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MAY 1991

Electronics®

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

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PAGE 48

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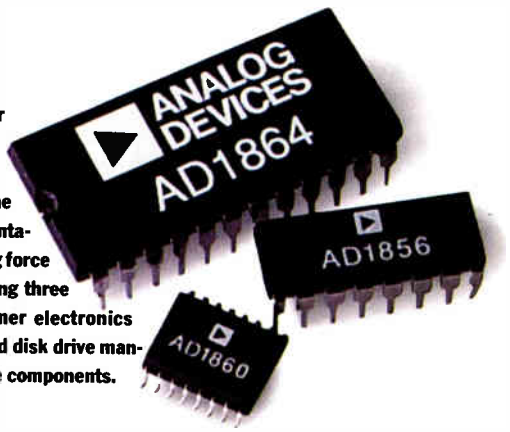

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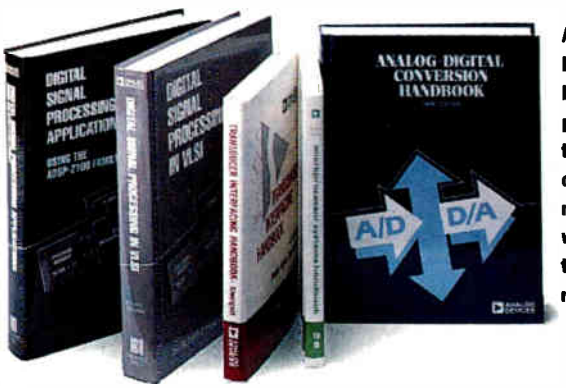

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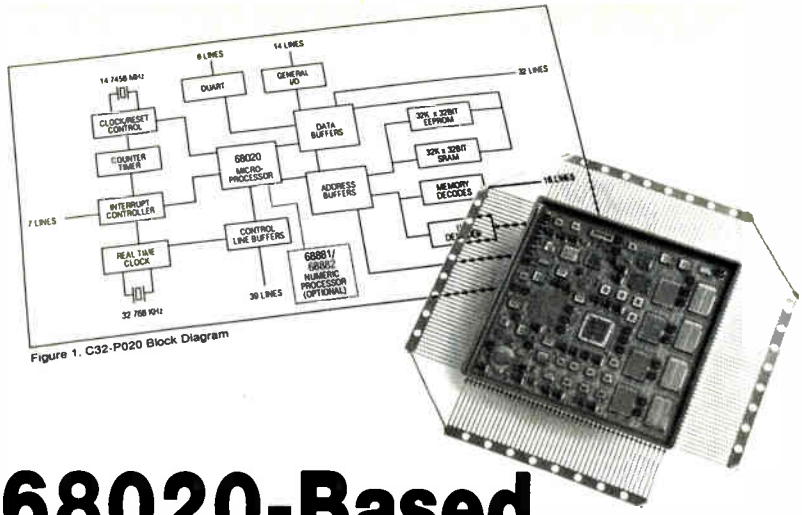

Figure 1. C32-P020 Block Diagram

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STYLE, SUBSTANCE, BALDRIGE

Football wisdom is a contradictory thing. On the one hand are the words of the writer Grantland Rice: "When the One Great Scorer comes to write against your name—he marks—not that you won or lost—but how you played the game." On the other is the dictum attributed to Vince Lombardi, the legendary coach of the Green Bay Packers: "Winning isn't everything, it's the only thing." The value system of the 20th century comes down flat on the side of Lombardi. In fact, the notion that winning is valued above all else exhibits itself in every aspect of our lives, from sports to school grades to job-performance ratings. Invariably, fans, parents, and employers toast the winning teams, reward the A's, and promote employees based on their ratings scores.

There's nothing wrong with wanting to be No. 1 and working hard to get there. But all too often, it seems, this winner-take-all philosophy creates problems in society as well as problems in the business world that conspire to reduce our ability to compete. Consider, for example, the highly visible Malcolm Baldrige National Quality Award. The award has been held up as the zenith in quality, yet some U.S. companies are treating it as just another contest to be won at all costs, without regard for the spirit of the enterprise. (For more commentary on the Baldrige, see Face-Off on p. 20.)

The contest was called into question by a *Wall Street Journal* article last fall entitled "Is Quality Award Becoming Job 1 for U.S. Companies?" The article quotes, among others, a consultant named Michael Maccoby, who advises companies interested in applying for the Baldrige. Some companies, Maccoby said, put more energy into creating an award-winning application than they do in fundamentally changing their operation to achieve the level of quality the award signifies.

Industry gadfly T.J. Rodgers, the president of Cypress Semiconductor Corp. in San Jose, Calif., likens the Baldrige entry process to preparing your income tax return. Rodgers, whose company is, in fact, applying for the award, says the procedure is cumbersome, time-consuming, and expensive, and demands the enlistment of outside experts to ensure that the application is correct. Just as dealing with the IRS has created a good living for an army of CPAs, so is the Baldrige spawning its own bureaucracy of specialists who help companies play all the angles in their Baldrige application forms.

For a company to chase style over substance—to win a Baldrige without producing the result it represents—is self-defeating. Over time, it's the customers who choose winners and losers. Having the Baldrige is, by itself, no guarantee that a company will be one of the chosen. ❑

Jonah McLeod

JONAH McLEOD
EDITOR

CAE Technology Report

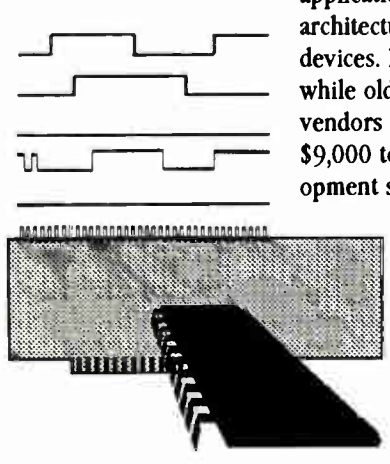
May 1991
Vol. 3, No. 5

Upgrades for Mentor, OrCAD and Viewlogic

SUSIE Concurrent Designer™ has been upgraded with interfaces to Mentor™, OrCAD™ and Viewlogic™. This allows these popular data entry tools to work directly with the real-time SUSIE simulator. Designs take only seconds to load. Operating in real time, SUSIE allows for instant design and test vector modifications without any compilations. All changes to JEDEC, hex files, FPGA designs, IC technologies, etc., can be performed while simulation is in progress. Equipped with a software accelerator, SUSIE allows the designer to select any design section and simulate at a speed that is totally independent of the design size. This has created a renewed user confidence about board level simulation. The SUSIE simulator is an excellent upgrade of Mentor, OrCAD and Viewlogic CAE tools that pays for itself typically within the first sixty days. **CIRCLE 101**

FPGA Competition Shifts to CAE Tools

With more entrants into the FPGA field, the product differentiation is becoming vague. For this reason, the new FPGA vendors stress the design environment and applications over the architecture of their devices. For example, while older FPGA vendors still push the $9,000 to $12,000 development systems, there are rumors that newer entrants, like PLUS LOGIC, will be announcing highly advanced simulation tools for under $500.



Even more important, these new CAE tools will take only hours to learn and will be easy to use due to their real-time interactive operation. Also, simulation of multiple FPGAs at the board level in excess of 200,000 gates will be possible with optional software.

■ ***SUSIE*** (Standard Universal Simulator for Improved Engineering) and ***Concurrent Designer*** are trademarks of ALDEC Co., Inc. Newbury Park, California, USA. **TEL: (805)499-6867 FAX: (805)498-7945. To obtain a free working model of these tools please contact ALDEC.**

Xilinx™, ACTEL™ Forge Ahead

With a growth rate of over 50% per year, field programmable gate arrays (FPGAs) have drawn so much attention from semiconductor vendors that most of them will have FPGA parts ready by the end of 1991. However, It is expected that Xilinx and Actel will retain their technological leadership, particularly now that designing with these parts has become quick and simple thanks to real-time SUSIE development tools from ALDEC which simulate these parts at chip and board level with an accuracy of 10 picoseconds. Since SUSIE allows for selective circuit simulation, you can simulate the FPGA parts cell-by-cell, section-by-section, IC-by-IC and any combination thereof. This dramatically speeds design development over the previously employed methods. **CIRCLE 102**

Cost - A Leading CAE Factor

With purse strings still tight, many CAE vendors find that their lower cost products are moving faster. Designers are particularly buying products that automatically create design documentation, handle archives and do other basic chores at affordable prices. For example, SUSIE simulator ($995) which allows designers to save, print, and archive design revisions, test vector files, error conditions, etc., is being purchased in greater numbers. Perceiving this shift to low-cost CAE environments, some workstation CAE vendors are talking to the PC CAE vendors about tool integration and licensing. This recession has considerably helped high performance PC-based CAE to gain ground on the expensive workstation-based CAE tools.

Real Cost of CAE Tools

Experienced CAE users are much more careful in selecting CAE tools than novices. While novices look primarily at price and features, the experienced users look primarily at ease of use, because the data base built around any CAE tool may quickly represent ten times the value of the CAE purchase price. Tools that work in real-time save the most. They save at least four to ten times more than those working in batch mode because of two reasons: they are free of any software compilations and designers are much more effective when they debug designs in real-time. The SUSIE logic simulator that is resold by most CAE vendors is the only existing real-time simulator and it provides the most cost effective design environment.

CIRCLE 105

MAY 1991 VOLUME 64, NO. 5

Electronics

60 YEARS OF GLOBAL LEADERSHIP.

COVER STORY PAGE 48

FEATURES

PAGE 65

PAGE 43

Jesse H. Neal
Editorial Achievement Awards

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

PAGE 74

DEPARTMENTS

NEWS ROUNDUP

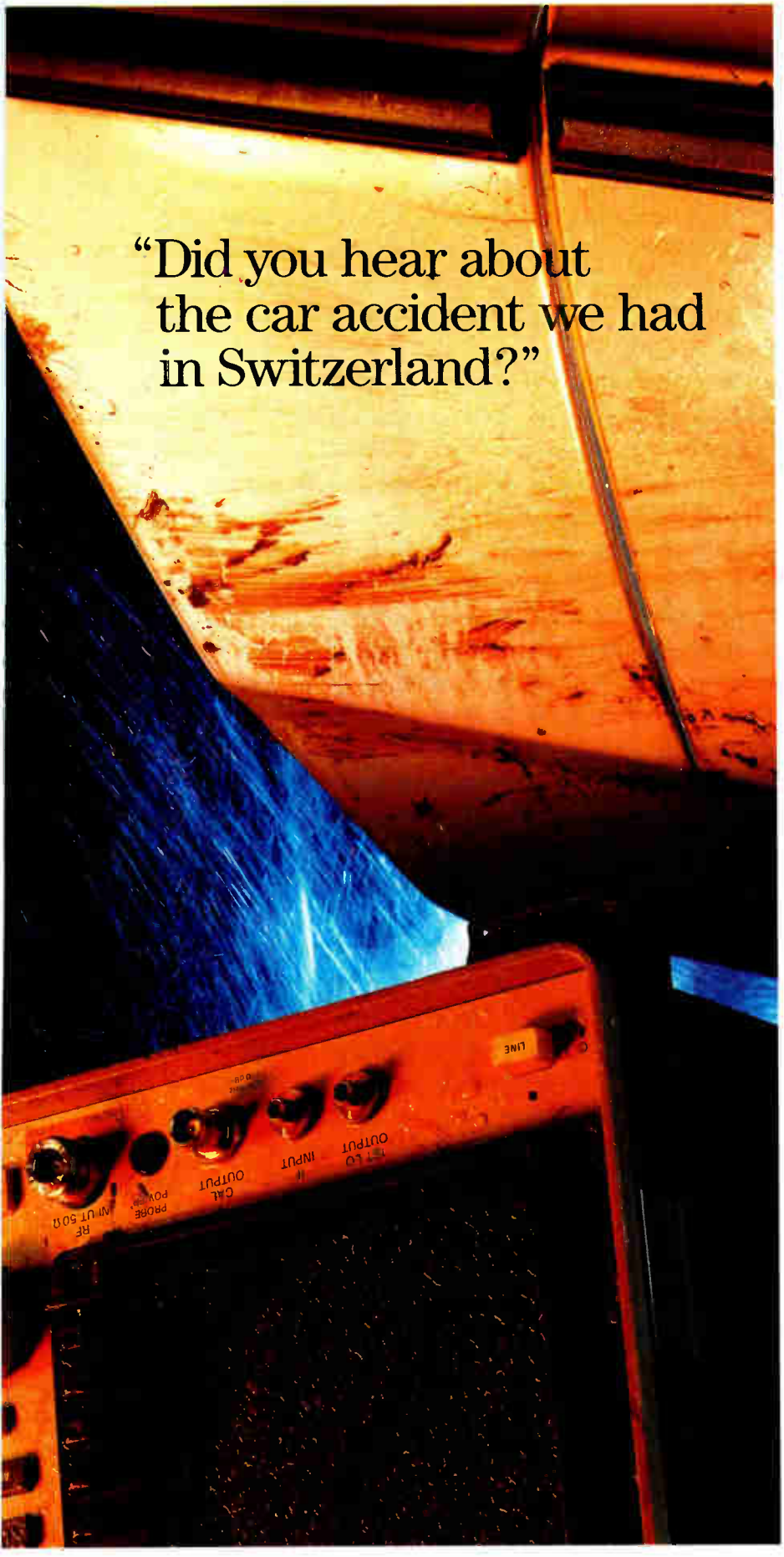
WORLDWIDE NEWS

EXECUTIVE BRIEFING

NEWSMAKERS

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

* International only



There were no serious injuries.

Not long ago, an HP salesman turned a routine product demonstration into a crash course in reliability.

Our District Manager in Switzerland, Ueli Nussbaumer, had just given a demonstration of an HP spectrum analyzer. He set the analyzer down beside his car, intending to pack it last.

Well, there was a lot to pack. And when Ueli backed the car out, an ear-splitting screech of ripping metal made him hit the brakes. The analyzer!

It was trapped under the car. Ueli jacked up the car, yanked out the analyzer, and ran back to his customer's office to test its vital signs. The spectrum analyzer worked perfectly. The customer was incredulous.

Stories like this underscore why HP rates highest for reliability among engineering managers. And we're still not satisfied. In fact, in 1979 we started our Total Quality Control program to increase quality ten-fold in 10 years. A goal we'll reach this year.

It just goes to show that when design and manufacturing productivity are at stake, there is no reliable substitute for HP. Because you never know what you might run into.

CIRCLE 178

There is a better way.

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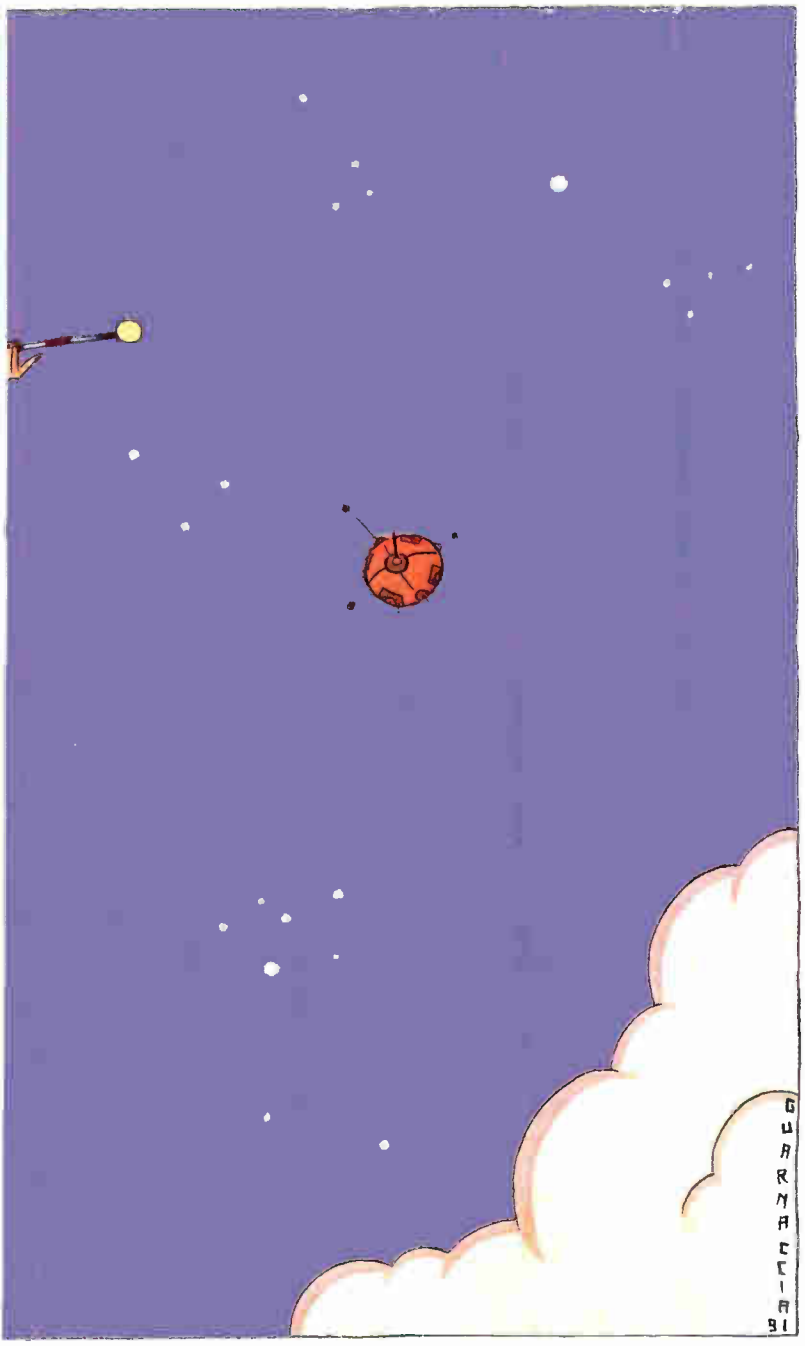

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And since high performance is the reason for *using* video RAMs, that's good news.

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In the meantime, our video RAMs will let you put on quite an act.

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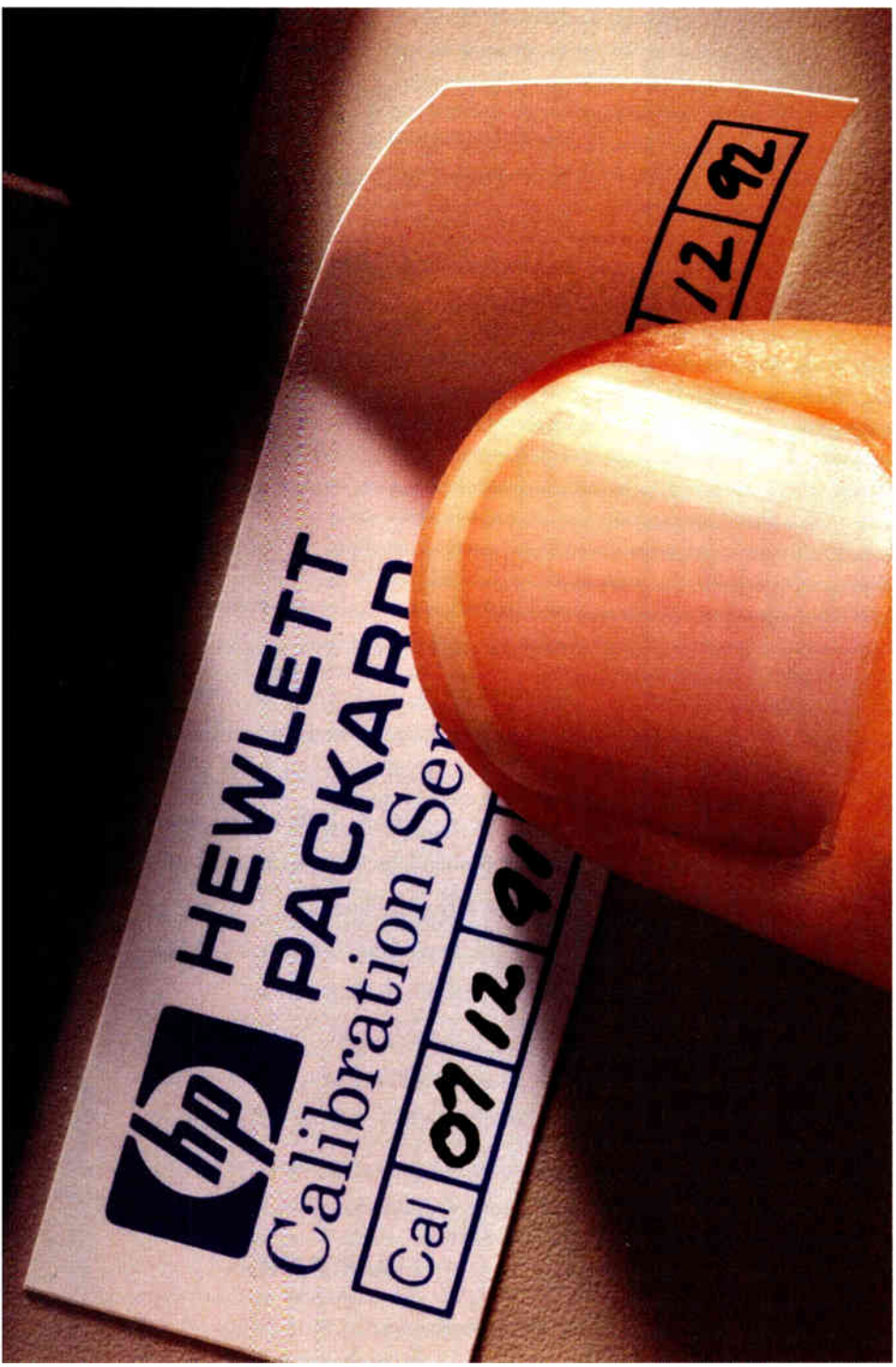

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If the quality of your product depends on the quality of your measurements, you have to be absolutely sure of the calibration of your test equipment. And the best way to do that is with HP Calibration Services. We'll help you develop a solid calibration program that fits your production requirements and calibration cycles, and complies with all the standards you have to meet.

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LETTER FROM

SAN JOSE

A MULTIMEDIA INFRASTRUCTURE BEGINS TO TAKE SHAPE

THE BIRTH OF AN INDUSTRY

BY JACK SHANDLE

The ground did not literally shake in San Jose, Calif., during the International Multimedia and CD-ROM Conference that ended in late March, but historians may look back on the conference as a birth tremor for the multimedia industry.

The requisite technology and product announcements in San Jose provided plenty of technoglitter, but the most significant news may have come from the business arrangements that surfaced. It seems an industry infrastructure is starting to emerge from the technological brick and mortar that has been piling up for the past few years.

The prime example of how that base will develop is Microsoft Corp.'s purchase of a 26% share of Dorling-Kindersley Ltd., a UK-based publishing house that currently has no CD-ROM titles, no on-line data bases, and no software titles. Microsoft chairman Bill Gates, declaring that he scoured the globe for the right publishing partner, says he gave Dorling-Kindersley the nod because its books—*The Way Things Work* by David Macauley is a prime example—are luxuriously illustrated masterpieces: the perfect CD-ROM vehicle into the home market. But just as important to the deal, says Gates, is the fact that Dorling-Kindersley owns all the intellectual property rights to its illustrations, photographs, and text.

That spotlights a fact little appreciated outside the developer community: many CD-ROM and multimedia projects are abandoned because when all the per-disk royalties for photos, music, and text are added up, a disk is simply priced out of the consumer market. Hence the Microsoft pursuit of Dorling-Kindersley; it was using the same general strategy as Japan's Sony Corp. and Matsushita Electric Industrial Co. Sony has purchased CBS Records Inc. and Columbia Pictures Entertainment Inc. while Matsushita owns media giant MCA Inc. And IBM Corp. has quietly made arrangements with the Smithsonian Institution, National Geographic Society, and other content-rich institutions.

Expect to see some DK/Microsoft titles on CD-ROM in about a year, priced at about $50. Microsoft thinks it can port from printed page to CD-ROM in six months, though Dorling-Kindersley chairman David Kindersley, a soft-spoken man of ironic wit, considers that "rather optimistic."

Eventually, DK/Microsoft CD-ROMs will be sold in bookstores, says Kindersley. Besides Microsoft, Sony also has mass-market plans for CD-ROM, according to Greg Smith, national sales and marketing manager in Sony's Monterey, Calif., CD-ROM Division. It will package a consumer library with a $40 audio playback product from Disney and has queried 150 CD-ROM publishers for titles. Sony's marketing thrust will include an 800 number for customers to phone; the strategy will be patterned after Sony's Columbia Records Club. Sony is also likely to introduce a U.S. version of its DataDiscMan portable CD playback device in the fall, says Smith. The project is still very much under wraps, but one likely application is in business-to-business communications.

In quite another venue, IBM struck an interesting distribution deal with Britannica Software Inc., an Encyclopedia Britannica company headquartered in Solana Beach, Calif. Beginning next month, Britannica Software will begin marketing a $1,000 hardware/software/content bundle for IBM's PS/1 that includes an IBM CD-ROM drive and Compton's Electronic Encyclopedia for Windows. IBM's strategy is to establish channels of distribution that fit niches, says Ron Palmich, international director of IBM's Multimedia Marketing Support Organization in Atlanta.

It is Palmich's job to find a common front for IBM multimedia worldwide despite regional variations in focus. In Asia, he is targeting presentations first and training second; in Europe, it is point-of-infomation and merchandising kiosks; and in the U.S. the emphasis is on training, "with a dramatic increase in presentations," he says.

Meanwhile, in addition to cooking up the deal with Dorling-Kindersley, Microsoft was the force behind the adoption of a "Multimedia PC" industry logo (left) that the consumer can recognize. It is intended to work the same magic for multimedia that the VHS mark did for video cassette recorders. According to Gates, the symbol on a product will guarantee interoperability of any hardware and software that also bears the logo. Although having such a symbol is not the same thing as establishing an industry, it won a significant number of endorsements, including those of AT&T Computer Systems, CompuAdd, Creative Labs, Fujitsu, Headland Technology, Media Vision, NEC, Olivetti, Philips Consumer Electronics, Tandy, and Zenith. Hardware and software specifications for a multimedia PC were unveiled by Mi-

crosoft, Tandy, and the others last year [*Electronics*, February, 1991, p. 43].

IBM is conspicuously absent from Gates's Multimedia PC, already known as MPC, compatibility club. As it turned out, IBM emerged during the conference as a prime mover in the Interactive Multimedia Association, a group known as the Interactive Video Industry Association from its inception in 1987 until its name change in August 1990. The same day Gates displayed his mark, the IMA announced its intention to provide an open forum for developing reasonable and equitable functional specifications for multimedia workstations. Such an open forum, IMA president Richard Thackray explains, "avoids problems associated with specifications drawn by special-interest groups."

The IMA's cross-platform compatibility stance has been widely interpreted as an IBM counterthrust at Microsoft's desire to dominate multimedia through the MPC spec and mark. But both industry movements have portability at heart. IBM and Microsoft have different perspectives. Gates is concerned almost exclusively with platforms that run DOS and Microsoft Windows, but IMA's scope is much wider. It has established several classes of multimedia platforms that include the Apple Macintosh, Commodore Amiga, Philips/Sony's Compact Disc-Interactive (CD-I), and Intel's Digital Video Interactive (DVI) as well as DOS-based video disc systems and Windows/CD-ROM.

It is quite conceivable, for example, that one class of IMA platform will be defined by the MPC spec, says IBM's Palmich, "although there might be some debate on giving it more platform portability." An accommodation seems likely since Microsoft is one of the IMA's chief financial sponsors, a point lost on some observers. Other IMA sponsors—that is, companies providing substantial financial support—are 3M, IBM, Intel, Eastman Kodak, and NCR.

Unlike MPC, which draws heavily on the computer community for its base and is heavy with West Coast firms, IMA traces its roots to the interactive-video-training industry and laser-disc technology. It has broad geographic coverage, but many of its members are suppliers to the federal government, the single largest user of interactive training. Unlike Gates, who from time to time refers to a killer application for multimedia—such as the spreadsheet was for the PC—IBM's Palmich sees niche markets for the time being. "What's the killer app?" he asks rhetorically. "It beats me. But I do know there are developers who are doing very well in training and information delivery."

The IMA platform portability initiatives are at least partially an attempt to protect a decade's worth of investment in that kind of courseware. That is the reason MPC and IMA might bump heads in the future.

Neverthless, the International Multimedia and CD-ROM Conference wasn't all business strategy. Wherever computer folk gather there is sure to be a good dose of technoglitter.

Sony and C-Cube Microsystems Inc. each conducted technology demonstrations for real-time video decompression using the Motion Picture Experts Group algorithms. Products from the two com-

panies await the International Standards Organization's adoption of the draft MPEG proposal. C-Cube's technology can execute MPEG algorithm extensions developed by JVC Corp. that can deliver broadcast-quality compressed video at a data rate of 6 Mbits/s. MPEG is close to VCR quality, and JVC's extensions are likely to compete in MPEG-2 demonstrations that are scheduled for July in Japan.

Writable CD-ROM came out of the closet in a big way when Philips Consumer Electronics of Knoxville, Tenn., announced it will start beta tests of a write-once drive in the second half of this year, with mass production expected in the first quarter of 1992. The product will emulate a hard disk and have a Small Computer Systems Interface. The Philips announcement is significant because the drives are expected to be far less expensive than the $30,000 systems now available.

Meridian Data Corp. unveiled SoundByte, a $250 box that digitizes audio at CD quality. This playback hardware opens the door to a low-cost solution for those voice-annotated multimedia applications—such as spreadsheets—that have been the buzz ever since multimedia came into vogue.

Sound is recorded at 8- or 16-bit resolution using the adaptive-differential-pulse-code modulation format, or ADPCM, and developers have a choice of two compression rates. This flexibility in resolution and compression rate allows data to be recorded at four speeds: 4, 8, 11, or 16 Kbytes/s. In addition to voice annotations, SoundByte is expected to be used for electronic music and biological monitoring.

It also appears that the concept of electronic books is an idea whose time is about to come. On the technology side, notebook computers with VGA screens and 60-Mbyte hard drives are available now, but within a year 150- and 200-Mbyte drives will be available, predicts Lou Reynolds, president of Electronic Book Technologies Inc. of Providence, R.I. There is a trade-off to be made between CD-ROM's 600 Mbytes of storage—but slow access time—and the 200-Mbyte and 25-ms access time of hard drives. One viable application where hard drives seem to be favored, Reynolds says, is service manuals on disk for field engineers.

But the compact hardware would be of little use without an efficient means of retrieving specific information from the 200 Mbytes of data on the disk, and, just as important, reliably indexing the information down to the byte level in a short time. Largely due to federal guidelines, major CD-ROM vendors are migrating to the standard generalized markup language, or SGML, as a data-interchange format for indexing documents, says Reynolds.

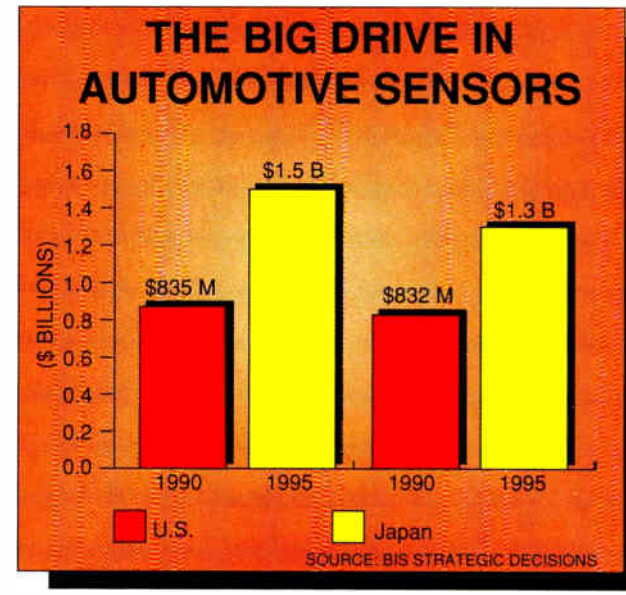
SGML is just an agreed-upon technique for creating an organizational hierarchy (chapters, sections, paragraphs, tables, footnotes) of a paper document so that indexing software understands it in electronic form. Electronic Book Technologies has come up with a software package that can complete 600-page volumes in less than an hour—a task that used to take days. It is working on multimedia extensions so that any data type can be handled. ❑

FULL SPEED AHEAD FOR AUTO SENSORS

Start with increasing concern over automobile safety, add antiskid brake systems and electronically controlled transmissions, and the result is a market for auto sensors that is barreling along at a breakneck pace. According to a study by BIS Strategic Decisions of Luton, England, demand for the devices in the U.S. will grow 15.4% annually, to $1.5 billion, through 1995; in Japan, the growth rate will amount to 10%, to $1.3 billion.

The most lucrative market sector will be that for speed and position sensors. The reason: they are part of almost all electronic control systems. However, the sensor sector that will grow at the highest rate during the 1990-1995 period is the one that includes accelerometers. That upsurge is traced to the rapid growth in the installation of air-bag systems as well as increased use of the devices for knock control in fully integrated engine-management systems.

In the U.S., annual growth in sales of accelerometers will be 22% to $269 million; in Japan, the growth rate will be the same, ballooning into an estimated 1995 market worth $220 million. ❑



HP'S NEW PALMTOP COMPUTER FEATURES LOTUS 1-2-3 IN ROM

Have you ever faced one of those aggravating situations when you are out of the office and have to do some calculating that requires the use of a spreadsheet? Now you won't have to fuss and fume—or wait until you're back at your desk to complete the task: executives on the go can thank Hewlett-Packard Co. and Lotus Development Corp. for combining to come up with a handheld computer that packs a full-fashion Lotus 1-2-3 into a read-only memory.

The 1-Mbyte ROM in the HP 95LX Palmtop PC, which made its debut late last month, also holds MS-DOS, HP financial calculator software, and software that can be used to display files from a remote PC, if the 95LX is connected to one.

The liquid-crystal display, which has a capacity of 16 lines by 40 characters, is the minimum size that is required to display a spreadsheet comfortably.

Powered by two AA batteries with a lithium battery backup, the 95LX can also be used to analyze spreadsheets or edit and send electronic mail messages. Two of the units, which measure 6.3 by 3.4 by 1 in., can exchange files across a room via an infrared link, or the device can be connected to a PC to exchange files with that computer or any other computer linked to it. The price for the 95LX has been pegged at $699; the RS 232 PC-cable/connector option adds another $100 to the total. ❑

DIGITAL JOINS THE MASSIVELY PARALLEL CLUB

Massively parallel processing got a major endorsement from an old-line computer company when Digital Equipment Corp. ventured into the business late last month. The Maynard, Mass., company has invested in Maspar Computer Corp. of Sunnyvale, Calif., and will also develop software for Maspar systems and sell them.

Once regarded as an arcane fringe of the computer market, massively parallel systems consist of 128 to 65,000 high-performance microprocessors, each of which performs parts of the same task in parallel. That brings blazing speed to supercomputing jobs the likes of molecular and meteorological modeling.

Digital's entry is likely to boost confidence in Maspar and in massive parallelism generally—a niche that has until now been served by alert but relatively small start-up companies, such as Thinking Machines Corp. of Cambridge, Mass., and Intel Scientific Computers of Beaverton, Ore. ❑

FAST ROUTE TO MIXED-SIGNAL CHIPS

That the market for mixed-signal ICs is heating up—it could double to $8 billion by 1995—is a given [*Electronics*, March 1990, p. 53]. But the question is how does a chip maker jump in quickly? One answer: check out Orbit Semiconductor Inc., the Sunnyvale, Calif., foundry and prototyping outfit that specializes in service.

Orbit, as part of its Mosis-based Foresight multiproject wafer service, permits a designer to partition a mixed-signal circuit. That way, the easier-to-handle digital portion can be fabricated and debugged while the trickier analog portion is being designed, to speed up the entire cycle.

The company promises to deliver 12 packaged parts in four to five weeks for $1,500. "That compares to $65,000 on a single-wafer basis," says Orbit president Gary P. Kennedy. ❑

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It's called 386™ Smart Cache, a family of chips that integrate a cache controller with up to 16Kbytes of SRAM onto a single, one-million-transistor chip. The result is a 16Kbyte chip that really cleans up, equalling the performance of 128Kbyte caches.

Intel's 386 and 386SX Smart Cache are one-chip solutions that give you extra space on your motherboards for other applications.

And when you stack them up against other caching solutions, you'll find their innovative architecture costs substantially less.

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Because the reasons to look into 386 Smart Cache are really starting to pile up.

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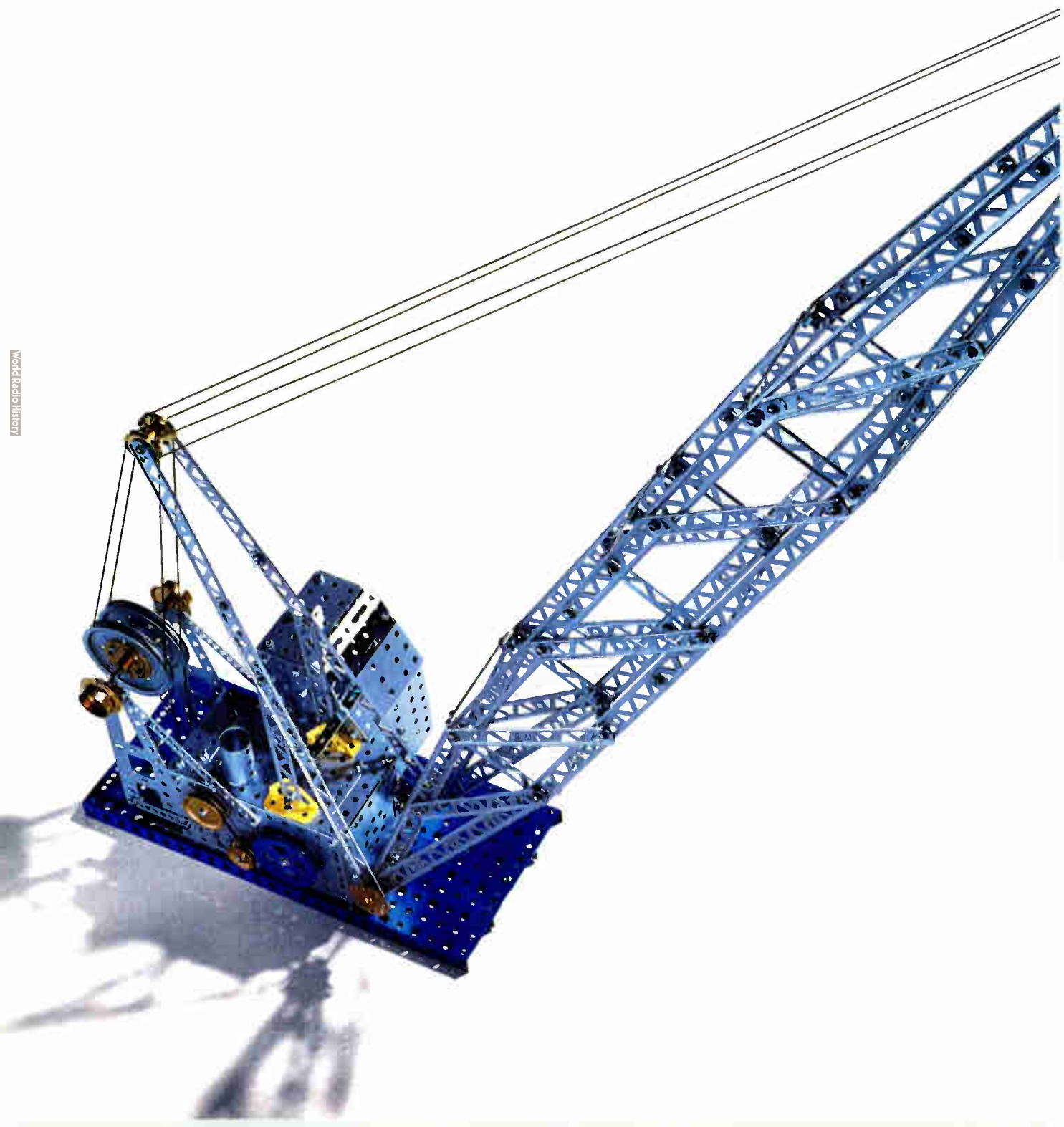
CIRCLE 185



AMPRO'S EMBEDDED SYSTEM MODULE FAMILY

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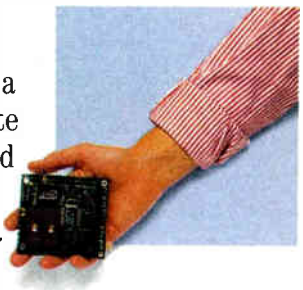
Remember the challenge of constructing "engineering marvels" with your Erector® set? That red metal box held a complete set of interlocking pieces — all that was needed to assemble just about anything. Your imagination was the only limitation.

That's the idea behind Ampro's new way for OEMs to build embedded control applications. Put your application together, simply and quickly, using Ampro Embedded System Modules.



Our CoreModule™ family packs ready-made full PC- or AT-compatible intelligence into 3.6" x 3.8" x 0.6". Just plug one into your circuit board — like plugging in a chip — to easily interface to your own logic. They operate over 0 to 70°C, and include a CMOS CPU, RAM, extended BIOS, Solid State Disk, serial and parallel I/O ports, keyboard and speaker interfaces, and a real-time clock.

Stack a CoreModule unit together with one or more of our expansion MiniModule™ peripherals (no backplanes or card cages needed). MiniModule products, also 3.6" x 3.8", can be used to add display controllers, more Solid State Disk capacity, network controllers, modem and facsimile features, additional I/O, and much more.

You'll get your product to market faster, with less risk, and at lower cost, because the CoreModule family is based on the most economical industry standard architecture. Now you can focus on the more challenging part of your system — the application itself.

Ultrasound monitors, point-of-sale terminals, robotics, network controllers — no matter what kind of "engineering marvel" you're building, you should be using Ampro's "Erector set" for your embedded control application.

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CIRCLE 213

A RECIPE FOR QUALITY...

The Malcolm Baldrige National Quality Award is only the tip of the iceberg in the resurgence of quality in the U.S. As the most visible symbols of quality, the award and its winners may appear at first glance to be the whole story. But the behind-the-scenes facts speak otherwise.

Though the Baldrige Award is a symbol of recognition, it is far more than a contest. Rather, it is a value system, a vehicle for cooperation, an agent for change. It is intended to help all U.S. organizations become more customer oriented, more productive, and more effective. Though still less visible, these larger purposes are the most important ones.

CURT W. REIMANN

Through the unique public-private partnership that is the Baldrige program, tough quality standards have been created and promoted throughout the U.S. The concept of quality embodied in the award–quality that is customer-driven–focuses on management of an entire enterprise toward delivering customer value. The concept goes well beyond traditional quality control and represents a significant step in the evolution of quality.

The award criteria—explicit requirements that simulate real competition in the marketplace—are already in wide use: while 203 companies applied for the award during its first three years of existence, in 1990 alone over 180,000 requested copies of the criteria. In 1991, the number should hit 250,000.

Uses of the criteria include self-assessment, training, networking, and curriculum design. Thousands of individuals have already been trained using the award criteria. Every individual and company that uses them—not just those who formally enter the competition—benefit from the program.

The Baldrige Award has had nine winners since the first prizes were given out in November 1988. Award-winning companies are permitted to publicize their awards provided that they agree to share information on their successful strategies with other U.S. organizations. In the short time since these first awards were announced, the winning companies have assisted literally thousands of organizations—other businesses, government agencies, health-care organizations, educational institutions, and other nonprofit organizations. This level of sharing strategies and methods is perhaps unprecedented in our national life.

In their more than 5,000 presentations, the winners have not only shared openly and graciously, they have stressed the importance of continuous improvement. Statements such as "the journey continues" and "tougher challenges lie ahead" are heard—not "we're No. 1."

The award program relies heavily upon volunteer efforts. About 400 volunteers have already contributed to it through service on the board of examiners and the advisory board of overseers. In addition to taking part in rigorous evaluations of applications and of the award program itself, volunteers also disseminate information about quality throughout the U.S. Their efforts reinforce those of the winners and add a different perspective.

As a result of all these activities, interest in quality is spreading rapidly. New networks are being created—many at the state and local levels—to help stimulate economic development. Many pockets of new leadership are emerging. New links of cooperation are being forged among institutions which heretofore have had no ties to draw them together. A common language for quality and a basis for sharing techniques now exist. Role models and advocates are emerging.

In sum, the Baldrige is playing a major role in spreading the quality philosophy throughout the U.S.—a role more vigorous and more effective than could ever have been expected.—*CURT W. REIMANN, director, Malcolm Baldrige National Quality Award*

...OR 'CHECK THE BOXES'?

The increasing media, public, and business attention to winners of the Malcolm Baldrige National Quality Awards is a tribute to former Commerce Secretary William Verity and others who conceived and designed the award program. However, in its increasing success lurk dangers the creators may or may not have anticipated.

The more prominent the Baldrige Award becomes, the more companies covet it. Winning the Baldrige has become a public relations and marketing windfall to be exploited, at times shamelessly. One might even see substantial irony in what is actually presented to the winners—a leather pouch containing a glossy photograph of the trophy itself. It is almost as if the sponsors understand that the photo, rendered as a "seal of approval" in company advertisements, is the real substance of the award.

KIRK O. HANSON

The extraordinarily detailed set of criteria for the award is both the strength and the weakness of the program. With 99 detailed questions to answer (down from 133 in 1990), only the most determined companies complete their applications. Although 180,000 application forms were requested from the program in 1990, only 97 completed applications were submitted.

Among the applicants is undoubtedly an overrepresentation of large companies, those that can afford to set a small army of employees working to complete the application. Also overrepresented will be those familiar with satisfying multiple and exacting criteria set down by corporate bureaucracies and government contracting procedures.

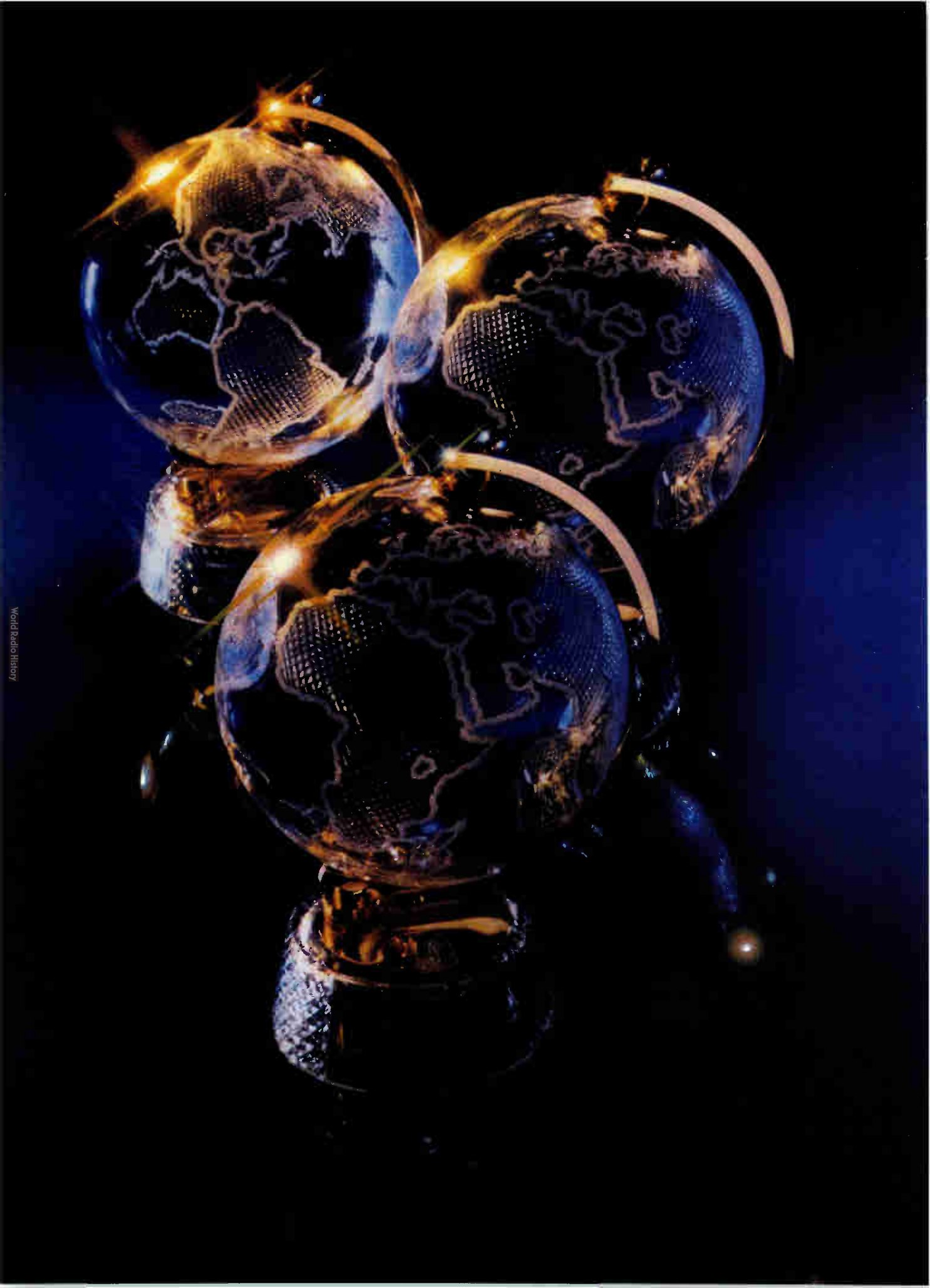
The danger is that the winners may tend to reflect a "check the boxes" approach to quality rather than a "passion," to use Tom Peters's term, for a few selected variables. It is entirely possible that we could learn much more about dedication and fanaticism for quality from firms that choose not to apply for the Baldrige. Many undoubtedly are simply too busy improving quality to ponder whether they meet all 99 criteria.

We might also conclude that the winners, while clearly committed to quality, are those whose efforts have been dedicated to checking boxes rather than to finding those few levers that enable a company to "get it right." Broad-based corporate programs too frequently fall victim to this mentality—measuring success in terms of meeting a set of bureaucratic criteria or quantitative measures that can be manipulated.

In contrast, over 400 nominations were received for our first annual Business Enterprise Awards, given by The Business Enterprise Trust for extraordinary acts or programs of business responsibility. The creators of this award have objectives similar to those of the Baldrige creators: to promote behavior throughout business that echoes the example set forth by their award recipients. But they have resisted setting down too explicit a set of criteria. Instead, nominees respond to such questions as "what are courage, integrity, and social vision in business, and how do you stimulate them?"

Our first awards went to a former clerical employee in a small business, an entrepreneur who left a large bureaucracy to start his own business, a middle manager who showed his division how it might better serve society in its day-to-day operations, and a large business. I doubt any of them would have taken the time to fill out a Baldrige-length application.

The Baldrige goal is to create a sourcebook to quality manufacturing and service—and the application form, chock full of approaches that can lead to better quality, may have accomplished this. The companies that pick and choose from among the criteria and don't bother to apply for the award may have the right idea.—*KIRK O. HANSON, president, The Business Enterprise Trust*



With honors come obligations.

Three consecutive Dataquest Supplier of the Year Awards motivate us for ever greater dedication to the Total Customer Satisfaction programs they recognize.

We are immensely proud that the Semiconductor Products Sector of Motorola Inc. has been named Dataquest's 1991 Semiconductor Supplier of the Year. Particularly as it's our third win in a row.

Our thanks to the world's leading electronics OEMs for their votes and to Dataquest for the opportunity.

This time, Dataquest asked the 200 top U.S. and 50 leading European and Japanese electronics companies (from Electronics Business Magazine) to rate the world's small, medium and large suppliers on Quality, Delivery, Price, Technical Support and Customer Service. Motorola came out on top in all five measurements. That's identical to the previous two years when the survey covered only the U.S. and there were no size categories.

This recognition is surely a reflection of the dynamic, evolving company-wide programs in quality, service, technical and customer support, and added value we've been working on for years.

Motorola introduced the concept of Six Sigma to industrial quality management, implemented Just-in-Time delivery programs and initiated effective ongoing cycle-time reduction programs in service as well as manufacturing organizations. Customer support such as EDI, Service Centers and Design Centers plus an industry-standard, professionally-trained customer-contact staff located around the globe extend these activities.

Six Sigma Represents 99.9997% Defect Free, Our Goal For All Activities By 1993

Ever greater dedication to the fundamental objective of Total Customer Satisfaction is our pledge. Motorola willingly accepts the obligation to continue to earn your respect and your business.

MOTOROLA

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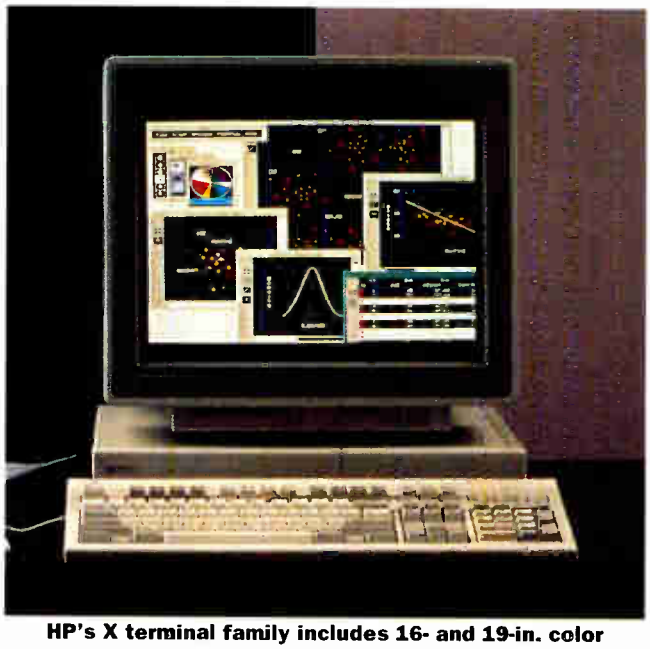
TO WATCH

RISC IC POWERS HP'S X TERMINALS

The first X terminals powered by a reduced-instruction-set-computing chip deliver performance similar to low-end workstations, says its developer, Hewlett-Packard Co. The X-terminal market is expected to grow from about $230 million last year to some $700 million by 1994, according to market researcher International Data Corp., Framingham, Mass.

Using the Intel i960 RISC chip, the HP 700/RX family delivers 50,000 to more than 70,000 Xstones, compared with about 40,000 for a competing workstation from Sun Microsystems Inc. Xstones are a benchmark for X Window servers that measure how fast they display and erase windows.

The family includes 16- and 19-in. monochrome and color displays, and is priced from $2,995 to $5,995. Delivery is in four to eight weeks. ❑



HP's X terminal family includes 16- and 19-in. color displays and is powered by Intel's i960.

TI WILL OFFER ASIC-LIKE DSPs

Texas Instruments Inc., market leader in digital-signal-processor chips, wants to use DSPs to penetrate two big markets where it is anything but dominant: microprocessors and microcontrollers.

TI's weapon is customer-configurable DSPs based on the CPU core of the Houston company's 320C5X. For the first time, TI has put the design of RAM, ROM, and peripheral modules totally under customer control.

Successful applications will require power ranging between 5 million and 10 million instructions/s. These include cellular phones, hard-disk-drive controllers, and automotive applications.

Customers need to have experience in DSP design and the ability to do ASICs. Nonrecurring-engineering costs start at $100,000, which includes the first 25 units and the mask works. ❑

INTEL'S FLASH FEATURES BLOCK ERASE

By providing block-erasure capability on its newest flash memory chip, Intel Corp. has matched a popular feature that was one of the major advantages of flash competitors such as Texas Instruments, Seeq Technologies, and Atmel.

Intel says its flash-memory chips already own 85% of the market, but previous versions had to erase the entire chip before reprogramming could take place. The new 1-Mbit 28F001BX can be erased in byte-sized blocks.

The 128-Kbit-by-8-bit chip addresses applications such as personal computer BIOS (basic input/output system) memory, embedded program memory, and parametric data storage.

Manufactured in Intel's 1.0-μm ETOX II CMOS process, the chip includes one 8-Kbyte block that is not accessible by the end user, in addition to two 4-Kbyte parameter blocks and one 112-Kbyte main block.

By combining one hardware-protected block for critical code storage with three separately reprogrammable blocks in one device, data integrity is ensured even during reprogramming. That's because erasing one block does not affect code stored in another block.

Access times are 120 ns or 150 ns, and the devices are available in PDIP, PLCC, or TSOP packages. The prices of the parts will range from $17.20 to $20.60 in quantities of 1,000. ❑

CIRRUS TO TACKLE OPTICAL DRIVES

Having conquered the controller market for magnetic disk drives, Cirrus Logic Inc. has set its sights on the nascent erasable-optical-drive market.

The Fremont, Calif., company expects demand to reach over 1 million units in 1994. It aims to capture the controller part of that business with a two-chip set, the CL-SM330/331. Samples are available now for $85. ❑

IMP'S IC TARGETS SHRINKING DRIVES

Using mixed analog/digital CMOS technology, International Microelectronic Products Inc., San Jose, Calif., has created an elegant solution to a knotty problem as disk drives shrink: implementing constant density recording.

In essence, the IMP42C55 is a programmable filter that lets the microprocessor specify the data rate off the disk track. As drives get smaller, data-storage capacity can still increase if data is packed as densely on the outer tracks as on the inner tracks. This means, however, that the linear data density changes from track to track.

In this application, the adaptive 42C55 can replace as many as eight filters. Sampling now, it costs $15. ❑

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We've also adopted all of the industry's most popular package styles, making our family more compatible with all of your PCB designs.

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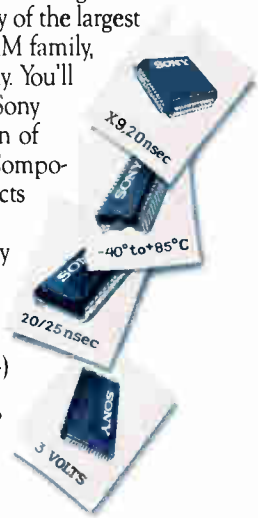
If you still can't find the right high-density SRAM, we've got your answer – a full team of designers in the USA, armed with 0.8-micron CMOS technology. And they're ready now to discuss your needs.

So, for the strength and security of the largest 1-Meg SRAM family, look to Sony. You'll find us at Sony Corporation of America, Component Products Company, 10833 Valley View St., Cypress, CA 90630. For details, call us at (714) 229-4190, FAX us at (714) 229-4285, or write to us "Attn: Communications."

Sony 1 Megabit SRAM Family Tree

	Model	Speed (ns)	Packaging	Data Retention Current	Special Features	Availability
128Kx8	CXK581000P	100/120/150	DIP 600mil	L/LL	B/X	Now
	CXK581000M	100/120/150	SOP 525mil	L/LL	B/X	Now
	CXK581100TM	100/120/150	TSOP	L/LL	B/X	Now
	CXK581100YM	100/120/150	TSOP (reverse)	L/LL	B/X	Now
	CXK581001P	70/85	DIP 600mil	L/LL		Now
	CXK581001M	70/85	SOP 525mil	L/LL		Now
	CXK581020SP	35/45/55	SDIP 400mil			Now
	CXK581020J	35/45/55	SOJ 400mil			Now
128Kx9	CXK77910J	20	SOJ 400mil		Sync ASM	2H '91
256Kx4	CXK541000J	25/30/35	SOJ 400mil			2H '91

L = Low LL = Low, Low B = 3 Volt X = Extended Temperature



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20 WATTS

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Actually meets

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MIL-STD-810C
MIL-S-901C
MIL-STD-461C
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All Mil/Pacs operate at temperature extremes from −55°C to +100°C. All are designed with a field-proven topology that has been verified by rigorous environmental stress screening.

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WHEN RELIABILITY IS IMPERATIVE.™

CIRCLE 219

LOOK FOR MIPS, MICROSOFT, COMPAQ, AND DEC TO MAKE BIG GAINS WITH THE ACE CONSORTIUM

AND THE WINNERS ARE...

BY LAWRENCE CURRAN

Who will be the winners and losers in the Advanced Computing Environment? Though the first platforms implementing the new industry initiative won't be widely available until next year, computer industry analysts are already putting together a scorecard in the aftermath of the consortium's announcement of its specifications and market directions.

The group's promulgation of an Advanced RISC Computing (ARC) spec for the MIPS Computer Systems Inc. microprocessor family represents a potentially formidable challenge to the de facto RISC chip standards—the Intel Corp. i860/i960 and Sun Microsystems Inc. Sparc architectures. For electronics and computer industry executives pondering major purchases of personal computers or workstations, the ACE consortium means keener competition among the three camps and more favorable prices from all vendors.

The 21-member consortium is an international who's who of computer and software companies. Among them, besides MIPS, are Compaq Computer, Digital Equipment, NEC, Microsoft, MIPS Computer Systems, the Santa Cruz Operation, and Sony. Importantly, however, neither Hewlett-Packard Co. nor IBM Corp. belongs; each has elected to go with a proprietary RISC architecture.

The ACE/ARC specs and directions include support for:

- An advanced version (release 3.0) of IBM's 32-bit OS/2 operating system, which has yet to score in a big way in the market. Release 3.0 will provide a migration path for the current users of MS-DOS, Windows, the earlier OS/2, and Posix-compliant (Unix) application software.
- Open Desktop, an advanced version of Unix, to be distributed by SCO, which is based in Santa Cruz, Calif. It will also accommodate other major variations of Unix, including Digital's Ultrix, which already runs on Digital's MIPS-based RISC systems. In fact, some analysts maintain SCO's Open Desktop is a repackaged version of Ultrix, which SCO denies.
- The ARC spec itself, to be applied in a range of future computers from laptops to mainframes, all of which will use MIPS RISC chips. Application programs for all of these will be binary-compatible with one another.
- Intel 80x86-based industry-standard PCs and PC systems, which means that application programs running on 386-, 486-, and future x86-based desktop PCs will be portable to the ACE.

Third-party software vendors should thrive because of the ACE initiative. They're now encouraged to develop new ACE-compatible programs to run on both PCs and workstations.

But despite what members may say about their reasons for joining, one of the motivations for forming the consortium is to counter the runaway success of Intel's 80x86 industry-standard architecture in PCs and the Sparc RISC architecture pioneered by Sun Microsystems Inc. in workstations.

For his part, analyst James I. Magid, senior adviser at Needham & Co. in New York, says ACE will succeed because it is "giving the customers what they want." He sees it as a response to two market realities—Sun's penetration of the commercial workstation market and IBM's success in its own customer base with its RS/6000 RISC workstations. Magid expects some of the big winners in the ACE camp to be MIPS itself, Compaq, Microsoft, and DEC. MIPS will gain customers and visibility because "ACE and MIPS's self-interests are completely congruent," he says. Compaq hasn't had a RISC architecture until its recent joint sales and marketing venture with Silicon Graphics Inc., also an ACE member. "Now Compaq has everything its customers want," Magid says.

COMPUTERS

For Microsoft, Magid points out that ACE is the vehicle that enables the firm to maintain its DOS operating system and Windows environment, as well as gain platforms in case Intel falters with future processors. Magid sees Microsoft founder and chairman Bill Gates as "the John. D. Rockefeller of our time; every deal must include him." That's because Windows 3.0 is so essential to ACE. Says Magid, "without Microsoft's successful implementation of Windows 3.0, nothing happens; if ACE's machine can't run Windows, it's just another well-supported Unix machine."

As for DEC, Magid points out that the company is coming out with Intel 486-based machines that will be ACE compliant. "DEC thus will have its own standard, not IBM's." Besides, "DEC is the only company in America with sales support and system software that can do the whole [ACE] job," Magid says.

Meanwhile, International Data Corp.'s Terry Shannon also sees DEC as a major winner if ACE scores big in the market. Shannon is director of the DEC Advisory Service at the Framingham, Mass., market-research organization. Compaq, Microsoft, and MIPS certainly stand to gain a great deal as well, in Shannon's opinion.

At DEC itself, president Kenneth Olsen in the past has sometimes faulted Unix because of a perception in some circles that it's a panacea for all

THE ACE 21

Acer	Pyramid
Control Data	Santa Cruz Operation
Compaq	Siemens AG
DEC	Siemens/Nixdorf
Kubota	Silicon Graphics
Microsoft	Sony
MIPS	Sumitomo
NEC	Tendem
NKK	Wang
Olivetti	Zenith
Prime	

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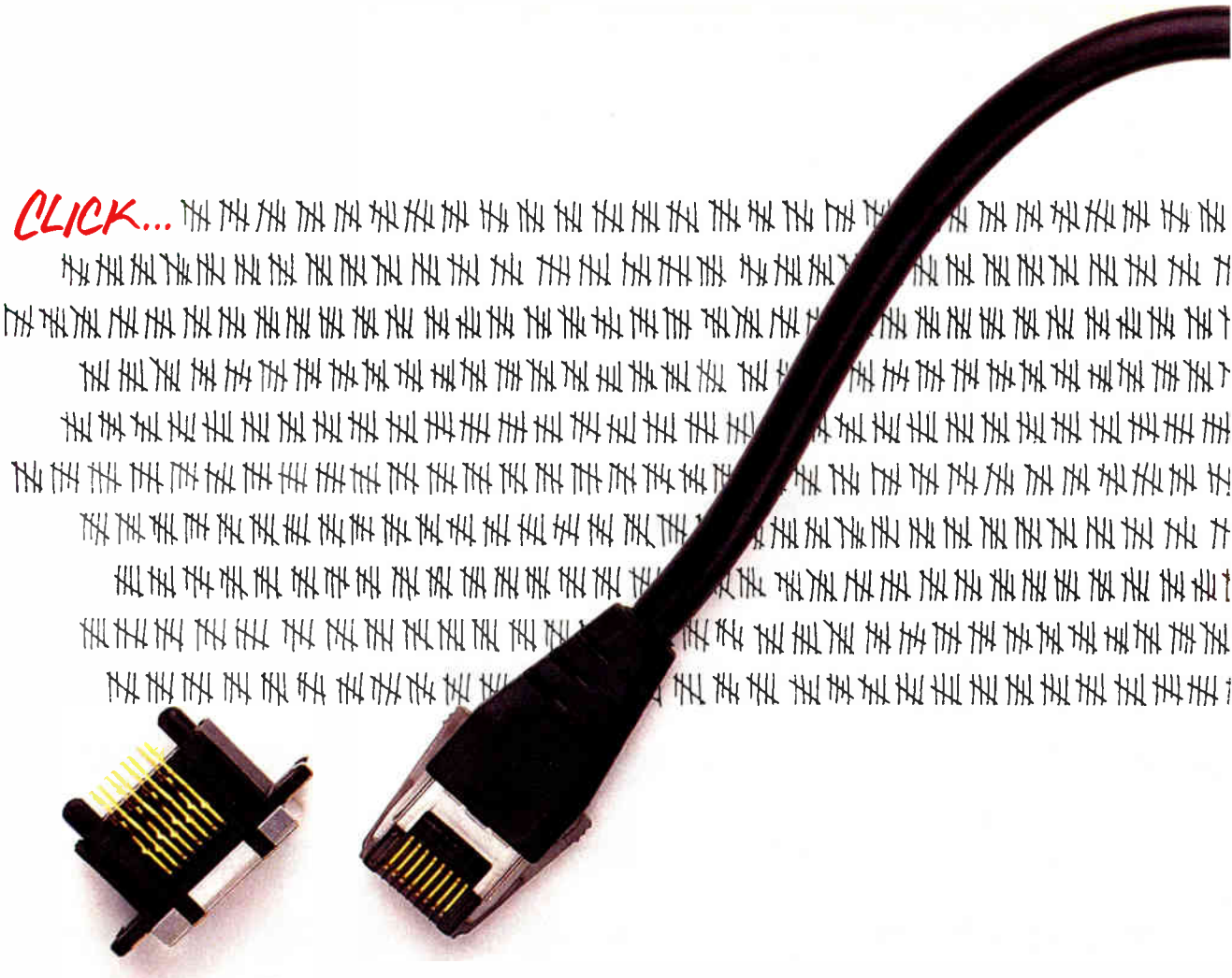

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But good-looking and hard-working start well before the user sees this connector. The highly effective shield is designed in, so our SDL connector comes as a no-hassle, one-

AMP SDL connectors—selectively gold plated for reliability and durability—come in 4, 6, 8, and 16 positions. Optional boot for round cable version protects against electro-static discharge.

Offset flange receptacle makes good use of real estate.

to hang in there.

piece assembly. It terminates to flat shielded cable in a single step—conductors and shield, plus two-point strain relief. Round cable takes only two steps.

AMP SDL connectors are a cost-effective alternative to crimp-snap type products, whether you do-it-yourself or order custom cables from us in flat, round, or coiled styles. Either way, you benefit from the same ease of application, the same well-thought-out design. And you walk away with the reliability and durability you need.

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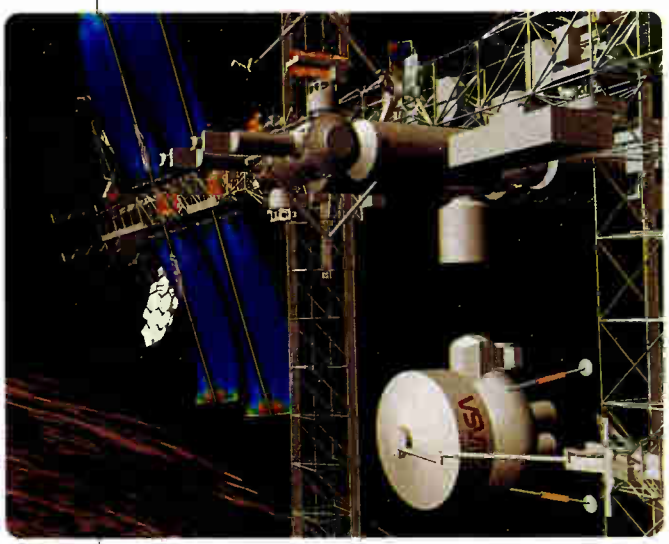
For technical information and literature on SDL connectors, call 1-800-522-6752. AMP Incorporated, Harrisburg, PA 17105-3608.

AMP Interconnecting ideas

CIRCLE 204



CASE and AI solutions include HP's SoftBench; Interactive Development Environments; Intellicorp; Inference; and Neuron Data.

Mechanical CAD solutions include SDRC; HP ME 10 and 30; McDonnell Douglas; Parametric Technology; and PDA.

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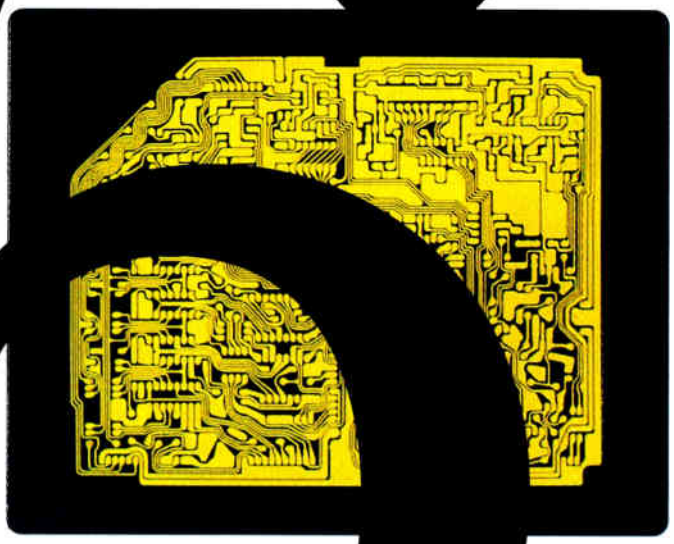
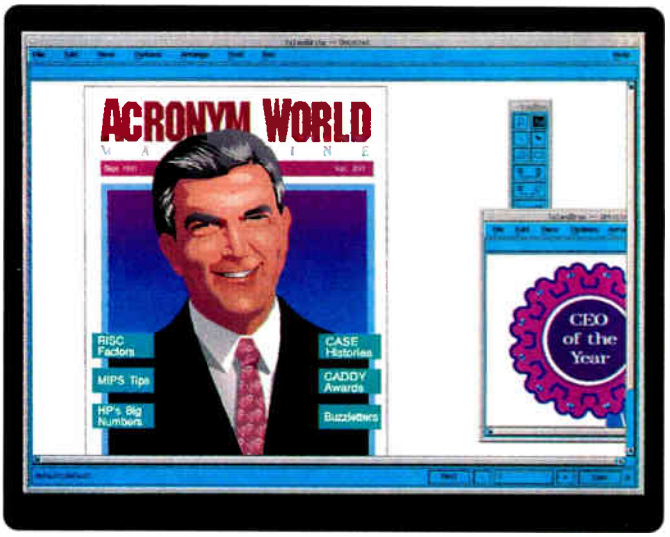


For electrical CAD, software is available from Cadence Design Systems; Mentor Graphics; Zuken; Racal-Redac; and VLSI, among others.



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HEWLETT PACKARD

CIRCLE 190

computers. But DEC enjoys rapidly growing revenues from its Ultrix-based Unix systems. Shannon says it isn't widely known that the consortium's Unified Unix to be offered by SCO "is a repackaged version of DEC's OSF/1 operating system. With DEC as the purveyor of Unix software for ACE, this should cast DEC in a more favorable light" in relation to Unix, Shannon says.

DEC also looks like a winner to Rikki Kerzner, senior industry analyst at Dataquest Inc., the San Jose, Calif., market-research firm. "I'm convinced the SCO Unix is DEC's Ultrix, based on what I've been able to learn," she says. But that shouldn't diminish SCO's chances to make hay in ACE as the Unix vendor "if they can pull it off," Kerzner says.

In her view, however, the major winner in the wake of the ACE initiative is the Open Software Foundation, based in Cambridge, Mass., one of the two Unix bodies jockeying for market leadership by touting their versions of the AT&T-developed operating system as the most widely supported "standard." The other is Unix International Inc., which boasts AT&T Co. and Sun Microsystems as members. HP, IBM, and DEC are founding members of OSF.

"It's the OSF version of Unix, in one form or another, that's going to be ported to ACE," Kerzner stresses. ACE's direction "is also an acknowledgment that Unix is important for desktop PCs. We've suspected all along that OSF would win the desktop war," she says.

John Logan, vice president at the Aberdeen Group, a Boston market research organization, believes the biggest potential ACE winner is Microsoft; the biggest loser stands to be Intel Corp. "Microsoft needs a strong platform for the future on which to sell application software," he says, "and ACE could provide that. If OS/2 release 3 becomes the next industry standard, Microsoft could create the upgrade path for application software" from MS-DOS, "and Microsoft could displace Word Perfect [in word processing] and Lotus [in spreadsheets] on the upgrade path."

Logan adds that Sony could also be a big winner because the firm is investing "multimillions of dollars" in MIPS-ACE computer systems, "which they expect to sell on an OEM basis to companies such as Bull, Control Data Corp., Tandem, and Wang." The other Japanese members of ACE could also be big winners if manufacturing volume becomes a key differentiator, Logan says.

Curiously, he says it's less likely that MIPS itself will be a big winner "unless the company can sell a lot of ARC-based systems." Logan points out that MIPS has realized only about $35 million in revenues in MIPS architecture licenses, and he doesn't expect MIPS to become a major player in the systems business.

As for Intel, Logan says the ACE initiative could hurt the semiconductor leader more than anyone else. "This [ACE] was established to attack Intel," he says flatly. "By restricting the supply of the 386, and by going into the systems business, they've made the industry rebellious. The industry has now ganged up on them to make sure Intel doesn't have a stranglehold on the microprocessor market."—*Additional reporting by Howard Wolff*

32-BIT EMBEDDED PROCESSOR IS INMOS'S ENTRY IN AN INCREASINGLY TOUGH MARKET

READY FOR A FIGHT

BY PETER FLETCHER

PROCESSORS

Consider the barber's broom that had five new heads and six new handles during its 20-year working life, yet was still the same familiar tool. The electronics business offers many parallels, cases where redesigned subsystems enable systems to keep pace with changing technology and user needs. The easiest example is the personal computer, where the "barber's broom" nature of the architecture defined by IBM Corp. and Intel Corp. has enabled them to maintain domination.

But it is not so common in the less-visible world of high-performance embedded processor systems and parallel-processing supercomputers. Yet that is just the design philosophy applied, in part, by Inmos Ltd. of Bristol, England, in the new version of its Transputer parallel-processor chip.

The company does not face an easy road. Embedded control is a tough market, and the 32-bit embedded-processor world in which the new part resides is only going to get tougher, predicts Dataquest Inc.'s London-based analyst, Mike Glennon. "It will become a bloodbath over the next two years," he says.

However, the T-9000, slated to start shipping in early 1992, has something going for it. The chip provides a 10-times performance improvement over the current top-of-the-line Transputer—the T-800—yet retains backward compatibility with the earlier part. The result is that it is binary-compatible with earlier Transputers and will run the same software code as the T-800 and others, and mix with them in multiprocessor networks. The new device is aimed at image processing, computing, and communications in the office-automation, telecommunications, military, and industrial markets.

Performance of the new chip is sizzling. T-9000 peak performance for the 32-bit floating-point processor will top 250 million instructions/s, or mips, and 25 million floating-point operations/s, or megaflops. Marketing manager Matthew Hatch calls those "virility mips and megaflops" that are based on standard benchmark programs.

> THE T-9000 FACES A MARKET THAT IS GOING TO BECOME A BLOODBATH OVER THE NEXT TWO YEARS, SAYS ONE ANALYST

"What is more important is to take existing Transputer code from a thousand T-800 users and make a direct comparison between the two devices," he says. On that score, sustainable performance works out at "60 to 100 mips and 10 to 20 megaflops," he states, and that comfortably exceeds the tenfold performance-improvement goal.

For comparison, Hatch quotes a figure for the computation of a 1,000-point fast Fourier transform. Running a program to do that task, Hatch says, the T-9000 model hits 99 mips and 19 megaflops.

Aside from raw processing power, the new part enhances the strengths of the Transputer. These are to provide direct scalability by equipping it with communications links that can be simply interconnected on a one-to-one basis so that system performance relates

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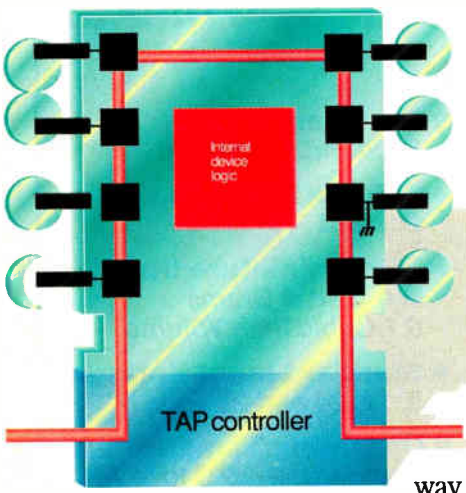

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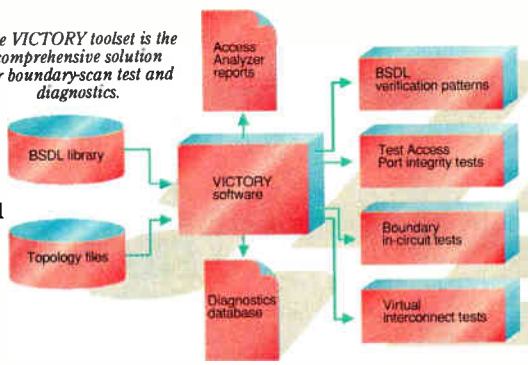

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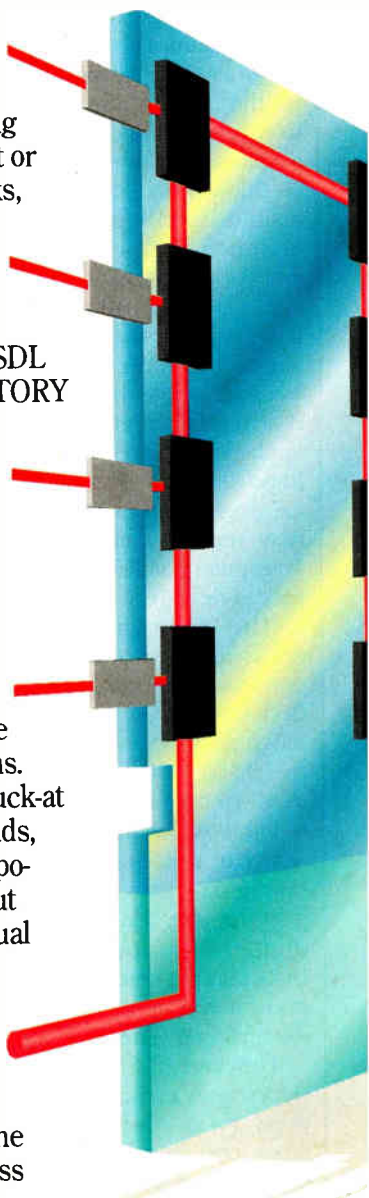

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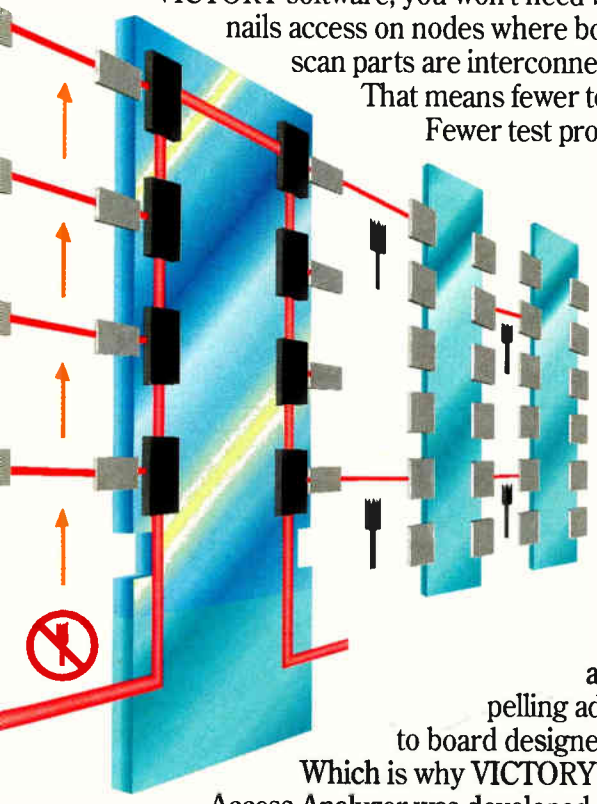
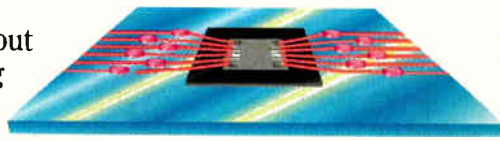


That's a compelling advantage to board designers. Which is why VICTORY's Access Analyzer was developed. With this concurrent engineering tool, designers get testability information early in the design process. They can easily see where test points are required for visibility and where they can be dropped, for optimized board layout without lowering fault coverage.



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directly to the number of Transputers used, and to place as much circuit functionality as possible on-chip to reduce the need for expensive external components.

He says that the four on-chip communications links have been redesignd to use a new packet-based protocol that allows up to 64,000 multiplexed virtual links to be established for each physical link, and that the communications paths will run at 100 Mbaud, providing an overall data communications bandwidth of around 80 Mbytes/s. The device also has a programmable memory interface that can directly drive up to 8 Mbytes of low cost two-cycle external dynamic random-access memory without degrading processing performance. Further systems cost savings stem from the self-clocking capability, which needs just a 5-MHz clock from the system, multiplying this on chip to its full running speed of 50 MHz.

Such system friendliness is essential for the target customers for the T-900 0. Hatch emphasizes that the chip is destined for embedded applications, rather than for use in stand-alone personal computers or workstations.

Project design team leader Clive Dyson says, "The one thing we don't support is slow-access paged virtual memory systems such as those demanded by Unix System V or other workstation operating systems. Nevertheless, Inmos is keeping a close watch on developments with distributed Unix, and Dyson points out that memory protection is provided on the chip to allow "untrusted" programming languages such as C to be more easily used with the T-9000.

Compared with unit demand for 4-, 8-, and 16-bit embedded controllers, the market for 32-bit models is quite small. "But if you multiply that by a relatively high unit price, then the dollar value of the market goes through the roof and it turns out to be one of the biggest market areas by value," Dataquest's Glennon states, "and every processor vendor is jockeying for position. Companies such as Intel, Motorola, MIPS Computer Systems, and Sun are beginning to recognize the limitations of the workstation and computer markets and are offering their devices as embedded controllers."

In this environment success is going to be determined more by marketing skill than by the brilliance of products, Glennon believes. "There will be some high-performance applications that you have to be in to maintain visibility, but most of it will be built around a processor manufacturer's ability to deliver niche product that customers want. So being close to customers is going to be vital." It is also a market whose most important sectors are dominated by a few major customers that have sufficient purchasing power to grind the last cent off the unit price. As a result, Glennon says, to be successful a 32-bit controller must cost $200 to $400.

Inmos will not yet reveal a final selling price for its part. However, Hatch says it will fit comfortably inside Glennon's $200-to-$400 price band.

As for second criterion for success, keeping close to customers, Hatch points out that the T-9000 was virtually designed by customers. In fact, the part is being "evolved" into the market, a process that started a year and half ago.

"When we decided to redesign the Transputer, we took a specification sheet to our major customers and got their comments before we froze the design—around 12 months ago." Since that time a developer's club has formed around the T-9000. Hatch says that there "over 60 members in Europe, the U.S., and Japan." They have been working together with Inmos on various aspects of the development program. "There is so much more to developing microprocessors than just the silicon," Hatch says. "There's all of the software—which we have already—the development tools, the documentation, and the field sales support for the initial design-in stages. And we have simulators already so people will know what they are getting."

The result is a respectable number of design wins already for the part. Among them are a Japanese laser printer; an American graphics workstation; a British military radar processor; and a number of European supercomputers. Marconi is the radar maker; four British, German, and French companies—Meiko, Parsys, Parsytec, and Telmat—are producing the computer. Inmos would not identify the others. ❑

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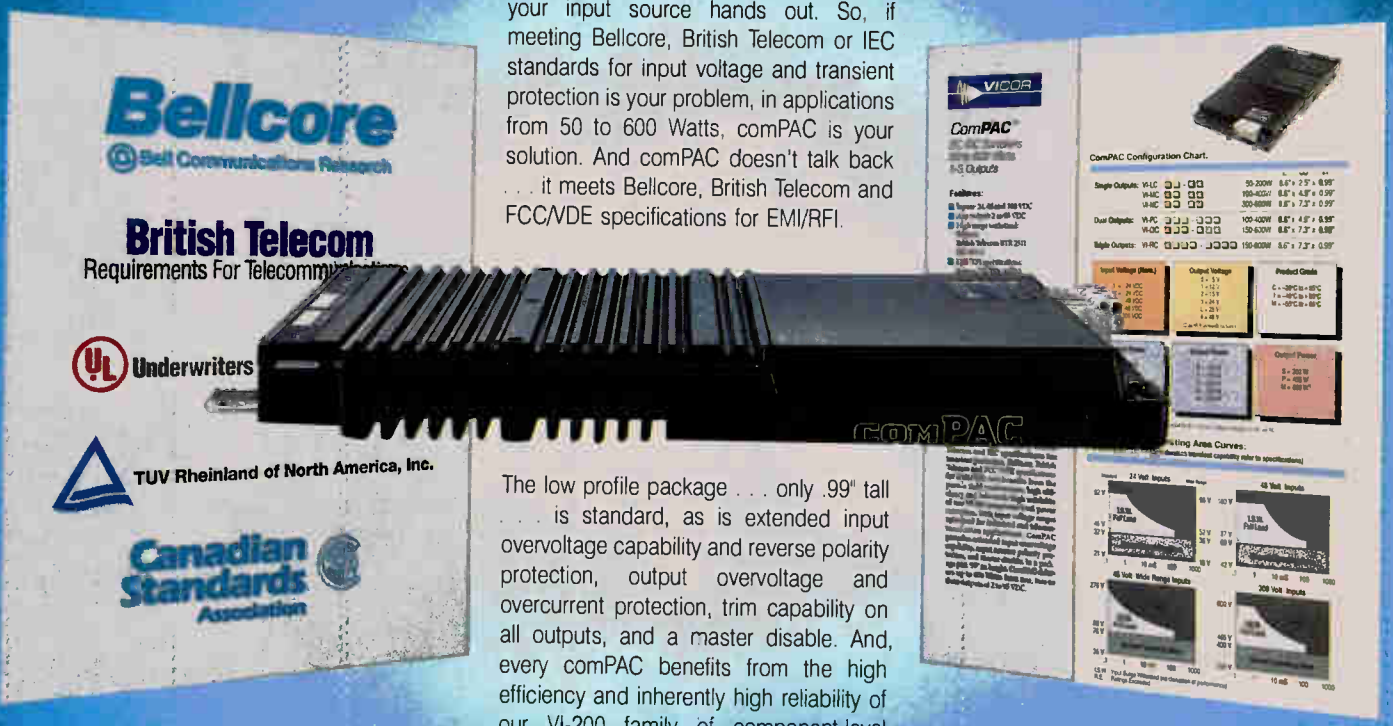

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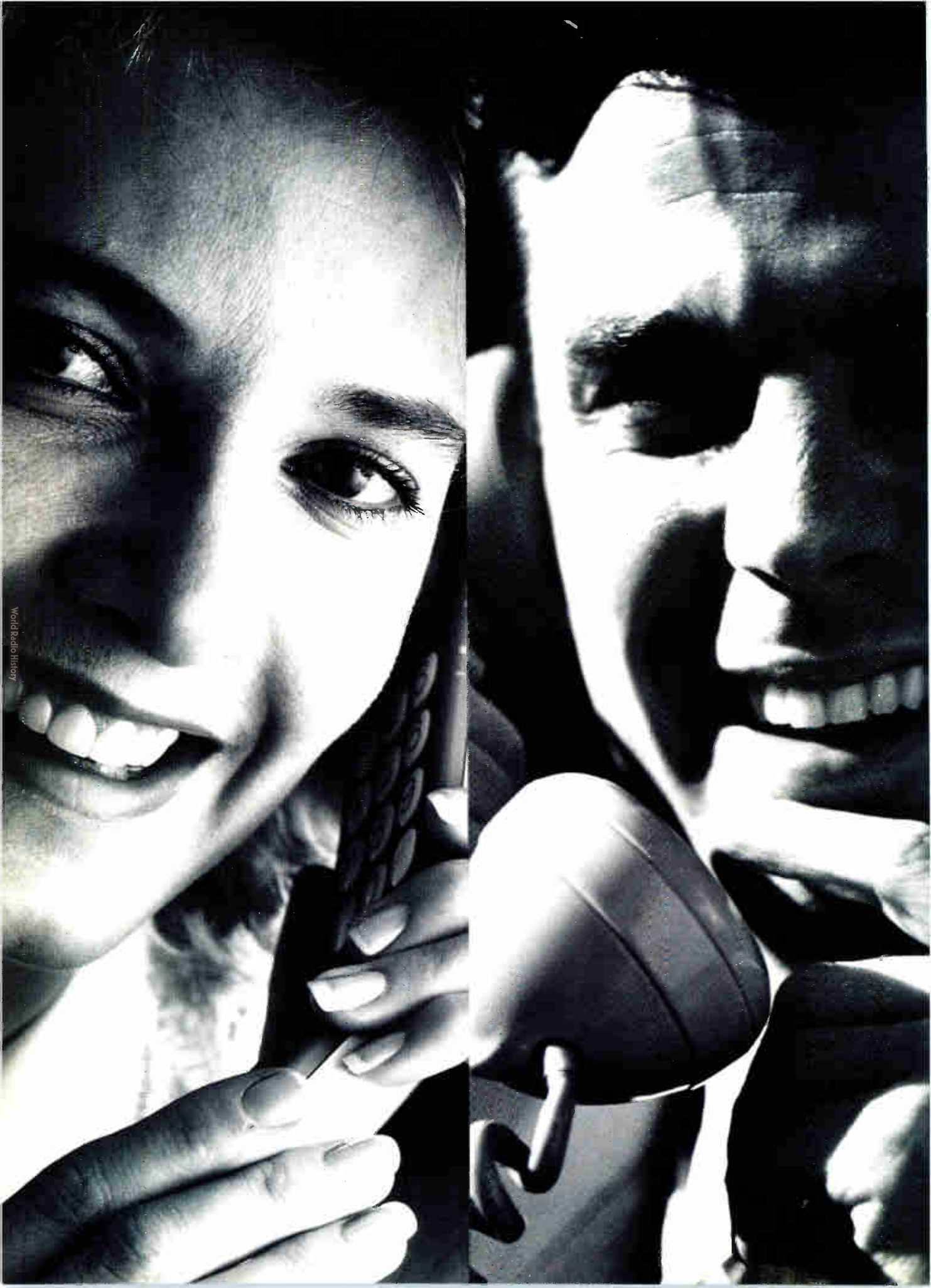

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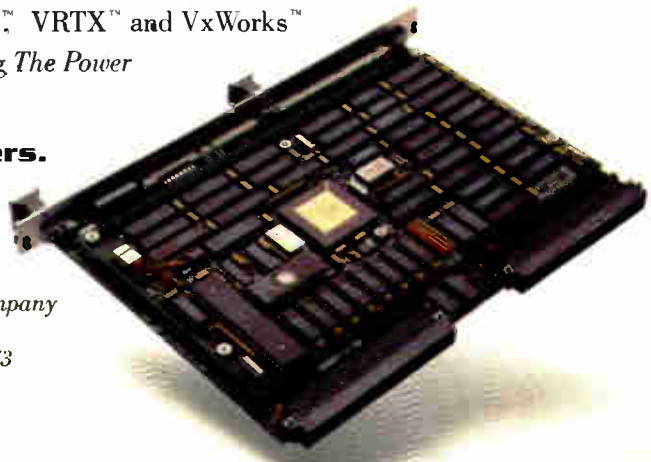

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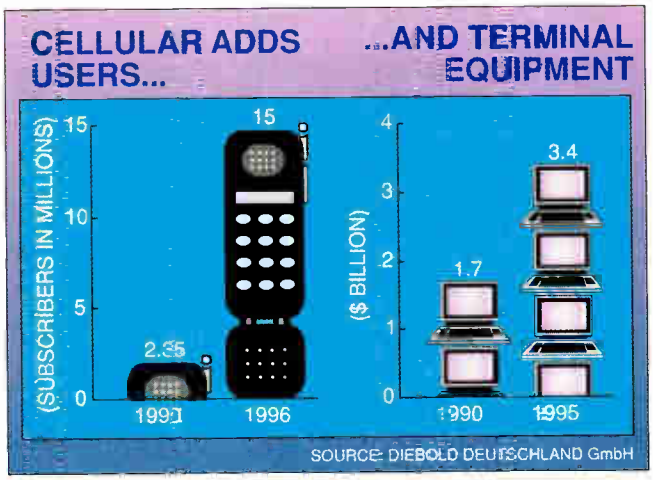
CIRCLE 183

MOBILE COMMUNICATIONS TO SOAR

The advance of digital technology in communications and the continuing liberalization of telecom activities will push Europe's mobile communications market, for both voice and data, toward a multibillion-dollar level by the mid-1990s. That's the gist of a study by Diebold Deutschland GmbH, the Frankfurt-based affiliate of the U.S. management and technology consulting firm.

Diebold estimates that the number of subscribers to cellular mobile communication services in Western Europe will jump about 36% a year, from 2.34 million in 1990 to probably 15 million in 1996. The terminal equipment market will double from the $1.7 billion level in 1990 to $3.4 billion in 1995. The expansion will be primarily in the voice sector; the share for data communications probably won't top the 10% mark.



In Germany, meanwhile, the Telekom Division of the Bundespost, the country's communications authority, as well as a private consortium will start digital cellular mobile around midyear. For its part, Telekom is investing more than $2 billion in its so-called D1 network. Initially, the agency will provide its services in metropolitan areas such as Hamburg, Frankfurt, Berlin, Stuttgart, and Munich, and on superhighways. By 1994 Telekom hopes to have 90% system D1 coverage of Germany with 500,000 subscribers by the end of that year. ❑

PHILIPS STREAMLINES LEGAL STRUCTURE

In an effort to make the company more efficient and transparent, Philips NV is about to simplify its legal structure. This means that its shareholders will be directly involved in assessing company policy and making appointments to its boards. Also, the decision-making process at the highest level will involve fewer board members. These changes were scheduled to go into effect on May 15.

The present holding company for shares in Philips will take over operational control of the Philips group, and it will be named Philips Electronics NV. It will be operated by a board of management whose members will be appointed by the shareholders. They, in turn, will pick from a list drawn up by the priority shareholders in accord with the supervisory board. ❑

EUROPE LOSES LAST GaAs WAFER MAKER AS WACKER QUITS

In a surprise move, Germany's Wacker Chemitronic GmbH has stopped production of gallium-arsenide substrates. Wacker had been Europe's only native producer of high-purity GaAs crystals. Among the factors that prompted the Burghausen firm to get out of the GaAs business are what it terms Japanese dumping practices and low European demand for the material.

"We don't see a trend in Europe that would justify the high investments in GaAs production," a Wacker spokesman says. "We'd rather invest in silicon to maintain a leading position in that field." Two years ago, the company gave up production of indium phosphide crystals.

As for the dumping charges, Japanese suppliers are said to sell GaAs substrate material in Europe at 20% to 30% below the level that Wacker considers adequate to cover production costs in Germany. There has been some speculation that Siemens AG, Germany's No. 1 electronics producer, would buy Wacker's GaAs activities. "We definitely won't," says a company spokesman, indicating that Siemens sees as little chance of success in Europe's GaAs market as Wacker does. ❑

EUROPE'S FIRST METROPOLITAN-AREA NETWORK GOES OPERATIONAL

Denmark has become the first country in Europe to put a public high-speed data network into regular service. Designed as a metropolitan-area network, the 34-Mbit/s system, from Germany's Siemens AG, is operated by Copenhagen's telephone company KTAS and connects the local data networks of a pharmaceuticals group in the Danish capital. System operation is based on the distributed-queue dual-bus principle in accordance with the IEEE 802.6 standard.

Siemens is installing similar metropolitan-area network systems in Germany, Italy, and the U.S. It is also in negotiations with network operators in other countries that could lead to still more installations.

Metropolitan networks are an evolutionary step toward the public high-speed communications networks of the future. They will be an integral part of the planned broadband integrated services digital networks based on the asynchronous transfer mode. ❑

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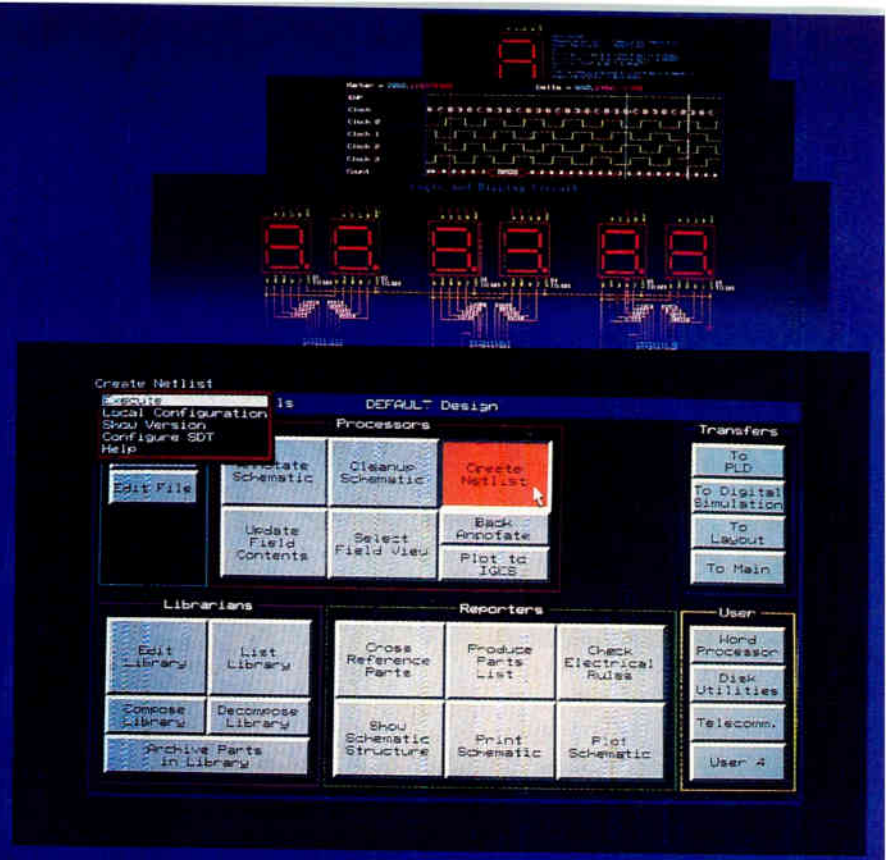

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CIRCLE 189

TO SUCCEED IN THE UNIFIED MARKET, U.S. FIRMS HAD BEST HEED THE ISO 9000 STANDARD

THE KEY TO EUROPE '92

BY JOHN GOSCH

"American companies had better go with the ISO 9000 standard if they want to succeed in Europe's unified market." That, briefly, is the message to U.S. firms from an executive at an established American electronics producer in Germany. Although U.S. companies won't be discriminated against if they do not comply with this quality standard, "they'll be in a better position to do business in Europe's more competitive environment after 1992 if they do."

Europe's Single Market, which the 12 countries in the European Community aim to set up by the end of next year, will be a no-barriers economic bloc, with people, goods, services, and capital moving freely across national borders. Along with the trade barriers, the architects of the "new" Europe will eliminate the patchwork of national standards—they currently differ from country to country—and replace them with harmonized norms.

One standard already common for all EC countries, plus six others in Europe, is the International Standards Organization's ISO 9000. Published in 1987, this standard is in line with the worldwide trend toward more stringent customer expectations in the quality of products and services. It also reflects industry's growing realization that continual quality improvements are necessary for success in the marketplace.

In accordance with the rules of the European Standards Committee, all its members—virtually all the countries in Western Europe—are bound to implement ISO 9000. Worldwide, about 30 nations have embraced it as well, including the U.S. There, the American National Standards Institute and the American Society for Quality Control have adopted ISO 9000 as the ANSI/ASQC Q90 standard.

However, many American firms seem unaware of the new norm and are largely conforming to MIL standards or following in-house quality rules, according to European quality managers. "As I see it, U.S. companies are moving within their own cosmos when it comes to quality standards," says Peter Naumann, an official at the German Society for Quality in Frankfurt. "But if they want to gain a foothold in the future Europe, they had better stick with ISO 9000."

QUALITY

In agreement is Günther Henemann, director of a quality-systems group at Munich-based Siemens AG. "In the U.S., the ISO 9000 standard is not too well known," says Henemann. "But that doesn't mean American firms are less quality-conscious these days than we are." Henemann notes that in the U.S. the concepts of total quality management and customer satisfaction are highly developed at many firms, especially in the computer and semiconductor industries (see p. 48). As do other European quality experts, he cites Motorola Inc.'s Six Sigma crusade (one Motorola plant has just qualified as an ISO 9000 company; see p. 46) and the industry's infatuation with the Malcom Baldrige National Quality Award (see p. 20) as examples that show how advanced quality thinking is on the other side of the Atlantic. "It's only because of their huge home market that American companies are concerned primarily with their own quality norms and are unaware of other standards," Henemann says.

Though there has been some misunderstanding among U.S. companies about the need for a quality standard, most doing business internationally are moving to comply, according to Kim Hawkman, consultant at E.I. du Pont de Nemours & Co. in Wilmington, Del. Du Pont, for one, has set up an internal operation, the Quality Management and Technology Center, to ensure that the entire corporation complies with the ISO 9000 standard.

What exactly is ISO 9000? Unlike many other standards, it is not a set of product specifications, nor is it specific to any single industry such as electronics, automobiles, or chemicals. Rather, it is a set of quality-system standards and guidelines that complement product or service requirements.

As Léon Tossaint, corporate quality manager at Philips NV, the giant Dutch

electronics producer, defines it. "ISO 9000 is a standard for a quality-assurance system." Its aim is to help an organization set up procedures "for achieving an optimum level of quality in products and services and to instill confidence in customers and company management that such quality is sustained." The 9000 relates to quality in all operations, from incoming inspection to final product installation and service.

Du Pont's Hawkman points out that the real benefit of ISO 9000 is that it codifies processes within a manufacturing operation and makes them uniform throughout. In U.S. companies today, one group or division may have superior quality and another only adequate. ISO 9000 sets some minimum acceptable level. And in the process, it forces an enterprise to think about how it approaches quality and how it can uniformly improve it companywide.

Though it goes under one name, ISO 9000 is actually an umbrella for five separate quality standards. The first in the series, the actual ISO 9000, defines key quality terms and is advisory in nature, in that it provides guidelines for selecting and using the other standards in the series. These are ISO 9001 through 9004. They can be used for a company's internal quality management and external quality assurance.

ISO 9001 describes a model for quality assurance in the design and development of a product, as well as its production, installation, and servicing. It is used when a supplier must demonstrate to a customer that it is capable of delivering and servicing a desired product. ISO 9002 gives more details on quality assurance in production and installation than does the ISO 9001. The next in the series, ISO 9003, is a model for quality assurance in final inspection and test. ISO 9004 is again advisory, offering guidelines on elements of quality management and quality systems. This series of standards is not clad in stone; ISO 9000 is flexible. If necessary, it will be periodically reviewed, taking into account user feedback. Further, its scope may be extended to include areas such as software, specifically software development, supply, and maintenance.

Throughout most of West Europe, ISO 9000 is increasingly being recognized as an important element in an organization's business strategy. Just how many firms in Europe or elsewhere have implemented ISO 9000 is difficult

Du Pont, one of few U.S. companies to adhere to ISO 9000, sees this standard—promulgated by the European Community—as part of a continuum leading to world-class quality.

to say. Speaking for Germany, Naumann points out that the standard is "widespread, particularly in high-tech and export-intensive industries such as the electronics/electrotechnical and machine-construction branches. Companies in these sectors cannot do without 9000 if they want to score on foreign markets," Naumann says.

Another sign of ISO 9000's growing importance in the European consciousness is the plethora of newspaper want ads for quality engineers and auditors familiar with its guidelines. To push the standard in the engineering community, the German Society for Quality plans to spread the gospel at technical universities and trade schools.

To become an "ISO 9000 company," an accredited agency must certify that the quality system the firm has implemented satisfies the requirements of the standard. In Europe, a number of such agencies provide certification—the British Standards Institute, the German Society for the Certification of Quality Assurance Systems, and the Dutch

TO QUALIFY TOOK '14 MONTHS OF HARD WORK'

It took "14 months of hard work," but Motorola Inc.'s Stotfold, Hertfordshire, mobile-phone plant in England has just won its ISO-9000 wings. The factory, which produces mobile and cellular telephones for use in the UK, China, Japan, and Eastern Europe, is one of few U.S.-owned concerns to go through the rigors of qualifying for this quality standard, which many see as vital to doing business in the unified European market (see p. 43).

What does it take? General manager Mike McTighe says that qualification was a demanding process that took more than a year, during which assessors from the British Standards Institute placed every aspect of the plant's operational procedures under a microscope. "The audit involves a detailed examination of the management system from the point at which a customer order is taken through the processes by which you translate that into a demand on the factory and, in turn, into work in progress," he reports.

The assessors evaluate "the ordering of materials, the way in which the materials are received and managed, and all of the peripheral processes, such as how you cost the product and how you pay the materials vendors—in fact, total management and documentation," says McTighe. They do not, he notes, "lay down rules about how a product should be made," only that your system can make it the way it's supposed to. That's in accordance with the British definition of quality, says Paul Lerch, lead BSI assessor: the ability of "the features and characteristics of a product or service to satisfy stated or implied needs."

One of the most potent facets of the ISO 9000 standards, also known as BS-5750 in the UK, is that gaining certification is not a one-shot deal. "It's a living assessment," says McTighe. "They visit you randomly at least once a quarter. So you don't just get certified once—you have to maintain those standards or else certification is withdrawn."

Is it worth the effort? McTighe thinks so. The root strength is that it is a public demonstration that a plant has been stringently assessed and approved as a competent manufacturing organization. Besides giving a company a competitive selling edge, it can improve relationships with components suppliers. "We have a vendor-qualification procedure that assesses a vendor for recognizable quality standards," says McTighe, "but we would prefer to buy from a vendor with ISO-9000 qualification."

There are public kudos as well. Now McTighe gets to print the ISO symbol on his company letterhead, and the chances are that the actual certificate will be formally presented by a passing politician, or even, if Motorola is very lucky, a member of the British royal family.—*Peter Fletcher*

KEMA, an agency akin to a standards institute, among others. These organizations carry out on-site audits and issue a certificate if the company passes the test. A company in one country can get certified by an agency in another; the quality certificates are recognized worldwide. Every two years or so, a company must prove to the agency that it is still conforming to ISO 9000.

In the U.S., the American Society of Quality Control has established the Registration Accreditation Board to accredit registration agents in the U.S. Hawkman points out that the registration process was not originally conceived as part of the standard. However, companies otherwise would have no way to prove to their customers that they are compliant.

After the auto industry, the electronics sector is strongly quality-conscious, and among the most active European ISO 9000 adherents is Philips. The Eindhoven-based company turned to the 9000 standard about two years ago and made it a keystone in its total quality-management philosophy. "The standard fits in with our 'quality way of life,' our company culture," says corporate quality manager Tossaint.

So much so that Philips has decided to introduce the standard to its operations throughout the world. In Europe, some 80% of all manufacturing units have already implemented the standard, and 20% of these have received certification from the various auditing agencies. For other units, certification is pending. The standard applies to almost everything the Dutch company produces, from integrated circuits to consumer and communications gear.

As for Siemens, Germany's No. 1 electronics maker has been working with quality norms for more than 20 years, conforming to the standards of the many countries to which it exports its wares. When ISO 9000 came out, Siemens—which, like other European firms, was instrumental in drawing up the standard—began adapting its existing quality systems to the 9000 guidelines. By now, eight of Siemens's 50-odd factories in Germany have received the ISO 9000 certificate while the other units have applied for certification.

Siemens not only delivers 9000 quality, it increasingly demands that its parts suppliers do so too. That requirement, Henemann says, "is now written into about 50% of our contracts." In the other half, the 9000 is not an absolute requirement but is regarded as desirable. The company has about 30 experts at the corporate level who are engaged in general aspects of quality. "They ensure that the same standards are applied throughout the company and that information on quality is exchanged among our various divisions," Henemann says. At each of the 15 divisions are hundreds of specialists directly concerned with ISO 9000 implementation.

If companies don't implement the standard of their own accord, pressure to do so may come from the outside. "Increasingly, customers demand that we produce 9000-specified quality," says Erich Schindler, manager for quality and reliability at the ITT Semiconductors Group in Freiburg, Germany. He points out that some of the firm's customers are auto-accessory makers whose customers, in turn, are the quality-mad automakers, for whom the utmost in quality is crucial in their struggle to compete against Far East imports.

What's more, many customers have begun to rate suppliers according to how well they fulfill an order for quality products, Schindler says. Class-A suppliers, he explains, have a fulfillment degree of better than 85%. Always asked first to fill an order, they are rated as preferred suppliers. Class-B suppliers have a fulfillment degree of better than 75% and are approached if the preferred supplier is unable to deliver. Finally, Class-C suppliers rate as the last resort for the parts a customer needs.

Besides being a powerful sales argument, in production ISO 9000 helps boost yields and speed throughput, Schindler adds. How so? Statistical process control can reveal weak spots in production. Because of bad process parameters, semiconductor parts, for example, may suffer from poor characteristics and therefore poor quality. By eliminating the weak spots, quality is enhanced and yields raised. And because the production process need not be interrupted to sort out bad parts for possible rework, the throughput goes up. That, in turn, could mean lower-cost products if the supplier passes on the advantages to the end user. ❑

Additional reporting by Jonah McLeod

DOES YOUR COMPANY PASS OR FAIL SERVICE?

ELECTRONICS EXECUTIVES ARE FINDING THAT CUSTOMER SATISFACTION IS MORE URGENT THAN MIPS AND MEGAFLOPS

By Jacqueline Damian, based on reporting by Lawrence Curran, Jonah McLeod, Jack Shandle, Samuel Weber, and Howard Wolff.

Hot technology isn't enough. Time to market won't do it, either, and neither will superb quality. All those attributes, rightly cherished by suppliers of electronic products, won't launch a company into the big leagues in terms of gaining market share without the addition of one crucial, if elusive, ingredient to the recipe: customer service.

In the fevered marketplace of the 1990s, customer satisfaction has become a major selling point among vendors jousting for client dollars. No longer are high technology and high performance enough to guarantee success. And high quality, once the industry's holy grail, has become a given, something the customer expects without question.

What's left is service, a multifarious construct of tangible and intangible considerations that can make a vendor stand out from the crowd of competitors—and keep his order book full.

The electronics industry only recently began to preach the service gospel [*Electronics*, July 1990, p. 50], but the doctrine has become so entrenched so fast that market-research house Dataquest Inc. is now endorsing it by handing out awards to companies whose customers grade them A+ on service.

"Customer satisfaction is the [most important] strategic marketing concept of the decade," says Greg Chagaris, vice president for customer-satisfaction products at the San Jose, Calif., research firm. Advanced technology "remains a crucial element in business success, but [by itself] it's no longer enough." That's because most electronic products—including personal computers, semiconductors, and printers, the three categories that Dataquest is evaluating—have become commodities, and manufacturers have to find more persuasive ways to differentiate their products. The answer is keeping the customer happy and meeting all his needs—i.e., service.

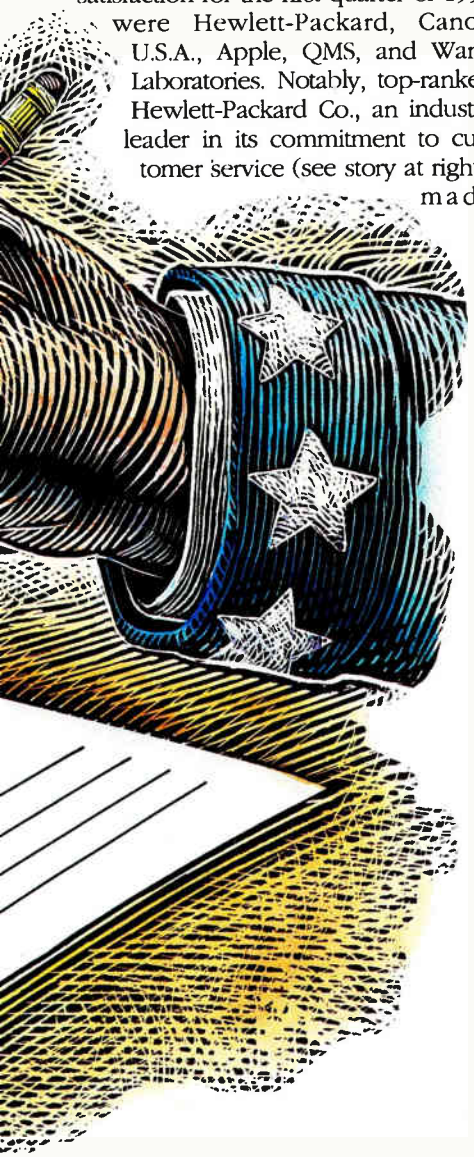
COVER STORY

The most recent Dataquest service awards offer up a few surprises. In semiconductors, for example, no Japanese company made the list of 15 chip houses, in three categories, that were deemed superior in service by a group of 160 chip buyers Dataquest surveyed worldwide. In fact, the highest-ranked Japanese supplier gained only 3% of the vote in Category 1, which comprises major vendors with $500 million or more in annual revenues. The winner, Motorola Inc.'s Semiconductor Products Sector in Phoenix, Ariz., garnered an awesome 35% of the vote.

"Going the extra mile, providing products with service, that's tough for [the Japanese]," says Mark Giudice,

senior industry analyst in Dataquest's semiconductor user service. Some industry watchers caution against such generalizations, while others say communication problems can interfere with service from Far Eastern suppliers. "They nod, they say they understand, they agree, and they don't understand at all," says one executive.

In personal computers, where 1,230 U.S. users ranging from corporate executives to secretaries were surveyed, heavyweights IBM and Apple made the list of the top eight—but they ranked beneath outfits whose names are not household words, like CompuAdd, Everex, and AST. In page printers that print 20 pages or less per minute, the top five companies in overall customer satisfaction for the first quarter of 1991 were Hewlett-Packard, Canon U.S.A., Apple, QMS, and Wang Laboratories. Notably, top-ranked Hewlett-Packard Co., an industry leader in its commitment to customer service (see story at right), made



LEARNING HOW TO LISTEN

How does a topnotch customer-service organization reduce its parts inventory by 21%, cut the time its engineers spend in filling out forms by 40%, and increase the quality of the information in its customer data base by 37%? If the company is Hewlett-Packard Co., it gives its customer-support engineers laptop computers so they can file reports electronically instead of by hand. For HP, the paperless customer engineer has preceded the paperless office.

The transformation came about because HP's cutomer-support organization is constantly running controlled experiments to maximize quality, says Jim Arthur, senior vice president and general manager of Worldwide Customer Support Operations. In the case of supplying customer engineers with laptops, HP listened to its employees. It listens to its customers just as earnestly.

When it comes to support organizations, the Palo Alto, Calif., company has few peers. Arthur's division contributed $3.1 billion to HP's revenues in 1990. It employs 16,000 professionals in 400 support units and has offices in more than 100 countries. On average, each professional in Arthur's group contributes $200,000 in revenues—HP must be doing something right.

"It is important to have a well-defined overall philosophy," says Arthur, "so that the people on the front lines have a framework in which to make decisions." In a large corporation, having front-line engineers make decisions—the right decisions—translates into faster turnaround and customer satisfaction. "We create a bias for action," he says.

Feedback is a key element in HP's overall support philosophy. Its customer-satisfaction survey, for example, is an 11-page booklet that asks more than 100 questions. "The questions are detailed," say Arthur, "because to improve the process you have to understand exactly what the customer is thinking in as much detail as possible."

But written surveys are not enough. HP also conducts focus groups in which it asks for face-to-face critiques. "Focus groups give us the intensity we would not see in a questionnaire," Arthur says. "They also let us develop alternative solutions and ask the customers which is the best trade-off."

Customer feedback was a driving force behind HP's becoming the first computer maker to move from paper to CD-ROM discs for the documentation of its systems. Through the questionnaire, HP learned far more than that customers were unhappy with the documentation. Results also showed that users considered documentation a key component in operating HP computers; that keeping track of system updates was a problem; and that the sheer volume of paper (600 lbs for a midrange computer) was overwhelming.

HP's first cut at a solution was to suggest magnetic tape as an alternative delivery vehicle. Taking the idea to a focus group, however, showed tape was not the answer. Customers wanted random access to the information, and that demand led directly to CD-ROM. Has it had an impact? Dataquest Inc.'s customer-satisfaction survey for minicomputer suppliers showed HP doubling the spread between its score for documentation and the industry average between 1988 and 1989. A follow-up HP survey revealed that nearly 50% of customers said the CD-ROM service saved up to five hours of systems-management time a month.

Still another HP support methodology is called design prototyping. It selects a set of customers that represent a range of potential users, gives them product prototypes, and asks for feedback. This process is repeated thoughout the product-development cycle.

The development of HP GlancePlus, a performance diagnostic tool used by data-processing supervisors, followed this route and led to a major design fix. In early prototypes, the GlancePlus displayed a screen full of performance metrics that customers found too complicated. "Less is more," they kept saying, reinforcing the fact that they found the human-factors aspect of screen design more important than sheer quantity of data. HP eased up on the density of information and emphasized readability. As a result, HP GlancePlus earned an initial customer-satisfaction rating of the sort usually achieved in the third or fourth versions of a software product.—*Jack Shandle*

the lists in the semiconductor and computer categories as well.

To install a world-class service apparatus requires, first of all, defining the term as it applies to your own customers, says service guru Armand V. Feigenbaum, the author of *Total Quality Control*, which has just appeared in a revised third edition (McGraw-Hill, $62). Feigenbaum offers his own sweeping definition: service is "whatever the customer says it is."

He adds that electronics companies that operate on the theory that their own engineers know more than the customer about what the customer wants will have trouble with service. In short, he says, service must be market, not technology, driven.

Feigenbaum, whose General Systems Co. in Pittsfield, Mass., installs service- and quality-oriented operational systems for companies worldwide, offers a carrot-and-stick quantification for the service equation: "Our data shows that when a customer reacts favorably [to a supplier] he will tell eight others. But when he reacts unfavorably, he will tell 22 others," he says.

The precept that each company must draw its own picture of service is reinforced by Dataquest president H. Glen Haney. "We find that what's good for one vendor isn't necessarily good for another," he says. "For example, Customer A expects maintenance for his equipment to be intimate enough so that it is never down more than one hour. Customer B expects maintenance within 24 hours. The level of satisfaction or dissatisfaction for Customer A is just as valid as that of Customer B."

Deciding how high to place the maintenance department's hoop, then, will vary depending on the expectations of a particular customer base. That level must be decided vendor by vendor, product by product, model by model, region by region, Haney says.

Electronics companies are indeed arriving at their own definitions of service, in programs that inevitably start with quality—the two are "absolutely tied together," says Feigenbaum. For example, Analog Devices Inc., the Norwood, Mass., chip house that ranked No. 1 in Dataquest's second semiconductor category (midsize suppliers with revenues of $50 million to $499 million), did a turnaround on service when it realized that customers were far from happy with the service they were getting (see p. 54). Cypress Semiconductor Corp. of San Jose is another chip maker that sternly evaluates the customer service it provides (see p. 59).

Dataquest, meanwhile, offers some insights gained from its ongoing customer-satisfaction surveys, which ask users in the three product categories to describe their most important concerns. In semiconductors, the firm found, what customers want most is reasonable prices, on-time delivery, availability of product, and help with cost control embodying such things as just-in-time delivery and inventory control.

The PC-customer wish list is shorter: here, the three most critical factors are value for price, quality, and the vendor's commitment to the customer, Dataquest found. Technological bells and whistles, product delivery, and technical documentation, while important, were judged less crucial than these three.

In printers, customers were generally happy with product quality but dissatisfied with value for price, citing especially the high cost of add-ons and options such as font cartridges, feeders, trays, and memory upgrades.

Ironically, says Dataquest's Haney, "There is a groundswell of knowledge that the god we've been pursuing all our lives—better price/performance, more mips per dollar—is really driving us to narrower and narrower margins. To differentiate your products this way is interesting, but it has brought all to the point where most products are commodities," he says. In such an environment, he says, real differentiation "will come from very specific and intimate knowledge of what the customer base wants."

For the systems house purchasing electronic components, one company that knows exactly what it wants—and spells out those desires for suppliers in no uncertain terms—is Intergraph Corp., the Huntsville, Ala., workstation vendor. According to Brom Sweet, director of worldwide procurement and transportation, Intergraph about four years ago put in place a program to deal strictly with supplier quality. It's the Purchaser Quality Council, which is composed of people from Intergraph's design-engineering, manufacturing-engineering, materials, management, quality, and purchasing departments.

"Each month we get an inspection-history report, printed out by vendor, showing the result of looking at a supplier's lots of materials received during the month," says Sweet. "It shows how many lots were inspected and tested, how many came in early, and how many came in late. It shows if there were any amounts over or under what we ordered, and their quality-acceptance percentage."

Anything less than a 98% rating gets meticulously reviewed by the council once a month, and this may lead to a visit to the supplier or an invitation to

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Advanced Micro Devices

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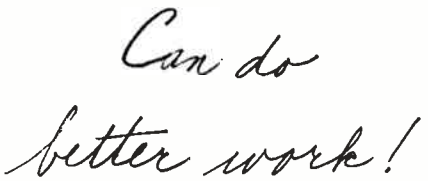
visit at Huntsville, so that the vendor can find out where it went awry and put some "get-well program" in place. Subsequent gaffes lead to warning letters, special board reviews, and ultimate disqualification. "This improves our overall quality," Sweet says, "and also automatically limits our supplier base, which is also a goal."

Satisfying a major consumer of semiconductors, components, and subsystems such as Intergraph or Northern Telecom Corp. can, in fact, mean the difference between being a certified supplier and being left out in the cold. Northern Telecom, for example, dealt



with 1,725 suppliers in 1984, says Adrian Despres, purchasing manager for the company's facilities in Research Triangle Park, N.C. By 1990, that number had fallen to 385, "with 104 certified suppliers providing 85% of our lots."

The three-step certification procedure is arduous, time-consuming, and expensive for both the prospective supplier and Northern Telecom. But it leads to what Despres calls "a codestiny partner: their success and ours are intertwined," he says.

The first step qualifies the supplier's process. Essentially it requires a positive assessment of a vendor's ability to manufacture high-quality components. Step 2 qualifies a specific component by extensive testing. Step 3, the most demanding, includes assessments of service-oriented issues such as the ability to control subsuppliers, provide just-in-time delivery, and utilize forecasting information to reduce delivery cycle time. When Northern Telecom's needs

CONQUERING THE LIMBO FACTOR

When Analog Devices Inc. was named by Dataquest Inc. as Semiconductor Supplier of the Year among midsize chip makers (see main story), the recognition told Art Schneiderman that "we're on the right track toward being rated No. 1 by our customers." It was a personal victory for Schneiderman, vice president for quality and productivity improvement at the Norwood, Mass., firm, and vindication for his boss, company founder, chairman, and president Ray Stata. Stata hired Schneiderman as quality guru five years ago to turn Analog Devices around in customer satisfaction.

Stata had become convinced that "on-time delivery of products that work has become the major factor in vendor selection and performance evaluation." At the time, however, his company's record for on-time delivery wouldn't have won any awards. Manufacturing cycle times at the Analog Devices Semiconductor Division in Wilmington, Mass., were 22 weeks in the first quarter of 1986, before Schneiderman instituted a quality-improvement program. By the end of 1989, they had been slashed to nine. They're now at eight weeks, with a goal of four to five next year.

Nor were yields anything to brag about. In 1987, for example, yields were about 20%. They're now at 38%, and the goal is to top 50% next year. "We measure four internal processes," Schneiderman says: manufacturing-cycle-time reduction, time to market, process-defect levels, and yield improvements. "They all play together and can't be treated in isolation," he asserts.

Schneiderman adds that customers don't care what a vendor's manufacturing cycle times or yields are. They're interested in the product's quality, price, and "our responsiveness to their needs. What they really want to know is how often we say 'you've got it' when they tell us they need a certain number of parts by a given date."

With a 22-week cycle time in 1986, Analog Devices was missing a lot of delivery dates. To attack the problem, Schneiderman and his team first measured the actual time required to process a batch of wafers from start to finish. That added up to 26 weeks. But the cumulative time encompassing each step along the way—wafer fab, assembly, and test—was 20 weeks. "We couldn't account for where the product was for six weeks, so we added another process step and called it limbo," Schneiderman recalls.

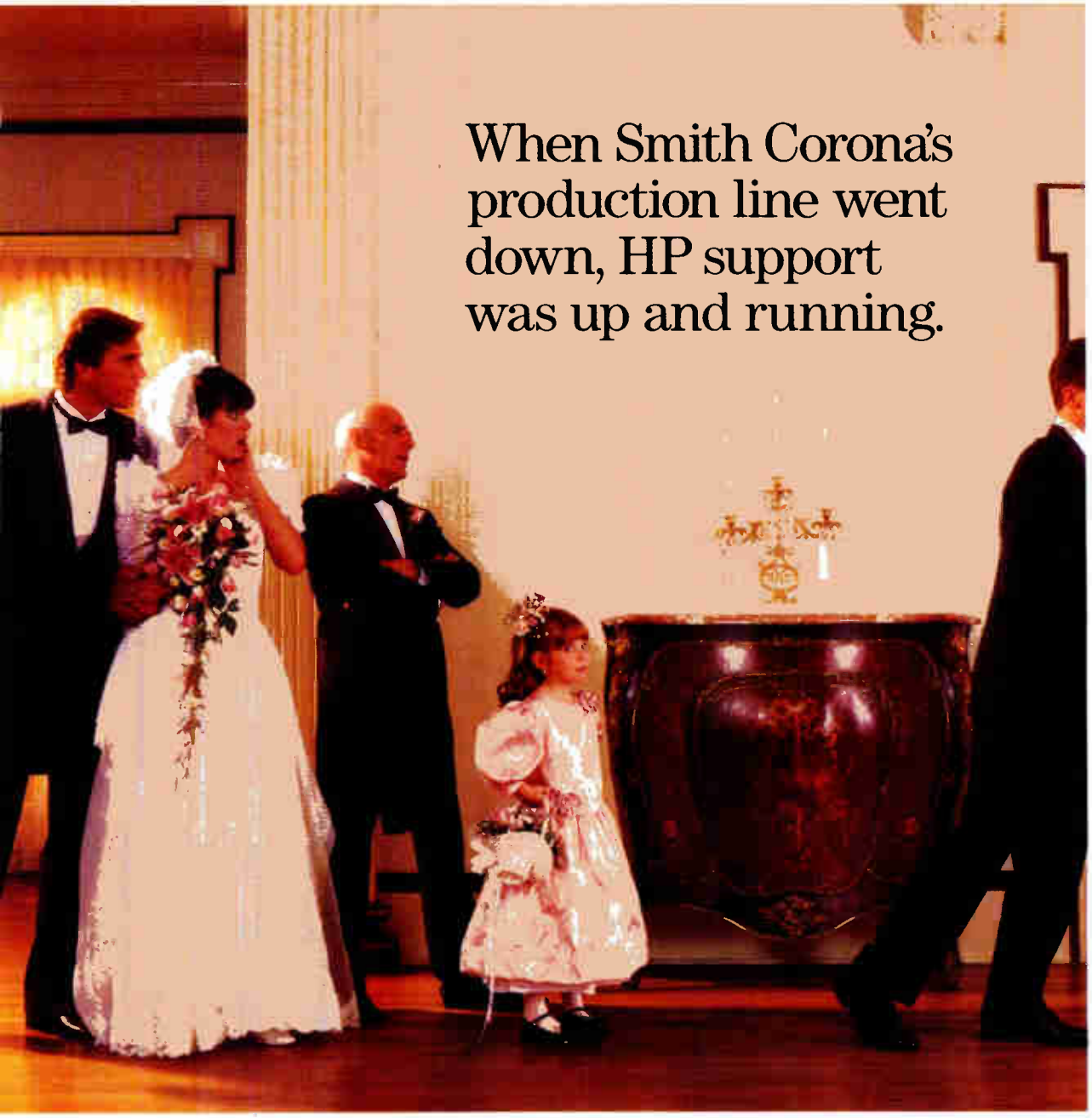
The next step was to determine the theoretical time that should be required for each step in the process. The biggest variance from the theoretical to the actual was the limbo factor, "so we assigned a team to cut the limbo time to zero," Schneiderman says.

Analysis showed that a major part of the limbo time was consumed when wafers were bumped out of a process queue to make room for a "hot lot" that had to be expedited. However, there was no automatic method to reschedule wafers that had been shunted aside. "They may have sat around for four weeks before being assigned to a new processing lot," Schneiderman says, because at the time, rescheduling was a time-consuming manual process done about once a month. Since then, Analog Devices has converted to computerized manufacturing-resource planning (MRP) that makes it easier to reschedule the floor more often; "we've also minimized the expediting of hot lots to those that are truly essential," he says.

The technique the firm uses is based on Pareto analysis—a method that identifies the most glaring problems in successive passes at a process. The limbo factor was by far the biggest, Schneiderman says. "Once that was solved, we went to work on the next biggest problem, and so on until we got those under control, as well." Testing also caused delays because of out-of-calibration equipment and the fact that updating the test schedule wasn't done often enough. MRP solved the latter.

Another statistic indicates how well the quality program is working—the percent of line items shipped on time vs. factory commit dates. That number has jumped from 72% on time in early 1986 to 96% at the end of 1989. The goal is 99% by 1992.

Do all these dramatic and measurable cycle-time reductions and yield improvements affect profits? Unfortunately, "I don't know of any company that has seen a direct bottom-line impact" after substantially improving on quality and delivery, Schneiderman says. "The benefits are passed on to customers in reduced prices," which keeps them coming back. "In today's highly competitive world, if you don't improve you can't compete; you'll be out of business."—*Lawrence Curran*



When Smith Corona's production line went down, HP support was up and running.

It happened on a freezing Saturday in February.

Joe Reiley, a Hewlett-Packard test and measurement support engineer, was at a wedding in Pottstown, Pennsylvania. The office was the furthest thing from his mind, when suddenly his beeper went off.

In minutes, Joe was on the phone to Travis Field, the support engineer for Smith Corona in Cortland, New York. An HP test system crucial to Smith Corona's production line had gone down. Suddenly, Joe's thoughts turned to figuring out how to get Smith Corona's production line back up. Joe bid the other guests goodbye and ran to his car.

After driving through a blinding snow storm over icy mountain roads, Joe pulled into Smith Corona at 10:30 pm. A thorough analysis of the problem made it clear they needed extra parts, so Joe called another HP support engineer, Pete Nahrgang, in Valley Forge. Working through the early morning, Pete took parts from a back-up HP system, then flew them to Cortland by special courier. By Sunday afternoon, just 24 hours after Joe's beeper first went off, Smith Corona's production line was up again.

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CIRCLE 173

change, a certified supplier must be nimble enough to act in one to three weeks instead of the industry-standard 12 to 16, says Despres.

Sun Microsystems Inc. has a similar evaluation scheme. The workstation market leader buys all its parts on a total-cost-of-ownership basis, says Frank Harrell, director of electronics commodity management at the Mountain View, Calif., company. "Our top 50 vendors get a scorecard with a numerical rating system," he explains. "We evaluate five criteria for every vendor and assign a value between 1 and 100 to each: quality is rated at 30 out of 100, delivery gets 25, technology 20, price

Must meet deadlines!

15, and service 10."

Using a formula that produces a grade between 1.1 (best) and 2.0 (worst), Sun determines the cost of doing business with each of its suppliers based on the scores. "If a supplier has a perfect score of 1.1, that means it costs Sun only 10 cents for every dollar we spend with that supplier," says Harrell. "A more typical score is around 1.25, which means it costs Sun 25 cents for every dollar spent with this vendor."

But there's more to Sun's recipe than keeping score. To ensure its vendors' willingness to work toward a common goal, Sun's middle management meets quarterly with the top 50 suppliers using the scorecards as a jumping-off point for determining how the two outfits can work more effectively together. After this meeting comes another between corporate managers, to further refine the working relationship.

The threat—implicit or explicit—of getting cut from the supplier roster is a powerful motivating force in whipping a service operation into shape, says Dataquest's Haney. It makes good business sense from the supplier's side, too, he notes, since it takes several years for a customer to book enough orders to pay off for a supplier. Clearly, longevity in a vendor-buyer relationship is a critical part of the equation.

What's more, suppliers should make it their business to provide topnotch service from the very outset, says consultant Feigenbaum. His data shows that fully 30% of buyers will remain dissatisfied with a supplier even if the supplier fixes the service problems they have cited. "The essence of running a business is the satisfaction of the customer, and the customer's primary satisfaction is the value that he receives the first time," Feigenbaum says. "Service is a very important ingredient of that."

Part of buying products is planning for future needs and making sure of a steady supply. Intergraph, for example, keeps its major suppliers informed about future requirements through technology and business-exchange meetings with top management. The competitive advantage for a supplier comes from knowing what the demand will be for the next product generation and then turning out that product in a timely manner, says Bill Burns, procurement manager for HP's Boise, Idaho, Printer Division. "Part of customer satisfaction is supplying the product the customer needs," he says.

Stability of supply is crucial, Dataquest's Haney points out. "[Customers] want tenure of a platform such as microprocessors, in which they could expect to make investments in software and application development that they could spread over a long period of time," he says.

They want tenure of needed parts,

Needs to plan time better!

too, and without that, profits can erode. Take the experience of one New England supplier of board-level subsystems. The company found this out when it encountered recession-related difficulties in getting the parts it needed. In an economy move, a longtime supplier of 16-bit digital-to-analog converters opted to discontinue production and asked the board maker to estimate its DAC needs well into the future. The board maker ordered what should have been a year's supply, then experienced a sudden doubling in bookings for the three boards in which the DACs were used.

As inventory dwindled, the board maker turned to an alternate source of supply, but the second supplier then revealed it had lost the recipe for the DACs and couldn't ship parts for at least

THE GODFATHER PROGRAM

One problem confronting suppliers evaluating their own performance in providing customer service is the tendency to deceive themselves: no one can picture himself as a villain. However, for a company to compete effectively it must be brutally frank with itself in evaluating precisely how well it is serving its customers, and how it could do the job better.

Cypress Semiconductor Corp. can attest to the benefit of knowing firsthand what one's customers think. Its Godfather program measures service directly. "Officers in our company are assigned key accounts," says T.J. Rodgers, president of the San Jose, Calif., chip house. "At intervals during the year, they visit the customers that buy and use Cypress's products."

The program has humbled Cypress's top managers as they listened to customers complaining about things the company had or had not done. "Customers tell you your delivery performance is poor, that a simple request such as not using styrofoam 'popcorn' packaging materials has gone unheeded, and so on," Rodgers says.

Rodgers himself is the godfather for Sun Microsystems Inc., the Mountain View, Calif., workstation leader. Satisfying Sun represents the greatest challenge a semiconductor company can face, because it purchases the most advanced devices—those that are the most difficult for a chip maker to ramp into production. And Sun is a very aggressive company that wants the latest technology and values a good supplier-customer relationship, Rodgers says (see main story).

In no way do Cypress and Sun have the kind of arm's-length relationship once typical of supplier and vendor in the semiconductor industry. Besides satisfying a valued customer, the new intimacy can make life easier for the supplier, Rodgers says. Where once "you had to build an 11-ns part to meet a 15-ns spec," he says, a close relationship, with the precise communication of needs this implies, eliminates the unnecessary margin—to both companies' benefit.—*Jonah McLeod*

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CIRCLE 225

two months. The board maker faced two equally unpalatable choices: hold up its own shipments or find yet another alternative DAC that wasn't pin-compatible with the original components.

"That would have meant we'd have to redesign a six- or eight-layer board, cutting into our profits on these products," a senior manager for the board maker says, explaining why the company decided instead to delay its own shipments.

Intergraph, meanwhile, has experienced some problems with suppliers in the Pacific Rim, shedding some light on the Dataquest semiconductor survey's finding that Japanese vendors do not seem to rank as high as their U.S. counterparts in customer satisfaction. At Intergraph, one big problem was a highly unreliable disk drive from Japan. Also, the company had quality problems with molded plastic parts from Taiwan, mainland China, and Hong Kong.

"It's difficult to get parts from these places that exactly match our drawings and specs," Sweet says. "I lay the blame largely on communication problems. We anticipated problems, but not to the extent we have experienced. We have to save a big sum of money to make it all worthwhile."

HP has also experienced service problems with Asian suppliers but lately has seen some improvements, according to Burns. Recently, he says, a Japanese supplier of crystal components responded with astounding alacrity to a problem. "Their components were failing in the factory, and we went to see them in Japan and made a technical contact. They had a person back here in the factory within 36 hours and we were able to resolve the problem in a couple of days. It was an absolutely exceptional effort on their part. Very refreshing."

HP's experience with a European vendor of a programmable-array logic device was far from refreshing, however. The devices were improperly programmed, and intermittently, some parts on the reels weren't programmed at all. HP engineers had to reprogram all the parts themselves.

Not working up to potential!

Feigenbaum, for one, cautions against pinning a poor-service label on Japanese or European companies based on a few bad experiences here and there. After all, Japanese electronics producers are among the most powerful in the world—they must be doing something right. "It is dangerous to generalize," Feigenbaum says, "because quality and service don't travel under exclusive national passports."

For its part, Hewlett-Packard's Boise operation rates suppliers on five different criteria: technology, quality, responsiveness, delivery, and cost. "We want to focus on suppliers that can give Hewlett-Packard a competitive advantage," says Burns.

Confirming the findings of the Dataquest semiconductor survey, cost is a major consideration. "All [five criteria] are equally important," Burns says, "but cost is more equal than the others." The reason? The division's own customers, says Burns. "In our business, customers are demanding more and more product features all the time, at less cost," he says. "So we're demanding the same thing of our suppliers."

Burns also confirms that quality of incoming semiconductor products has become a given and is therefore no longer a major concern for chip buyers. But technology for HP is still a major factor in getting a competitive edge. And that puts a burden on the company's suppliers.

"We have quite a bit of product turnaround," Burns points out. "Our product-introduction cycle time is getting shorter and shorter. To do that requires product availability in increasingly narrow market windows. To do business with us, suppliers have to be on time with the technology. We stock at low inventory levels, so they have to be there. Along with cost, delivery is a critical issue."

However, Burns agrees with Dataquest's Haney that a preoccupation with product turnaround time is not by itself sufficient to differentiate a supplier in the marketplace. Turnaround time must be combined with delivering the precise product the customer wants, Burns says.

In recent years, time to market has become a kind of competitive watchword in the industry. Turn out more and more products, faster and faster, make the market window when it opens, and you'll be guaranteed success. But the single-minded pursuit of product innovation can be self-defeating, Haney believes.

Should pay more attention!

"Time to market is very appealing to clients, but it also creates its own problems," he says. "The ability to proliferate products at such a heavy clip brings a degree of instability to the marketplace that is very attractive from the technology point of view. But from the profitability point of view, it can wreak havoc—for the semiconductor supplier as well as his customer, say the personal computer vendors. I feel that if you pursue production engineering and design engineering for better and better price/performance and that is your main differentiation, sooner or later you're going to be in trouble."

Haney is not advocating a halt to investment in technology development, but rather a reallocation of resources. "In allocating resources," he says, "there should be a higher set of expectations on the marketing side as opposed to the development side. So if you believe the user has the answers for you in his shop, then you shift some of the money you use to differentiate in the lab out to the market, and find out what the market is doing." ❑

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JAPANESE BROADEN WEDGE IN DISK-DRIVE MARKET

THE ADVENT OF LAPTOPS MAKES IT A WHOLE NEW BALL GAME; CAN THE U.S. STAY ON TOP? BY JONAH McLEOD

It's been a bastion of U.S. competitiveness, but today the disk-drive industry is under siege. If ever American suppliers were vulnerable to a major attack by the Japanese, it is now. The dawning of the age of laptops offers an advantage to manufacturers that can build miniature drives in high volume at low cost—namely, the Japanese. So it looks like another scuffle, and another shuffling of fortunes, in this fiercely competitive industry, which boasts annual sales of $25.7 billion internationally.

U.S. drive makers have maintained a lock hold on the market by simply outperforming their Japanese rivals—they've been quicker to market and quicker building quality products in high volume. They also have an inside track with U.S. computer makers. But the never-ending skirmish for market share has forced U.S. suppliers to trim margins to the bone so that only the most efficient can remain profitable.

"The result is fallout and consolidation," says Todd Bakar, market analyst at Hambrecht & Quist Inc. in San Francisco. "No longer are there tens of small, medium, and large OEM drive manufacturers. Now there are only six or seven major companies." Japanese drive makers are the beneficiaries of this trend, since they have the funds to stay in the market while competition takes U.S. companies out. What's more, the Japanese are starting to take advantage of the shrinking U.S. supplier base by forging partnerships to manufacture products for U.S. companies unable or unwilling to build new capacity.

But the biggest question mark is laptop personal computers, a high-growth segment dominated by Japanese manufacturers. While some American drive makers are successfully competing for laptop and notebook accounts, both Japanese and American, industry observers believe this new PC arena gives Japanese disk-drive suppliers their best shot yet at eating into U.S. market share. Japanese companies are already beginning to increase their share worldwide of the small drive segment, says Phil Devin, industry analyst at Dataquest Inc., the San Jose, Calif., market research outfit.

STORAGE

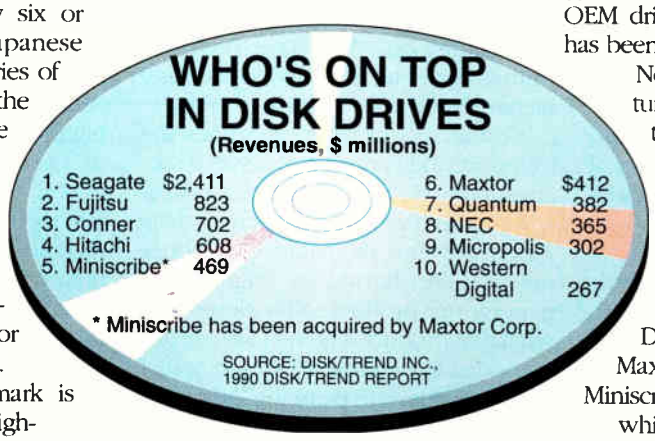
In the traditional 5.25-in. business—the drives used in standard desktop machines—they never garnered more than a 10% share, Devin says. But Japanese share of the 3.5-in. market hit 18% in 1990. And they are getting downright aggressive in the newer market for 2.5-in. drives. Already, says Devin, "there are eight major Japanese producers of under-3.5-in. hard-disk drives." That's because the preeminent makers of laptops are Japanese, says Bakar of Hambrecht & Quist, and "Japanese [manufacturers] tend to buy Japanese products."

The smaller form factor defines the hard-drive product much more narrowly than larger form factors did. "A 2.5-in. drive has fewer parts and lends itself to mass production more than other, larger drives," Bakar says. Besides miniaturization, the main demand is for strict power management—and that's another Japanese strength.

Still, U.S. vendors are by no means out of the fray. One historical example is instructive in demonstrating the agility American companies have shown in meeting technical and marketing challenges: JVC (Victor Company of Japan) in Tokyo fielded a low-power 3.5-in. drive in early 1986, well before Conner Peripherals Inc., the fast-growing San Jose company that today leads the 3.5-in. industry with 20% market share. But Conner ultimately came out on top; JVC's share today is just 1.4%.

The moral: the winner in the drive business isn't necessarily the first out the door with a product. Rather, it's the company able to mass produce the latest technology ahead of everyone else, says Garry Garrettson, vice president of product planning at Seagate Technology of Scotts Valley, Calif., the giant of OEM drive manufacturers. So far, that has been U.S. firms.

Nowhere is the competitive nature of this industry fiercer than in the 3.5-in. arena. In recent months, a price war in 40-Mbyte units between Seagate and Western Digital Corp. of Irvine, Calif., has all but edged Maxtor Corp. of San Jose out of the market, says analyst Devin. In March of last year, Maxtor purchased the bankrupt Miniscribe Corp. of Longmont, Colo., which recently ranked second to Seagate in 3.5-in. drive shipments. Maxtor tried to compete with its



U.S. companies dominate, but their Japanese competitors may have an edge in 3.5-in. units.

Model 8051A, the Miniscribe 40-Mbyte half-high drive, but then took the drive out of production, due to the stiff competition from Seagate and Western Digital along with the difficulties it encountered in reconstructing Miniscribe, which Devin says had shut down production altogether. Today, Maxtor has a mere 6% of the market, with 20% going to Conner, 15% to Seagate, 14% to IBM Corp., 10% to Western Digital, and 8% to Japan's NEC Corp.

But Maxtor should not be counted out too quickly. The hot competition in the drive market has infused U.S. competitors with a remarkable resilience. No better example exists than Micropolis Corp. "We were strapped for cash and battered by massive price erosion in our major products in 1988," says Chet Baffa, senior vice president of marketing and sales at the Chatsworth, Calif., firm.

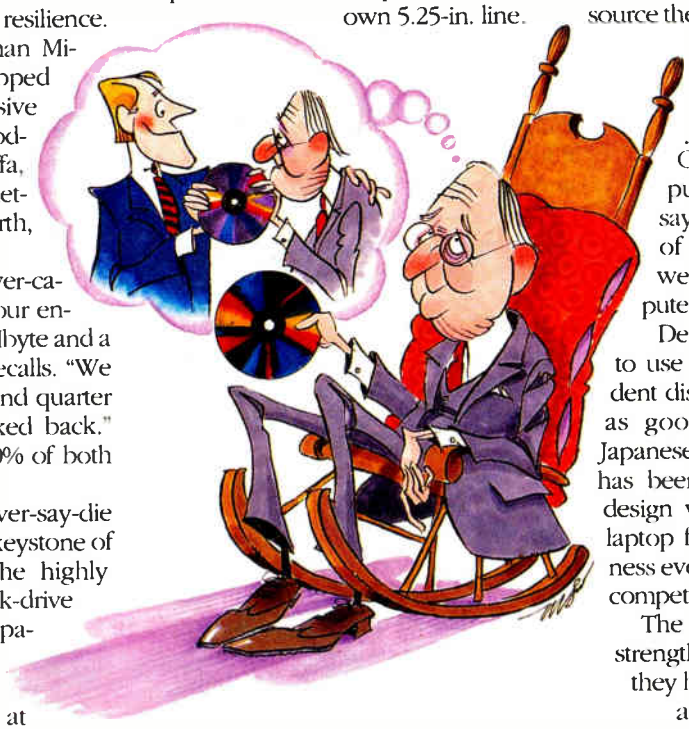
"We closed out the lower-capacity products and put all our energy into developing a 760-Mbyte and a 1-Gbyte 5.25-in. drive," he recalls. "We turned profitable in the second quarter of 1990 and have not looked back." Today, the company has 30% of both those target 5.25-in. markets.

Indeed, the plucky, never-say-die quality of U.S. suppliers is a keystone of the American industry. "The highly competitive nature of the disk-drive business has made U.S. companies more innovative and aggressive," says Bill Schroeder, vice chairman at Conner Peripherals. "Complacency has not crept into the top management."

A case in point is Conner itself. This four-year-old company, something of a Silicon Valley wunderkind, "illustrates how an agile company can create a market that heretofore did not exist," says Russ Krapf, president and chief operating officer of Censtor Corp. in San Jose and president of the International Disk Equipment and Materials Association in that city. "The company innovated very low-power 3.5-in. drives standing just 1-in. high and created a whole new product category out of this existing market."

As a billion-dollar company aiming at 2.5-in. drives, Conner remains as nimble as it was in its startup days. As with the 3.5-in. units, Conner wasn't the first in the market—startup Prarietek Corp. of Longmont, Colo., introduced 2.5-in. drives in late 1988—but it got into production faster. As a result, Conner surpassed Prarietek and others to zoom into a commanding position in this market: 74% in 1990, according to Devin.

Even a giant like Seagate, which enjoyed revenues of more than $2.6 billion last year, can be an agile competitor. After acquiring Minneapolis-based Imprimis Technology Inc. from parent Control Data Corp. in the fall of 1989, Seagate, which had no credible 3.5-in. offering, quickly moved to integrate the Imprimis 3.5- and 8-in. products with its own 5.25-in. line.



History shows that even entrenched U.S. companies can be agile competitors with next-generation drives.

Moving from a position fully a year behind the mainstream in 3.5-in drives, "today we are only six months behind," says Garrettson. "We have used Imprimis drive technology to achieve higher areal density at a lower price."

Conner's Schroeder says that the disk-drive industry cannot achieve success simply by leapfrogging the competition with the next higher-capacity product. Rather, the nature of the business requires having the "right" next-generation product. "To determine what that product is going to be means you need to be close to the computer makers as they are planning their next-generation systems," he says.

Schroeder is confident U.S. computer companies won't start inviting major Japanese drive manufacturers into their R&D labs to divulge new product plans. After all, the Japanese disk-drive firms are divisions of larger, vertically integrated companies that compete with these same U.S. computer vendors in laptops.

Their "in" with computer makers is, therefore, a big plus for American drive makers—assuming, of course, that the U.S. computer industry remains strong in laptops. Right now U.S. vendors are unleashing a slew of products, and the drive makers are reaping the rewards. For example, Conner's latest coup is winning the OEM contract to second-source the 60-Mbyte 2.5-in. drive for the IBM L40SX laptop portable. In addition, Conner, Maxtor, and Quantum Corp. of San Jose are vying for a lucrative OEM contract at Apple Computer Inc. in Cupertino, Calif., says Jack McLaughlin, publisher of *Rumors and Raw Data*, a weekly newsletter on the computer-storage industry.

Despite any Japanese tendency to use Japanese suppliers, independent disk-drive companies may have as good a shot as anyone with Japanese laptop manufacturers. That has been demonstrated by Conner's design wins with the Toshiba Corp. laptop family. Conner won the business even though Toshiba has its own competitive disk-drive operation.

The Japanese are mindful of the strengths of U.S. companies. One way they have managed to acquire a sizable position in the hard-drive market is by partnerships, like that between Matsushita Kotobuki Electric Ltd. (MKE) in Takamatsu City, Japan, and Quantum. MKE, the world's largest manufacturer of video cassette recorders, joined its manufacturing machine with Quantum's rapid design innovation and marketing prowess, resulting in a series of highly successful products, including all of Quantum's lower-capacity 3.5-in. drives. Other Japanese firms coming into the market by way of partnerships include Alps Electric Co. in Tokyo, a big player in the floppy-drive market, and JVC. "In 1990, Alps signed a contract to produce the 2.5-in. Prarietek drive," says James Porter, president of Disk/Trend Inc., the Mountain View, Calif., research house. JVC has a similar arrangement with Rodime plc of Glenrothes, Scotland, says Dataquest's Devin. ❑

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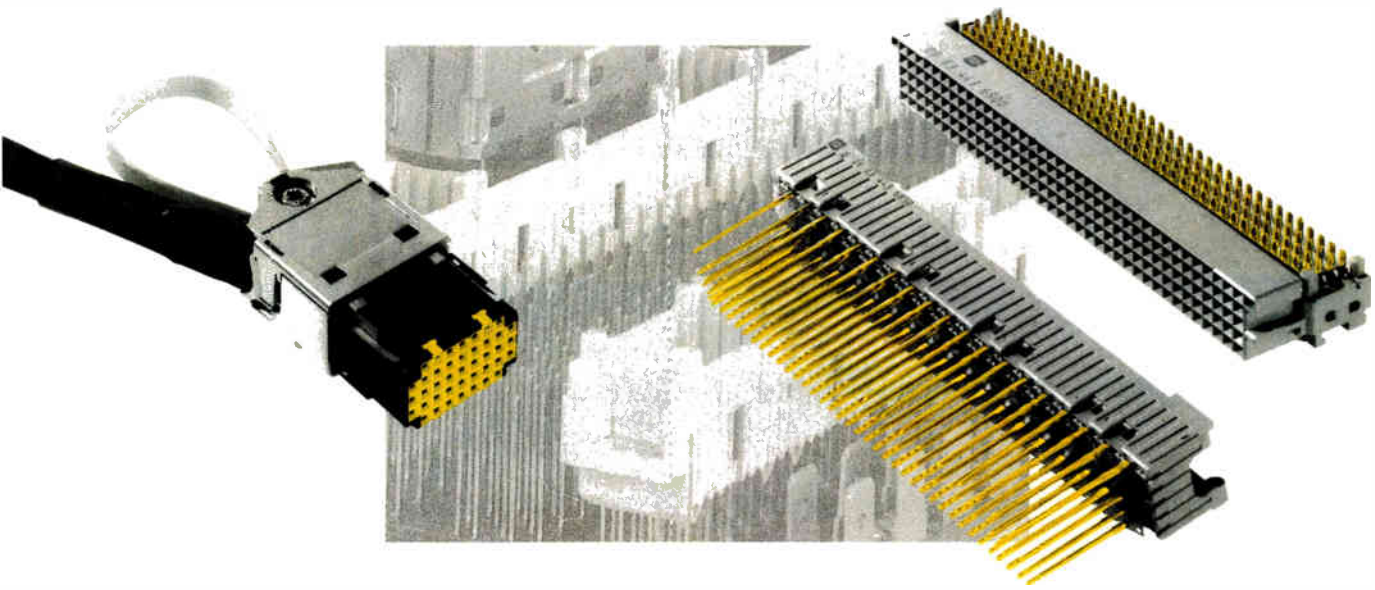

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CIRCLE 2

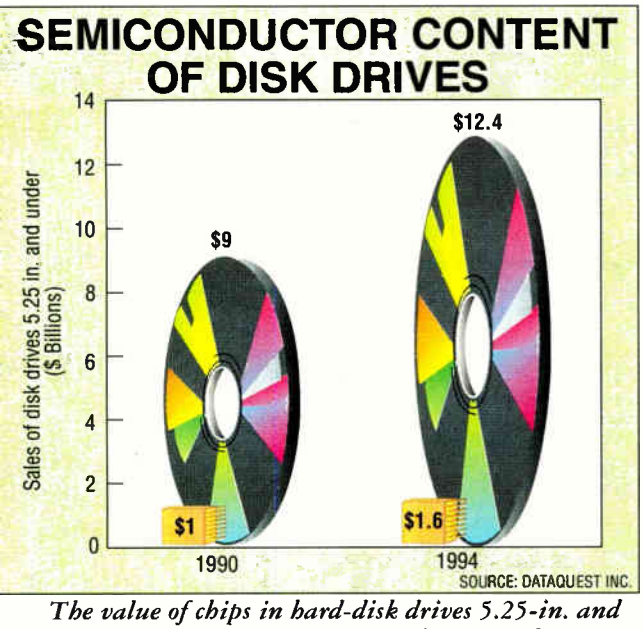
CHIP MAKERS SEE MARKET EXPLODING IN HARD DISKS

IN THE AGE OF LAPTOPS, SHRINKING DISK DRIVES DEMAND MORE ELECTRONICS IN LESS SPACE

BY LAWRENCE CURRAN

The advent of ever smaller laptop and notebook computers has spawned a growing market for 3.5-in. and smaller hard-disk drives—and a concomitant scramble for market share among suppliers (see p. 59). It's also creating a niche for semiconductor houses eager to furnish a range of integrated circuits that control drive operation and move data on and off the disk surface.

At stake for chip makers is a billion-dollar market. Sales of disk drives 5.25-in. and smaller will hit $12.4 billion in 1994, from $9 billion last year, says research house Dataquest Inc. in San Jose, Calif., and the value of the semiconductors in those drives will jump from $1 billion to $1.6 billion. "A billion-dollar market is difficult to ignore," says Gary Tietz, director of the mass-storage business group at National Semiconductor Corp. in Santa Clara, Calif.



The value of chips in hard-disk drives 5.25-in. and smaller represents a billion-dollar market.

To make disk drives smaller requires greater integration of the electronics, which in today's units include analog components consuming several square inches of board real estate. Chip vendors are pursuing two integration strategies: combining analog and digital functions on one mixed-signal chip and using digital signal processing to replace analog components.

To add storage capacity while also shrinking drives into the newer 2.5- and 1.8-in. form factors makes for big integration demands. A typical 3.5-in. 40-Mbyte drive today uses about 15 ICs, says National's John Schabowski, marketing director for the mass-storage business group. "But customers want a five-chip solution. Because there are [many] analog interfaces in a drive, you can get to that lower chip count only with a mixed-signal IC."

SEMICONDUCTORS

National's latest bid is probably the most highly integrated IC for the read/write channel yet available. Introduced in April, the DP8491 is the first to incorporate four previously independent analog and digital read-channel functions into one mixed-signal device, Tietz says. The CMOS IC runs off a single 5-V supply—a requirement in battery-driven laptop and notebook PCs.

Dave Karlak, product marketing manager for hard-disk drives at Hitachi America Ltd.'s Semiconductor and IC Division in Brisbane, Calif., says bipolar ICs can be used for some of the four read/write functions. But a mixed-signal CMOS device is dictated "because customers want a single chip, which has to talk to a [microcontroller] bus and deal with motor drives, the read/write channel, [and other components that] are analog," he says.

Most chip-house managers say going from 15 to five ICs is an interim step toward a one-chip solution. At Analog Devices Inc. in Norwood, Mass., disk-drive marketing manager Ron Kroesen believes the industry is six to nine months from having a true single-chip read-channel solution. Getting that one-chip read channel is essential to reaching the five-chip level for the overall drive electronics, he says.

"A drive manufacturer can build a drive with five of our chips today, and we're on our way to three- and two-chip solutions," says Rick Goerner, senior vice president for business operations at Silicon Systems Inc. in Tustin, Calif., the leading IC supplier to drive manufacturers in terms of revenue. Also promising two-chip solutions soon are Hitachi America, Exar Corp. of San Jose, and Cherry Semiconductor Corp. in East Greenwich, R.I.

Another element that has defied integration is the read/write channel, which reads data to and from the disk. The channel's filters are made up of inductors, capacitors, and resistors—all discrete components. But a new digital filter from International Microelectronic Products Inc. in San Jose squeezes in 64 such components to save several square inches of board space, says Steve Dollens, director of product development at IMP (see p. 24). ❑

An open letter of thanks to Charlie Sporck

On the eve of your retirement as President and CEO of National Semiconductor Corporation, we wanted to let you know how much we appreciate everything you've done for us, for this industry, and for this nation.

Since 1986, electronics has been the largest industry in the U.S., employing nearly 3 million people building over $295 billion worth of products annually, almost all of them based on semiconductor technology. Obviously, this industry is of great strategic importance to the economic and political security of this country.

Charlie, you have spurred us to action by reminding us that product innovation alone will not suffice; that design plus manufacturing are the keys to America's industrial strength.

You have lived this message as one of the genuine pioneers of Silicon Valley. First as Production Manager and later General Manager of Fairchild Semiconductor. Then as President and CEO of National Semiconductor. As a founder of the Semiconductor Industry Association (SIA), developing public policy solutions to international trade and business issues. As the catalyst between industry leaders and government policy makers in SEMATECH, the first consortium to advance American manufacturing technology. And as a founder of the National Advisory Committee on Semiconductors.

You once said, "This country is full of starters. But there are damn few finishers. That's what it's all about: getting good at finishing."

You've set the standard, Charlie. There isn't anyone in this industry—anyone in this country—who hasn't benefited from your vision, your strength, your determination, and your steadfast leadership for more than three decades.

Thanks, Charlie. It's been an honor to have worked alongside you.

Your friends and colleagues in the SIA,

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ISDN: THIS TIME IT'S FOR REAL

LOW-RISK, FEATURE-RICH, STANDARDIZED—AND IT'S HERE

BY JACK SHANDLE

In about six months, the much-maligned integrated services digital network will emerge again, this time with a radically new look. The telephone network of the future will abandon its switch-specific, multiple-personality life and adopt a single, nationwide specification. It will also be salable. That is, virtually all of the Bell operating companies will actually have ISDN tariffs—something for customers to buy.

At first, tariffs for ISDN's 64-Kbit/s Basic Rate Interface service will predominate. But eventually 1.5-Mbit/s Primary Rate Interface tariffs for business users will become more widespread. ISDN will be low-risk and feature-rich, because after a decade of bickering over whose proprietary flavor of ISDN would win, the switch makers, phone companies, and potential users are all on the same northbound train.

Those are the promises. But if mass deployment is really in ISDN's future, its advocates have to sell the software developers, hardware suppliers, systems integrators, and value-added resellers—in short, the computer industry—on the idea that applications will drive adoption of the service and that money is to be made in ISDN.

COMMUNICATIONS

The ISDN community took an important step in that direction on Feb. 26 by announcing a standard set of technical specifications called National ISDN 1. The suppliers of ISDN switches have promised to deliver software that implements these specs on their switches by the fourth quarter of this year. The major suppliers of software for customer-premises equipment will follow suit, also in the fourth quarter. Only then can National ISDN 1 conformance testing by the phone companies, Bellcore, and—significantly—the Corporation for Open Systems begin. The target date for the beginning of ISDN's mass deployment of Basic Rate services is late in 1992.

Clearing a circuit-switched path to the end user has long been the bane of ISDN. National ISDN 1 solves most of those problems. Chief among them was the incompatibility of phone company

central-office switches offered by AT&T, Northern Telecom, and Siemens. National ISDN 1 resolves this issue for a broad range of functions.

"National ISDN 1 is essentially a contract between the switch vendors and the Bell operating companies," says Steve Jones, director of business-services product marketing for Northern Telecom Corp.'s Integrated Network Systems Division in Research Triangle Park, N.C. "The switch vendors are promising to deliver a standard and the operating companies are pledging mass deployment." To assure third-party suppliers that the market is not fraught with risk, the ISDN community will "not fiddle with the protocols from this time forward," says Jones. Subsequent versions of National ISDN, he says "will add but not subtract." Among the coming enhancements will be 7-KHz voice-transmission technology and features further defining the 1.5-Mbit/s Primary Rate Interface. On that front, the ISDN community has been considering late 1993 for a second round of functionality. But this is for planning purposes only, says Jones. "We need market feedback on ISDN 1."

In the meantime, phone companies are well into the process of renovating their business infrastructures to provide operation and support for ISDN. As a technology, it requires new line cards, and to facilitate the process of equipment switch-over, Northern Telecom is offering ISDN line cards free of charge to the phone companies. ISDN's new functionalities have also meant extensive revamping of billing systems and other support operations such as service-personnel training by the local carriers. Nitty-gritty issues such as billing have been a serious growth inhibitor. Early ISDN users tell stories of bills that were prepared by hand, three months late and full of errors. The very fact that the BOCs feel safe enough to file tariffs means they are confident their business infrastructure can handle the new load.

Conformance testing and certification of ISDN products now has a firm foundation. When the Corporation for Open Systems (COS) in McLean, Va., organized its ISDN Executive Council in July 1990, the fragmented and sometimes fractious ISDN community finally signaled a willingness to work together toward a common goal.

Bellcore, the research arm of the seven Regional Bell Operating Companies, will be the repository for National ISDN 1's specifications. COS, which has its roots in computer and data communications technologies, has joined Bellcore and the RBOCs in providing conformance testing. It also distributes test suites developed to help suppliers test for standards conformance.

DGM&S Inc., the leading third-party vendor of ISDN development software, has endorsed National ISDN 1 and expects to have compliant software ready by the end of the year, says Jonathan Geisler, vice president of marketing for the Mt. Laurel, N.J., firm. "AT&T will have its first release [of switch software] by the end of 1991," he says, "and we have been working closely with their lead as well as Northern Telecom's."

Once the switch and third-party development software is available, applications developers can go full steam ahead on implementing National ISDN 1 versions in their hardware and put it in the conformance-testing loop. Larger companies need not wait for the third-party vendors. IBM Corp., for one, will be ready with a PS/2 coprocessor and software package next month, says Mary Patterson, director of ISDN systems at the Armonk, N.Y., company. Apple Computer Inc. is focusing its resources on building an ISDN tool box for applications on the Macintosh, and Toshiba Corp. is building an ISDN facsimile machine, to name two others.

National ISDN 1 is being cast for a starring role in the Baby Bells' scenario for the next half century. Its longevity will depend on its ability to boost its data bandwidth and features, says Richard Aloia, assistant vice president for Bellcore's Network Access Division in Red Bank, N.J. "ISDN is the beginning of a multiservice pipe," he says. "Although it has a fairly narrow bandwidth now, it will follow a graceful evolution by enhancing technologies such as SMDS [a 1.5-Mbit/s service with a clear evolutionary path to 45 Mbits/s], frame relay, and broadband ISDN."

Although ISDN's most widely publicized roadblock had been the incompatibility of switches, other impediments can be traced directly to business strategies. Most Bell operating companies have been offering only ISDN Basic Rate Interface service. Moreover, this service is generally linked by tariff to the phone company's Centrex offering. This strategy brings in more revenue for the phone companies than the 1.5-Mbit/s ISDN Primary Rate Interface service, but it made customers familiar with the cost savings of current high-bandwidth T1 leased-line services unhappy. "Instead of using dumb T1, they want to have a smart primary-rate interface," says Mike Albers, director of system engineering at Fujitsu Business Communications Systems Inc., Phoenix, Ariz.

User dissatisfaction with a Centrex offering and the momentum of National ISDN 1 are forcing the BOCs to offer a primary-rate tariff, and that is good news for manufacturers of private branch exchanges with ISDN-capable products, such as Fujitsu. Bell Atlantic, for example, offered Centrex-based tariffs in the second quarter of this year and will follow with a Primary Rate Interface tariff in the fourth quarter, says John Seazholtz, vice president of tech-

ISDN DOES IT BETTER

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Securities	Reconciliation Training Remote transactions Portfolio management	Medical	X-ray consultations Expert physician conferencing Outpatient clinic support Record retrieval
Insurance	Agent support Electronic data interchange New product distribution	Manufacturing	Repair center support Customer record lookup CAD/CAM file sharing Inventory control
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Nynex has identified more than 300 business applications, mostly in data, that are ripe for exploitation by ISDN.

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NEW NICHE FOR CHIP MAKERS

Although attractive from the business angle, the multitude of new applications that ISDN seems likely to spawn is sure to create headaches for vice presidents of engineering in hardware companies. Minimizing the time and money spent in making the transition to new product lines is a daunting task when the application has not yet been imagined.

Luckily, a few chip makers are trying to ease the pain with a new breed of communications supercontrollers that handle both datacom and telecom functions. These chips include Siemens's SAB 82532 [*Electronics,* February 1991, p.58], Motorola's 68302, and National Semiconductor's 16400.

Looking forward to ISDN, the Motorola Inc. chip, which is in many ways indicative of all the new offerings, handles data rates up to 2 Mbits/s and is flexible enough to cope with high-level protocols such as AT&T Co.'s Signaling System 7, ISDN's LAP-D, or the X.25 packet-switching protocol.

This can be done simply by downloading microcode, says Trey Oprendek, program manager for the device. Since it is programmable, the 68302 is just as comfortable with data communications as it is with telecommunications. It integrates three serial channels, which are required in ISDN terminal and rate-adaption applications where an ISDN data channel, a control channel, and a local interface are needed.

The chip has an integrated processor, which makes system-bus-interface capability a minor issue. By using this supercontroller for existing applications, Oprendek adds, design teams become even more familiar with the chip's 16/32-bit 68000 core processor and its RISC microcontroller, which provides the major elements of flexibility in the various serial channels and interfaces with the 68000.

Likewise, the 68302 can support the chip-to-chip interfaces that have become de facto standards in the ISDN chip sets. All of the supercontroller chips integrate glue-logic features needed in virtually any application.—*J.S.*

nology and information services.

By contrast, Fujitsu was ready for the phone companies two years ago. Its F9600 PBX had a primary-rate interface compatible with Northern Telecom's DMS 250 switch when it was introduced in 1989, says Albers. It added a primary-rate interface for AT&T Co.'s 4ESS in October 1990 and will add a basic-rate interface in June 1991. "We think we will come in second in the ISDN market behind AT&T's Definity PBXs," says Albers. "National ISDN 1 means we are now all on the same northbound train."

Switch vendors are well aware that simply starting the train will not get ISDN rolling at top speed. Applications will drive the market, and the key innovations will probably come from small companies. "We want to inspire the next Steve Jobs to stop thinking about modems and start thinking about ISDN," says Northern Telecom's Jones.

Not surprisingly, applications addressing data—as opposed to voice—are the most promising. "There are no silver-bullet applications that cannot be satisfied with today's services," says Joe Gustafson, director of ISDN market planning for Nynex in White Plains, N.Y. "The key is to understand what applications ISDN can do better." Nynex has identified more than 300 business applications that it believes fall in that category. Gustafson's view that there are no new applications is not universally shared, however.

"We probably understand only 10% of the applications that will spin out of ISDN," says Chuck Kissner, president of Aristacom International Inc., an Alameda, Calif., developer of voice-processing software. One area of great potential, he says, is the simultaneous delivery of voice and image data. The automatic number-identification feature of ISDN could also be a force driving adoption. "The speed in which you can identify and route a customer is much greater," says Kissner. "If this allows you to process one-half to one-third more calls without human intervention, it could be a significant cost saving."

Meanwhile, companies that specialize in personal computer plug-in cards could realize an ISDN windfall. "Nobody makes a MicroChannel card in volume yet that implements the basic-rate interface," says Kissner. "When these arrive in volume, we have a software product that will eliminate the telephone set." With Aristacom's application, users will be able to dial from the keyboard and listen from a headset that plugs into the card.

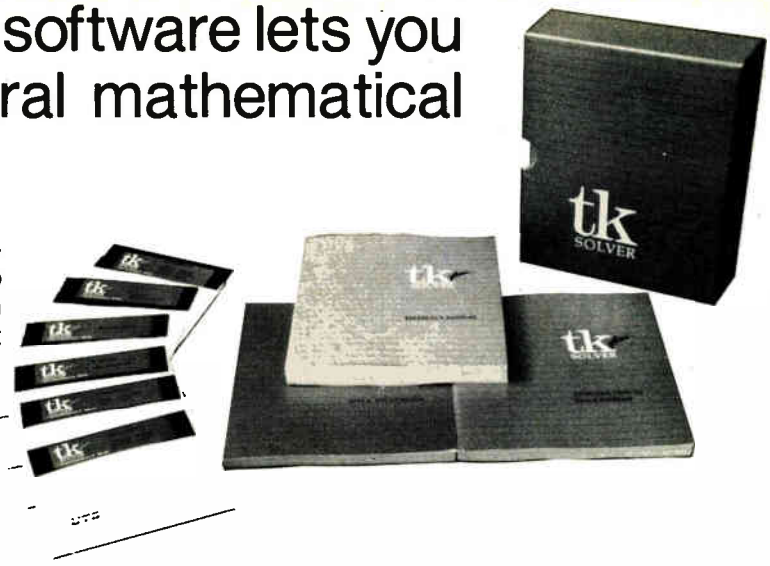
Geisler of DGM&S sees a strong link between ISDN and multimedia. "The Bell operating companies are going to tariff new types of functions based on multimedia," he predicts. To capitalize on that market, DGM&S is marketing a development-system board and software that will handle a wide range of functions including Group 3 and Group 4 facsimile, modem emulation, and still-image video compression.

The modem-emulation function elegantly lets ISDN users communicate with modem users. It recognizes the fact that there will be a gradual displacement of modem technology and that in the meantime ISDN terminals should be able to communicate with modems. Similarly, Group 3 fax machines are not going to disappear overnight. "Group 4 fax [which uses ISDN's 64-Kbit/s data rate] will be the largest international application initially," says Geisler.

ISDN is an international technology, and although the European and Japanese flavors differ from National ISDN 1, they do offer marketing opportunities abroad. As part of its ongoing procurement activites in the U.S., Japan's NTT Corp. has set up two ISDN programs, one of them a bid for joint-development products, for which NTT provides substantial support. One recent request-for-proposal project targets ISDN voice-storage equipment capable of being expanded to nonvoice media in the future. NTT also has broadband ISDN procurement programs, and while the company has already chosen its major broadband ISDN partners, other contracts on more specific technologies are likely in the future.

ISDN is also quickly becoming a potential strategic weapon in global communications. In 1990, NTT, AT&T, Pacific Bell, and Kokusai Denshin Denwa (Japan's overseas carrier) jointly announced an international ISDN link between Tokyo and California. Meanwhile, ISDN spanned the Atlantic in May 1990 when France Telecom and AT&T established a service for 64-Mbit/s voice calls, says Igor Douplitzky, assistant vice president for business development at France Telecom Inc., the company's U.S. subsidiary. As early as 1993, he says, additional ISDN services such as caller identification and call forwarding will be available. ❑

This microcomputer software lets you program using natural mathematical notation



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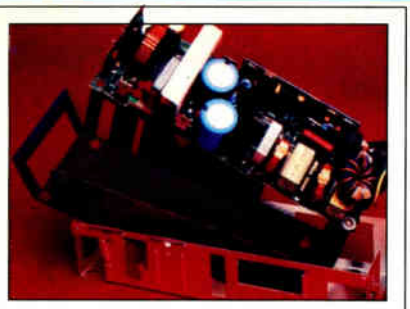

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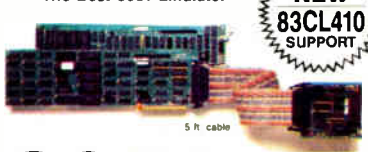

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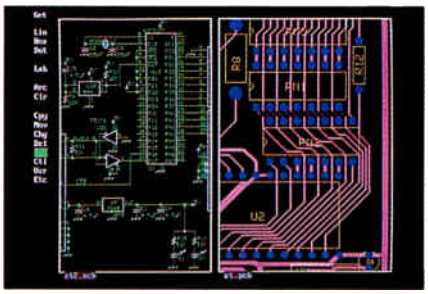

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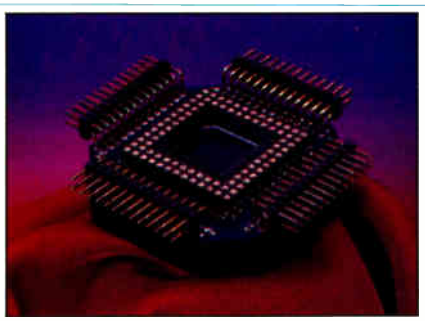

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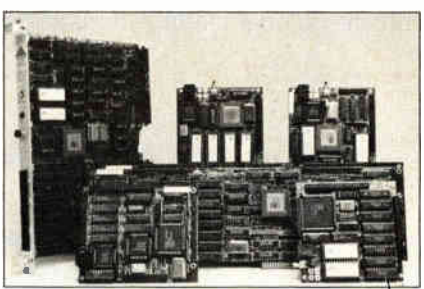

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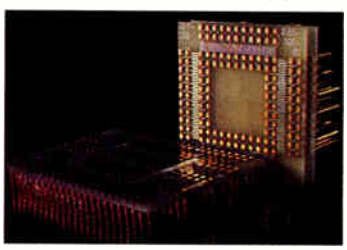

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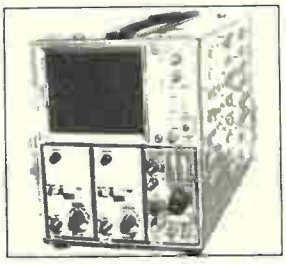

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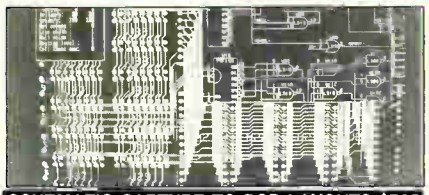

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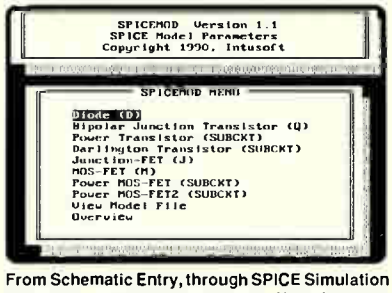

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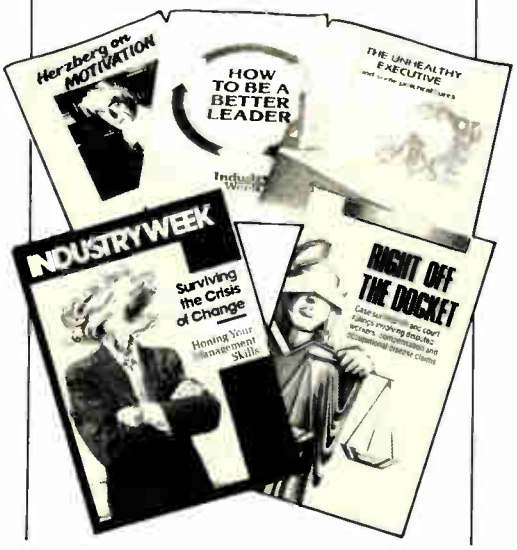

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Anyone trying to offer world-class service without world-class quality is shouting into the wind. And when it comes to quality, the man who wrote the book is W. Edwards Deming.

Calling Deming a Washington-based consultant in statistical studies is like calling the sun a bright object. He is credited with shaping the Japanese emphasis on quality as that nation rebuilt its industrial capacity in the aftermath of World War II. Invited to Japan by Gen. Douglas MacArthur, Deming soon won the admiration of the Union of Japanese Scientists and Engineers. In 1951, that body established its Deming Prizes, which are awared annually to Japanese companies demonstrating outstanding quality control.

U.S. industry has recognized this prophet only in recent years—after being stung by Japanese competitors that live by Deming's philosophy. That philosophy includes a strong emphasis on the "intrinsic motivation" of workers, who are encouraged to be proud of their efforts. Following are excerpts on that topic from a speech that Deming, now 90, delivered in Osaka.

Managements of industry, education, and government operate under the supposition that all people are alike. Actually, people learn in different ways and at different speeds. Some learn best by reading, some by listening, some by watching. Actually, people are born with a need for relationships with others, and with a need to be loved and esteemed by others. There is an innate need for self-esteem and respect. Management that denies employees dignity and self-esteem smothers intrinsic motivation.

Some extrinsic motivators rob employees of dignity and self-esteem. If for higher pay, or for a higher rating, I do what I know to be wrong, I am robbed of dignity and self-esteem. No one can enjoy learning if he must constantly be concerned about grading for his performance, or about rating on the job.

QUALITY

Our educational system would be improved immeasurably by abolishment of grading. One is born with an inclination to learn and to be innovative. One inherits a right to enjoy work.

Extrinsic motivation is submission to external forces that neutralize intrinsic motivation. Pay is not a motivator. Under extrinsic motivation, learning and joy in learning in school are submerged to capture top grades. On the job, joy in work, and innovation, become secondary to a good rating.

W. Edwards Deming wrote the book on quality.

Under extrinsic motivation, one is ruled by external forces. He tries to protect what he has, to avoid punishment. He knows not joy in learning. Monetary reward is a way out for managers who do not understand how to manage intrinsic motivation.

Transformation—a metamorphosis—is required in government, industry, and education to move out of the present state, not mere patchwork on the present system. The transformation will take us into a new system of reward. We must restore the individual. The transformation will release the power of human resources contained in intrinsic motivation.

In place of competition for high rating, high grades, there will be cooperation on problems of common interest. The result will be greater innovation, applied science, technology, expansion of market, greater service, greater material reward for everyone. There will be joy in work, in learning.

A good orchestra is an example of a system well optimized. The players are not there to play solos, to catch the ear of the listener. They support one another. Similarly, a business is not merely an organization chart, all departments striving for individual goals. It is a network of people, materials, methods, equipment, all working for the common aim.

A system of schools is not merely pupils, teachers, school boards, and parents. It should be, instead, a component in a system of education in which pupils take joy in learning, free from fear of grades and gold stars, and in which teachers take joy in their work, free from fear of ranking. It would be a system that recognizes differences among pupils and among teachers.

The performance of any component is to be judged in terms of its contribution to the aim of the system, not for its individual production or profit, nor for any other competitive measure. Some components may operate at a loss to themselves, for optimization of the whole system, including the components that take a loss.

It would be poor management for a company to save money on traveling expenses without regard to the physical wellness of the travelers. For example, it would be bad to save $138 on a night rate for transportation that would force the traveler to be up most of the night but unfit for duty the next day. It might be better for the travel department to ensure, at whatever cost, that the traveler arrive alert and well. ❑

DON'T BOTHER LOOKING FOR A STRONG REBOUND

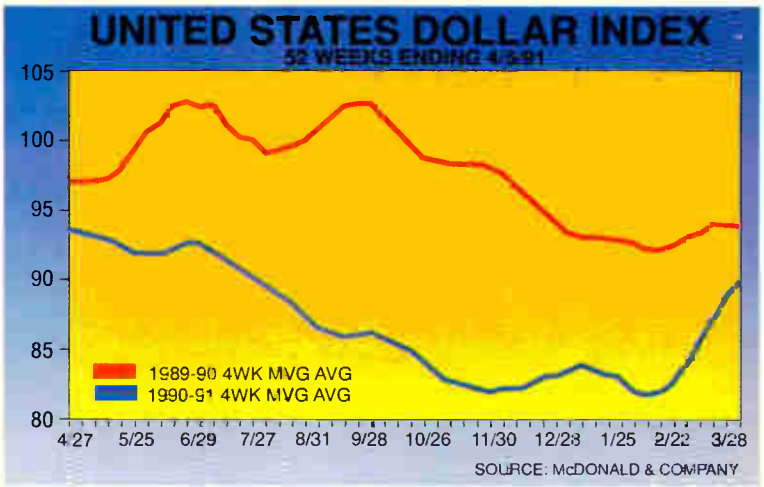
If the government can't increase spending, consumers are tapped out, foreign markets are weakening, and interest rates are dependent on world credit demands, then how can we expect a strong recovery? The answer is, we can't. Although many expect the economy to come roaring back, the economic, empirical, and anecdotal input suggests we've still got a long way to go.

Interest rates have declined somewhat, but record domestic deficits and new credit demands from the Middle East, Eastern Europe, and the Soviet Union provide new competition in the credit markets. Consumer balance sheets are as leveraged as we've ever seen. Automobiles are becoming less affordable due to increased safety, performance, and potential product-liability issues. European growth has slowed dramatically, and increasing competition on a world scale is changing the way companies do business.

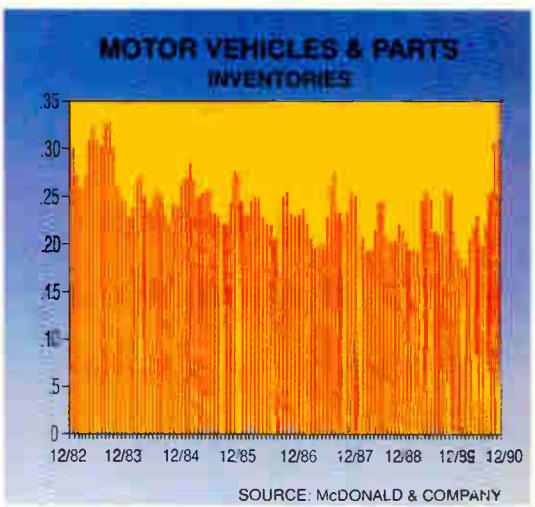
A poll of a fairly broad representation of components manufacturers regarding March trends shows that year-to-year comparisons have worsened steadily since December. If industrial production stays flat over the next several months, this downward trend will persist.

Chances are the second quarter will see more of the first quarter's sluggishness. The dollar's strength will dramatically reduce currency gains, and price increases by domestic manufacturers may further delay any increase in demand. Orders appear to be stabilizing after dramatic declines last fall, but there is little evidence to suggest any sustainable uptrend. Relatively lean inventories will help narrow the lag between an uptick in demand and stronger component orders, but it appears increasingly likely that the rebound, when it comes, will evolve excruciatingly slowly. ❑

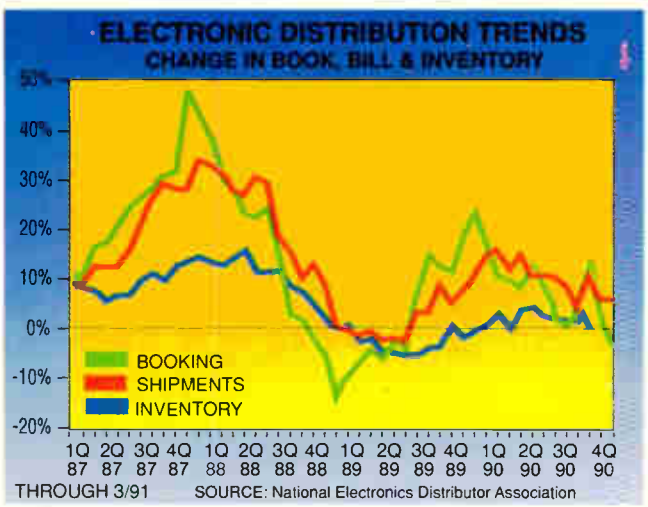
By Mark Parr, McDonald Securities Inc., Cleveland (216-443-2379)



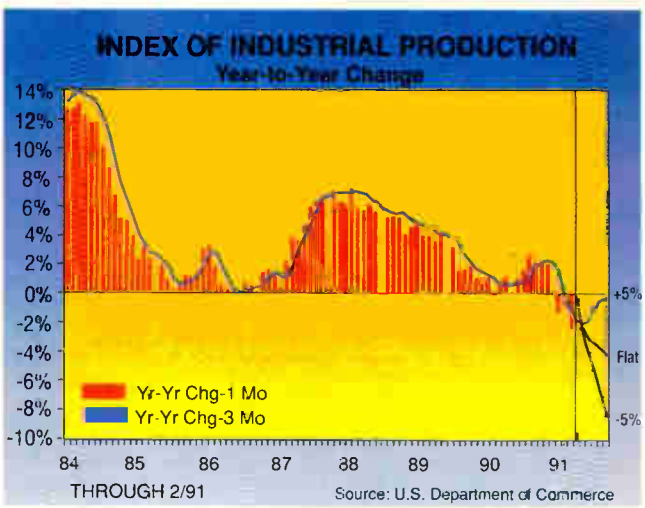
Strength against European currencies is driving the trade-weighted dollar as competition heats up in the credit markets.



U.S. sales of automobiles are lagging, in part, because cars are less affordable.



Slim inventories will help speed an upturn in component orders once demand turns healthy.



Of three possible scenarios (5% growth, flat, or 5% decline), a flat to down half-year seems most likely.

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COMMUNICATIONS

183 - **CMC**—Accelerate your Ethernet solution with the power of partnership.
177 - **Fujitsu**—The secret to better Ethernet is NICE, the MB86960 Network Interface Controller with Encoder/Decoder.

COMPONENTS

206 - **Pico**—High-voltage dc-dc converters with 1,000-V dc output.
206 - **Pico**—Ultraminiature surface-mount dc-dc converters, transformers, and power inductors.
198 - **Siemens Matsushita**—Surface-acoustic-wave components for superb-quality video and audio.
225 - **Teledyne**—The Centigrid DPDT relays are CMOS-compatible.

COMPUTER BOARDS

215 - **CEC Capital Equipment**—Control any IEEE-488 device; cards, cables, software for the PC/AT/386, EISA, MicroChannel, and NuBus.

CONNECTORS

204 - **AMP**—They're simple and they're shielded: AMP's Shielded Data Link connectors.
209 - **Amphenol**—We supply our clients with a wide array of connector parts.
201 - **Harting**—A world leader in the DIN 41612 connector market, we've been instrumental in setting standards.

DISK/TAPE DRIVES

2 - **3M**—Virtually every size and format data cartridge.

EMBEDDED CONTRDL

213 - **Ampro**—Pioneering solutions for embedded control.

LOCATIONS

192 - **Northeastern Indiana**—150 businesses moved here in 18 months—just for the climate.
179 - **Utah**—Low labor, low costs, great life style.

MANUFACTURING SYSTEMS

187 - **Canon**—Only one I-line stepper comes with all these safety features.

MANUFACTURING SYSTEMS

176 - **Chicago Laser Systems**—Now laser trimming is as easy as opening a window.

MATERIALS

216 - **BASF**—Materials for a wide range of uses in an international commitment to the worldwide electrical engineering community.

MEMORIES

191 - **Samsung**—The place to go for high-performance video RAMs.
203 - **Samsung**—Continuing to deliver high quality and service.
195 - **Sony**—Sony's family of 1-Meg SRAMs gets larger all the time.

MICROCOMPUTERS

175 - **White Technology**—A 68020-based supercomputer in a 180-pin flat pack.

POWER SUPPLIES

219 - **Abbott**—Mil/Pac high-density military power supplies now available in both ac and dc models.
193 - **Vicor**—ComPAC dc input power systems for telecommunications and industrial applications.

SEMICONDUCTORS

212 - **Analog Devices**—When you're looking for a mixed-signal supplier, make sure it provides these high-performance parts.
188 - **Integrated Device Technology**—When cost-effective performance counts, you can count on IDT.
185 - **Intel**—If you're tired of pouring on SRAM to get 128-Kbyte cache performance, try the 386 Smart Cache.
199 - **ITT Semiconductors**—The future of TV is digital; the future of digital TV is Digit 2000.

SOFTWARE

258 - **T-Cubed Systems**—Reliability-prediction software.

SUBSYSTEMS

208 - **Fujitsu**—The FTP-423 thermal printer features high-speed, low-noise printing at up to 5.8 character lines/s.

TEST & MEASUREMENT

181 - **Anritsu**—The highest levels of measuring accuracy for all types of communications.
172 - **GenRad**—30% off combinational board-test systems.
173 - **Hewlett-Packard**—We'll tailor our hardware and software to your T&M needs.
178 - **Hewlett-Packard**—When design and manufacturing productivity are at stake, there is no reliable substitute for HP.
187 - **Hewlett-Packard**—When quality depends on calibration, depend on HP.
186 - **Yokogawa**—The AR1100 all-in-one analysis tool makes measuring easier than ever before.
217, 218 - **Photo Research**—The SpectraScan Spectraradiometer brings near-real-time testing to the production line.
221 - **Teradyne**—Boundary scan is a breakthrough in low-cost, high-quality board testing: the Z1800VP system.

WORKSTATIONS

196 - **Cearpoint**—Extending the life and performance of your hardware investment is our business.
190 - **Hewlett-Packard**—76 mips for just $20,000 (gray scale) to $27,000 (color) in the new HP Apollo RISC workstations.

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12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	817
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	818
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	819
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	820
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	801	821
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	802	822
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	803	823
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	804	824
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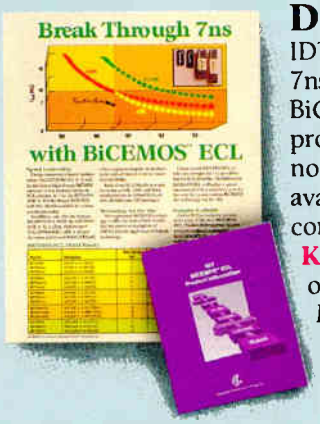

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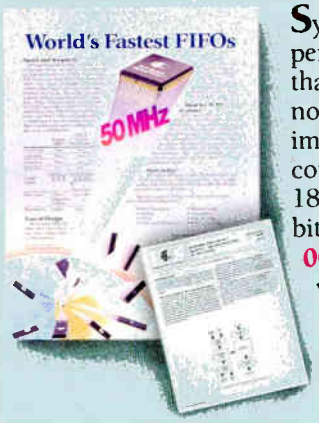

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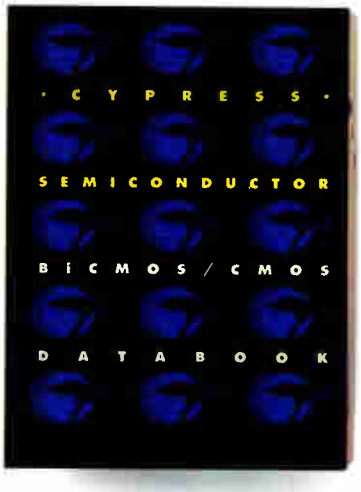

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