to-rail switching noise of digital."



Meeting the challenge with world-class products.

"Our U interface is a perfect example of how difficult this really is. ISDN is digital, but it has to operate over the existing telephone wiring using analog signals. And there's only one twisted pair. So your transmit and receive signals appear on the same terminals. You send 160Kbits/sec digital pulses at 2.5V and it has to travel maybe three or four miles over the subscriber loop without repeaters or amplifiers. Over that distance, you're getting up to 40dB attenuation, so it arrives at about 25 *milli*volts. So the problem is, how do you pick that signal out of all the noise and the local transmit signal, which is 100 times more powerful?"

"You need low power, so if you tried to do it just with analog filters, it would be too complicated and too sensitive to process variations. But if you tried all-digital, it would be too complex to compensate for the limitations of the analog front end. So we combined analog filtering and a 13-bit A-to-D converter onto a single chip with dedicated DSP."

"The point is, we did it."

Meeting the challenge with world-class analog and digital designers.

"Building something like the U-interface transceiver demands some of the most sophisticated design techniques in the world."

"And not only are the individual analog and digital functions difficult to design, but then you have to integrate them onto the same chip."

"So you need world-class digital designers, world-class analog designers, and strategic partners who know how to work together."

"We've got them all. And they've been working on joint designs for many years."

"That's how we do it."

Meeting the challenge with world-class process technologies.

"Another problem for chip designers is that they are limited to the process technologies available to them."

"But, because of our heritage in both analog and digital, we've developed probably the broadest range of process technologies of any company in the industry, including bipolar, CMOS, and BiCMOS."

"We employ a 'core-process' concept. We have six basic core flows, then we add modules for specific functions."

"We can take our advanced M²CMOS core, for example, and add a bipolar module. Or a linear capacitor module. Or EEPROM. Or we can do a bipolar core with a CMOS module. Or we can go to BiCMOS. Or LFAST or LMCMOS or DMOS or JDMOS."

"The key is, our designers have the freedom of selecting the best combination of processes for every analog and digital chip. The application drives the process choice. Not the other way around."

Meeting the challenge with world-class design tools.

"When you try to put analog and digital together, all the existing simulators, place-and-route CAD software, and behavioral models fall apart."

"So we've developed our own. And we're working closely with one of the world's leading CAD-tools companies to create a universal, end-to-end design environment."

"But already our ASIC Division has used our DA4 tools to introduce significant new standard cells, some of which allow high-voltage outputs to be combined with +5V CMOS to 30,000 gate densities."

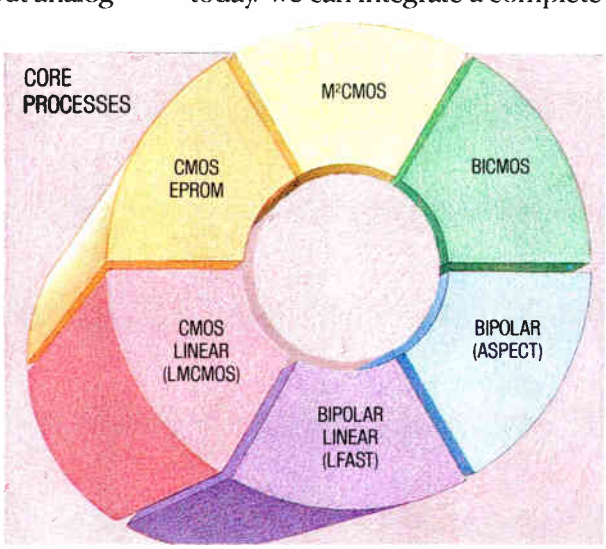
"So now, for example, you can put logic, RAM, ROM, or EEPROM on the same chip with D-to-A converters and high-voltage drivers."

"No one has ever done this before."

"And it's only the beginning."

Putting the pride of National to work for you.

"The point is, our customers *need* mixed analog+digital capabilities. And we can offer that to them today. We can integrate a complete system solution for them. Or we can work with them at a particular phase in their design. We have the right products, the right processes, the right tools, the right people. And we're putting all of it just a simple phone call away."



1-800-NAT-SEMI, Ext. 30

National Semiconductor

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"All I'm doing is applying technology to solve the world's human communications."

HOW NATIONAL SEMICONDUCTOR IS HELPING YOU MEET THE CHALLENGES OF NEXT-GENERATION DATACOM AND TELECOM SYSTEMS.

Mike Evans, National Semiconductor's Director of Strategic Applications, Integrated Systems Group, talks about applying high-performance VLSI solutions to communications problems.

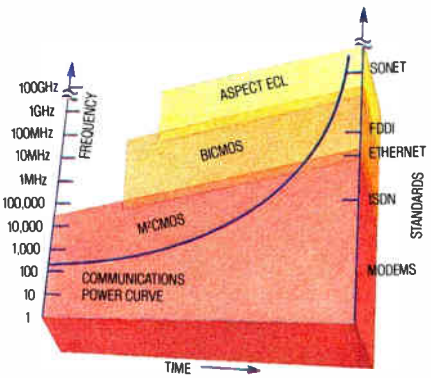
Achieving single-chip integration for IEEE 802.3 local area networks.

"We're already a generation ahead in Ethernet chip design. We're the LAN market leader and the de facto standard in the industry. And now we've set a new standard in analog and digital integration with SONIC, for 'Systems-Oriented Network Interface Controller.' It combines a controller, an encoder/decoder, and a phase-locked loop onto a single chip that delivers a data rate of 10Mbits per second.

"It's the first device that implements all 802.3 network management functions. And the first capable of embedding the Ethernet control functions in 32-bit computer systems. High performance, low power, small footprint."

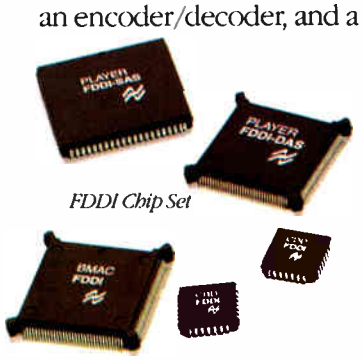
Setting the pace for tomorrow's fiber-optic solutions with FDDI.

"This is a quantum leap from Ethernet. Fiber Distributed Data Interface. It's the backbone of next-generation LANs. And it delivers at an incredible 100Mbits per second, and with an incredibly low bit-error rate. We have a four-chip set, one in CMOS, three in BiCMOS. Our BiCMOS gives us the bipolar speed necessary for these data rates, with the CMOS density for high-speed logic functions. And we're already adding a fifth chip — a high-performance system interface. This is the frontier — and we're right on the edge of it."

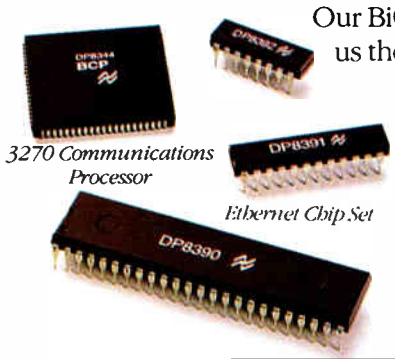


Creating the world's first analog programmable CODEC/filter.

"Here's another example of how we're building on our leadership position. Our COMBO I, combined coder/decoder and filter, is already on nearly half of the non-captive analog linecards in the world. But the telecom market needs higher performance and more flexibility, so we've given



FDDI Chip Set



3270 Communications Processor

Ethernet Chip Set

SONIC


COMBO Series

he world's most advanced s most ancient problem:

them the COMBO II. Second-generation, proven technology, fully qualified, fully characterized, in production. And it's the only one in the world that is fully programmable for gain *and* hybrid balance *and* time-slot assignment *and* A- or μ-law..."

Bringing unprecedented power and flexibility to fax designs.

"If you think facsimile is 'old' technology, then you haven't seen our solution yet. Actually our *range* of solutions — you can go from low-end designs to high-end designs without rewriting a single line of code. Full 32-bit processing power. Optimizing your fax functions, but also allowing you to utilize the processor for other functions when it's not sending or receiving faxes. So you can do PostScript calculations, laser printing, network management. Single chip, single box, single company."

Putting the pride of National to work for you.

"You know, communications affects the whole world. But the first step in communicating is overcoming our natural reluctance to do it. If I wanted to talk to communications experts, I'd call National. That's where it starts."

1-800-NAT-SEMI, Ext. 60

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National Semiconductor

"I came here because linear leadership. I stay here vision of the linear future."

HOW NATIONAL SEMICONDUCTOR IS HELPING YOU DESIGN HIGH-PERFORMANCE SOLUTIONS WITH ADVANCED LINEAR TECHNOLOGIES.

Dennis Monticelli, National Semiconductor's Design Manager, Analog Division, talks about pushing the performance limits of linear-IC design.

Building the world's first high-speed, high-power monolithic op amp.

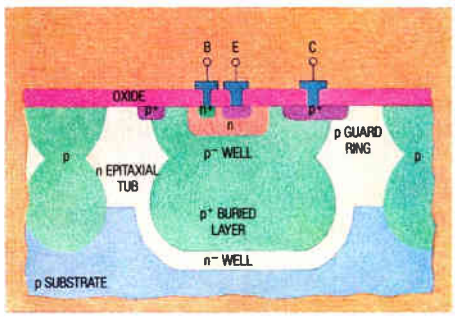
"No one in the world has ever done this before. Our LM6313 delivers a 250V/μs slew rate, yet can drive a 50-ohm load directly with a 20V swing. Before this, you'd need a separate op amp and buffer or an expensive hybrid. We did it in one device using a unique bipolar technology we call 'Vertically Integrated PNP' or 'VIP.' It's a junction-isolated complementary bipolar process. And we were the first in the industry to do it."

Setting the standard in high-resolution CRT design.

"Today's CRT designs have run out of gas. Only integrated solutions can deliver high speeds without bandwidth losses due to discrete board layouts. So we created the LM1201 video preamp. One chip. 16 pins. Replaces 40 components. Put it with our CRT driver, and you can design a 1280 x 1024 display with a 6ns pixel rate. Without the EMI. Without the real estate."

Delivering bipolar performance in CMOS op amps.

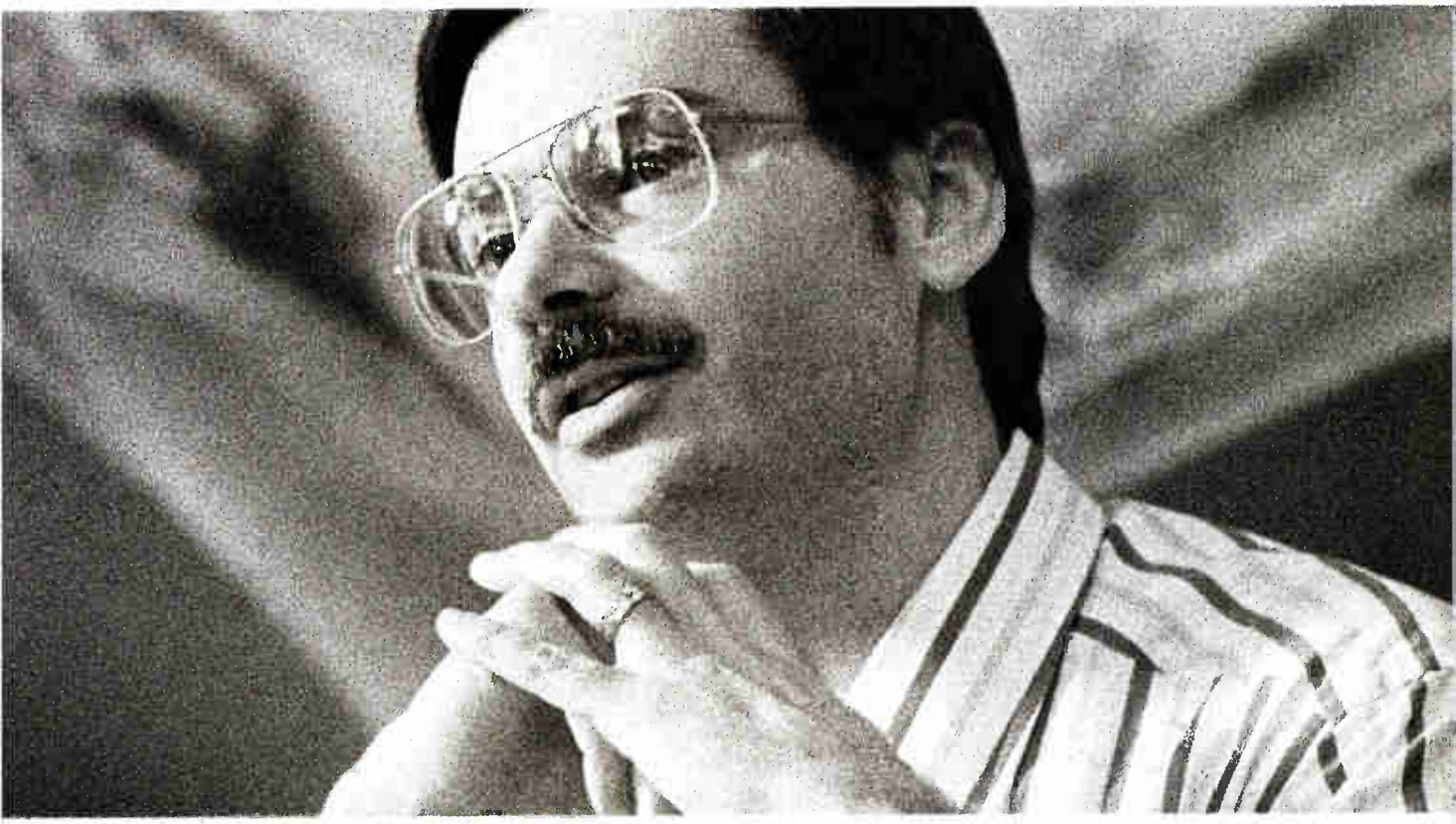
"Single-supply 5V systems need optimized op amps. So we developed a proprietary linearized CMOS process called LMCMOS. We get the ultralow input bias current and frugal power consumption of CMOS with the driving power and input precision of bipolar. Our new LMC660/662 op amps, for example, can drive 600-ohm loads rail-to-rail. With input bias current of 40 *femto*amps. Remarkable."



Making switching-power-supply design truly simple.

"Switching regulators are efficient and versatile, but you need a PhD in Power Conversion to design one. Not anymore. Our new Simple Switcher family makes it easy. Our free design software even gives you a printed schematic and a manufacturers' parts list. And you get an output voltage that's guaranteed to be within ±5%

National has a heritage of because we also have a clear



regardless of line, load, temperature, and external component tolerances. Simple, right?"

Integrating three technologies to make power devices smarter.

"We've actually packed CMOS, bipolar, and DMOS onto the same chip in our new LMD18200 H-Bridge. It's rated at 55V at 3A, and delivers 150W continuous and 300W peak power to the load. All under the command of CMOS-logic-level inputs. And since R_{ON} of each FET is just 0.3 ohms, even if you draw peak current of 6A, that still leaves 50V for the motor. So it's perfect for printers, plotters, industrial controls, whatever. Now that's smart."

Putting the pride of National to work for you.

"I've spent my entire design career here at National. We have a long heritage of linear leadership. We have a clear vision of the linear future. And we have some of the best linear designers in the world, pardon my modesty. If I were in the market for advanced linear, I'd call National. Period."

1-800-NAT-SEMI, Ext. 20

National Semiconductor

National Semiconductor

"We don't just offer complete ECL solution – you with a single supplier. Us."

HOW NATIONAL SEMICONDUCTOR IS HELPING YOU MEET THE DEMAND FOR VERY HIGH-PERFORMANCE SYSTEM SOLUTIONS.

Bami Bastani, PhD, National Semiconductor's Vice President of Technology Development, talks about the challenges of very high-performance ECL I/O technology.

Delivering on the performance promise of high-speed SRAMs.

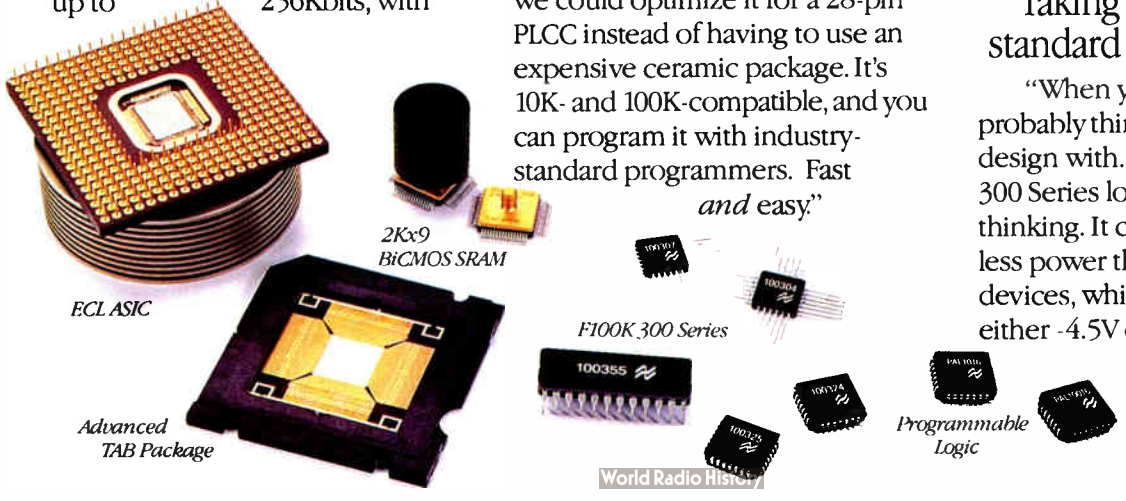
"Here we have a completely self-timed 2Kx9 SRAM with an access time of 5ns. And it's fully synchronous – a real advantage in designing memory arrays for high-speed ECL CPUs, which can run at up to 200MHz.

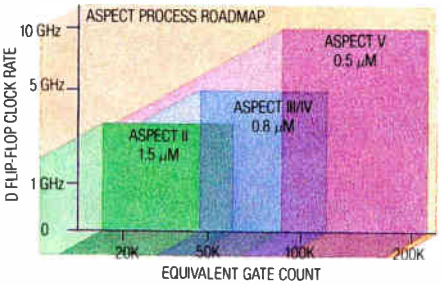
"We have an entire family of high-speed, high-density SRAMs, up to 256Kbits, with 1Mbit in development.

"They're all fabricated in our production-proven BiCMOS III process. It gives us bipolar-ECL speeds and high drive-currents with CMOS densities and low power-drains. It's perfect."

Building the world's fastest programmable logic devices.

"We've just set a new PLD speed record – again. We had it with our 4ns PAL, and now we've introduced a new PAL with a worst-case propagation delay of less than 2ns. It's in bipolar ECL, yet it dissipates power at TTL levels. So we could optimize it for a 28-pin PLCC instead of having to use an expensive ceramic package. It's 10K- and 100K-compatible, and you can program it with industry-standard programmers. Fast *and* easy."





Reaching new levels of speed and density in ECL ASICs.

"We're one of the few companies in the world offering ECL standard cells and gate arrays. Our standard-cell library already contains 175 functional blocks and 25 soft and hard megacells. We offer up to 100K equivalent gate densities with embedded SRAM in standard cells at 0.8μm and 30K gates in gate arrays at 1.5μm, scalable to 0.8μm. And we're planning on 0.5."

Taking the heat out of standard ECL logic design.

"When you think ECL, you probably think fast, hot, and hard to design with. Well, our new F100K 300 Series logic could change your thinking. It consumes nearly 50% less power than standard 100K devices, while still operating at either -4.5V or -5.2V. All without

ECL capability, we offer a can design an entire system

sacrificing a nanosecond of speed. Because they're so much cooler, we've put them in plastic packages, yet they're still fully compatible with 100K and 10K systems. And they will be qualified over the full 883C military temperature range."

Employing the most advanced ECL process technologies.

"One key to National's strength in ECL is the range and maturity of our process technologies. We've had BiCMOS since 1976. We've refined it, honed it, shrunk it, pulled more performance from it. The same with our ASPECT III bipolar process. It's at 0.8μm, scalable to 0.5μm. It's four-layer metal with a polycide local interconnect to form contactless transistors. So we get higher packing densities, lower capacitances, smaller parasitics, and f_{TS} in the 15GHz range. And we're not even near the limit of the technology yet."

Putting the pride of National to work for you.

"If I were a design engineer looking for an ECL system solution, I would call National. We have the products, the processes, the experience, the support. Why take chances with someone who offers less?"

1-800-NAT-SEMI, Ext. 50

National Semiconductor

The pride of National

Our products. Our processes.
Our people. Our professionalism.
All working together to create innovative
high-performance silicon solutions that
build on our heritage in analog
and digital technologies.

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CIRCLE 190

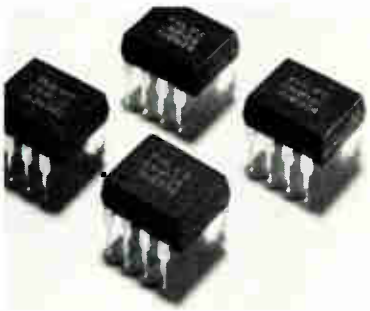
Components News

FROM YOUR STRATEGIC PARTNER

Philips Components, Marketing Communications Dept.
Building BA, Eindhoven, The Netherlands.
Telefax: +(31)40 72 28 61

DIP optocouplers provide 7 kV DC isolation and 11 MHz bandwith

Three new high-speed optocouplers from Philips Components withstand 7 kV DC (5 kV RMS) between the terminals of their wide-bodied DIL-8 package. The optocouplers have short propagation delay times of typically just 0.8 µs,



These TTL compatible optocouplers are suited for demanding applications.

and a high 3 dB bandwidth of 11 MHz. Aimed at consumer and industrial applications, the CNW135, CNW136 and CNW4502 are ideal for application in high-reliability medical and professional equipment.

These TTL-compatible optocouplers have an infra-red emitting GaAlAs diode optically coupled to a silicon photodetector. The maximum DC output current is 10 mA, and the maximum collector-emitter voltage is 20 V. With an input current of 16 mA, a supply voltage of 4.5 V, and an output voltage of 0.4 V, the DC current transfer ratio is at least 0.19 (CNW136/4502). The saturation voltage is low, while the common-mode transient immunity is a high ±1.0 kV/µs. The CNW4502 has no base connection, thus providing increased ESD protection and high common-mode rejection.

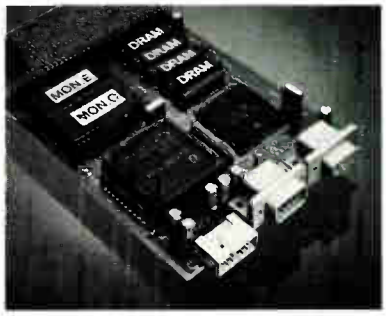
The optocouplers comply with VDE 0883, UL 1577 and IEC/BSI specifications. Samples are available now.

CIRCLE 801

Video and system controller replaces up to 30 ICs in display systems

By integrating all of the glue logic needed for 68000-based systems, a new video and system controller circuit from Philips replaces around 30 ICs, allowing for the construction of colour display systems with a quarter of the number of components previously required. Featuring a resolution of 768 by 560 pixels, the SCC66470 is suitable for application in PCs, colour monitors, videotex terminals, industrial man-machine interfaces, and CARIN process control systems. The IC also works in CDI (interactive Compact Disc) systems.

The SC66470 is a colour display controller, system controller and image manipulator in one IC. It offers acceleration logic and fast image manipulation; an operation (including copy, swap, and patch) on a 16-bit word takes less than 500 ns. This is between three and



The high level of integration of the Philips SCC66470 video and system controller slashes system costs.

eight times faster than the 68000, and adding a co-processor for dedicated drawing or image manipulation can increase this speed advantage by a factor of three or five.

The IC offers acceleration logic and fast image manipulation; an operation (including copy, swap, and patch) on a 16-bit word takes less than 500 ns. This is between three and eight times faster than the 68000, and adding a co-processor for dedicated drawing or image manipulation can increase this speed advantage by a factor of three or five.

The chip connects directly to 68000-family ICs or, via extra glue logic, to other families such as the 8086 and 80186. It reads a bit-map into dynamic RAM, manipulates the image, serializes the pixels, and displays them on a screen at up to 15 MHz. The IC also incorporates system controller functions (such

as address decode, reset, and time-out signals) for 68000 systems.

The circuit works with 50 or 60 Hz screens, as well as double frequency scan types. It comes in a 120-pin plastic quad flatpack. A 'microcore' board is available for system evaluation, development and prototyping.

CIRCLE 802

Advanced planar technology produces InGaAs/InP PIN photodiodes

Philips Components has introduced a range of PIN photodiodes using the advanced 90 µm planar top-entry crystal structure, based on MOVPE technology. These InGaAs/InP diodes, for both 1.3 µm and 1.55 µm fibre-optic wavelengths, can receive at bit rates up to 2.4 Gbits/s.

The CPF30 is a large-area photodiode (350 x 300 µm) for use in short and medium distance links as well as in measurement equipment. The CPF31 features a smaller sensitive area (90 µm diameter)

The CPF31/21 InGaAsP/InP photodiodes are also available in receptacles.

and is intended for use in medium and long distance fibre-optic links. Both types are packaged in a modified flat window low-profile TO-18 encapsulation. A receptacle-mounted version of the CPF31 (designated the CPF31/21) is also available. All types feature superior responsivity, extremely low dark current, high-stability and long lifetimes.

CIRCLE 803

DTMF dialler with redial improves system cost effectiveness

Two CMOS DTMF diallers from Philips Components cost just

The PCD4420 and PCD4421 DTMF diallers incorporate functions for PABX.

US$1.00 each in quantities of 100000, and feature 23-digit redial. The PCD4420 and PCD4421 diallers meet CEPT distortion specifications without requiring external components, and offer special features for PABXs. Retaining the RAM contents right down to 1 V, they work from a supply voltage that can vary between 2.5 and 6 V, and have a mere 1.5 µA standby current.

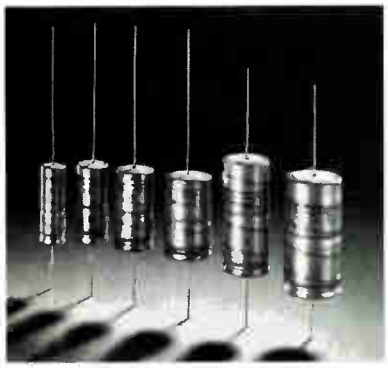
The dialler implements special PABX features such as flash, access pause, and disconnect. When dialling from a PABX to the public network, an access pause can be inserted after the first digit. The IC also works in sets which provide remote banking facilities, programmed alarm-calls, and so on.

The PCD4420 comes in a 16-lead DIL or SO package, the PCD4421 in an 18-lead DIL or 20-lead SO package. They draw a maximum of 150 µA during conversation mode, and 1 mA during dialling.

CIRCLE 804

Non-solid aluminium electrolytics with CECC approval

Philips Components' 119 series non-solid aluminium electrolytic capacitors are now available with full CECC approval under detailed specification CECC 30 301-802. These compact electrolytics are high-reliability, long-life components intended for use in extreme ambient temperatures (such as in military, automotive and telecommunications applications). Specified from −55 to +125 °C, they're available in the E6-series capacitance values from 1 to 4700 µF, and with a rated voltage range (U_R) of 10 to 63 V. Under endurance test conditions at 125 °C and with maximum ripple current, the 119 series capacitors operate for 2000 hours.



These CECC-approved 119 series non-solid electrolytics can be used in extreme ambient temperature.

CECC inspections are carried out on large lots instead of small delivery lots. This means customers can confidently reduce incoming inspection to visual checks for transit damage. CECC approval can also be incorporated into ship-to-stock programmes.

CIRCLE 805

COMPONENTS ▫ INTEGRATED CIRCUITS ▫ MATERIALS

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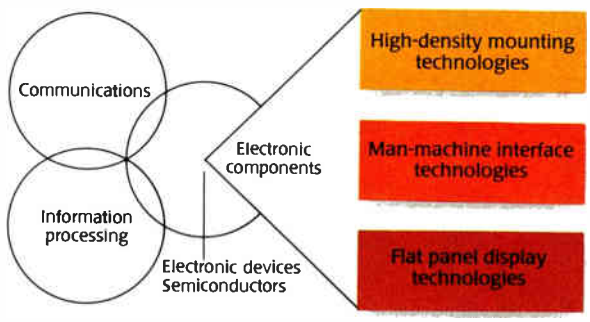
Every oak starts with a tiny acorn. And every computer or communications system starts with thousands of component parts.

For over half a century, Fujitsu has specialized in computers and communications. And we've grown into the world's third largest computer company and the tenth largest maker of communications systems.

One reason for our success is the quality of our component parts. A great many of them made by Fujitsu.



We've developed the specialized component and electronic device technology required for advanced computer and communications systems. Half-pitch connectors and miniature relays for high density mounting. Large-screen plasma displays. Ergonomically designed keyboards and low-noise, high-speed thermal printers for advanced man-machine interface devices. And more.

We've also developed the systems concepts and experience to see that our computer and communications components technology is always state-of-the-art.

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Whether you're a big oak – or a little acorn – we have the specialized components technology and computer and communications application experience to help your business grow.

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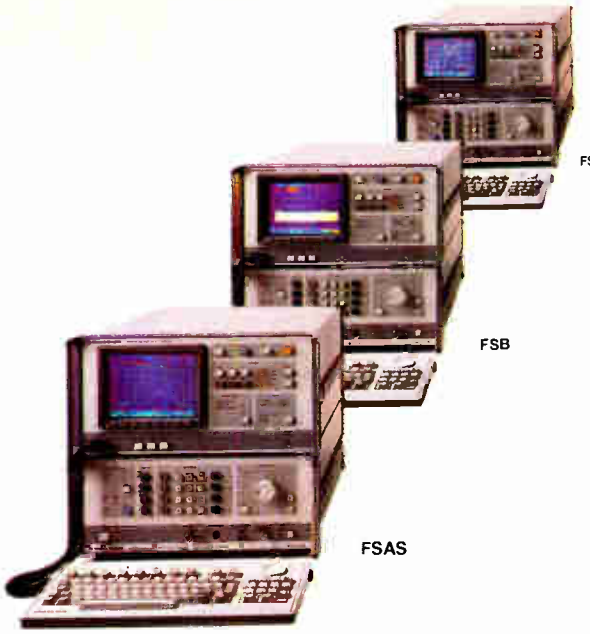
CIRCLE 219

Five times a winner



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CIRCLE 174

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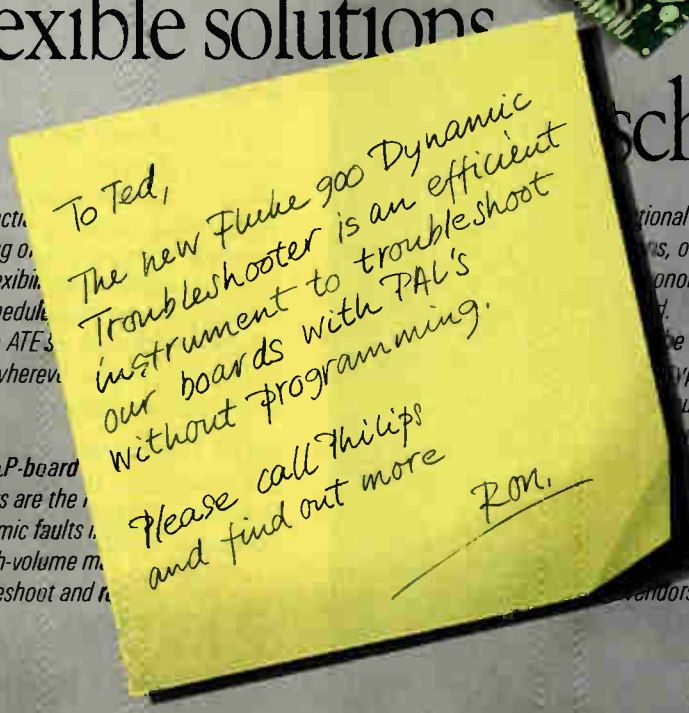

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The fastest µP-board

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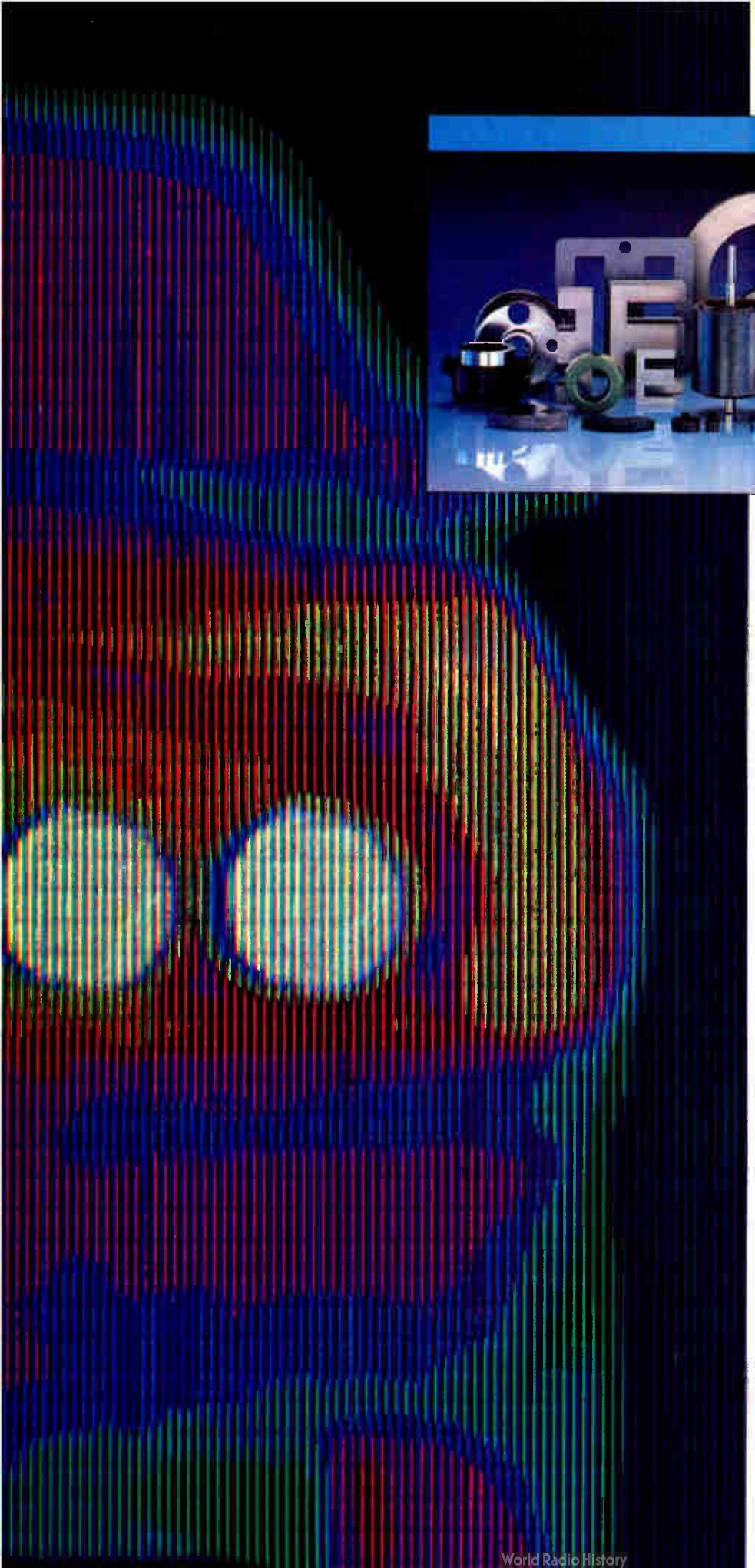

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CIRCLE 188

TEST

82000 LINE GROWS

A NEW JOB FOR FAMILY

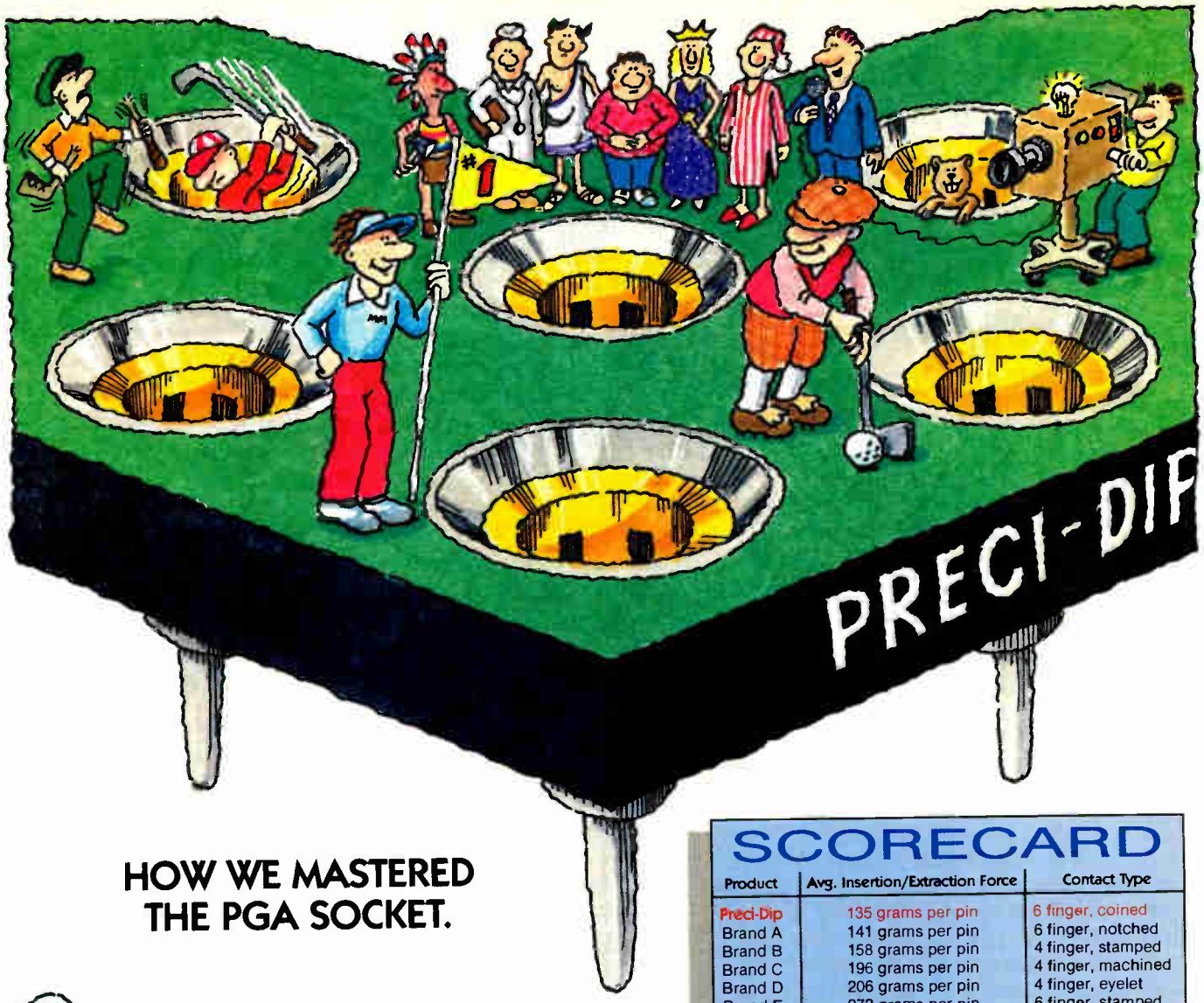
BY JACK SHANDLE

HEWLETT-PACKARD CO.'S latest addition to its 82000 family of IC test systems does more than just push the performance envelope out to 400 MHz. The model D400 software also moves the family beyond prototype testing and into production testing in small-batch applications.

The complexity and speed of the most recent generation of application-specific ICs have stretched the capabilities of HP's current 82000 systems: the 200-MHz model D200 and the 50-MHz model D50, says the Palo Alto, Calif., company. In the best of all worlds, IC test equipment should run fast enough to push the device being tested to its operational limits. Otherwise, problems associated with high-speed operation—such as internal capacitances, transmission-line effects, and internal crosstalk—will plague the device after it goes to beta site. Typically, test equipment has not run this fast, however, and this has dictated a design strategy that uses mathematical models of the device under test to predict high-speed behavior from lower-speed test results.

IC prototypes also should be characterized by the test equipment; this requires tests of timing and voltage levels for each pin independently with a large file of test vectors. The D400's tester-per-pin architecture allows this with up to 1 megavector behind each of up to 512 input or output pins.

Along with the D400, HP took the wraps off its new, high-throughput software that makes the systems suitable for small-batch production applications. Automated test functions embedded in the software enable routine measurements to be performed without additional programming. This capability leverages the value of the D400 because its high pin counts and vector rates are not available in automated test equipment. ATE systems are also more expensive than the 82000 series ($3,400/channel) because they are geared to high-volume testing.



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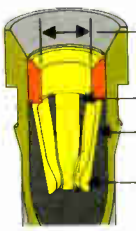

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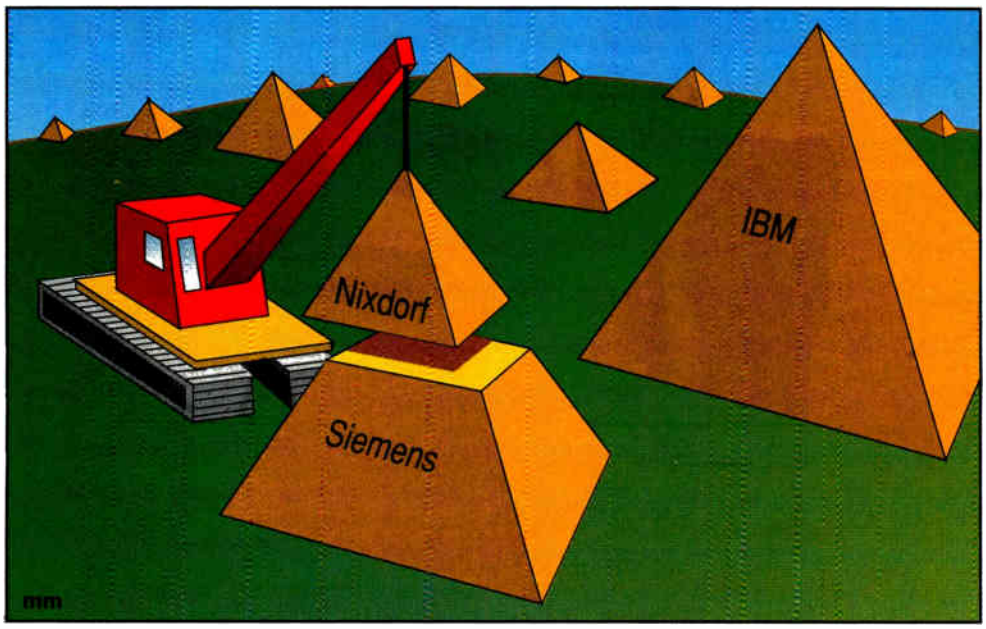
SIEMENS CLIMBS IN THE RANKS

Its acquisition of West Germany's financially troubled Nixdorf Computer AG, expected to take effect later this year, will significantly improve the ranking of Munich-based Siemens AG in the world's computer market. The sum of the two companies' global 1988 sales, $6 billion, would rank the combine, Siemens-Nixdorf Information Systems AG, No. 8 worldwide (following IBM, Fujitsu, DEC, NEC, Unisys, Hitachi, and HP), up from Siemens's 13th place.

In Europe, combined 1988 sales of $5.7 billion would make Siemens-Nixdorf No. 2, up from fourth, following only IBM. However, with a whopping $20.3 billion in 1988 European sales, IBM leads by a wide margin. Now that West Germany's cartel office and the Commission of the European Community have approved, the new combine should be in business by the last quarter.



IBM TO SET UP CENTERS FOR CZECHS AND HUNGARIANS

IBM Corp. is shouldering its way into Eastern Europe through the groves of academe. Using its contacts with the European higher-education establishment, IBM Europe is setting up Computer Competence and Development Centers in Hungary and Czechoslovakia in partnership with academic institutions in those newly democratic nations.

The centers are part of a broader IBM Central and Eastern Europe Academic Initiative. Assuming it can get the necessary export licenses, IBM will provide the centers with advanced hardware as well as system and application software. Training and education for the centers' staffs will also be provided.

Once established, the centers will be staffed and operated by the local IBM partner, usually a university. Each center will offer a means to increase the level of information-technology skills, prepare materials for service and support to other users, and provide access to advanced applications.

The centers' staffs will offer their services to less experienced users in the universities, agriculture, and industry. The centers will also provide high-level education to students.

The centers will be linked through a computer gateway in Vienna to existing academic networks in the West. This will provide the opportunity for the local academic community to talk to the West.

NEW PRESIDENT EXPECTED TO RESTORE PHILIPS'S IMAGE

The just-appointed president and chief executive officer of Philips International NV, Jan Timmer, may be just what the doctor ordered. Analysts predict that he will restore profitability and investor confidence in the Dutch electronics giant, but they warn that the remedy may be harsh and painful. The industry watchers are basing their prediction on the performance record Timmer has had as a troubleshooter and cost-conscious manager during his 38-year career at the Eindhoven company.

Known inside Philips as a hardnosed cutter of bureaucracy and people, the 57-year-old Timmer turned around the financially troubled records-producing affiliate Polygram in the early 1980s. Then he transformed Philips's Consumer Electronics Division from a loser into the company's biggest profit center.

Timmer's appointment to the top post follows the departure of former president Cor van der Klugt. The Philips supervisory board, in a move that company insiders consider "very un-Dutch and un-Philips," forced him to resign a year before his official retirement. This came after the announcement that profits for the first quarter of this year had tumbled to a piddling $3 million on sales of $7 billion, compared with $124 million for the same period in 1989. Van der Klugt had predicted a better 1990.

Besides currency fluctuations on world markets, a major factor for the profits debacle was the poor performance of the Information Systems Division and the Components Division. Both are said to be operating in the red. Timmer is expected to apply the same cost-cutting methods he used before to turn Philips around.

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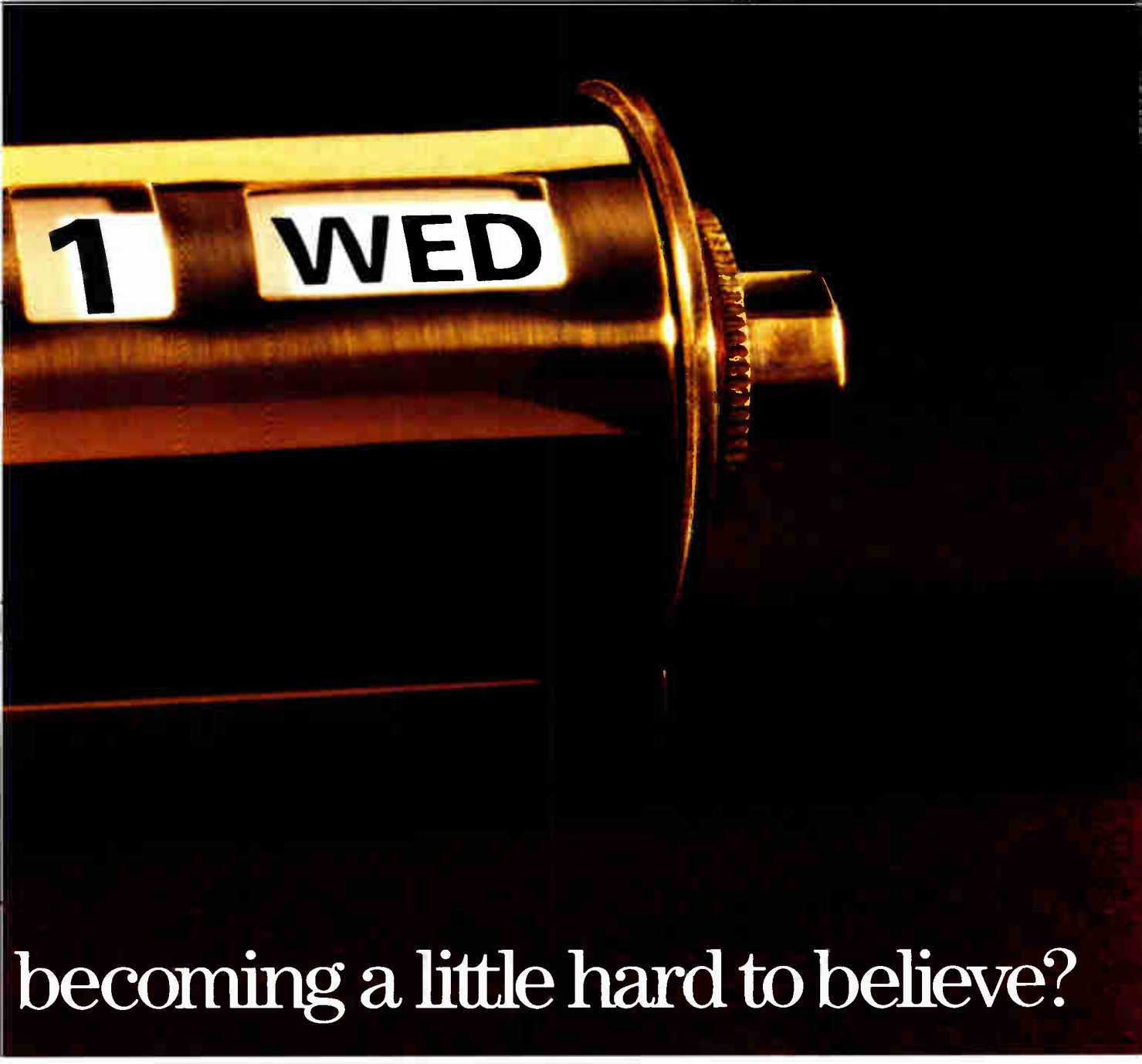

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CIRCLE 175

CUSTOMER SERVICE: THE GREAT INTANGIBLE

THE ELECTRONICS INDUSTRY IS PREACHING THE SERVICE GOSPEL, BUT CAN IT BE CONVERTED INTO SALES? BY JACQUELINE DAMIAN

AT THE CONVEX COMputer Corp. plant in Richardson, Texas, big gold banners hang by the hundreds proclaiming, in bold black letters, "What have you done for the customer today?" Two states away, at SGS-Thomson U. S. in Phoenix, Ariz., employees at an open house add their signatures to a billboard naming customer service as the company's No. 1 priority.

And at the many offices of Motorola Inc. in the U. S. and abroad, every worker carries a laminated, wallet-size card saying, in any of 11 languages, "Our fundamental objective (everyone's overriding responsibility): Total Customer Satisfaction."

The mottoes and billboards are but the most visible aspects of a movement that's sweeping the electronics industry and changing the way it conducts business—the new creed of customer service. Just as manufacturing was the passion of the 1970s and quality the watchword of the 1980s, so service is the gospel today.

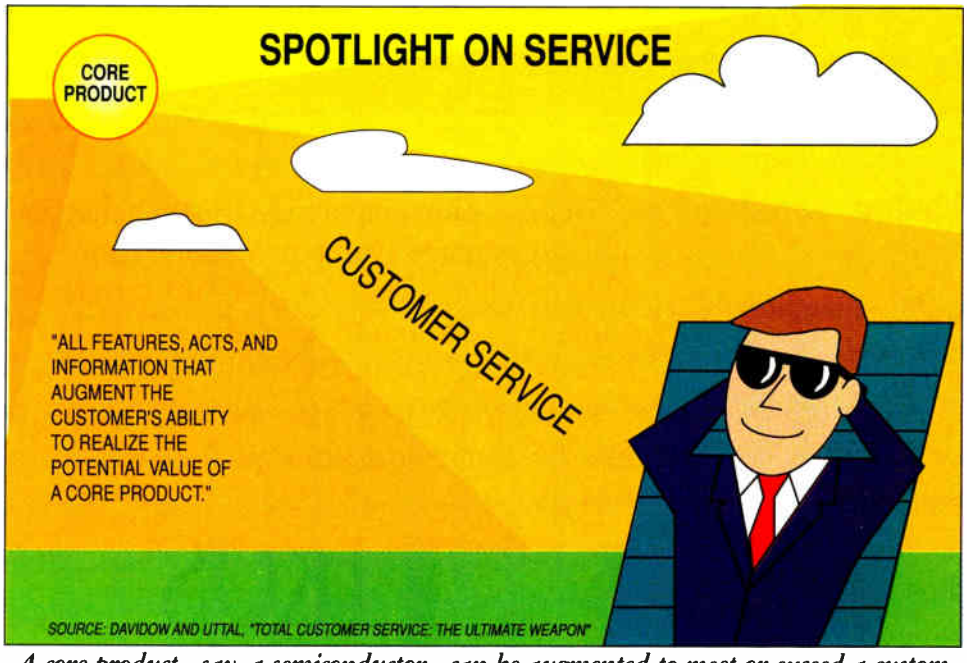
SERVICE

From chip maker to system builder, from large company to niche supplier, electronics manufacturers are implementing customer service strategies, sometimes in the form of highly structured, corporate-wide reorganizations like the one going on at IBM Corp. (see p. 27). The impetus is competitive advantage. As IBM chairman John Akers puts it, "If we can be the best at satisfying the needs and wants of customers in those markets we choose to serve, everything else important will follow."

But "service" is the great intangible. It's a multifaceted concept that means far more than simply marshaling an efficient, responsive repair crew, the hallmark of an earlier definition of service. This elusiveness is reflected in the diverse ways different companies describe their service goals. At Motorola it's Total Customer Satisfaction; at Texas Instruments Inc., Total Quality Control (see p. 54). The folks at IBM speak in terms of "customer partnership," while European executives promise "full customer support" and "technical services" (see p. 66).

At some companies, service does a pas de deux with systems integration. At others it means creating a product that's so well built and so well designed the user won't need much in the way of service in the traditional sense. Often it means making the customer an intrinsic part of the design process. Just as often, it means more accountability and better performance in concrete service areas—keeping accurate and up-to-date shipping and inventory records, for example—and speedy delivery of parts once an order has been placed. And always it means forging closer, more intimate relationships with customers.

"I think the electronics industry is becoming aware of the [service] problem," says venture capitalist William H. Davidow, coauthor with Bro Uttal of *Total Customer Service: The Ultimate Weapon* (New York: Harper & Row, 1989). "I think they will find out how incredibly difficult the problem is to solve when they try it." Why so difficult? "It requires that you do everything else right first," Davidow says. "It's a much more difficult problem to solve than



A core product—say, a semiconductor—can be augmented to meet or exceed a customer's expectations by, for example, applications support and customer design input.

the quality problem." Many see quality assurance as the first step on the road to service. Quality is relative to tangible standards and to absolute measurement—defects per million, mean time between failures, and so on—he says.

Customer service, by contrast, can be measured only in terms of what customers expect. "You must evaluate your performance relative to their expectations, which is fundamentally different than what a company must do to set up quality standards that are absolute," says Davidow, who once held senior marketing jobs at Intel Corp. and Hewlett-Packard Co.

For example, he says, "take a look at on-time delivery. There's a big difference between what a [supplier] thinks is meeting a customer's schedule and what the customer thinks." The same with service calls: "Your policy might be to have a service engineer at the site two hours after you receive the service call, 95% of the time. That may meet the customer's expectation. It may not."

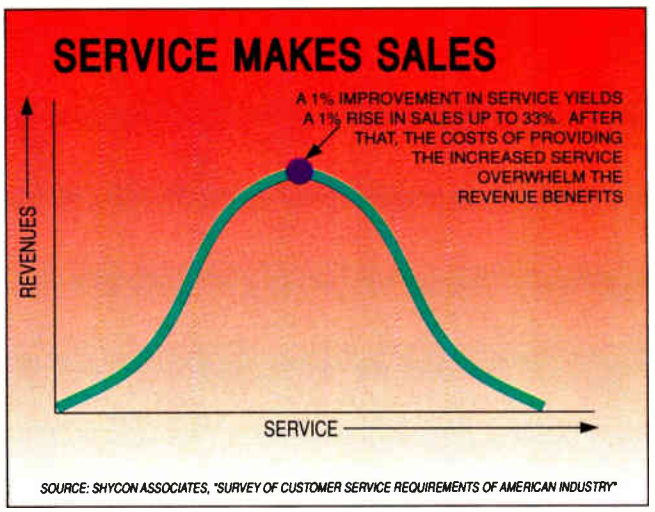
Understanding expectations, much less satisfying them, is no easy matter. Expectations are something of a moving target, changing all the time. And expectations are heightened by every service improvement a company—or one of its competitors—may make, placing the hoop higher and higher.

The ideal is to treat the customer as a partner. But "the problem in such partnerships is typically miscommunications of perception," says Daniel Queyssac, president of SGS-Thomson U. S. "The partners must have complete understanding of what each other is capable of doing."

Simply gaining that understanding is "one of our biggest challenges," says Bob Becknell, director of sourcing at Motorola Communications in Schaumburg, Ill. Then comes the task of "continuing to update that information and translate it into actions and programs."

And just what does a customer want? "Simply speaking," says Becknell, "they expect a product that will perform for them without a failure; and that should anything out of the ordinary occur, we will respond very quickly to solve the problem, or to address a new opportunity they might have." Finally, he says, "they also expect us to deliver our product to them at ever increasing speeds."

It's a daunting challenge, but one that no company can afford to sidestep, in Davidow's view. The perils of ignoring service, he says, can be seen among U. S. vendors of semiconductor production equipment, many of which went bust in the last decade despite their often advanced technology (see p. 60). "In company after company that failed," says Davidow, "every one of them identified either [inattention to] quality or to service as the reason for their failure."



In one study, every 1% rise in such concrete services as shaving lead time for orders and boosting on-time deliveries brought a 1% rise in sales.

If neglecting service can bring catastrophic losses, embracing it brings gains that show up on the bottom line. In *Total Customer Service*, Davidow and Uttal cite a study by the Strategic Planning Institute of Cambridge, Mass., that pinpoints quality and service as the crucial factors in financial performance for 2,600 businesses or business units (freestanding corporate divisions). "In the long run," the study found, "the most important single factor affecting a business unit's performance is the quality of its products and services, relative to those of competitors."

In this study, companies that customers ranked high in perceived quality had an average return on investment of 32% and an average return on sales of 14%. By contrast, the return on investment for outfits in the lowest perceived-quality grouping was 17%, and the average return on sales 7%.

Another study has found that the disparity between very good and very bad service can make a difference in absolute sales of 6% or more, and some executives put the stakes even higher. For example, when Robert W. Galvin, chairman of the executive committee at Motorola, launched that company's broad-ranging service program, he estimated that it could boost sales volumes perhaps as much as 20%.

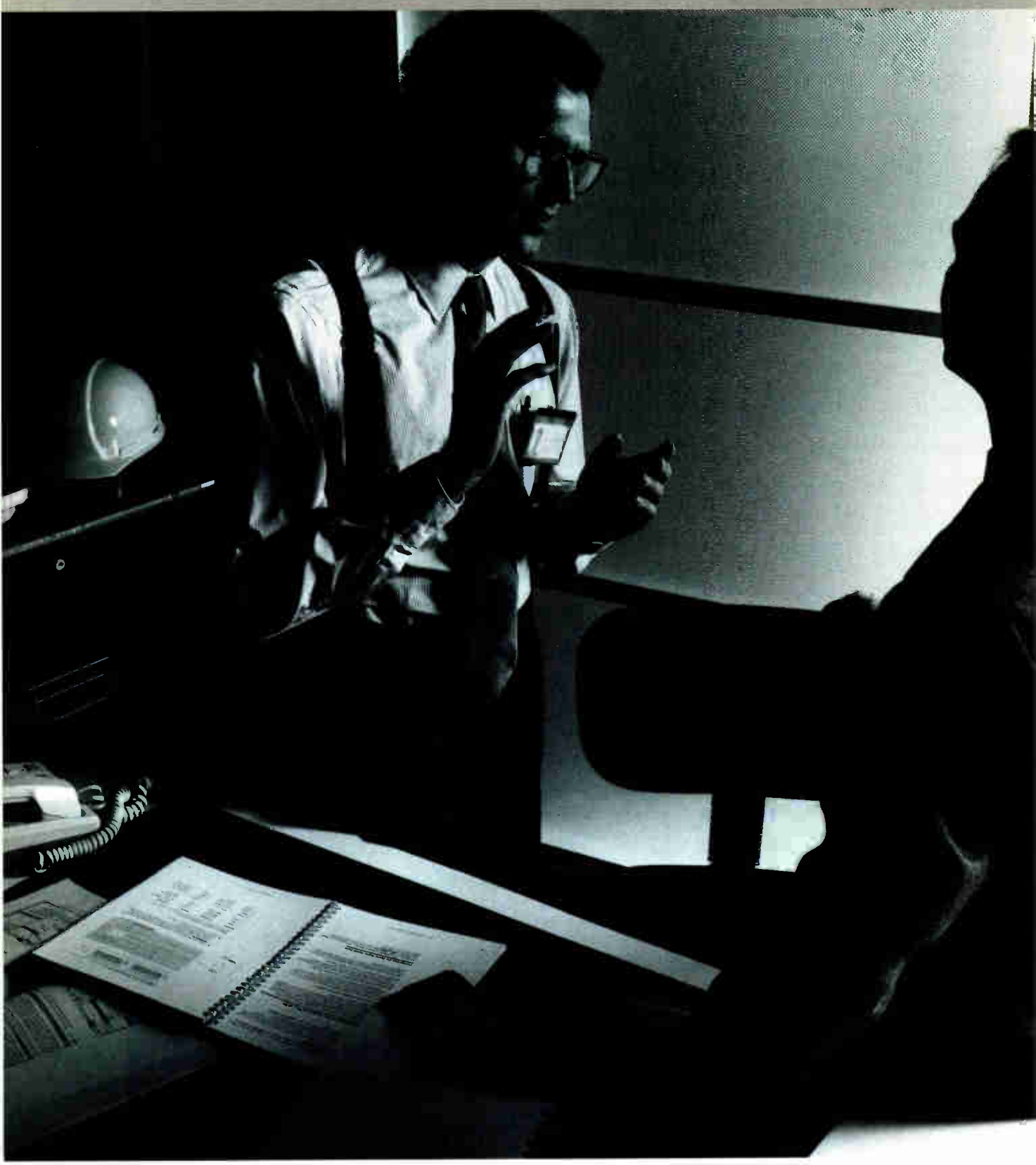
Conner Peripherals Inc. in San Jose, Calif., has earned honors as the fastest-growing startup company in American history by hewing to a service philosophy. Unlike other disk-drive manufacturers, Conner's strategy is a kind of partnership with its customers, building new products to suit their particular needs. The game is simply to "identify customer needs faster and satisfy them," says founder Finis F. Conner. The proof is in the pudding: the company zoomed to $705 million in sales in 1989 from $113 million in 1987, its first year of shipping products. Analysts expect Conner to pull in more than $1 billion this year.

Besides the hard-cash impact, a service philosophy makes more subtle contributions to revenue as well, says author Davidow. First and foremost, it keeps customers in the company fold, no small matter when all over the electronics industry companies are paring their roster of suppliers.

Since it costs much more to win a new customer than it does to service one you already have, Davidow says, losing clients and replacing them with new ones is a drain on a company's resources. Who will make the cut when supplier lists are trimmed? Given equivalent product quality, it will probably be the company that offers the most in the way of service.

For some companies, a service philosophy has been a way of life for many years. For others, it's a new concept they're just beginning to implement. Building an effective service program and keeping it on track takes "a momentous effort" that must start with the CEO and permeate the entire organization, Davidow says. Momentous or not, at this juncture in the history of the electronics industry, it's the only game in town.

"I'll bet Toshiba's new 172,000-gate array could handl



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CIRCLE 191

IT'S A WHOLE NEW WAY OF DOING BUSINESS

FOR CHIP MAKERS LARGE AND SMALL, SERVICE MEANS NEW, MORE INTIMATE RELATIONSHIPS WITH CUSTOMERS

BY SAMUEL WEBER

SOME CALL IT "TOTAL Customer Satisfaction." Some call it "Total Quality Control." Others call it simply "Customer Service." But whatever it's called, there's a new religion in the semiconductor industry that promises deliverance to the customer and sanctification to the vendor.

Across the vendor spectrum, from giant broad-based suppliers like Motorola, Texas Instruments, and SGS-Thomson to ASIC companies like Actel and niche suppliers like Cirrus Logic, chip makers are forging new, more intimate relationships with their customers and, in many cases, establishing formal, structured customer-oriented internal programs that are radically changing their ways of doing business. The aim: to completely satisfy the customer in every stage of the buyer-seller relationship.

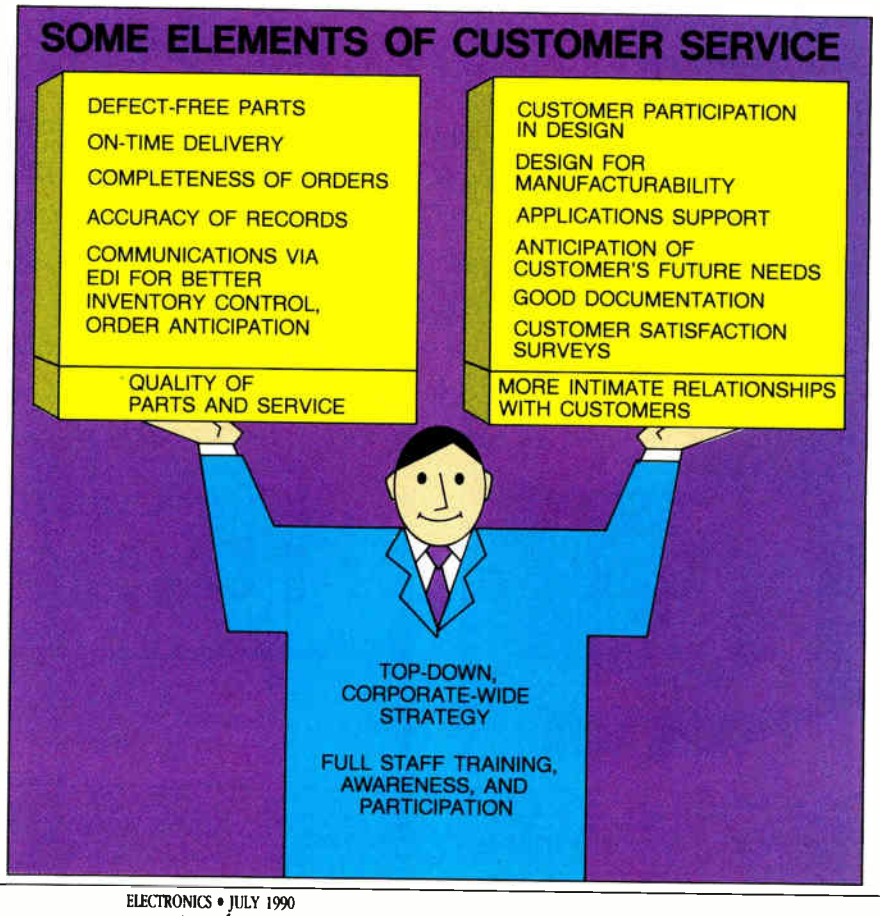
Some might argue wryly that completely satisfying the customer's needs—so that he'll continue to be a customer—is the minimum that a successful business requires and should have been the industry's credo all along. But as long as technology was the driver in the semiconductor industry, this was not the case. While customers sought the latest technology to differentiate their products, they had little understanding of how it worked, nor did they care very much.

"In this industry, the customer's level of sophistication and knowledge of the product 10 or 15 years ago was such that he was happy just to get it," says Jim Watson, vice president of Texas Instruments Inc.'s Semiconductor Group in Dallas and overseer of the company's Total Quality Control program.

Semiconductor companies took advantage of this kind of selling power, says John East, president and chief executive officer of Actel Corp. of Sunnyvale, Calif. "When I first got into this business," he says, "you could make money if you just got a few chips to work out of your wafer fab. It was very much a seller's market, and the customer was really treated with some disdain. Then about 10 years ago we started to take turns—first a buyer's market, then a seller's market, then a buyer's market again—and your marketing crew would act accordingly. But since the downturn of '84, it's been strictly a buyer's market, and the attitude of all the companies toward customer service has turned completely around."

SERVICE

What turned attitudes around, however, was more than simply economics. It began in 1979 when Richard Anderson, a vice president of Hewlett-Packard Co., pointed out in a controversial speech that Japanese memories were of significantly higher quality than those being supplied by U. S. vendors. It was the first time that a customer's voice had been publicly raised on this issue, and despite denials from the chip industry, it set off a vigorous, if not frantic, quality-improvement effort that has resulted in a substantially level quality playing field. Today, shipment of defect-free components is almost taken for grant-



ed. But quality has since taken on a whole new meaning.

The advent of the microprocessor and the application-specific integrated circuit began to put more and more flexibility and functional power in the hands of system designers—that is, customers. At the same time, competition began to heat up, with startups taking over niches in the marketplace, the Japanese becoming ever more aggressive, and the general globalization of the demand for semiconductors.

It has become more and more difficult to differentiate competitors by their technology. New criteria for judging customer-vendor relationships have emerged as equally—or more—important. "What's happened is that all the global pressure that we and our customers are now facing has required that we step back and take a fresh look at how you stay competitive beyond the traditional buy-and-sell relationship," observes Kevin McGarrity, a TI vice president and director of worldwide sales and marketing. "And what we've found is that a lot of the elements of customer satisfaction have to do with other issues beyond cost."

ONE ELEMENT IS SPEEDY delivery. "Before, shipping products within a window of a couple of weeks was acceptable," says Daniel Queyssac, president of SGS-Thomson U. S. in Phoenix. "Today, you have to ship within a couple of days—and in many cases, the customer expects to receive the part the day it is ordered."

Time to market is, in fact, one of the biggest drivers of the service thrust [*Electronics*, April 1989, p. 62]. The chip industry has officially declared the customer is king, and the king wants to cut the time to market for his products. Help the customers ship products before their competitors and you can sign them up for life. Make them miss their market window, and you'll never hear from them again.

Motorola and TI (see p. 56), both of which have entrenched, elaborate service programs, are good examples of how chip makers are attacking the problem. At Motorola Inc., the thrust started at the very top, and the goal at first was product quality alone. It all began at a managers' meeting about 10 years ago when one executive threw cold water on everyone's parade, says Charles Thompson, Motorola's vice president of worldwide marketing.

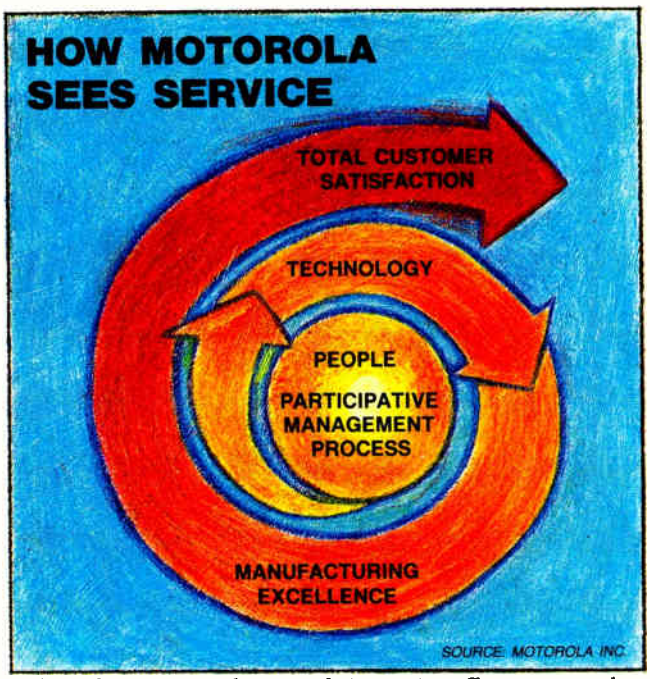
The then marketing manager of the Communications Sector got up at the very end of the meeting and told his colleagues, in effect, that their self-congratulatory mood was not entirely justified, Thompson recalls. "As your representative in the marketplace," he went on, "I can tell you Motorola's quality is a big disappointment." That certainly got the attention of the assembled managers, especially Robert W. Galvin, who was then chairman of the board and is now chairman of the executive committee. The anxiety was further fueled by the Japanese quality issues raised by HP's Anderson.

Shortly thereafter, Galvin set into motion a major program for quality improvement. "Our tracking of quality indices became a religion," says Thompson. "Everybody went to quality school, everybody was part of a quality circle team, and everybody had a quality goal." In 1987, Motorola invested $44 million in training, much of it in quality improvement. The company set a goal for a tenfold improvement in the quality of products and services by 1986—and it achieved it. Motorola's current goal for 1992 is six sigma, a statistical term that translates to 3.4 defects per million. But it had become apparent that quality as perceived by the customer was not merely defect-free products.

Galvin personally began to visit customers and talked directly with purchasing people, designers, and incoming inspection and component engineers. He found that although Motorola was liked in the marketplace, the company fell short in the eyes of its customers in areas of on-time delivery, completeness of orders, record accuracy, and other service areas. Sales volume could increase from 5% to 20% if these problems were corrected, he estimated.

That was the beginning of a pervasive corporate goal known as Total Customer Satisfaction. The program includes not only product-quality improvement, but concentration on team efforts to effect problem solving, adoption of techniques in cycle-time management to reduce the time from order entry to delivery, and greater concentration on design for manufacturability. Employee training is a major effort. The company established Motorola University with one campus at corporate headquarters in Schaumburg, Ill., and a new one in Mesa, Ariz. Employees get a week of training per year.

Customers are brought into product development in a process called concurrent engineering. "The computer companies and terminal companies that we support expect us to be a member of their design teams," says Bob Becknell, director of sourcing at Motorola Communications in Schaumburg, "just as we in the communications sector expect our 400 key suppliers to be a part of our design team or new-product team."



The culmination of Motorola's service efforts came when it won the 1988 Malcolm Baldrige quality award.

As with other semiconductor companies, many transactions are handled via EDI, the electronic data-interchange network used by industry to communicate with its customers (see p. 58). According to Thompson, mutual production plans are shared this way. "We put their forecast right into our backlog and we have visibility into whether their forecast or backlog changes," he says.

Following a general industry trend, Motorola has trimmed the number of

TI LINKS CUSTOMER SERVICE TO PRODUCT QUALITY

TALK TO ANY EXECUTIVE—or for that matter, any employee—at Texas Instruments Inc. these days and the cryptic words "Customer No. 1 through TQC" come up repeatedly. It's a reflection of the intensity with which the concept of Total Quality Control, TI's customer satisfaction program, has been promulgated throughout the corporation.

It all began in Japan, says Jim Watson, TQC czar and vice president of TI's Semiconductor Group in Dallas. The year was 1985, and TI's Miho operation had just won Japan's prestigious Deming prize for total quality achievement. The award opened the eyes of TI's management to the importance of total quality and culminated in Watson's new assignment: to build a strategy to achieve TQC for the Semiconductor Group.

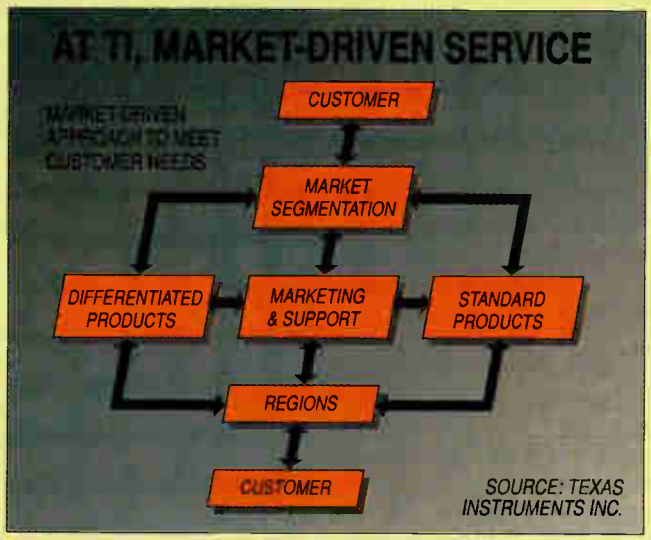
Like Motorola Inc.'s Total Customer Satisfaction (see p. 54), TQC involved organizational changes, in-house training, and establishing more intimate relationships with customers and suppliers worldwide. And it has a strong product-quality component as well. This year, TI set Malcolm Baldrige National Quality Award criteria as a measure of TQC progress.

For the program's full launch in 1988, "we developed a battery of training modules," says Watson. "Over the next two years these evolved into a step-by-step process that begins with management and ends with checking to be sure the customer gets what he expects. It's a whole process, with the input and output of each step defined and measured."

Starting with Pat Weber, president of the Semiconductor Group, along with all the managers who report to him, Watson began with a series of intensive training courses and awareness seminars. By the end of 1988, every organization in the group had been exposed to TQC, and another round of corporate-wide training occurred in 1989.

The result is the establishment of a group of tools and methodologies that cut across all lines of TI business activity, ranging from product development to manufacturing to sales and marketing. A major thrust of all these tools is reducing cycle time of internal processes and services. "It's real easy to follow if you keep in focus our rallying cry: 'Customer No. 1,'" says Kevin McGarrity, a TI vice president and director of worldwide sales and marketing. "That is, focus all efforts on making your customer successful."

He cites as one example a TQC tool called Business Profit Management. "That's where we go in with a team to solve problems such as how to reduce order-entry cycle time or reduce the time it takes for paperwork to flow from our customer into our books." The tool was responsible for trimming cycle times for many processes, McGarrity says. For example, reviews of specification changes were reduced from five months to four weeks.



At TI, customer needs drive product development and support, channeled through regional organizations.

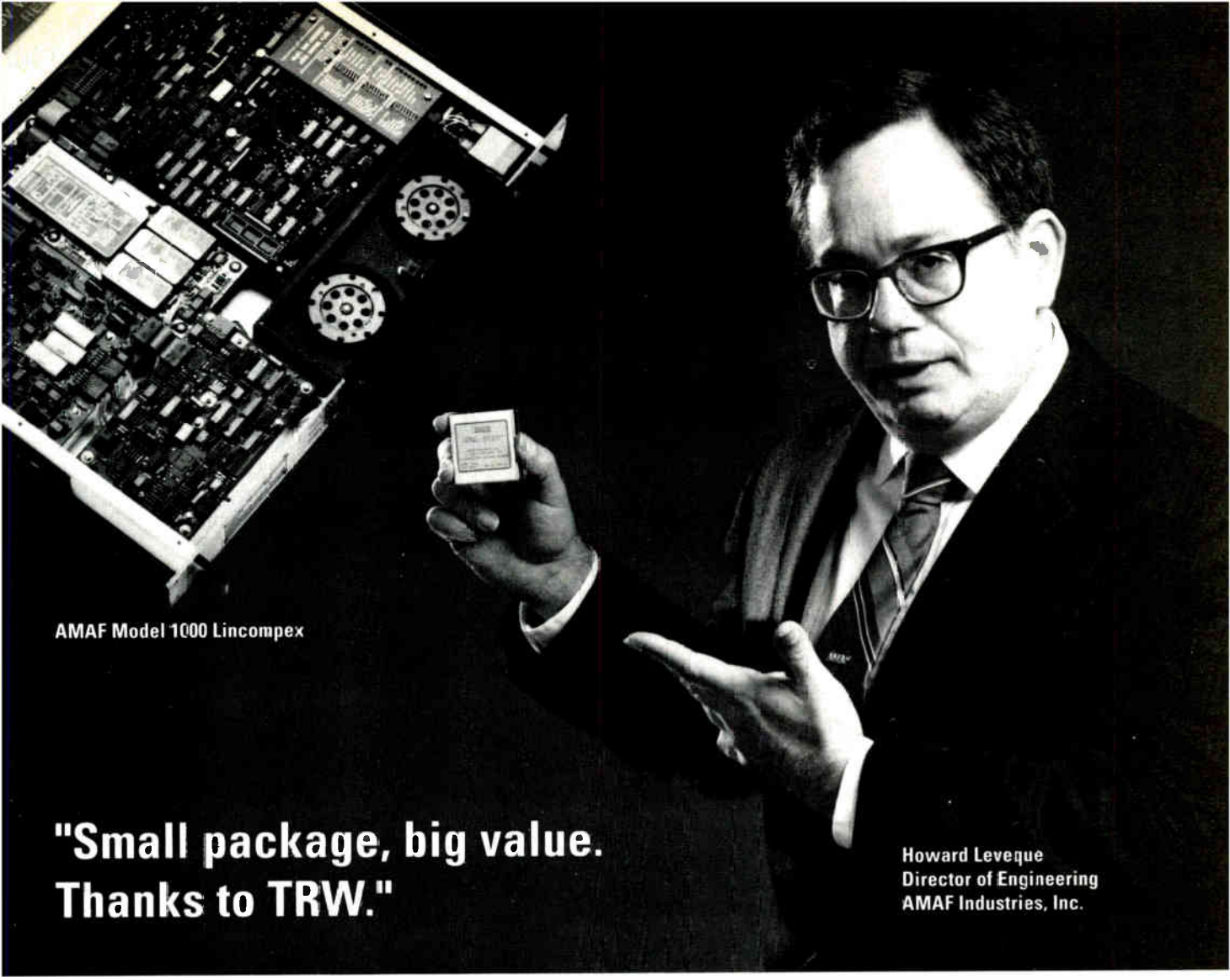
TI has also mustered Quality Improvement Teams (QIT) that are analogous to the quality circles of the Japanese. Product development, too, is the result of team effort with a methodology called Quality Function Deployment (QFD), in which teams are organized on a cross-functional basis and might include marketing, product planning, specification review, or field sales people.

The customer's engineering, quality, and purchasing people are consulted frequently—QFD is aimed at giving end-system designers an effective voice in planning and developing new products. It is based on a product planning matrix that documents customer needs through a written survey that captures what TI calls customer "care-abouts." (Incidentally, the customer need not be an external one. TI departments and groups are handled with the same TQC principles as outside buyers.)

The technique has been applied to the definition of TI's 16-Mbit dynamic random-access memory, now in development. "We had a team of people," says McGarrity. "They traveled around the world and met with specific customers in a formal process, asking them to define timing, packaging, organization, speeds, and so on. All of this was structured into an actual document delineating customer requirements for that particular product." This document became the basis for a TI team of experts from all disciplines "to sit down and pinpoint cost trade-offs that we could take back to our customer and ask him if he would be willing to pay for," McGarrity says.

TQC entered into TI's planning in programmable logic devices, too. In fact, the program is credited with shortening product development time and making TI first to market with a 5-ns PLD family. The development team comprised representatives from design, engineering, wafer fab, marketing, packaging, modeling, and planning. They tackled such issues as whether to develop a new process or build around an existing one, what package to use, and speed-versus-power trade-offs.

Now that TQC is becoming well entrenched, one concern that furrows Watson's brow is the fear that customer satisfaction could become a sort of cliche, "like quality has become. It really does require a step-by-step methodology, a focus that is continually on what the customer wants," he says. "If you start doing a lot of arm waving about customer satisfaction, it will become a mere buzz word and it won't achieve what it should."—*S. W.*



"We came to TRW with our Model 1000 Digital Lincompex, a rack-mounted unit used to suppress noise in strategic voice communication systems. It weighed 22 pounds and drew 115 watts of power. TRW's engineers helped us redesign the unit using just a few off-the-shelf digital signal processing ICs and software-programmable memory chips.

"We ended up with our Model 2200 LINK-PLUS, an all-digital, software-driven module that far exceeds the capabilities of traditional Lincompex units. It weighs less than 3 ounces, draws only 0.5 watts of power, and is small enough to fit in the handset of the world's most powerful tactical radio communication systems.

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its suppliers from around 6,000 ten years ago to about 1,000 today. Some 400 of these are identified as key or preferred suppliers, Becknell says. In Motorola's view, fewer, but completely dependable, suppliers makes for more efficiency and a more stable business environment.

A culmination of all this effort came in 1988, when Motorola won the first Malcolm Baldrige National Quality Award, established by the U. S. Department of Commerce and its National Institute for Science and Technology to stimulate industry's product and process quality. Galvin has notified all Motorola's suppliers that they must apply for it too. "If I don't have Malcolm Baldrige suppliers, I can't be a Malcolm Baldrige customer," he has said.

Although it's difficult to tie revenues directly to quality and service functions, it's worth noting that sales have grown along with the Total Customer Satisfaction program. Net sales have risen from around $5.5 billion in 1985 to $9.6 billion last year, while net earnings as a percentage of sales went from 1.3% to 5.2% in that time span.

IN A COMPANY DEDICATED to ASICs like Actel, a manufacturer of field-programmable gate arrays, customer satisfaction is an inherent part of the business. "For our customers, service is convenience. Their view is they are being serviced if we help them get their design done," says Al Haines, director of marketing. "We let them use the standards that are out there instead of forcing them to use something that is unique to us. That's more important to them than how many defectives in a lot. Our applications guys are at the customer's site, helping get started, or on the phone at the factory."

A somewhat unusual aspect of Actel's attention to customer needs is a program that provides masks for customers to convert designs to hardwired arrays. "If you get into production with our products and it becomes high-volume and cost-sensitive, we have masks that will automatically let you go to a hard array," says East. "People say we're out of our minds—that we're sending the customer to a competitor. But that's a form of service to the customer. We think we'll be ahead by giving the customer what he wants."

At Cirrus Logic Inc., a San Jose, Calif., specialty manufacturer of VLSI mass-storage, graphics, and communications peripheral chips, customer service stems from the company's expertise in system-level design. "One of the key things we focus on is a high level of system content in our products," says George Alexy, vice president of marketing, "so we hire systems engineers who develop products with a very much higher knowledge of the needs and problems of our system-designer customers."

Cirrus provides "much more than a chip," says Alexy. "It's not only the silicon but an extensive amount of software, board-design capability—any support we can supply the customer to help bring out his product." He cites as an example a 1987 project involving the development of an EGA chip for Video 7, a computer-board manufacturer in Fremont, Calif. Video 7 was planning to introduce a next-generation EGA video-display board that would be backward-compatible with CGA and Hercules display standards.

But in April 1987, IBM Corp. announced its VGA standard, and Video 7 saw an opportunity to penetrate a new market with a VGA board that would be compatible with earlier standards. The company asked Cirrus Logic to redirect the EGA chip development to a VGA controller. Working together, the two firms completed specifications in June and Cirrus produced first silicon samples in August. Seven months after the initial concept, the product was in volume production. As a result, Video 7 established a leadership position in the VGA display-board market.

To Matthew P. Crugnale, a marketing consultant in Palo Alto, Calif., total customer satisfaction means nothing less than satisfying the total customer. "That means the whole customer, not just the buyer or the design engineer, but the whole company organization. Who isn't affected by a significant semiconductor purchase?"

For the semiconductor industry, Crugnale says, the move toward customer satisfaction is "a momentous opening. On the lowest level, providing total satisfaction can save the customers money [through better accounting, lower inventory, etc.]. And on the highest level it is putting them in a new business or giving them a competitive edge. But you have to follow where the customer is going and stay up or even ahead of him. To me that's the ultimate weapon against foreign competition." E

TECHNOLOGY FUELS SERVICE

THE CHIP INDUSTRY'S march toward customer service is built on the convergence of a number of different technologies, says Murray Duffin, vice president of service and quality at SGS-Thomson Microelectronics in Agrate, Italy. Prime among them are bar coding, high-speed global networks, distributed processing along with on-line transaction processing, and relational data bases that can operate in a distributed-processing environment.

- Bar coding has been around for more than a decade, but the chip industry has been slow to adopt it, Duffin says. However, the service thrust means manufacturers must have a labeling scheme that accurately identifies components to prevent orders from being mixed up. Bar coding has become a necessity as a result.
- Like bar coding, international high-speed data-communications networks are not new. But developing a network that connects all a chip maker's computers over an X.25 network requires a level of reliability and integrity—as well as network bandwidth—that has only become available in the last year or so, Duffin says.
- A third required technology is distributed processing. Only recently have chip makers begun to distribute their computing resources, especially their order-processing system, outside of a central location. The demand for faster response times to international customers has driven this transition.
- Distributing the data processing is only half the battle; the other half is OLTP. As each order is entered, the data base is updated to show that components in finished-goods or work-in-process inventories have been earmarked for specific customers.
- The ultimate solution is the electronic data-interchange network, which allows customers to interrogate a supplier's data base for component pricing and availability. Also, EDI lets the customer reserve products for a time before placing a formal order.
- The final piece of the puzzle is relational data bases that can be distributed across several computer systems worldwide.—*Jonah McLeod*

WHERE SERVICE IS A DO-OR-DIE PROPOSITION

IN SEMICONDUCTOR PRODUCTION GEAR TODAY, QUALITY AND RELIABILITY ARE NECESSITIES

BY JONAH McLEOD

IT USED TO BE THAT BUYERS of semiconductor production equipment put up with unresponsive suppliers, hard-to-use equipment that needed frequent repair, and products that were difficult to integrate into a production facility. But that has all changed now. "Customers of semiconductor production equipment take state-of-the-art functionality and high reliability for granted and make buying decisions based on the service provided with the product," says G. Dan Hutcheson, president of VLSI Research Inc., a San Jose, Calif., market research firm that follows the industry.

Suppliers are aggressively addressing this market demand. Most have instituted customer satisfaction programs and methods of monitoring them. In addition, thanks to the ready availability of low-cost mips, manufacturers are building products that are easy to use and easy to service or self-servicing to cut maintenance down time. To reduce a customer's system-integration nightmare, suppliers are also making equipment that works more easily with other vendors' gear and are helping with the customer's integration chore. Finally, suppliers have gone the extra mile by building equipment that addresses problems the customer itself has not anticipated.

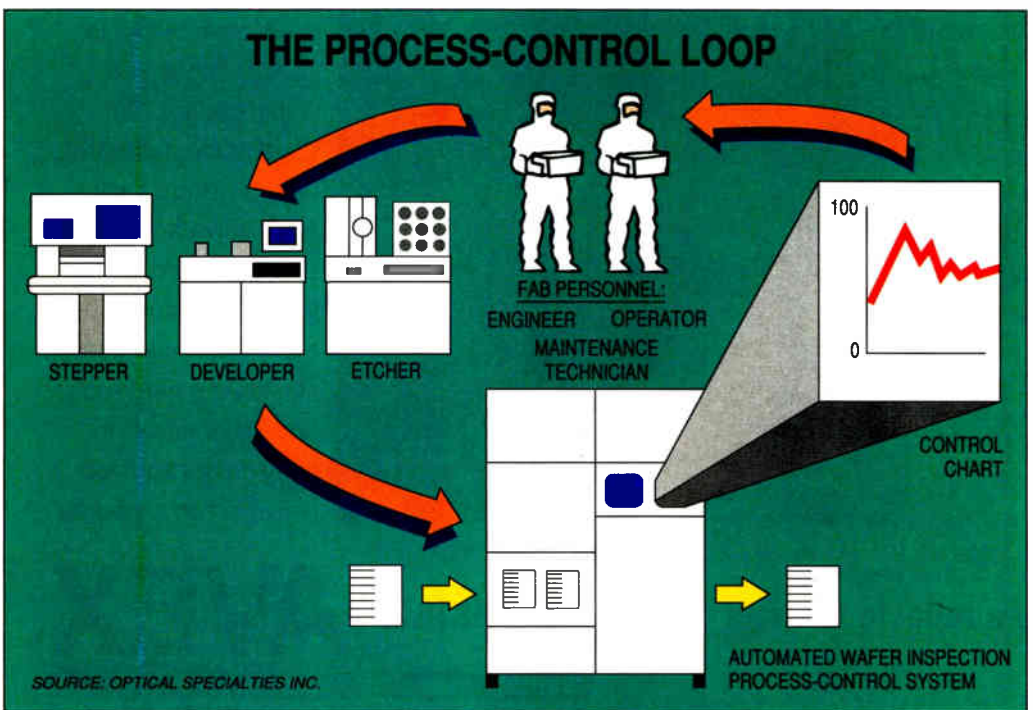
SERVICE

The new focus on service is necessary today, when equipment costs have soared so high, Hutcheson says. "A chemical-vapor-deposition furnace that used to cost $30,000 [10 years ago] costs $1.2 million today," he says, and a buyer can't afford to let it sit idle. Thanks to the quality push, he says, lithography equipment that once had a productive up time of 70% is now running 98% to 99% of the time.

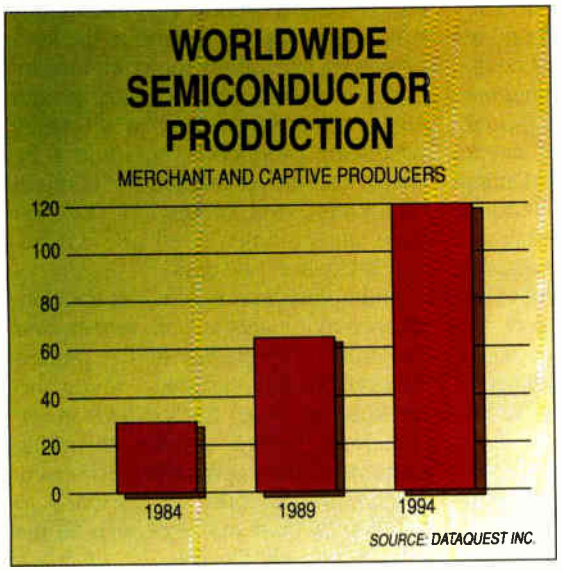
VLSI Research publishes an annual report on customer satisfaction based on surveys of equipment buyers. "In the lists of the top 10 companies over the past 10 years, we have seen 20 companies come and go," Hutcheson says. "The ones that have remained consistently in the ranking are those that have provided the best customer service."

The lesson is being heeded all over the industry. "Since 1988, achieving the highest level of customer satisfaction has become the goal of GenRad," says company president Robert Anderson. A manufacturer of automatic test equipment based in Concord, Mass., GenRad Inc. hired an Indianapolis company, Walker Customer Satisfaction Measurement, to develop a set of measures of customer satisfaction. "The idea was to ferret out via telephone surveys and focus groups what constituted customer service and then relate these factors to what goes on inside of GenRad," Anderson says.

At the same time, Anderson launched a company-wide program to develop awareness of and concern for achieving total customer satisfaction. "It isn't enough to give the customer what he wants," Anderson contends. "ATE



Monitoring equipment for any stage of the chip-making process can generate reams of data; increasingly, the analysis of such data is being automated in process-control systems.



vendors must anticipate what a customer needs beyond his present requirement. That means an ATE manufacturer must understand fully the testing problem the customer faces."

The same story is echoed everywhere. "Two years ago we elevated the consciousness of our employees to providing customer satisfaction," says Pat O'Conner, vice president of customer services at the Silicon Valley Group Inc., which makes automated wafer-processing equipment. In mid-1988, the San Jose company formed a customer services group, which combined field engineering and quality control. "We recognized a need to design service into the company and its product and then take care of the customer after the sale is made," O'Conner says.

Establishing a customer service department is just the beginning; companies must then take steps to measure how effective is the service they provide. For example, ASM International NV, another manufacturer of wafer-processing equipment, has established a program called QEST, for quality, excellence, service, and technology.

Launched a year and a half ago, "the program measures the efficiency of these four aspects of product using a scale of 1 to 10," says Arthur H. del Prado, president and chief executive officer of the Bilthoven, the Netherlands, company. "We started out at 5 and are now at around 7, but we need to get above 9. The industry average is around 7."

Making equipment that is easy to use is one sure way to satisfy a customer, says Jim Anderson, president of Applied Intelligence Systems Inc. in Ann Arbor, Mich., which makes automatic vision systems. A case in point: in the old days, an operator took a hands-on role in running a vision system, says Anderson. "He had to adjust the contrast, draw a block around each character or label, tell the system what the character was, teach the vision system what he wanted it to do." This process is now automatically handled by software in the company's AIS3000 and AIS4000. Where it once took two to five minutes, "it now requires only a few seconds," he says.

The software development effort to automate this process was no mean feat. "There are more than 200 man-years in software development in the machine-vision system," says Anderson. The hardware to execute this software is also quite complex. It consists of a massively parallel array of 64 to 512 processors connected in a neural network.

Applied Intelligence Systems isn't the only company to use software to automate the control of a process. Statistical process-control methodology espoused by manufacturing guru W. Edwards Deming and wholeheartedly embraced by Japanese manufacturers reduces any manufacturing process to a set of steps. Using statistical methods to measure the output of each step, a manufacturer can ascertain whether his process is working as it should.

In semiconductor manufacture, measurement equipment monitoring a stage in the process can generate reams of data, which a skilled process engineer must analyze to determine if all is well. "In the past, this analysis was done manually," says J. R. Harris, president of Optical Specialties Inc., a San Jose manufacturer of semiconductor process-control systems. A Sun Microsystems Inc. workstation on one of the company's newest Inspectra 500 machines automatically processes this data in real time and produces a graph that a less highly skilled operator can then easily evaluate.

To better serve their customers, production equipment manufacturers are making preventive and corrective maintenance just as easy as process control. "In a vapor-deposition system, gases that are used to deposit on wafers also end up on the inside of the equipment," says O'Conner of the Silicon Valley Group. "Wherever possible, the equipment performs in-situ cleaning, but eventually the equipment must be cleaned up." Cleanup means stoppages, and O'Conner contends that customers want to plan around down time "so that they can service different portions of the line at different times. It has to merge into the production schedule." If an equipment supplier can provide a better preventive maintenance schedule and a procedure that takes less time than a competitor, he has a competitive advantage.

Repairing equipment that has failed likewise must be done quickly. For example, Lam Research Corp. in Fremont, Calif., has begun to modularize its equipment for easy repair. "Before, none of the major parts of the equipment was accessible from the outside," says Jack Hinkle, vice president of customer service. "On our new Rainbow 4600 metal etcher, every one is [accessible], and the result is that a mean time to repair of days is now cut to four hours."

Besides keeping equipment up and running, the one service that customers need most is help in integrating equipment from a number of different vendors. "In the past, equipment vendors shipped hardware to a customer without a clear understanding of what the customer was trying to get at the end of the line," says O'Conner. "Now,

THE UPS AND DOWNS OF AN INDUSTRY

Ranking 1989		Ranking, Past Years 1979	1984	1988
1	Tokyo Electron	26	3	2
2	Nikon	N.A.	17	10
3	Applied Materials	3	12	4
4	Advantest	15	11	3
5	Canon	18	10	6
6	General Signal	N.A.	2	5
7	Varian	6	9	7
8	Hitachi	N.A.	17	11
9	Teradyne	5	6	9
10	ASM	21	16	13

SOURCE: VLSI Research Inc.

with the complexity of technology and competition in the market, customers are becoming partners with their suppliers." Both sides will share technology, he says, so that suppliers will understand the problems customers have with other manufacturers' equipment, "even modifying [their own] equipment to help it better fit in."

One example of such a relationship is found at Spectrum CVD Inc., a Phoenix-based manufacturer of chemical-vapor-deposition equipment, such as its new Vision system, introduced in May. One of Spectrum's major customers is Motorola Inc., also in Phoenix, which helped found the company. Motorola shared technology and future processing requirements with Spectrum to get exactly the production equipment it wanted for current and future needs.

When a company such as Silicon Valley Group installs a new piece of equipment, it provides factory representatives—mechanical, software, and process engineers—to help integrate the system into the customer's equipment. During installation, O'Conner says, vendors must understand customer expectations, and even if they do, the unforeseen occurs. "In a presite installation review before equipment was to be shipped, we discovered that a customer's site could not accommodate the equipment as it was configured," he recalls. "We modified our equipment to fit the site."

After the equipment is installed, customer service takes on another dimension. The new machine must work with other manufacturers' products in the customer's process line. The task of making this happen resembles the kind of system integration the computer industry performs for its clients, though ASM's del Prado notes that the semiconductor production equipment industry has not yet reached the computer makers' level of service. "By and large, the customer is still his own system integrator," he says.

In this environment, vendors traditionally pointed fingers at one another over the cause of problems in the process line, while the customer wrung his hands trying to get his line back in service. Now, though, vendors are taking on more of the responsibility. For example, the Silicon Valley Group works to integrate its own machines with all the other systems in the line.

ASM goes even further: del Prado says the company actually posts a representative at a customer's site to keep the process line up. "Also, a multidisciplinary team from ASM with expertise in different semiconductor processing areas provides additional support," he says. "This group of three to five people solves problems created by any vendor's equipment in the line."

AT THE END OF THE DAY, what matters most to the customer is increased yields from its production lines. Service to address this need comes in two forms. One is providing continual updates to squeeze more efficiency out of older equipment—for example, ASM continually enhances older machines to achieve better performance. Another is to provide advances in the state of the art that boost yields perceptibly.

Lam Research took the approach of solving the corrosion problem that affects the metal-etching step during IC manufacture. The problem is that the chemical used to etch away unwanted metals on a layer of silicon continues etching after the process step is completed because of residual chemicals remaining on the wafer.

Lam's new Rainbow Model 4600 etching system contains several hardware changes that solve the problem. In the past, "it required a second wet bath to rid the wafer of the etching chemicals," says Hinkle. "The problem was to move the wafers in seconds from the etcher to the wet bath. The new system has a rinse station that spins the wafer and sprays it with deionized water. It should improve yields by 20% to 25%." E

SPREADING THE GOSPEL

IN EVERY ELECTRONICS industry segment, suppliers are scrambling to offer customer service. Vendors of computer-aided engineering tools are helping customers create designs. Wafer suppliers are tailoring wafers for individual customers. Printed-circuit-board contract manufacturers are making engineering change orders faster, giving faster feedback on problems in a run, and helping customers make their designs more manufacturable.

In the CAD business, vendors supply products that cut design time. "A customer typically wants to know how fast he can get our routing tool to route a board to 100%," says Jack Hendren, vice president and general manager of P-CAD Inc. in San Jose, Calif. To be more competitive, P-CAD solves a customer's problem on average in six hours or less with a goal of under four hours. "When we started the program, it took over a day," Hendren says. Ultimately, P-CAD will use an expert system to understand a customer's question. "Different designers describe the same problem differently," he says. "An expert system will analyze and categorize a request so our service rep can give the right answer."

To produce the wafers that semiconductor manufacturers use to make chips, service takes a different form. "A customer wants customized wafers for his process and he wants to quickly change parameters—electrical parameters—of wafers on order," says Joe Arruda, marketing manager for Kawasaki Wafer Technology in San Jose. Connecting supplier and customer by network, the electronic data interchange will allow fast, automatic changes without creating a paper trail. Once KWT implements EDI, it will offer ship-to-stock programs.

"Our customers sample-inspect incoming products," Arruda says. "Eventually, we will provide the customer, via EDI, statistical process-control data from our manufacturing process to eliminate incoming inspection."

EDI can also help pc-board contract manufacturing provide better customer service. Manufacturers accept a design from a customer and from this fabricate a board. "EDI helps us expedite engineering change orders and provide feedback on manufacturing problems," says Winston Chen, president and chief executive officer of Solectron Corp. in San Jose, which has partially implemented EDI with IBM Corp., a major customer.

Solectron also studies failure mechanisms in boards being manufactured—components or traces spaced too close together, for example—and makes a case with supporting evidence for implementing design changes, thus reducing the customer's field failures. One of the more profitable contract manufacturers, Solectron is a model of a company putting service first.—*J. McL.*

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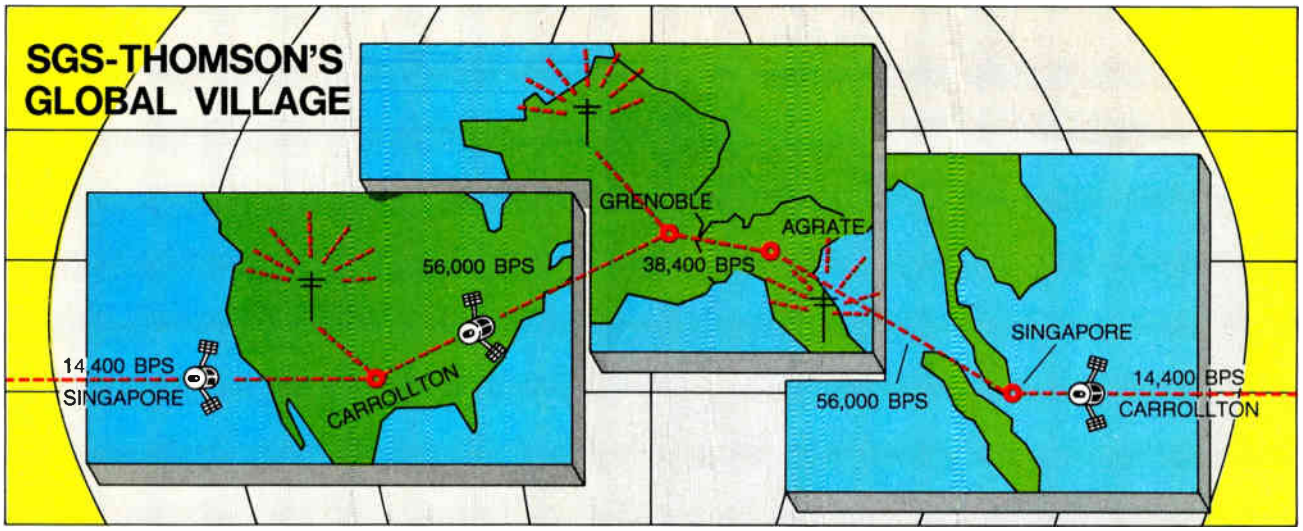


SGS-Thomson Microelectronics has set up its own international, high-speed data-communications network, into which clients may link during the design phase and to gain immediate access to stock.

EUROPEAN MAKERS, TOO, HEED THE SERVICE CALL

THE BIG ELECTRONICS PRODUCERS SAY THEIR WELL-ESTABLISHED PROGRAMS HAVE AN IMPACT ON SALES

BY JOHN GOSCH

THEY MAY NOT CALL IT by the same name, but executives at the big European electronics manufacturers are just as involved as their U. S. colleagues in customer service. Keeping customers fully satisfied, they say, is a credo they've been practicing for a long time, and only a few regard this practice as just another weapon to beat off Far Eastern competition in the short term. Rather, customer satisfaction has been, and will remain, part of a company's long-term business strategy.

At West Germany's ITT Semiconductors Group, the moniker is "full customer support," while Siemens AG calls it "technical services." At Philips International NV in the Netherlands it is part of an efficiency and quality-improvement program. And SGS-Thomson Microelectronics, the Franco-Italian semiconductor combine, makes a service effort that few can equal: the company has invested about $2 million in monitoring service levels via statistical process control. Common to all of these schemes, however, is the fact that customer service is a corporate activity, one that's tightly woven into each company's structure.

SERVICE

How companies go about satisfying customers depends on the products they make and the type of business they're in. (Some are just getting started; see p. 68.) One approach is that of the ITT Semiconductors Group in Freiburg, West Germany. In the mid-1970s, ITT executives realized that if they wanted to be successful in the integrated-circuit sector and avoid the ups and downs of the volatile semiconductor business, they would have to set themselves apart from their competitors selling standard devices.

So the group discarded standard IC products and started specializing mainly in chips for three industry sectors: consumer electronics, car instrumentation, and communications equipment. Today, these sectors account for about 60%, 25%, and 15%, respectively, of the group's IC business.

The focus on market-specific ICs meant that "our engineers had to learn a different language—that of TV designers, auto instruments people, and communication engineers," says Reinhard Preuss, the group's spokesman. "They had to attune themselves to customers' design problems, propose solutions, and recognize and understand their needs, wishes, and whims—in short, they had to satisfy customers in every way."

This dialogue sparked a symbiotic relationship between the ITT engineers and their counterparts at the customer. In the end, it led to the realization that "if we want to be successful in our business, we must want our customers to be successful in theirs," Preuss says. ITT Semiconductors' concept of full customer support was born.

Carrying out this support is the Con-

cept Engineering department, a section set up in the late 1970s and now consisting of 35 engineers at the group's main operation, Intermetall GmbH in Freiburg, and at facilities in Japan and the U. S. The department comprises engineers who are not just circuit designers "but are right at the interface between circuit development and the markets using the ICs," says Ulrich Schmidt, chief of advanced projects. Strategically, Concept Engineering is ITT Semiconductors' most important department.

The ICs ITT develops usually start out as customer-specific parts—that is, components the customer wants on a proprietary basis so that his product will have an edge on competitive equipment. After an agreed-upon time, the customer relinquishes his priority rights and ITT will make the ICs generally available as standard devices.

The dialogue between ITT and customers begins at the management level, with executives from both parties exchanging their ideas on a proprietary circuit design. In this regard, Schmidt says, the procedure is different from the standard practice at large companies, where component procurement decisions are made by purchasing and sales departments.

When top managers have agreed on a design, Concept Engineering gets into the act. Together with the customer, ITT engineers determine whether a chip is feasible under various technological and economic considerations such as chip area, feature size, supplier's development and production capability, as well as cost. If ITT thinks the project can produce profits, it gives the OK.

During each of the next steps—from simulation and prototyping to volume production, quality control, and on to the mature product and its application—ITT concept engineers work closely with customer engineers, with the latter virtually looking over their partners' shoulders. If, after first silicon, the customer wants an alteration, or if at a later stage it wants a different pinout or package or a redesign on the wafer level, ITT will comply. Even after the start of volume production, performance-enhancing changes will be made if the customer is willing to carry the extra costs.

ITT's customer support doesn't stop after the delivery of the finished products, however. If the equipment incorporating the new components doesn't perform to expectations or if undesired effects are encountered in operation, ITT application engineers will analyze the problems and help the customer solve them.

Schmidt concedes that the dialogue with customers does not always go smoothly. "It's often difficult to convince outside engineers who are well versed in analog techniques of the benefits that, say, digital circuits bring," he says. "The dialogue is also difficult with TV-set makers from Third World countries who want to leapfrog several generations of analog TV receivers and jump right into the latest technologies." But in the end, the method has borne fruit. Some 85 TV brands from 70 set makers around the world use ITT digital circuits. And many of these producers are in Third World, developing, or East European countries.

'IF WE WANT TO BE SUCCESSFUL IN OUR BUSINESS,' SAYS AN ITT EXECUTIVE, 'WE MUST MAKE OUR CUSTOMERS SUCCESSFUL IN THEIRS'

Has ITT's many years of full customer support paid off? "Yes, very much so," says Preuss. To begin with, "our customers are satisfied, and a satisfied customer is the best reference." While many electronics companies in Europe see the Japanese as a threat, "we count them among good customers, as partners we want to help succeed."

A satisfied customer base, in turn, has helped the group's profit performance. "Even when times were bad for the semiconductor industry generally, our profits were in the double-digit range," Preuss says. High profits enabled the company to acquire the latest technology available. While many companies are still using 1.0- to 1.5-μm technology, ITT Semiconductors has production equipment providing 0.8-μm features. The newest circuits are laid out so they can be made with the 0.5-μm technology that is expected to become available in 1993 or so.

Given the advantages of satisfied customers, healthy profits, and good returns on investments in equipment, it's little wonder that ITT Semiconductors is a big proponent of full customer support and is eager to continue improving the services it provides.

SIMILARLY DEVOTED TO customer service is Siemens, which sets a good example for satisfying customers of industrial systems and automation equipment. The Munich-based company has pursued this activity for a long time, meeting customers' needs both during systems development and after equipment installation. Supporting the activity is the Technical Services operation.

This operation extends its services to six Siemens groups: Industrial and Building Systems, Drives and Standard Products, Automation, Power Generation, Power Transmission and Distribution, and Transportation Systems. (The company's other nine groups—among them Semiconductors, Medical Engineering, Defense Electronics, and Communications—have similar service activities of their own).

Although Siemens has provided customer services for many years, it was not until the early 1970s that the company put this activity on a more systematic basis. Prompting the formal services program was the rising complexity of automation systems and products, which by then had reached a level beyond the customer's ability to cope with it. With the complexity of automation equipment accelerating since the early 1970s, the Technical Services organization for the six groups has grown to 18,000 persons in West Germany alone.

The services program makes sure that in the development of, say, extensive automation systems for a steel plant, chemical factory, or cement-processing facility, "the customer be part of the Siemens development team if he desires," says Walter J. Hayn, deputy director of Field Services and Workshop Operations in Fürth. Tied in with development activities, the customer's engineers ensure that system specifications are met, propose design changes, and generally keep tabs on progress and system performance.

Technical Services activities proceed according to a formal program that spells out the procedures for cooperating with the customer in such phases

as systems development, engineering, software development, manufacturing, and quality control. In other words, it includes virtually all phases from the start of a project to its completion. In most instances, the program even extends to after-sales services to guarantee that systems perform properly once they are in place.

When it comes to products such as numerical controls or programmable logic controls for, say, machine tools, the customer is also tied in with the development. With such more or less standard products, "service and maintenance facilities are generally built into the equipment in the form of self-test features, test and measuring points, and software tools," Hayn explains.

An important aspect of Siemens's involvement is the remote assistance tools it offers. First is what the firm calls the Hotline service. In this scheme, a company engineer gives the customer tips over the telephone on how to correct a malfunction and get systems operation back to normal. If Hotline proves ineffective, Teleservice comes into play. This setup connects a terminal or a Siemens expert system to the customer's equipment, also via telephone lines. Running through its service program, the expert system or a human expert at the terminal comes up with the answers to a problem and tells the customer what to do to fix it.

"With the Technical Services concept and with the service tools we provide, we think we are the leaders among systems suppliers and engineering firms in Europe," Hayn says. "Our service operations have paid off well," he adds. They have given Siemens's marketing and distribution activities a powerful sales argument. Good sales, in turn, have helped the company reach leading positions with many products.

For example, Siemens now ranks as the world's No. 1 supplier in programmable logic controllers. With numerical controls for machine tools, the company is No. 1 in Europe and No. 2 worldwide. And in turnkey factory automation projects and other automation-related activities, it also rates among the world's heavyweights. Says Hayn: "A customer given full technical support not only is a satisfied customer but also a loyal one who keeps coming back for more."

PHILIPS INTERNATIONAL has also long given corporate attention to customer service and satisfaction. This activity, which is part of the Dutch firm's Corporate Organization and Efficiency Bureau in Eindhoven, has been pursued on a formal company-wide basis since 1983 "as a reaction to Japan's increasing sales efforts on our markets," says Matthijs Vermaas, a bureau director. "What was formerly a seller's market turned more and more into a buyer's market, with customers becoming ever more demanding as regards service," Vermaas says.

Along with satisfying customers through improved service, Philips's top management has made product quality an issue of first importance to strengthen the company's position on global markets. This is done through the Company-Wide Quality Improvement (CWQI) program.

Since its inception in the early 1980s, CWQI has quickened in pace as Philips became convinced that quality improve-

FEELING THE PRESSURE OF 1992

ALTHOUGH THE BIGGEST European electronics companies have long embraced customer service (see p. 66), analysts say that many others have been relatively slow to adopt the concept. "Because European manufacturers have been favored with captive national markets in the past, they did not see the need to appeal to clients," says Bill Coleman, an analyst with the James Cappel investment firm in London. But with the economic unification of Europe now imminent, that may be changing.

The Single Internal Market that will become a reality in 1992 is putting pressure on even the so-called "national champions" to upgrade customer service in order to remain competitive. That service can help sales has long been apparent to UK computer maker ICL. Now even conservative companies like France's Groupe Bull are beginning to see the light.

The UK computing market has always been the most open in the European Community, and the deregulation there prompted ICL to begin stepping up customer service in the early 1980s. "Services now provide 50% of our $3 billion turnover," says Harvey Dodgson, director of business strategy for ICL Services.

ICL, which sells mainframe systems to businesses and local governments, starts planning its service offer to a customer well before the sale is a done deal. "Our sales force is trained and motivated to offer systems software and applications software with the initial offer," Dodgson says. For example, when a large retail chain makes a tender offer for an in-store system, ICL offers standard implementation packages as part of its proposal.

Once the sale is made, ICL offers three possible maintenance contracts, which it calls "gold, silver, and bronze" depending on the level of service they provide. Another ICL innovation is to give customers two choices in software: they can opt to merely use the software as is—that is, they buy the right to the intellectual property—or to have ICL continue its guidance and updating. "Many of our customers feel that our support is worth [the extra fee]," says Dodgson.

The installation of large systems requires user training, and for this ICL has set up a separate training subsidiary in Birmingham, England. Despite the huge expenses incurred by such an endeavor, ICL thinks that the possibility of extensive training lures clients. For example, when local governments buy an ICL system, the company's ability to train them is a considerable incentive, he says.

Service tactics like those employed by ICL are now being adopted at Bull. "Bull now proposes custom-made maintenance packages," says a company spokesman in Paris. "We offer every level of service, from total care to mail-in. The customer can choose the response time he needs, anything between immediate response to the next day or the next week."

To simplify maintenance and upgrades, Bull now designs its computers with a standard chassis. The user can plug in new boards if he wishes to replace parts or upgrade without changing the box itself.

"The new design reflects the fact that there is less money to be made today with maintenance, and a great deal more to be had from added value," the spokesman says.—*Andrew Rosenbaum*

ment is the way to a stronger market presence and higher profitability. "If service and quality are coupled with a product, customers are willing to spend more money on it," Vermaas says.

Vermaas sees service and quality as crucial factors for success in the 1990s. In the decade ahead, he says, "we'll face an increasingly competitive environment as internationalization of business picks up momentum, the trend toward shorter product life cycles accelerates, and price competition grows. In the 1990s, customer satisfaction will more and more become a key to success."

To achieve quality and full customer satisfaction, Philips listens to the customer's voice even before the start of product development. A good example of how the process works was the design of a professional portable TV camera, the LDK90, a few years ago. The customers' cameramen from all over the world were invited to contribute their ideas to this project. Under the motto "Philips invites cameramen to help design their cameras," customer wishes were defined in a workshop to serve as a basis for a new design.

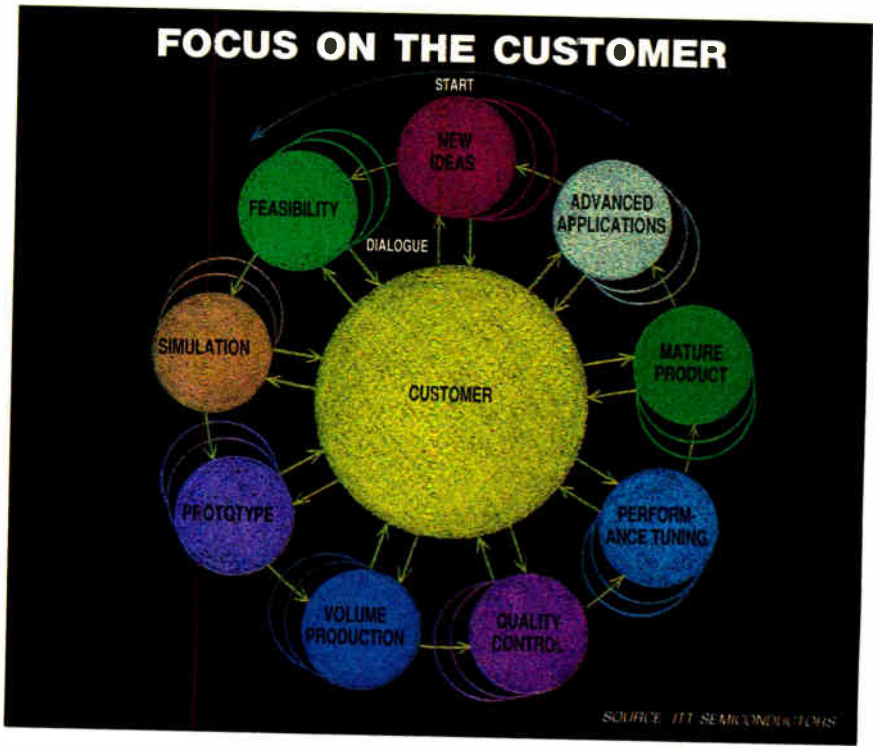
The workshop was a vehicle for obtaining as much information as possible about aspects of newsgathering, the ways in which cameramen work with portable cameras, and what their specific requirements are. Plenary and subgroup discussions as well as written surveys provided background information for the hands-on workshop sessions.

This approach, Vermaas says, was a big success. Within 18 months, the company delivered the 1,000th LDK90. By using charge-coupled-device sensors from the Philips Research Labs instead of tubes, and by listening well to customer input, Philips created a product that really satisfied its users.

Customer participation in development work at Philips is not limited to professional products like the TV camera. It also goes for TV sets. In this case it is not so much the end user who has a say in development but the wholesalers and retailers who generally have a good feel for what type of features and the kind of performance and functionality their customers want.

In principle, every Philips employee is, or should be, geared to strive for full customer satisfaction, Vermaas says. "At our company, the attitude implicit in 'I work for my boss' should be 'I work for my customer.' "

It's difficult to quantify the success of Philips's efforts in promoting quality and customer satisfaction, Vermaas says. But he believes that for many products the efforts have helped the company keep, and even increase, its market share. "Aside from that, the need to satisfy customers is a strategy for survival in the marketplace. It's fundamental to our business."



At ITT Semiconductors, customer service is in the hands of the Concept Engineering department, which interacts with clients every step of the way.

THE MANAGEMENT AT SGS-Thomson Microelectronics holds the same belief. Every aspect of the SGS-Thomson service program is carefully watched, and every week each of the giant chip maker's divisions is graded on its ability to maintain the standard. Quick response to customer demand, rapid delivery, and the ability to answer client questions with the briefest possible delay are all areas that SGS-Thomson considers top priorities, says Fabbio Borri, director of quality and reliability at the Milan-based firm.

"There is a very simple reason why managing director Pasquale Pistorio has made services an essential priority," Borri says. "Every semiconductor buyer has at least two possible sources of supply. Failure to provide services means loss of market share. It's as immediate as that."

SGS-Thomson is already pushing to have 90% of its sales delivered just-in-time. It's also working to implement the so-called "ship-to-stock" method for distributing its merchandise. "Ship-to-stock" means that clients do not have to control the quality of the SGS-produced semiconductors when they enter the client's factory. The pieces are guaranteed to be defect-free, so that the client can move them immediately into production. SGS-Thomson pays a penalty should there be a problem. "The procedure saves [the customer] an enormous amount of time," says Borri. The pieces are bar coded so that the client can move them to the correct areas of his production line without delay.

SGS-Thomson is also improving its logistics to speed delivery. It is about to open a central warehouse for Europe on French territory near Geneva, Switzerland. And it already possesses a worldwide private telecommunications network, which gives clients immediate access to stock.

Also, says Borri, "we are committed, in the shortest possible period, to be offering EDI [the electronic data-interchange network] to all our regular customers" (see p. 58). "EDI will cut down the time it takes for just-in-time delivery even further." E

Additional reporting provided by Andrew Rosenbaum

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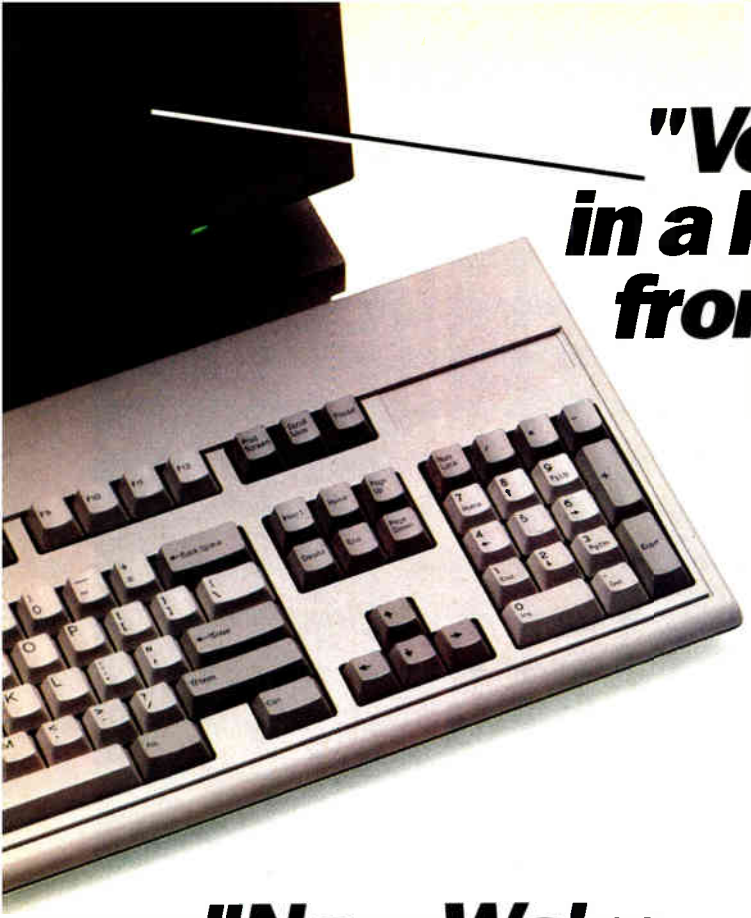

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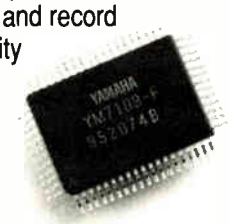

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CIRCLE 214

COMPUTERS AND PBXs: DIALING A NEW DESTINY

SOFTWARE INTERFACES THAT TIE PHONE LINES TO DATA BASES ARE CREATING BIG MARKETS

BY JACK SHANDLE

IMAGINE A TECHNOLOGY that retrieves a customer's data base and routes it to the most appropriate customer-service terminal the second the customer completes a phone call. Did you guess ISDN? Then you were wrong.

An aggressive public relations campaign by telephone companies around the world has made the integration of voice and data seem almost synonymous with the integrated services digital network. But widespread deployment of ISDN is at least a half decade in the future. Even when it arrives, ISDN will reside in the phone company's network—not in the millions of corporate data bases and terminal servers that hold the key to marketing success.

But another technology that integrates voice and data has been maturing at a much faster pace along an independent path, and this one completes the critical business link between a voice on the phone and the computer. So when ISDN finally arrives, its intelligent-network features will have an equally smart partner waiting for it inside the customer's premises.

TELECOM

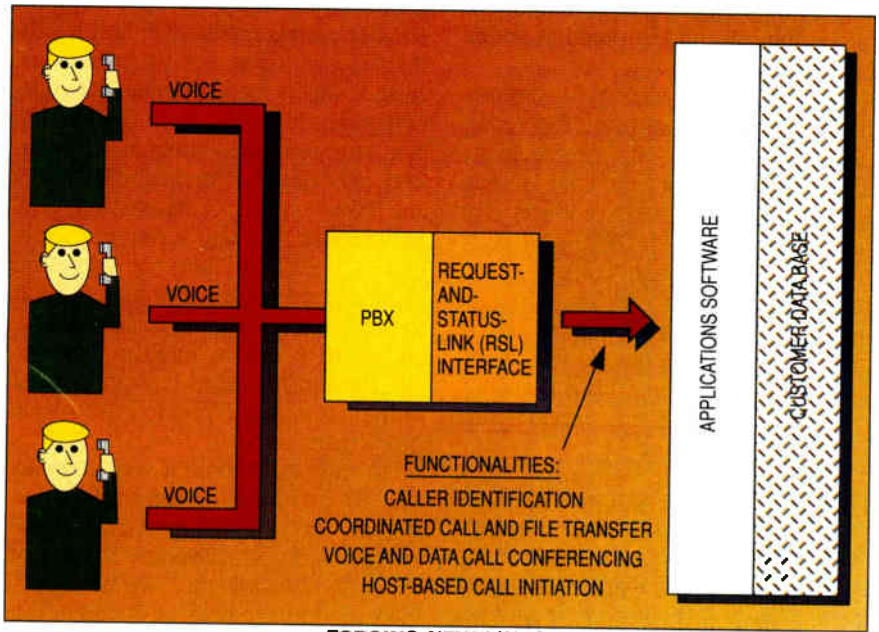
Unlike ISDN, computer-to-PBX interfaces are ready to burst onto the scene in a big way, creating a major new market for nimble companies in applications software and special-purpose hardware. "Both the computer and the private-branch-exchange people are moving very fast," says Greg Borton, president of Nabnasset Corp., a consulting firm based in Tyngsboro, Mass. Culminating with IBM Corp.'s introduction of computer-to-PBX hardware and software in mid-May, every major computer and PBX manufacturer has thrown its hat into the ring. "We are seeing an endorsement that this is an important approach to voice and data integration," says Borton.

The software interfaces that let PBXs conduct relatively complex interactions with computers on voice calls are called request-and-status links. "RSLs basically let computers and PBXs tell each other what they are up to," says Northern Telecom Corp.'s John Spindler, product manager for Meridian Link, an RSL that connects Northern Telecom's switches to computers and local-area networks.

Because of the tendency to view voice and data integration from the ISDN perspective, a common misconception about RSLs assumes that data is routed through the PBX. This is not the case. Spindler points out that the relationship is really one of coordination: the PBX routes the incoming phone call to a customer service representative, for example, while simultaneously using the RSL interface to tell the computer to send its data to that same customer-service terminal. More sophisticated interactions are also possible, in which the computer initiates dialing instructions for the PBX.

In areas where ISDN is available, ISDN's caller-identification-number feature can be used—along with lookup tables in the host computer—to locate the caller's data file. ISDN's rich feature set will complement RSLs as it becomes a reality. In the meantime, an automated answering machine can ask the caller to key in his or her phone number or customer account number.

The first users of RSL technology are corporate call centers such as customer service operations, where large numbers of inbound calls—most often from toll-free "800" numbers—have to be handled. But outbound calling produces a larger number of applications



FORGING NEW LINKS

RSL links between PBXs and computers will let applications software act on incoming calls by accessing the appropriate data base.

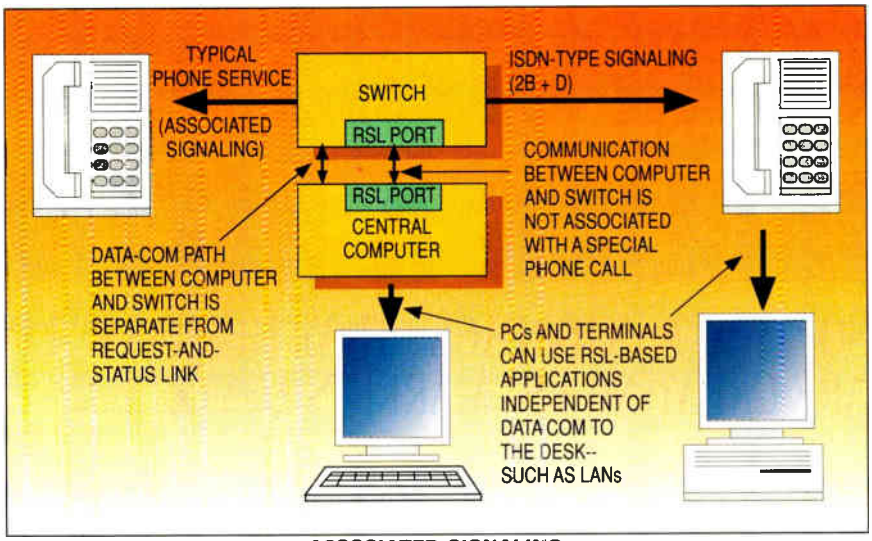
scenarios. "In a telemarketing application," says Spindler, "the host can direct the PBX to make calls from a list of numbers and when the PBX gets an answer, it immediately turns the line over to a customer service representative and directs the computer to ship the information in the customer's data file to that terminal."

For the immediate future, RSL interfaces will not be plug-and-play. Although standards bodies are hard at work in both the U. S. and Europe, the name of the game today is for PBX and computer makers to work out their own interfaces. "Standards are not here yet, and everybody has his own variation on what the standard should be," says Nancy Pryor, AT&T Co.'s marketing manager for call-management products in Bridgewater, N. J. In the meantime, customers are demanding RSLs that they can use now.

For its part, AT&T has published a specification called the Adjunct/Switch Applications Interface, which describes much of the functionality and implementation of an RSL. It has also introduced two products that are subsets of ASAI: ISDN Gateway and the Integrated Telemarketing Gateway. Northern Telecom's version of an RSL is the Meridian Link. In all likelihood, ASAI and Northern Telecom's generic specification will converge with the work of standards bodies as standards evolve.

AT&T's ISDN Gateway is a fairly simple one-way interface that converts ISDN formats to the CCITT X.25 protocol and passes the information to the computer, many of which already accept the X.25 format. AT&T's Integrated Telemarketing Gateway (ITG) comes much closer to an RSL, since it allows two-way communication between the switch and the computer. "When we move to ASAI," says Pryor, "customers will be able to port their applications from ITG easily." Today's products are, in fact, protocol converters—boxes that stand between the computer and the PBX. In the future, RSLs will be implemented inside the PBX. "As soon as three years from now, potential customers will not even talk to PBX makers that do not have RSLs onboard," says Nabnasset's Borton.

Besides Northern Telecom and AT&T, other market-leader companies with RSL programs include British Telecom, Digital Equipment, Hewlett-Packard, IBM, InteCom, Mitel, Rolm, Siemens, Stratus, Tandem, Unisys, and Wang. Harris Corp.'s Digital Telephone Systems Division in Novato, Calif., offers an RSL that can take fuller advantage of ISDN's capabilities. Primarily aimed at the narrow market for high-security government agencies, the Harris Secure Network Switch implements complex security functions, says Dave Hochman, manager of product planning.



ASSOCIATED SIGNALING

Whether the incoming call is formatted in conventional phone service or ISDN, the initial voice-call setup uses associated signaling.

"Coupled with ISDN, we can use our computer link to set up a security server," he says. Using ISDN's signaling channel, the computer will inform the switch where a call originates and whether the caller has security clearance to phone a particular number. If clearance is granted, the call can go though over ISDN's data channels. If it is not, the call can be routed to another number.

Companies specializing in telecommunications software have also recognized the value of RSLs. Aristacom International Inc., Alameda, Calif., recently released a series of products that link AT&T PBXs with IBM System/370 mainframes. RSLs let "agents spend more time working with the customer and less time dealing with the phone and computer systems," says Charles D. Kissner, president. "The company delivers better customer service—that is what it is all about."

The progress in computer-to-PBX links opens a big opportunity for applications programmers. "For the first time," says Nabnasset's Borton, "software engineers now have access to the telephony service, instead of just the telephone." If past experience is any indication, he adds, the industry can expect to see an explosion of innovative applications for RSLs similar to—but smaller than—the one that followed the introduction of personal computers. Although similar opportunities exist for hardware vendors that can find a multimedia niche in storage or networking technologies, software will be in highest demand.

BUT "APPLICATIONS DEvelopment expertise is in short supply for these technologies," says Taia Ergueta, multivendor support product marketing manager for Hewlett-Packard Co. in Mountain View, Calif. Still other opportunities will be found in providing network support. To address this market, HP and Northern Telecom have set up a strategic alliance called the Corporate Networks Organization. At the core of the HP/Northern Telecom strategy is the interface between the Meridian SL-1 PBX and HP's Applied Computerized Telephony call-processing server and applications interfaces. Third-party software vendors are brought into the equation to provide application-specific software, and an HP-Northern Telecom joint service agreement means customers need only place a single phone call to have problems solved.

"It starts to become a very complex task to maximize system-level performance," says HP's Ergueta, "and the customers do not have any models or expertise to handle that. We are including support to remote users within our basic support service, for example, and that is something that would tax the resources of most of our customers if

they had to do it themselves."

Implementing an RSL involves new architectural features in the PBX-to-computer interface. The new architecture is driven primarily by two capabilities not now available in the interface: the proxy function and the monitor function. In the proxy function, the computer can dial on behalf of a telephone; in the monitor function, host-based applications software can query the PBX to determine a telephone's status (busy, on hold, or ringing). The host will be notified whenever there is a change in the phone's status.

Just as important to RSLs as proxy and monitoring capabilities is the concept of associated and disassociated signaling, says Nabnasset's Borton. With existing PBX technology, when users pick up the the phone and dial a number or press a feature button the information being passed is inextricably bound to the call in the same physical channel. This is known as associated signaling. "Under proxy dialing," says Borton, the dialing instructions are passed via the RSL. This procedure, which in ISDN terms is called disassociated signaling, enables applications on the computer to initiate calls or other features on behalf of the user."

Whether the incoming call is formatted in conventional phone service or ISDN, the initial voice-call setup uses associated signaling. In conventional signaling, the data-com path in the computer is set up by the customer keying in his or her phone number or account number, and this information is passed to the central processing unit.

MONITORING OF THE status of different terminals in the customer service network is provided over the RSL interface. Once an idle customer service representative is found, the CPU delivers the customer's data file to the appropriate terminal over a LAN and directs the PBX to deliver the voice call to the same representative's phone.

If an ISDN line is being used, the customer's phone number comes in over the signaling channel. An exchange of information between the CPU and the switch takes place to route the call to a particular customer service representative. But instead of using a separate data path—such as a LAN—to transmit the customer's file from the CPU to the terminal, the CPU has the option of sending the data-base information over an ISDN data channel back through the PBX for routing to the terminal. Meanwhile, the voice portion of the call is also being routed to the customer service representative.

Although a firm standard for RSLs is not expected for a couple of years, at least, standards bodies in the U. S. and Europe have already tackled the issue and are even consulting with one another. Representatives of the European Computer Manufacturers Association and the T1S1 committee of the American National Standards Institute met informally in San Francisco late in June to discuss their mutual interests and directions on RSLs.

ECMA has already published a document for the Computer Supported Telephony Application standard. It details application scenarios and establishes operating principles for a call model, says Domenic Iacovo, director of Northern Telecom's market-planning division in Richardson, Texas. But the ECMA document does not set forth a protocol architecture.

The U. S. T1S1 committee has not published a document yet. "It is somewhat behind ECMA," says Iacovo, "but not as dramatically as may be thought, because it has addressed a protocol architecture. But it does not have an end-to-end call model."

The committees are focusing on standardizing several areas including call-processing requests, status-and-event messages, and network-provided information. Call-processing requests include being able to make calls or conference calls, transfer calls, and implement special features required for automated call distribution. Status-and-event messages make it possible for the computer to know when a particular phone connected to a PBX is being used, is on hold, or is ringing.

Network-provided information is generally associated with ISDN and includes automatic number identification. Other features being discussed by ECMA and T1S1 include allowing computers to monitor automated call-distribution queues and giving PBXs the means of requesting routing information from computer-based applications.

SINCE THE VALUE OF THE RSLs can be enhanced by ISDN, the rapid progress of RSL standards work in both Europe and the U. S. prompts the question of migration strategies to the future world of totally digital communications. There is general agreeement that evolution toward ISDN will be slow for two reasons: the telecom industry is highly regulated and its enormous capital-equipment infrastructure must be replaced.

But the evolution is as inexorable as it is slow, which has prompted some LAN companies to ready themselves for the digital era. "We expect to have quite a few products over the next few years that provide connections to ISDN," says Chris Oliver, vice president of engineering for Cabletron Communications Corp., Rochester, N. H.

Oliver does not view ISDN as a viable competitor to existing LAN technology in the office or campus environment, but thinks it is essential to include it in wide-area-networking strategies. "We have not talked to many customers who are interested in ripping up existing plants to install ISDN," he says. "They are pretty happy with the T1 links they have now."

Similarly, Codex Corp. sees significant market opportunity in the slow migration toward ISDN, says Ray Wright, director of ISDN marketing for the Mansfield, Mass., manufacturer of modems and statistical multiplexers. "An increasing portion of our business is in selling complete solutions instead of boxes," he says. Computer makers won't install ISDN interfaces until the number of ISDN lines grows significantly, he says, and in the meantime, Codex will be marketing adapter gear.

To that end, Codex announced in May an analog-to-digital strategy that lets customers slowly replace analog equipment. The migration path includes an ability to consolidate its new digital products with existing analog items under the same network management system. E

LINKING VOICE AND DATA

The integration of voice and data is not the province of the telephone companies' ISDN alone; computer-to-PBX interfaces will make the same link on a customer's premises.

Every major computer and PBX maker has announced products implementing such interfaces, and the market is wide open for applications software.

JAPAN INC. MAKES ROOM FOR ENTREPRENEURS

ENTERPRISING UPSTARTS BELIE THE MYTH OF A MONOLITHIC CORPORATE SOCIETY

BY SHIN KUSUNOKI AND LAWRENCE CURRAN

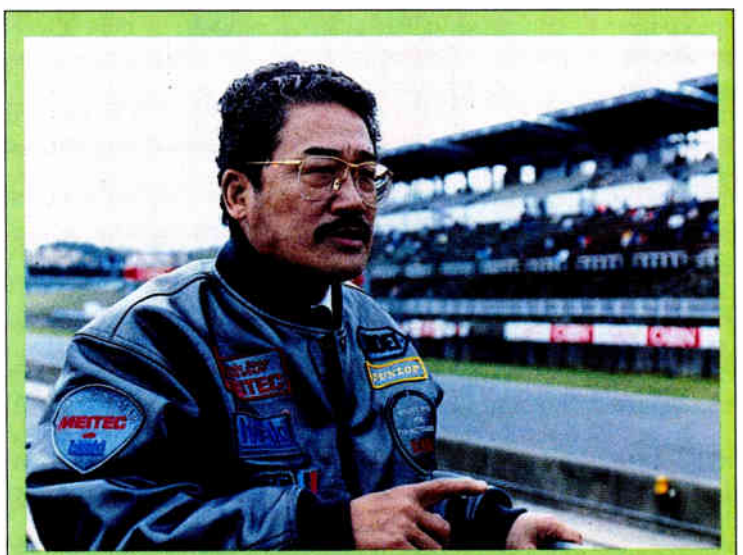
CORPORATE JAPAN MAY appear to the casual observer to be populated mostly by stodgy, monolithic companies that trace their roots to the 19th century, but the entrepreneurial spirit is alive and well in the island nation. And if the founders of a handful of electronics companies are somewhat representative, it would seem that there's not a great deal of difference between risk takers in Japan and the U. S. They're tough-minded, independent, and willing to risk their own money to chart their own courses.

The founders of Meitec, Nippon Densan, Rohm, and Giken Engineering all bankrolled their own startups, and each had the tenacity to endure serious setbacks. Two crises common to all included the very newness of their companies in a society that honors longevity, and a devastating 1973–74 recession stemming from the worldwide oil crisis.

For Fusaro Sekiguchi, the oil crisis proved to be not a blow but an opportunity. In fact, his company—Meitec Corp., a design-engineering service—would not have existed without it. By 1974 the oil shortage had "dealt a great blow to the Japanese economy," Sekiguchi says. The land of lifetime employment saw large-scale layoffs, he recalls, and at the same time the big corporations moved to make their production, design, and development facilities more energy-efficient.

Sekiguchi concluded that there was in Japan a considerable shortage of design engineers, "the kind of shortage that could not be replenished overnight. This gave me the idea for a new type of business. Our engineers would go into client companies when needed and forge ties with personnel there while on the job. When the job is over, the client sends our engineers back to us." Technically, Meitec's industrial classification is engineering design, but Sekiguchi says his company was one of the first in Japan to provide a personnel-dispatch, or "brain-leasing," service.

JAPAN



'I like to think that I get right in with the employees, link arms with them in a kind of scrimmage, and spearhead the rush forward. Because they've trusted me, they've followed me.'
FUSARO SEKIGUCHI

Sekiguchi founded the company, then called Nagoya Technology Center, in 1974 in cramped quarters on the second floor above a bookstore in Nagoya. The company trains and places engineering temps in manufacturing firms specializing in electronics, automobiles, and machine tools. Since then, Meitec has set up shop in Tokyo as well, and has sales and other offices in more than 30 additional locations in Japan. Sales for fiscal 1989 were $179 million and employment has grown over the years from seven to 4,900.

The company operates much like a U.S. temporary placement agency for engineers and technical talent, although the time Meitec's engineers are employed by client firms may be as long as three years. Meitec's Nagoya training center each year grooms 200 to 300 high-school graduates to do engineering, sending them out to client companies after a year of practical training.

One part of the Meitec rationale is Sekiguchi's conviction that Japanese companies are quick to copy successful new merchandise or even patented material. What's more, the technology in most so-called "high-tech" products these days "is more or less a rehash or adaptation of conventional technology. And you need brainpower to do the adaptation—to work the new elements into conventional technology," he says. Meitec provides that brainpower.

Sekiguchi's motivations for staking a small claim above that bookstore were simple: he wanted to run his own busi-

ness and had enough self-confidence to risk his own money when there was no venture capital available. He also wanted to make a unique contribution, and in Sekiguchi's case, that goes well beyond providing a service that was unprecedented at the time. It also means applying a management style that encourages the "dreams and aspirations" of employees. For example, in each issue of the company's magazine, he publishes ads encouraging employees to concoct viable business ventures; Sekiguchi will back them financially. He encourages employees in other ways as well. His hobbies include race horses, fast boats, and fast cars. To cultivate an appreciation for fine design, he displays in the Nagoya lobby a $2 million Bugatti. And to reward good work, he turns over the corporate Ferrari Testarosa to the employee of the week for a weekend.

Sekiguchi says Meitec's success began with three major projects for the giant Mitsubishi Heavy Industries involving production of the U. S. Air Force/McDonnell Douglas Corp. F-15 fighter aircraft, the U. S. Navy/Lockheed Corp. P-3C antisubmarine patrol plane, and the Boeing 767 commercial airliner.

Meitec's client list grew to include Hitachi, Toshiba, and Toyota Auto Body, some of which were concerned about Meitec's ability to maintain confidentiality about proprietary information. "But once we did work for them, they were pleased with the results. Now we're doing business with nearly all the companies on the Tokyo Stock Exchange." In fact, Meitec takes great pains to protect client confidentiality. For example, Sekiguchi says, "we don't send a person who designed cassettes for Matsushita to design cassettes for Toshiba. Because we strictly observe these guidelines, we've been able to gain the trust of our clients."

Winning the clients' trust is only half the battle; as Sekiguchi sees it, winning your employees' trust is the other. "The most vital element in this business is maintaining the trust of your employees," he says. Because the engineering-design service Meitec provides was so unique at the outset, it wasn't easy for early employees to feel secure in their jobs, a situation that Sekiguchi had to correct.

In the early days, he went so far as to pay a cadre of engineers to remain at home on call during times when he had no work for them. "I had to retain the necessary personnel in preparation for the expansion. That's why I didn't let them go," he says.

Anecdotes like that confirm Sekiguchi's overall philosophy: "At Meitec, I like to think that I get right in with the employees, link arms with them in a kind of scrimmage, and spearhead the rush forward. Because they've trusted me, they've followed me."

'Most companies stop concentrating on building market share when they reach 70%, but we have no intention of lowering our guard.'
SHIGENOBU NAGAMORI

THE FIRST CUSTOMER FOR Nippon Densan Corp., based in Kyoto and now the overwhelming worldwide market leader in supplying spindle motors to manufacturers of hard-disk drives, was 3M Co. Happily for Nippon Densan, 3M made its purchase decision based on the performance of sample motors, without visiting the "plant."

That was 17 years ago, when Nippon Densan was a four-person operation in a small dye works in Kyoto. Founder and president Shigenobu Nagamori located 3M through the Yellow Pages, eventually supplying the complex motors then used in magnetic tape-duplicating machines.

From that humble start in 1973, Nippon Densan has grown to supply 95% of the world's supply of disk-drive spindle motors, recording revenues last year of $292 million. But there's nothing humble about Nagamori, who wants to reach $1 billion in sales in 1993. He says the company has never had an unprofitable year.

BRASH IS PROBABLY THE best description for Nagamori, who was 28 when, with his own money and the help of three associates, he started Nippon Densan. His colleagues were 27, 26, and 24—hardly impressive in a society that honors experience.

Nagamori recalls that "the Japanese companies we approached asked us how long we'd been in business. When we replied, 'about half a year,' they'd ask why they should deal with a complete novice when there were 30 or 40 other motor manufacturers around." Prospective Japanese customers also wanted to see the facility.

At the time, Nagamori hadn't moved to the dye works. He and his associates still worked in a single room in his home. "No one would have anything to do with us," he says. "We consequently tried to sell to American firms." It worked. With Nippon Densan performing due diligence from long distance, 3M never had to set foot in the home-style dye works.

Nagamori's fascination with motors stems from his grade-school days, when he received praise from an otherwise critical teacher for assembling a motor from a kit. "That made a big impression on me. I became determined to learn about motors once I entered college," he says. Before founding Nippon Densan, he had worked for three years at Teac and Yamashina Precision.

Teac makes tape recorders. "The president asked me what I would like to do at the company," Nagamori says. "I was brimming with confidence, and I asked him what he was having most trouble with. When he said it was motors, I replied, 'That's exactly what I want to do.'"

He got the assignment and soon became an authority. When Teac established a subsidiary—Shinano Teac—to produce spindle motors, the 24-year-old Nagamori asked Teac's president three times in two years to be put in

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charge of the new venture. Two of those requests came after the subsidiary suffered a long stretch of defective production. After all three requests were denied, Nagamori decided to leave Teac. (Fittingly enough, Nippon Densan acquired Shinano Teac, then known as Shinano Tokki, along with its 25% market share, in 1989.)

Nagamori then joined Yamashina Precision, a machine-tool manufacturer that liked his idea of branching out into motors. "At age 25, I was appointed director of one of their divisions," he says. Two years later, he became head of the subsidiary set up to make the motors and a member of the board of directors. But his plan had always been to start his own business, and for seed money, Nagamori dreamed up a novel tactic: he bought a life-insurance policy that named a bank as beneficiary, then approached that bank for a loan. Asked to show collateral, he produced the policy—and got the loan.

BUT IT WAS FAR FROM smooth sailing after Nippon Densan got off the ground in 1973. The fledgling company survived three brushes with bankruptcy and then, in 1986–87, just after the yen appreciated, it faced another crisis because 65% of its sales were from exports.

When competitors hiked their prices, Nippon Densan gambled by lowering them, gaining market share while managing to remain profitable. "We were headed toward bankruptcy at the time," Nagamori says, and as a last resort, "I thought we might as well try to gain market share."

By this time, venture capital was plentiful in Japan; Nippon Densan found backers, invested in additional production facilities, and "achieved our greatest growth after the yen's appreciation. Our competitors weakened overnight," Nagamori says. "Our market share shot from 40% to 70%." Nippon Densan boosted its share to 95% with the Shinano Tokki (the former Teac subsidiary) acquisition.

But Nagamori isn't resting yet. "Most companies stop concentrating on building market share when they reach 70%, but we have no intention of lowering our guard," he says. His boldness and commitment suggest there's a good chance Nippon Densan will reach his goals for the 20th anniversary—sales of $1 billion and a Class A listing on the Tokyo Stock Exchange.

NECESSITY may be the mother of invention, but the founder of Rohm Co. Ltd. learned early on that there has to be a necessity *for* the invention, too. He is Ken Sato, who came up with a patented way to produce small resistors because the electric furnaces he used to fire the products in 1957 would not accommodate the large size of conventional units.

"But they didn't sell," Sato reports. Even though he was satisfied that the devices offered an equivalent 2-W output to the standard size, Sato says that prospective customers "couldn't believe resistors that small could perform as well as the big ones. When we didn't find any buyers, I thought for sure that the business was finished."

'When you're playing piano, your performance is rated by a third party. In business, it's the same—the third party is the customer.'
KEN SATO

Then along came transistor radios, which served to launch Rohm, now a Kyoto-based multinational company with 1989 revenues of $1.1 billion. The tiny radios, introduced by Sony Corp. in 1958, couldn't accommodate conventional resistors. "That's when the compact models we made began to sell like hotcakes," Sato says. "The world of radios changed overnight from vacuum tubes to the transistor, and we rode the crest of that change."

Rohm's catalog now includes resistors, capacitors, transistors, integrated circuits, semiconductor lasers, print heads, and LED- and LCD-display devices. The firm owns 61% of Exar Corp., the San Jose, Calif., producer of monolithic linear ICs and application-specific ICs. Rohm has nine factories in Japan, three in the U. S., two each in Brazil and Malaysia, and one each in Thailand and South Korea.

As a university student and accomplished pianist, Sato had no plans to start an electronics company. But he failed to win a coveted prize in a piano competition, "which made me resolve to do something else," says the reticent Sato, whose monklike daily regimen has given him a reputation for eccentricity. He says that he peruses business documents as if they were musical scores, and it's been said that he leads Rohm the way a conductor leads a symphony orchestra—with a combination of passion and self-analytical composure.

The idea that became Rohm came to Sato in his bathroom, which in Japan is used only for bathing and in older homes is separate from the main building. "I suppose it would have been a garage in the United States," he quips, "but in those days, almost no Japanese could afford a car, so there were very few garages."

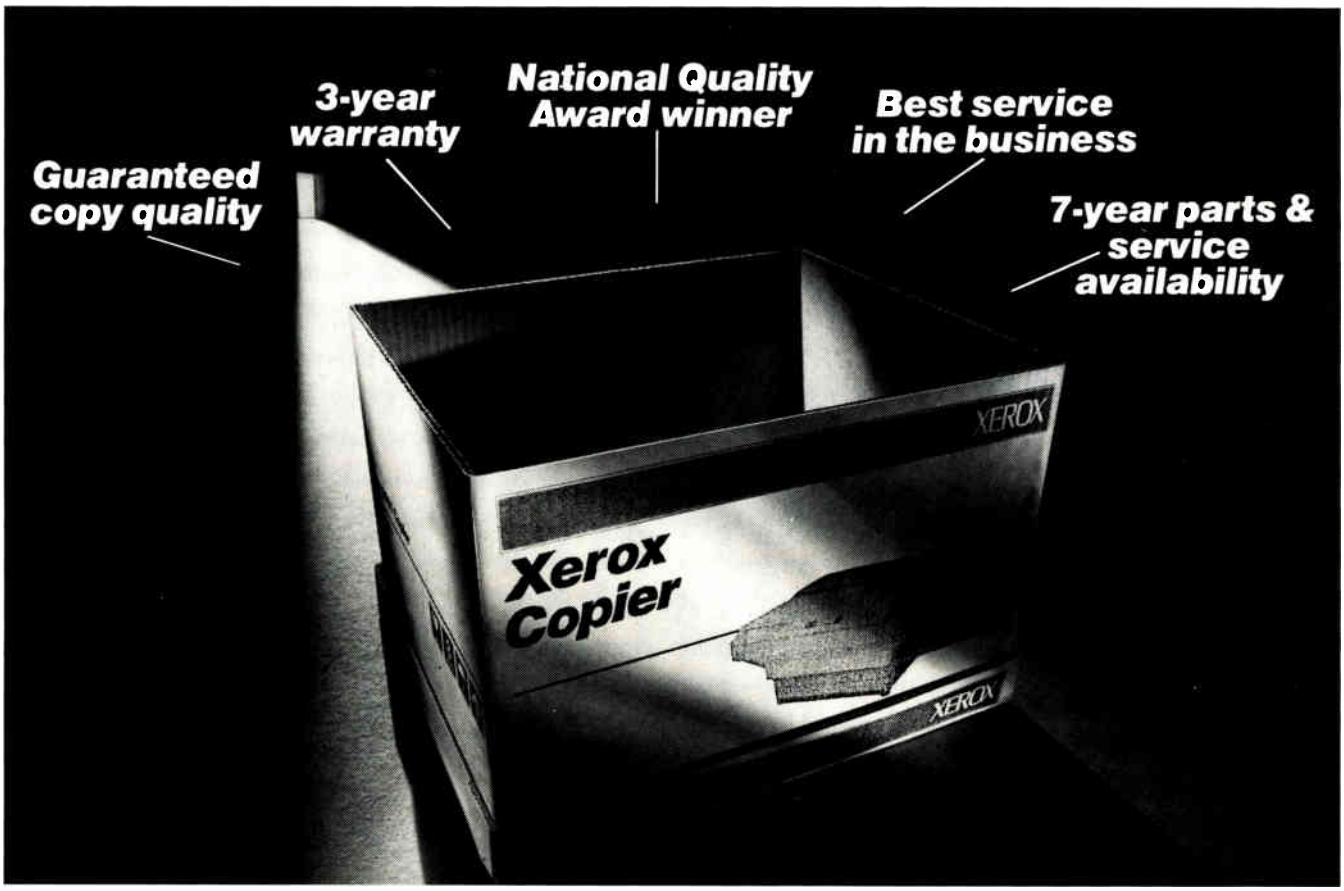
While he was still a university student, Sato's bathroom laboratory was the incubator for the tiny resistors. He filed for a patent covering his manufacturing method, got it two years later, and eventually moved production to a house obtained rent-free from a friend.

With about $100 borrowed from an uncle, Sato purchased or made the equipment he needed and began producing resistors. After the initial frustration of trying to sell them, he began to find acceptance from makers of tube-type portable radios and later hit paydirt with Sony's transistor radios, "selling resistors by the tens of thousands."

INCORPORATING IN 1958, Rohm soon moved to more substantial production facilities and branched into additional products—first diodes, then transistors. A pivotal development came when Rohm learned after opening an office in Irvine, Calif., that the U. S. market favors standards. Rohm made its resistors even smaller to conform to the American standard, which in turn made them more attractive to customers in Japan and elsewhere.

Like many Japanese firms, Rohm endured its worst corporate crisis during the 1973–74 oil-related recession. Rohm's products then also included LEDs and thermal print heads, as well

XEROX



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CIRCLE 2

THE

NEWSMAKERS

COMPAQ COMPUTER CORP.

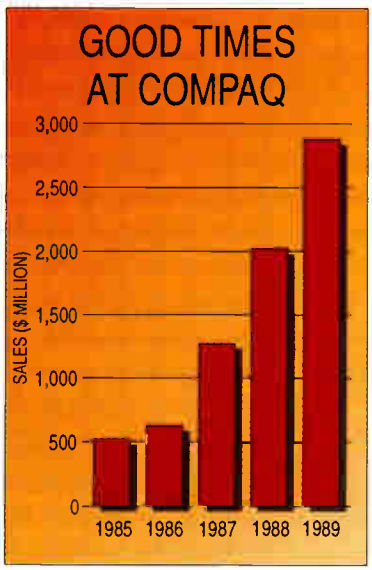
SYSTEMPRO FAMILY THRUSTS THE PC MAKER INTO THE MINICOMPUTER/SERVER ARENA

COMPAQ DIPS A TOE INTO A BIGGER POND

BY LAWRENCE CURRAN

WHEN HOUSTON-BASED Compaq Computer Corp. announced its Systempro PC System last November, the company served notice that it was ready to swim in another pond. Despite the PC label, their performance puts these computers in a class with minicomputers and mini-class servers.

But they put Compaq, which has thrived in the IBM-compatible PC business, under the guns of a new class of competitors. Among them are: Digital Equipment and Hewlett-Packard, as well as IBM. Early signs are that Compaq can take it.



Compaq closed 1989 with net income of $333 million on revenue of $2.87 billion. That's a 39% boost in revenue and almost 31% in net income over 1988. Rod Canion, cofounder, president, and chief executive officer, says Compaq grew twice as fast as the PC industry.

Those percentages, however, aren't nearly as eye-popping as Compaq's experience in its first full year of business. That was 1983, when it set a first-year record for U.S. companies: $111 million in revenue by providing a portable 31-lb pound IBM-compatible PC.

Indications that Compaq's move into more powerful computers comes at an opportune time include the company's sound financial position, a trend toward PCs instead of minis or mainframes as network servers, and the early acceptance of the Systempro.

Canion says of the response to the Systempro that he's "very pleased. Meanwhile, we're building our capability to support and distribute" it.

Indeed, Compaq's ability to distribute a computer that requires a more technical sell than PCs is one of the biggest questions about Systempro. Compaq has always relied on dealers as its sole market outlet, numbering Businessland and Computerland among them. Some observers question whether such dealers can sell Systempro.

Canion is convinced they can, but he doesn't rule out affiliations between dealers and system integrators to help the process along. "The world said that dealers couldn't sell local-area networks and computer-aided design systems, too," Canion points out, "but they're doing those things."

For his part, analyst William Zachmann sees no reason why dealers can't adapt to a more technical sell. Zachmann is president of Canopus Research, a Duxbury, Mass., consulting firm that follows the computer industry. "So far, the results seem to be good," he says. Shipments of three

models of the Enhanced Industry Standard Architecture (EISA)-bus Systempro PC System began last December. They carry resale prices of $15,999 to $25,999. Their central processors use a 33-MHz version of the Intel 80386 to deliver performance ranging from 8 million to 40 million instructions/s. A CPU built with a 33-MHz version of the 80486 will be added to the family soon. The Systempro can run MS-DOS, OS/2, the Santa Cruz Operation's SCO Unix, and two network operating systems—Novell Inc.'s Netware and Microsoft Corp.'s LAN Manager running on OS/2.

Compaq's effort to stake a larger claim in the minicomputer/server market doesn't mean it will pay less attention to its historic PC business. Says Canion, "We think we've established ourselves as the No. 2 business PC supplier around the world, behind IBM. We're taking the right action from a product and marketing position to protect that position."

FOR EXAMPLE, WHEN THE Systempro was announced, Compaq also unveiled its Deskpro 486/25 PC, which uses a 25-MHz 486 CPU to deliver 15 mips, which is as much as three times faster than 386-based desktop PCs.

And earlier Compaq PCs have enabled the company to make a major mark as CAD/CAE workstations, especially in running AutoCAD applications. "AutoCAD is the best-selling application in CAD. It's been the key to our success there," Canion says.

Canion sees no need for Compaq to jump on the trend to Unix-based reduced-instruction-set-computing workstations. "It's not clear that we need to go to RISC-Unix to compete effectively" for that business.

In last year's annual report, Canion said of the Systempro family that "this product is at the forefront of a revolution that will see the dividing lines [among] PCs, minicomputers, and mainframes virtually disappear by the end of this decade."

And Compaq appears to be well-positioned to take advantage of such a dynamic market. Zachmann of Canopus Research says, "The company introduced 386-based products before IBM did, and has a better share [than IBM] in higher-margin products. Compaq looks like one of the best-positioned companies for the 1990s." E

NCR CORP.

'CENTERS OF EXCELLENCE' OFFER ONE-STOP SHOPPING AS SERVICE COMES TO THE FORE

NCR WOOS CUSTOMERS

BY WESLEY R. IVERSEN

THERE ARE A NUMBER OF reasons to improve customer service (see p. 50). But at NCR Corp., the global move to open computing is precipitating what amounts to a revolution. "The last biggest change we made as a company in service and support was probably 15 years ago, when we had to make a major conversion out of the world of mechanical products into the world of electronic products," says Richard B. Reese, vice president of customer services at the Dayton, Ohio, computer maker.

In May, NCR unveiled a new strategy for customer service and support in the 1990s, based on what it calls "Centers of Expertise." NCR hopes to have the new structure operating worldwide by year's end. The plan serves as a blueprint for developing and delivering what Reese calls the "higher level of professional services and consultative types of skills" that customers will require as the era of cooperative, or standards-based, computing unfolds.

The NCR initiative mirrors what's happening across the computer industry, as vendors move toward a broader range of services geared toward one-stop shopping for the customer. But the NCR plan goes further than most in formalizing various service components and channeling their delivery, industry watchers say. The NCR setup, in fact, "provides an interesting model for the rest of the world in terms of how you might organize a customer services group," says Rebecca Segal, an analyst at market researcher International Data Corp. in Framingham, Mass.

The Centers of Expertise approach is part of what NCR calls Open, Cooperative Computing (OCC)—an umbrella strategy for standards-based computing that was unveiled in February. "For many years, the kinds of support that you brought to the customer tended to be oriented around your proprietary solution, so you had a lot of knowledge about that, but not a lot of knowledge in general in the context of what you need to know in an open environment," Reese says.

In the fast-emerging open-computing era, customers will require more depth from their service providers, he says. Customer priorities will shift toward more specialized services like systems integration, software porting, training, and consulting on migration strategies in multivendor environments, for example. Under the new framework, NCR's customer service organizations will be realigned into different types of centers, each concentrating expertise in a specific area: systems integration, product application, customer support, education, logistics, industry environments, software engineering, and business management.

One key is the Account Support Center, which is responsible for coordinating delivery of services from the other eight. A single account manager serves as a primary point of contact for the customer for any service need.

The company has already set up group-level Systems Integration Centers for the U. S. (Dayton) and Europe (Frankfurt), and plans to set up additional division- and country-level units. A similar structure will be used in NCR's other two marketing regions—the Pacific, and Latin America/Middle East/Africa. The Systems Integration Centers are staffed by professionals with broad knowledge in communications architecture, networking products, and development engineering techniques. The aim: to help customers integrate NCR products into multivendor computing environments.

Software Engineering Centers will come in several flavors, Reese says. "In Europe, we have a major Software Engineering Center in Zurich, and we're putting porting centers in the U. S. Essentially, these centers are to help teach customers how to best utilize the applications development environment that's available in an OCC way of computing." E

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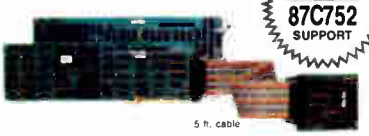

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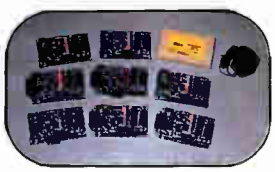

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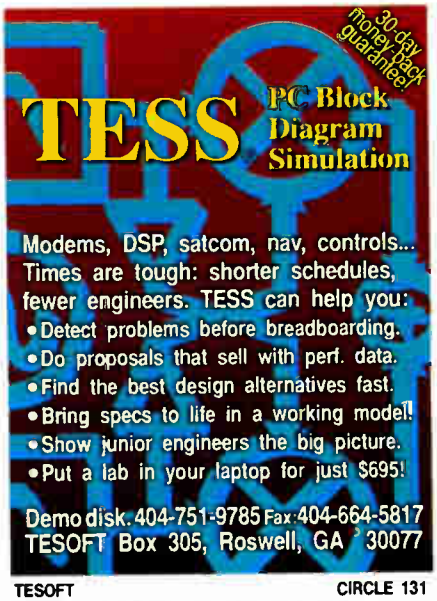

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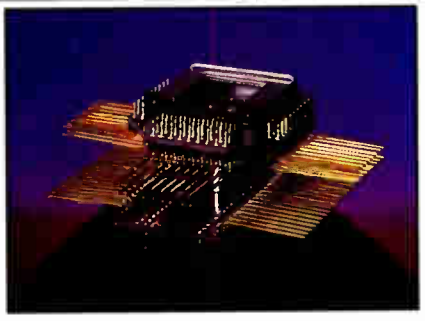

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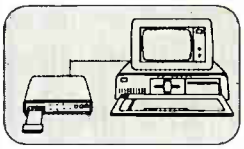

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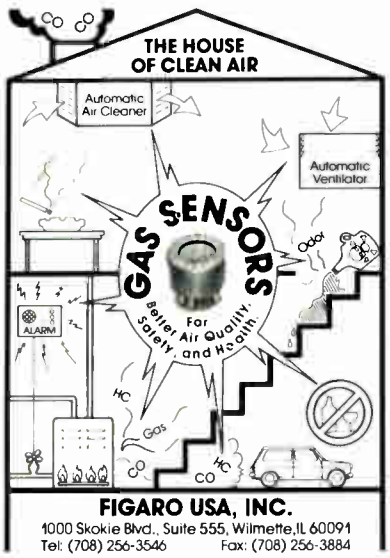

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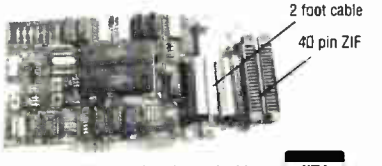

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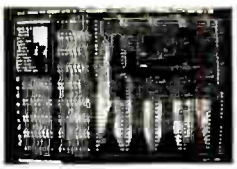

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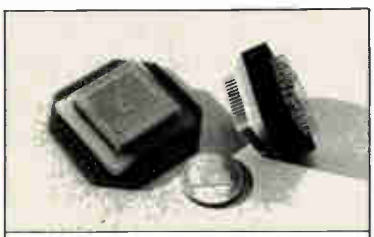

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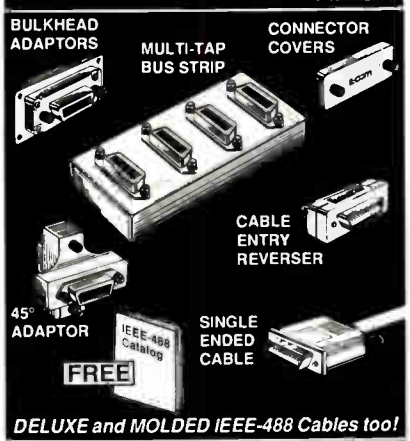

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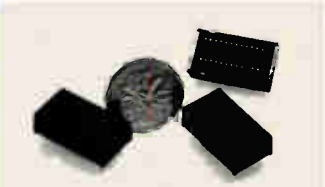

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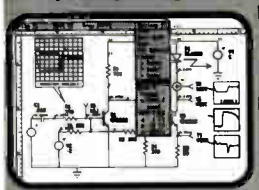

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Supervisor - International Nuclear Field Support. Supervise personnel providing worldwide technical support on the installation, preventive and corrective maintenance of nuclear medical product line and training and on-site support to international service engineers, when necessary; communicate technical & safety information concerning product changes, troubleshooting techniques, changes to product operating adjustment procedures and/or specifications to the field; develop installation, calibration and maintenance procedures; provide management with information on technical support requirements worldwide and unique geographical and/or economic situations; consult with local service management in the international territories to recommend changes/additions to enhance serviceability and assist in the development of service plans, maintenance procedures and troubleshooting procedures; influence product design and change with respect to product serviceability and reliability; analyze data on system performance, cost of maintenance and failure information for installed product base to identify trends and implement solutions; utilize specific knowledge of dedicated instruments for the European and Eastern markets such as Single and Dual Rota Camera, Lesa Camera, special modified detectors and collimators computer programs and interfaces in performing the above referenced duties. Bachelor's degree in Electrical Engineering Technology required together with 4 years experience in the job offered or 4 years experience as Manager, Customer Technical Service or International Service Support Manager. In lieu of Bachelor's degree in Electrical Engineering Technology and 4 years of experience in the job offered or as International Service Support Manager or as Manager, Customer Technical Service, will accept applicants who have completed 3 years of college majoring in Electrical Engineering Technology and have 6 years experience in the job offered or as International Service Support Manager or as Manager, Customer Technical Service. Experience as International Service Support Manager or as Manager, Customer Technical Service must have been in the nuclear medical diagnostic equipment industry directing the service and clinical application of Gamma Camera systems made for worldwide application as well as special developed instruments such as the Single/Dual Rota and Lesa Cameras, collimators, color printers and software. 40 hrs./wk., M/F, 8:00 a.m. to 4:30 p.m., $43,500/yr. Send resumes to: Illinois Department of Employment Security, 401 South State Street - 3 South, Chicago, Illinois 60605, Attn: Joan Sykstus, Ref #V-IL 1016-S. AN EMPLOYER PAID AD.

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SYSTEM ANALYST: Design and analyze interface circuits and software modules to insure compatibilities of computer hardware and software. Analyze and evaluate the Patter Design System (PDS) software. Modify C and LISP language interface for Computer Aided Design (CAD). Develop software using structure computer language and Microsoft window in Local computer network system including troubleshooting. Test and enhance Erasable and Programmable Read-Only memory chips for VLSI-based computer system. Requires Master of Science degree in Electrical Engineering & Computer Science. Also requires three months experience in the job to be performed or three months experience as a Software Engineer. Entire three months experience must include software and hardware interfacing and local network analysis. Education to include completion of one course in each of the following: Network Synthesis, Structure Programming, List-Processing (LISP). Hours: 8:00 a.m. - 5:00 p.m. 40 hours per week at $33,000.00 per year salary. Please send resume to: ILLINOIS DEPARTMENT OF EMPLOYMENT SECURITY, 401 South State Street - 3 South, Chicago, Illinois 60605, Attention: L. DONEGAN, Reference #1426-D, AN EMPLOYER PAID AD.

EMPLOYMENT OPPORTUNITIES

ELECTRICAL ENGINEER

The successful candidate will: 1) be responsible for designing modules, subsystems and complete communication systems, and for preparing related documents; 2) evaluate satellite and microwave telecommunication concepts; 3) structure engineering concepts to develop and prepare project management plans to bring satellite and telecommunication systems into production; 4) be responsible for writing test procedures and for providing guidelines and test parameters for testing and quality assurance personnel; and 5) assist in budget preparation, employee evaluations and drafting of specifications and manuals for equipment. Education required: B.S.E.E. or certified equivalent, with electrical engineering as major field of study. Experience required: five years in the job offered or in a related electronics engineering position. Other special requirements: 1) must have performed complex circuit analysis, such as microwave theory, high voltage power supplies, control logic circuitry, video and data transmissions, and must have formulated schematic wiring designs for two years; 2) must have tested, operated and maintained sophisticated communications systems and equipment, such as upconverters, downconverters, modems and transmitters for two years; and 3) must have taken undergraduate courses specializing in microwave frequency technology and satellite communications transmission analysis, with minimum requirements as follows:

- satellite communications—4 courses
- microwave transmission technology—2 courses
- radio transmissions—1 course
- antenna theory—1 course

Forty-plus hour basic work week, 8:00 a.m. to 4:30 p.m. Basic salary is $38,000 per year, no overtime. Applications and resumes should be submitted to: **ILLINOIS DEPARTMENT OF EMPLOYMENT SECURITY**, 401 South State Street - 3 South, Chicago, Illinois 60605, **ATTN:** Robert S. Felton, Reference #V-IL 9938-F. AN EMPLOYER PAID AD.

DESIGN ENGINEER. Digital processing software design, employing Z transforms and Fourier, for the TMS320 family of processing products, used in the telecommunications industry. Requires design capability with analog and digital hardware which interfaces with digital signal processing software. Design involves use of the TMS320 assembly language programming. Perform digital filter design, (both IIR and FIR). Use numerical analysis concepts to improve signal quality. Minimum Requirements: M.S. in Electrical Engineering (6 years of college), including at least one graduate course or 2 semesters of graduate research work in: a) digital signal processing, using TMS320 microprocessor, and TMS320 assembly language; & b) digital filter design (both IIR and FIR). 40 hours per week; overtime as required. 8:00 a.m. to 4:30 p.m. $33,000 per year. Submit resume to: Illinois Department of Employment Security, 401 South State Street, 3 South, Chicago, IL 60605, Attention: Mr. Leon Donegan, Reference #1273-D, AN EMPLOYER PAID AD.

SOFTWARE ENGINEER: Design, implement, test, and support multi-task graphics and image libraries to be used for application design in manufacturing of nuclear medical workstations and medical image devices based on 68020 microprocessors including implementation and integration of new hardware and software features. Will update **VRTX** tools to version v.4.0 on VAX running VMS 5.x including software modification to assure compatibility with tools such as compilers, assemblers, and linkers. Will use emulator to assure modification of tools. Will modify system software windows and DCP software to assure proper access to information including test functions and design implementation. **Requires** M.S. degree in Electrical Engineering with major field of study in Computer Engineering. Education to include completion of one course in each of the following: Computer Graphics, Software Engineering, Computer Architecture, Operating Systems, Expert System, Pattern Recognition (for images), Artificial Intelligence, VLSI (Very Large Scale Integration). Education to include use of the following computers VAX/VMS, Apollo workstation, and 68020 microprocessors as well as use of Assembler language (68000/68020) in coursework. Education to include completion of Master's thesis in the following: designing, testing, and developing of both hardware and software for use in medical devices. Hours: 9:00 a.m. - 5:00 p.m. 40 hours per week at $33,500.00 per year salary. Please send resume to: ILLINOIS DEPARTMENT OF EMPLOYMENT SECURITY, 401 South State Street - 3 South, Chicago, Illinois 60605, Attention: L. DONEGAN, Reference #1404-D. AN EMPLOYER PAID AD.

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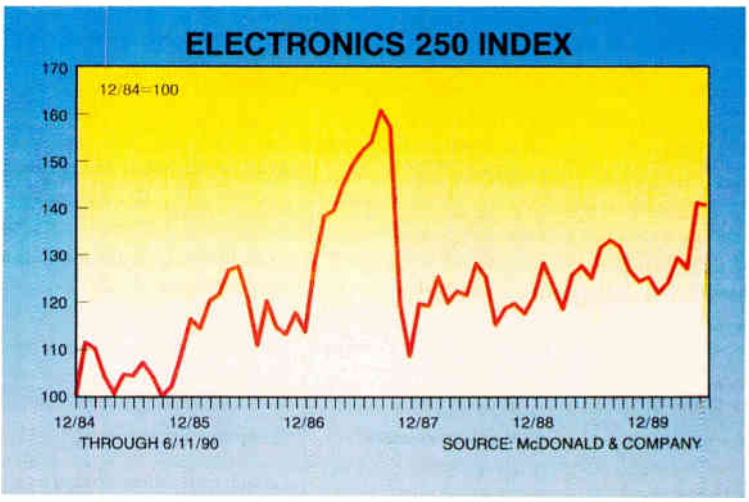


Orders are growing slowly, with computers showing the way as the industry is spurred by IBM's first-quarter gains.

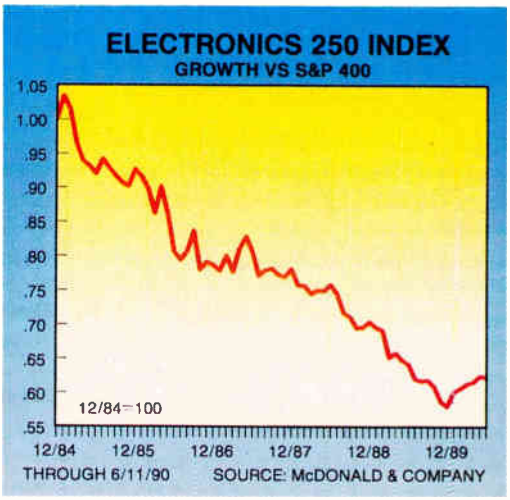
COMPUTER ORDER ACTIVITY MAY BE starting to turn up. Falling on the heels of IBM Corp.'s very strong first-quarter revenue gains, the rest of the industry appears to have finally passed the trough in order momentum. Backlogs have stabilized. Inventory productivity, while still lagging behind 1988 performance, is improving.

Electronic component orders were relatively weak in April, but this was expected coming off an unsustainable March performance. Backlog levels have started to turn up, and inventories remain tight. Availability of Intel 80386 microprocessors remains very tight, and the company is now indicating that supplies will not come into balance with demand until October or November. Modest pent-up demand is being created, a good sign for leading-edge component company earnings. Communications orders in April increased a strong 17%.

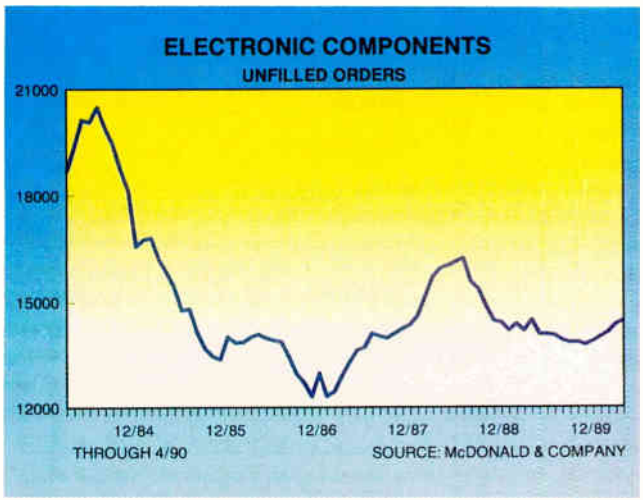
In general, order growth appears to be accelerating modestly. Computer order growth, which has been stuck in a 1%-to-4% range since late last summer, is now growing 3% to 5%. Component growth has risen to 6% to 7% from 5% to 6%. Motorola Inc. recently increased its outlook for worldwide 1990 semiconductor growth to 10% from 4%. Communications equipment orders are pushing 10% growth.

Abroad, events in Brazil appear to have stabilized for the time being. The automotive and appliance sectors were particularly hard hit in late March and April, but capacity utilization rates improved in May—several companies say they are up to about 70%—as the government eased a little more money back into the economy. There also is talk of some weakening in Japan and the UK, but increasing domestic strength appears to be an offsetting factor. E

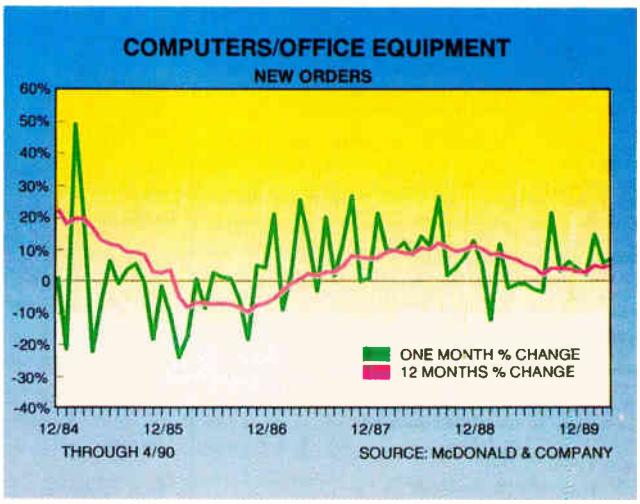
By Mark Parr, McDonald Securities Inc., Cleveland (216-443-2379)



The increase in orders is reflected in strong performance versus the S&P index.



Electronic component orders backed off in April, but that was no surprise in view of the strong March.



In computers and office equipment, backlogs have stabilized as inventory productivity improves.

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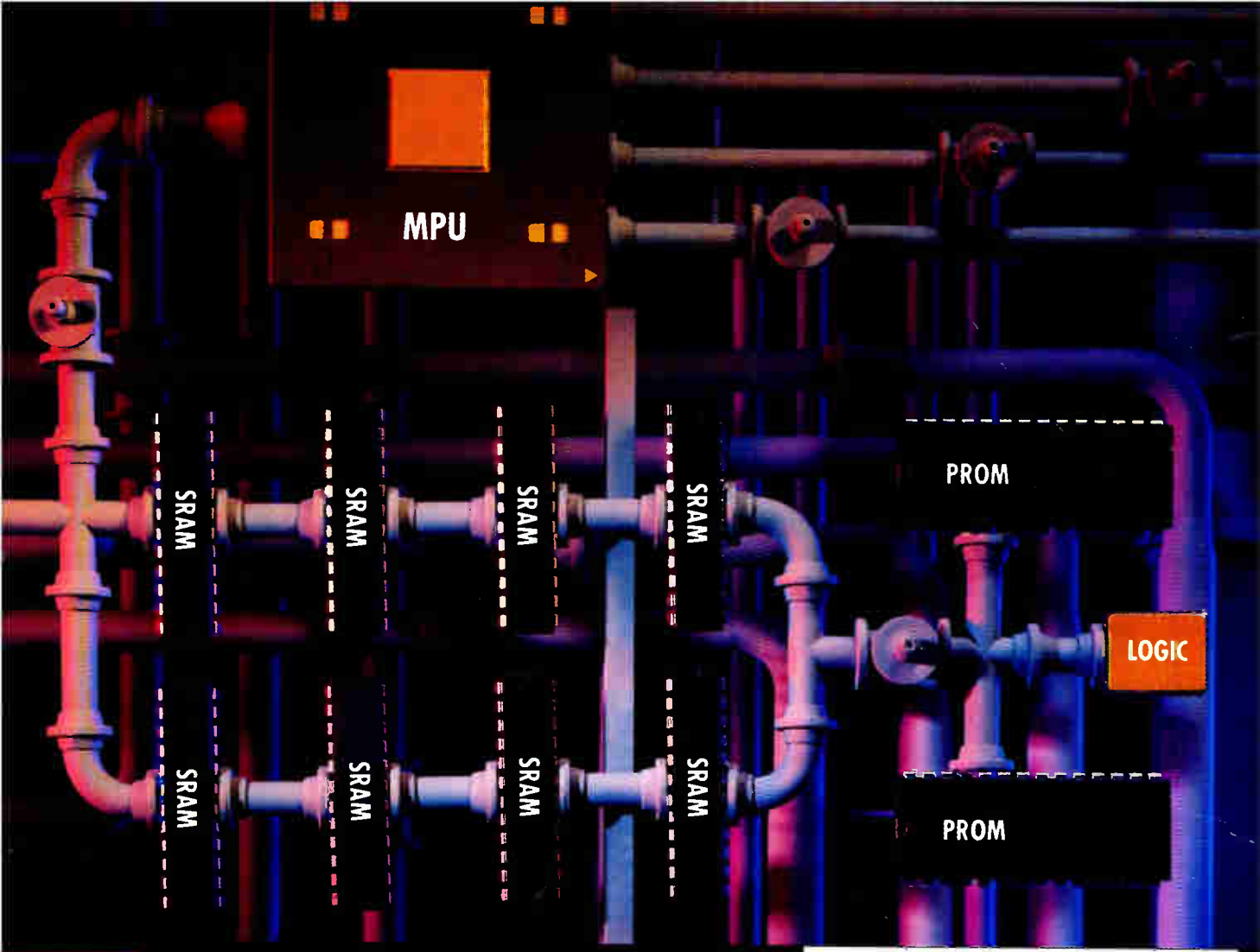

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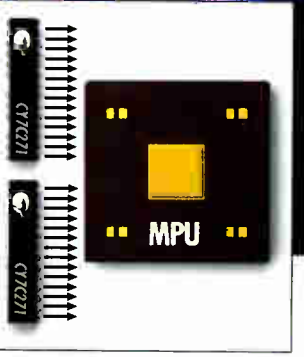

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