


A PENTON PUBLICATION

JANUARY 1992

Electronics

BUSINESS / TECHNOLOGY PERSPECTIVES FOR GLOBAL ELECTRONICS MANAGEMENT



1992
WORLD MARKET
FORECAST
RIDING
IT OUT
AND LOOKING
FOR THE
UPTURN
PAGE 26

GenRad is about to change your thinking about low-cost board test.



We've always had a reputation for the best board testers in the world. That's why we've maintained the world's leading market share for more than twenty years.

Unfortunately, too many people associate the best with high price.

Not so. Our new Essential Test Collection (ETC), for example, a powerful, versatile software and hardware package, brings you new ease-of-use in high throughput board test. And the price is *lower* than other systems with less capability.

ETC puts powerful new automation tools at your fingertips to simplify and speed the whole process from test program development to data collection. Now you can have the very best in low-cost test for your complex boards. Even those with ASICs, SMT, Boundary Scan and other new technology you thought required expensive test systems.

It's time to take another look at the best in test. We have something new for you to think about in low-cost board test.

Call your local GenRad office or 1-800-4-GENRAD for more information about the new ETC package.

 **GenRad**
A New Way of Thinking



Now you can perform NIST-traceable, spectrally-based photometric and colorimetric measurements anywhere, anytime. With the battery-powered Photo Research® PR-650 SpectraColorimeter™. You no longer need to settle for the inaccuracy of filter instruments just for the convenience of cost-effective portability.

This hand-held portable offers AutoSync™, a unique feature which automatically locks to, and measures, refresh frequency. Pritchard®-style spot viewing and measuring optics are also included.

A plug-in Integrated Circuit Memory Card holds the complete and easy-to-use program software for the internal microcomputer--and there is enough space for over 150 measurements. Fast-Charge Nicad batteries, Energy-Saving Auto Shut-Off, an RS-232 interface permitting remote control from a host computer, plus numerous other features make it the most flexible and versatile colorimeter on the market.



Backlit super-twist LCD display

Proven SpectraScan® diode-array technology captures the entire visible spectrum from 380 to 780 nm – simultaneously. With the press of a button. And a wide variety of accessories are also available to choose from.

Call us and discover how affordable, easy and accurate spectrally-based light and color measurement can be.

**FAST.
ACCURATE.
LIGHT.**

**The PR-650.
Light Measurement
on the Move.**

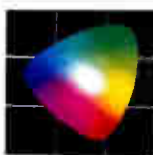


PHOTO RESEARCH®

The Light Measurement People®

Division of **KOLLMORGEN**

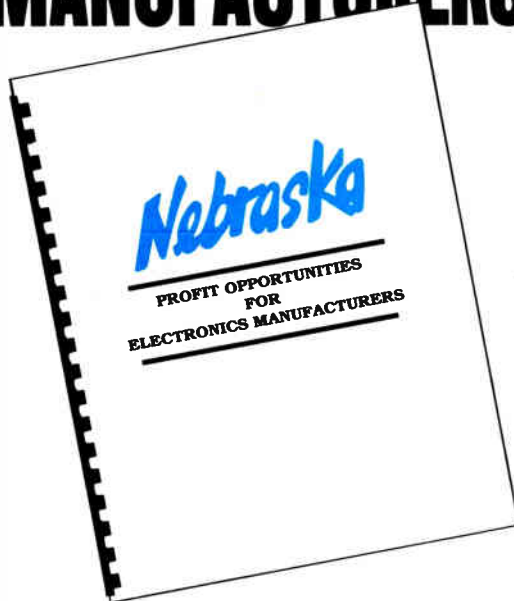
9330 DeSoto Avenue, P.O. Box 2192, Chatsworth, CA 91313-2192 USA
(818) 341-5151 FAX: (818) 341-7070 TLX: 69-1427 Cable: SPECTRA

International Sales Representatives: AUSTRALIA HADLAND PHOTONICS Ph: (03) 560-2366 BELGIUM ANALIS SA Ph: (81) 225085 CANADA OPTIKON CORPORATION Ph: (519) 885-2551 FRANCE INSTRUMAT S.A. Ph: (1) 69-28-27-34 GERMANY OPTHEMA ENGINEERING GmbH Ph: (2) 126-7352 HOLLAND INTECHMIJ B.V. Ph: (20) 56-96-611 INDIA PHOTONICS INTERNATIONAL Ph: (812) 363-573 ISRAEL ANKOR Ph: (03) 575-4242 ITALY PHOTO SYSTEMS SAS Ph: (29) 532-4363 or (29) 532-1366 JAPAN KYOKKO TRADING COMPANY Ph: (3) 3586-5251 SPAIN INSTRUMATIC ESPANOLA SA Ph: (1) 555-8112 SWEDEN SAVEN AB Ph: (8) 630-93-00 SWITZERLAND MAC TECH SA Ph: (21) 28-9177 U.K. MICRON TECHNIQUES LTD. Ph: (202) 841-261

All trademarks are property of Kollmorgen. Patents Pending.

**Circle 219 - Please have salesman call
Circle 220 - Please send literature**

ELECTRONICS MANUFACTURERS



You'll Find Our New Study On Locating In Nebraska Electrifying.

If you're a growing electronics manufacturer, our new publication entitled **Profit Opportunities for Electronics Manufacturers** is for you. This study highlights the benefits of operating in Nebraska, including: lower manufacturing costs, among the lowest industrial electrical costs in the U.S., and performance based tax incentives for new investment and job creation in the state.

For your **FREE** copy, contact:
Dennis Hall, C.I.D.
Area Development Manager
Nebraska Public Power District
P.O. Box 499
Columbus, NE 68602-0499
Or call 1-800-282-6773



Powerful Pride in Nebraska

CIRCLE 228

Electronics

EDITOR

Jonah McLeod
MANAGING EDITOR

Howard Wolff
SENIOR EDITOR

Lawrence Curran
EDITOR-AT-LARGE

Samuel Weber
914-428-3595

ASSISTANT MANAGING EDITOR

Jacqueline Damian
DEPARTMENT EDITORS

Communications:

Jack Shandle
201-393-6228

System Technology:
(San Jose) **Jonah McLeod**
408-441-0550

EDITORIAL PRODUCTION MANAGER

April Messina
ASSOCIATE ART DIRECTOR

Tony Vitolo
STAFF ARTIST/DESIGNER
Anthony White

BUREAUS

Boston: **Lawrence Curran, Manager**
508-441-1113

Midwest Correspondent: **Francis J. Lavoie**
Mid-Atlantic: **Jack Shandle, Manager**
201-393-6228

Frankfurt: **John Gosch, Manager**
011-49-61-71-53834

France Correspondent: **Andrew Rosenbaum**
011-331-4236-1867

Italy Correspondent: **Andrew Rosenbaum**
011-331-4236-1867

Japan: **Shin Kusunoki, Consultant,**
Nomura Research Institute
011-81-45-336-7064

UK Correspondent: **Peter Fletcher**
011-443-226-64355

Electronics Index: **Mark Parr**

VICE PRESIDENT-EDITORIAL

Perry Pascarella
GROUP ART DIRECTOR

Peter Jeziorski
EDITORIAL ADMINISTRATION

Bradie S. Guerrero,
Tina A. Montone

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

Production Manager:

Doris Carter
(201) 393-6259

FAX: (201) 393-0410

Order Entry

Beverly Desbians

PUBLISHER

John G. French
617-890-0891

January 1992 Volume 65, Number 1
Electronics (ISSN 0883-4989) is published monthly by Penton Publishing, Inc., 1100 Superior Ave., Cleveland, OH 44114-2543. Second class postage paid at Cleveland, OH, and additional mailing offices.

Editorial and advertising addresses: Electronics, 611 Route #46 West, Hasbrouck Heights, NJ 07604. Telephone (201) 393-6060. Facsimile (201) 393-0204. San Jose, Calif.: Telephone (408) 441-0550. Circulation (1100 Superior Ave., Cleveland, OH 44114-2543); (216) 696-7000.

Title registered in US Patent Office. Printed in U.S.A. Copyright ©1992 by Penton Publishing, Inc. All rights reserved. The contents of this publication may not be reproduced in whole or in part without the consent of the copyright owner.

Permission is granted to users registered with the Copyright Clearance Center Inc. (CCC) to photocopy any article, with the exception of those for which separate copyright ownership is indicated on the first page of the article, for a base fee of \$1 per copy of the article plus 50¢ per page paid directly to the CCC, 27 Congress St., Salem, MA 01970. (Code No. 0883-4989/90 \$1.00 + .50) Can. GST #R126431964.

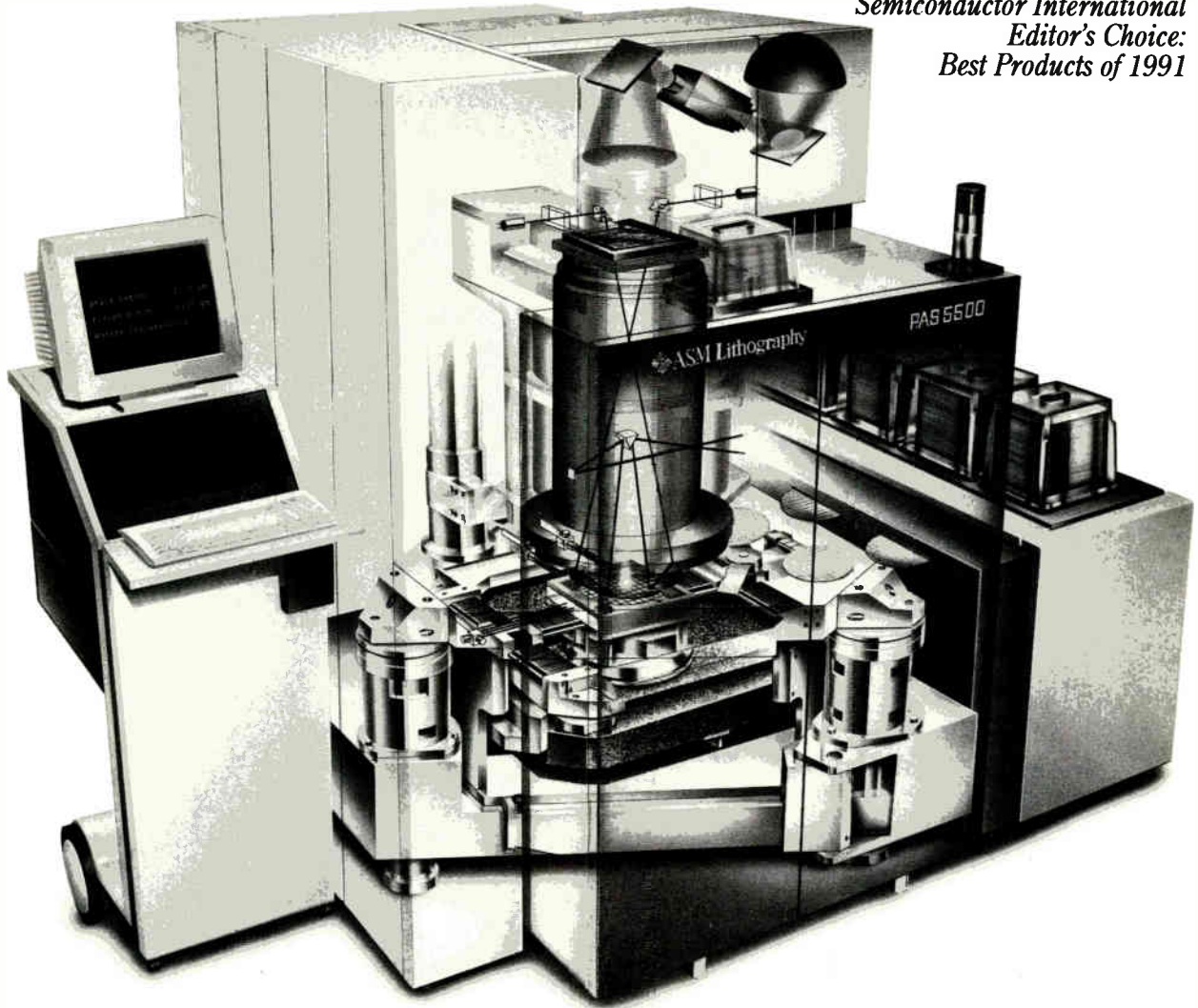
Microfilm of issues or articles can be ordered from University Microfilms, Ann Arbor, Mich. 48103. Telephone: (313) 761-4700.

Subscriptions free to qualified managers. All others: \$60 for one year in the U.S.; \$70 in Canada; \$136 in all other countries. For subscriber change of address and subscription inquiries, call 216-696-7000.

POSTMASTER: Please send change of address to ELECTRONICS, Penton Publishing, Inc., 1100 Superior Ave., Cleveland, OH 44114-2543.

"PAS 5500: Our choice for new stepper of the year."

*Semiconductor International
Editor's Choice:
Best Products of 1991*



It's catching on.

ASM Lithography's new PAS 5500s are becoming the steppers of choice all over the world.

Semiconductor International Magazine has just judged this new family of i-line and DUV machines worthy of SI's annual award. It was given for new products introduced in 1991 that are "truly exceptional" and "break new ground".

Early PAS 5500 i-line users agree. Their 5500s are out-performing our own remarkable specs with resolution better than 0.45 μ m. And overlay better than 85nm. Even on the toughest metal and polysilicon process films.

Imagine being able to let your design engineers really go for it. Creating IC designs down to 85nm overlay, any layer to any other layer. Without compromising chip designs or product reliability.

You'll be able to give your customers the devices they really want. Chips never before possible.

Not only will your market share and margins improve, your productivity and yield will increase, too.

With a throughput of 88 wafers per hour in a Class 1 clean environment, you'll need one-third fewer steppers and fewer wafer tracks.

And down the road, as *Semiconductor International* says, "its modular design lets you upgrade ... without buying entirely new machines".

"Breaking new ground," you bet. Delivering chips never before possible. In volumes never before possible. Using upgradeable steppers that let us guarantee you the lowest cost per good die.

See the stepper of the year in action, call or write:

 **ASM Lithography**
Steppers for the decade ahead.

In U.S.A.: 2315 W. Fairmont Drive, Tempe, AZ 85282. Phone: (602) 438-0559; FAX: (602) 438-0793. In Europe: Meierijweg 15, 5503 HN VELDHOVEN, The Netherlands. Phone: (40) 580800.
In Taiwan: Hermes-Epitek, 110 Ming Chuan Road, Hsin-Chu City, Taiwan, ROC. Phone: (886) 35-339131. In Korea: Intraco, 903 Kwang Sung Building, 831-47, Yuk Sam Dong, Kangnam-Ku, Seoul, Korea. Phone: (82) 2-562-8381.

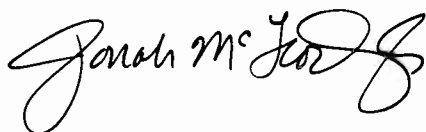
THAT WAS THEN, THIS IS NOW

In years to come, 1991 will be remembered as a watershed—a time that irrevocably affected the direction of the electronics industry in the last decade of the 20th century. The worldwide downturn the industry is experiencing (see p. 26) highlights the paradigm shift. We have entered an era of rapid change, and old models of labor and production are no longer valid. Thirty years ago, a young college graduate could join IBM Corp. right out of school and spend his or her entire life with the company, assured of a comfortable retirement at age 60. In those days, large companies like IBM could produce a computer—the IBM 360, for example—and expect it to generate a constant revenue stream for up to 10 years. Manufacturing lines could be tooled up and amortized over this long period. Year-to-year gross margins of 50% or more could be counted upon. That's all changed now.

Asian and European conglomerates have joined the U.S. big league in vying for customers worldwide, and the competition has gotten keen. As a result, U.S. companies—and individuals too—are having to become much more aggressive than ever before. As companies offload nonrevenue-generating functions and race to take advantage of fast-moving market windows, the outcome is wholesale layoffs. IBM let go of 20,000 people in 1991 and will lay off 20,000 more this year. Apple, Compaq, Digital Equipment, and Hewlett-Packard are all making similar cuts. And the large numbers of skilled workers put on unemployment rolls are confronting a stark reality: their skills and experience have lost value in the labor market, as any of the current surplus of digital circuit designers will tell you.

The reality is that the individual worker can no longer be a specialist with a limited set of skills. Workers at all levels, from the manufacturing line to the front office, must have a broad knowledge of a number of disciplines to accommodate rapidly changing labor-market demands. Our education system, which encourages engineering students to concentrate on narrow specialties, needs to produce graduates who are problem solvers rather than highly directed specialists. Today's unemployed digital designers will hardly find it consoling to know that there is a concomitant dearth of EEs with any analog experience.

Companies, too, must become much more flexible. An electronics company identifies a market, fields a product, then immediately attempts to find the next set of features that will make the current model obsolete. All of this can occur in less than 18 months. The 1990s will be like that. Economic prosperity will depend on the creativity and agility of commercial enterprises. How swiftly can a nation's producers recognize a worldwide demand and configure their enterprises to satisfy that need? Likewise, the prosperity of the individual will rest on how quickly she or he can adapt skills to the demands of commercial producers. □



JONAH McLEOD
EDITOR





Finally, a SPARC chip set that comes equipped with everything you need for the Sun.

VISIT
BOOTH #532
AT
BUSCON

Now, from the Advanced Products Division of Fujitsu Microelectronics — something new under the Sun. A SPARC® chip set that offers the world's most advanced, cost-effective solutions for Sun-compatible workstation designs and specialized, compute-intensive applications. Including voice response, medical imaging and pattern recognition systems.

Our new SPARC chip set is packed with all of the advanced features you need to differentiate your systems from Sun and yesterday's Sun clones. Such as higher integration. More system flexibility. Clock speeds of up to 40 MHz. And graphics options. All at a price to help



you outshine the competition.

Plus, to get you to market faster, we offer three distinct hardware designs: Busless, Sbus and VME bus. What's more, from our alliance with INTERACTIVE Systems Corporation — the premier independent UNIX® source — comes the latest SunOS™ 4.1.1 ported to each design.

And with comprehensive documentation and training, you'll find your place in the Sun more quickly.

So equip yourself with everything you need to develop the highest performance SPARC-based systems. Call us at 1-800-523-0034. And discover why our new SPARC chip set is the perfect Sun set.

FUJITSU

Delivering the Creative Advantage.

FUJITSU MICROELECTRONICS, INC., Advanced Products Division, 77 Rio Robles, San Jose, CA 95134-1807. Ph: 408-456-1161 Fax: 408-943-9293.
 FUJITSU MICROELECTRONICS ASIA PTE LTD. (Head Office, Singapore): Ph: 65-336-1600 Fax: 65-336-1609. HONG KONG SALES OFC: Ph: 852-723-0393 Fax: 852-721-6555.
 TAIPEI SALES OFC: Ph: 886-2-757-6548 Fax: 886-2-757-6571. JAPAN SALES OFC: Ph: 81-3-3216-3211 Fax: 81-3-3216-9771. KML CORP. (Rep., Korea): Ph: 82-2-588-2011 Fax: 82-2-588-2017.
 PACIFIC MICROELECTRONICS, PTY. LTD., (Rep., Australia): Ph: 61-2-481-0065 Fax: 61-2-484-4460.
 FUJITSU MIKROELEKTRONIK GmbH (Dreieich-Buchschlag, Germany): Ph: 06103-6900 Fax: 06103-690122.
 SPARC is a registered trademark of SPARC International. UNIX is a registered trademark of UNIX System Laboratories, Inc. SunOS is a trademark of Sun Microsystems, Inc.

Electronics



COVER STORY PAGE 26
PHOTO: JOOK P. LEUNG



26

**COVER:
1992 WORLD MARKET FORECAST
Riding It Out**

It's hard to see where growth will come from this year. Hostage to a worldwide recession, the electronics industry may rise just 6% overall.

MAJOR U.S. MARKET SEGMENTS

28

Uncertainty unlimited: a year of guarded forecasts

Workstations remain the brightest spot on an otherwise gloomy computing horizon.

34

LANs keep humming and new niches are coming on strong

Communications growth may hit 15%, with wide-area networks, VSATs, and cellular rising fast.

40

Spotty outlook ahead for consumer electronics

But some sectors—notably, home-office equipment—will benefit from the hard times.

43

For chip makers, another year of blah growth

Despite gains in a few hot niches, the industry may not see a 10% rise overall.

47

Forget 1992: equipment makers look ahead to '93

Demand will start to build, they hope, for 16-Mbit DRAMs; but test and EDA are holding their own.

INTERNATIONAL

31

Workstations shine in a ho-hum year for data processing

45

For the semiconductor industry, misery loves company

37

Consolidation holds the key to European communications

48

Worldwide slowdown is seen for capital equipment

41

Japan treads lightly, Europe falters in consumer electronics

DEPARTMENTS

4 Up Front

10 Letter from Redmond

18 Face-Off: Whither the GATT?

24 Information Center

50 Advertisers' Index

51 Electronics Index

52 The Last Word

NEWS ROUNDUP

14

Products to Watch

- Tiny PC timer from Dallas Semiconductor fits in a steel can
- MIPS eases R4000 system design
- Harris unveils 8-GHz bipolar process
- Toshiba's LCD panel is thinner, lighter
- Motorola puts flash memory on a 32-bit microcontroller

16

News Front

- Manufacturing aid needed, says a report from the U.S. Office of Technology Assessment
- Clock speeds are pushing good old oscilloscope to the fore
- Digital and Microsoft team up to enhance Windows on LANs

25

European Observer

- The Europeans take another shot at supercomputers
- European group adopts PLC standard
- Siemens steps up its activities in China...
- ...and signs a RISC pact with Toshiba

WORLDWIDE NEWS

21

Microprocessors

Betting it all on ACE: chip maker MIPS is staking its future on a consortium that may be in trouble

22

Supercomputers

Finally, makers of massively parallel machines are basking in a long-awaited spotlight



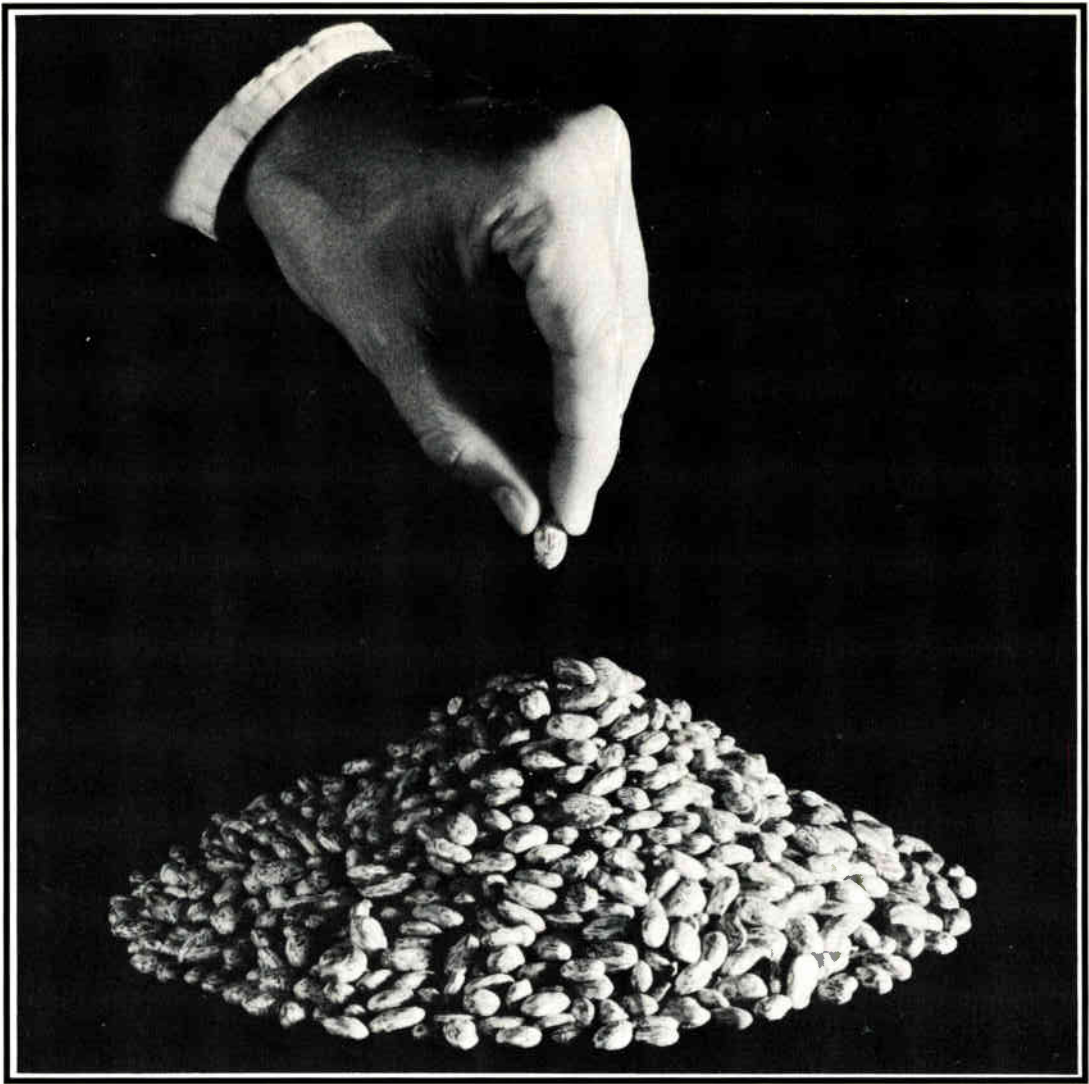
Jesse H. Neal
Editorial Achievement Awards

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

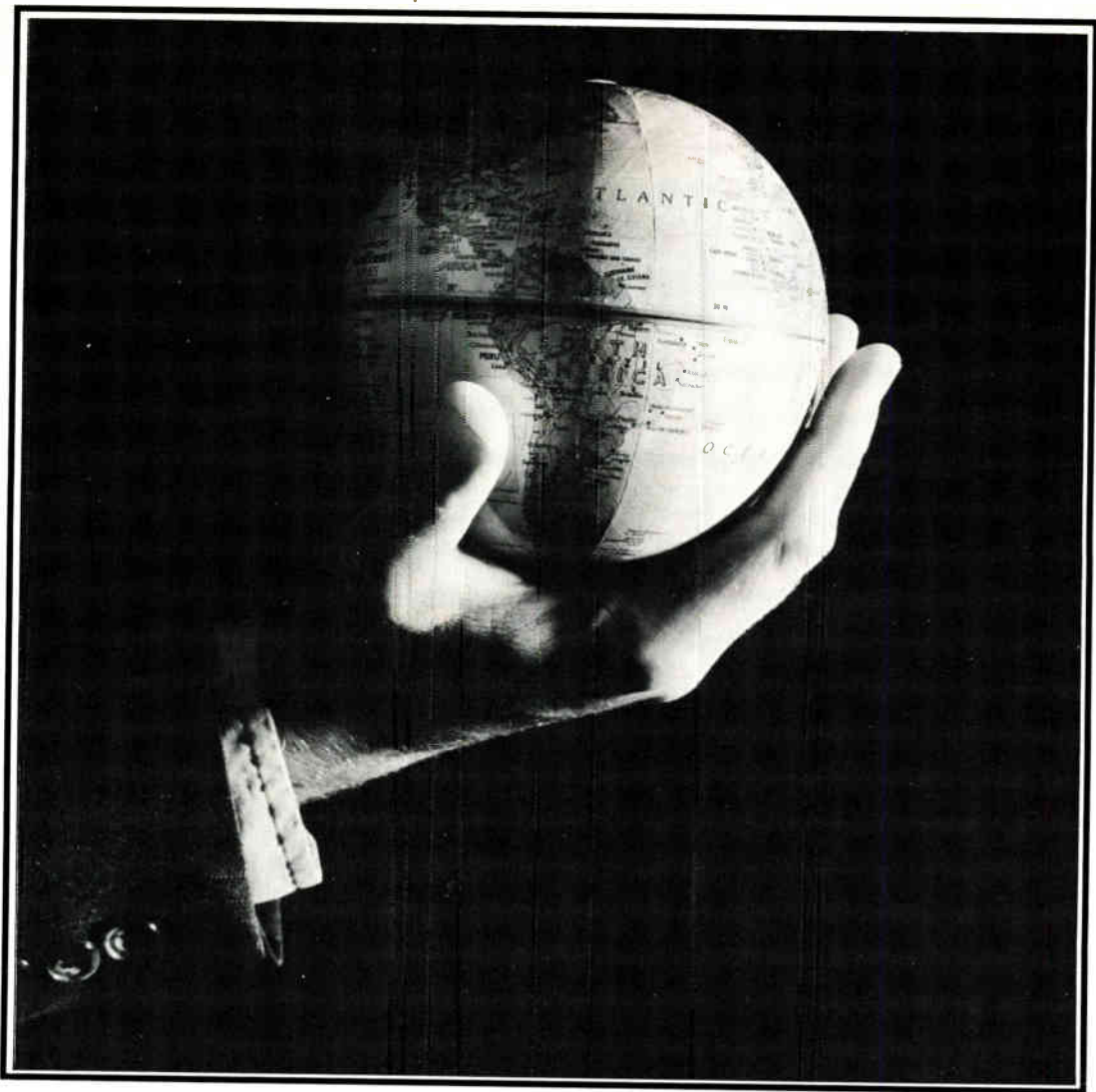
Companies covered in this issue, indexed to the first page of the article in which each is mentioned.

3Com Corp.....	34	LSI Logic Corp.....	43
Actel Corp.....	43	McKinsey & Co.....	26
Advanced Micro Devices Inc.....	43	Mentor Graphics Corp.....	47
AEG AG.....	25	Microsoft Corp.....	16, 21
Alcatel NV.....	34	MIPS Computer Systems Inc.....	14, 21, 28
Alliant Computer Systems Corp.....	22	Motorola Inc.....	14, 47
Apple Computer Inc.....	4	National Semiconductor Corp.....	43
Aristacom International Corp.....	34	Needham & Co.....	43
Beijing International Switching Systems Corp.....	25	Next Computer Europe.....	24J*
Bell Atlantic.....	34	Nintendo Co.....	40
BIS International.....	34	Nokia GmbH.....	40
British Aerospace.....	24D*	Nomos.....	28
Burr-Brown Corp.....	47	Northern Telecom Corp.....	34
Canon Inc.....	40	Open Systems Advisors Inc.....	21
Cap Gemini.....	25	Oppenheimer & Co.....	26
CASA.....	25	Paradigm Semiconductor.....	43
Centigram.....	26	Parsytec GmbH.....	25
Cirrus Logic Inc.....	43	Philips Electronics NV.....	25
Cisco Systems Inc.....	34	PictureTel Corp.....	34
Compaq Computer Corp.....	4, 28	Quality Semiconductor.....	43
Computer Intelligence/ Infocorp.....	28	Rohde & Schwarz.....	47
Comsat.....	34	Romtec plc.....	28
Cowen & Co.....	34	Santa Cruz Operations Inc.....	21
Cray Computer and Supercomputer Systems Inc.....	22	SEL Alcatel.....	24D*
Cray Research Inc.....	22, 28	Semiconductor Industry Association.....	43
Daimler-Benz AG.....	25	SGS-Thomson Microelectronics.....	43
Dallas Semiconductor Corp.....	14	Sharp Electronics.....	40
Data General Corp.....	28	Siemens AG..24H*, 25, 34, 43, 47	
Dataquest Inc.....	26, 28, 34, 40, 43, 47	Siemens Plessey Defence Systems.....	24D*
Digital Equipment Corp.....	4, 16, 28, 34	Sierra Semiconductor Corp.....	43
Eaton Corp.....	47	Signetics Corp.....	43
Echelon Corp.....	34	Sony Corp.....	40
Electronic Industries Association.....	40	Standard Elektrik Lorenz.....	34
Elsevier Advanced Technology Ltd.....	40	STET.....	43
Ferguson Ltd.....	40	Sun Microsystems Inc.....	28
Fraunhofer Society.....	25	Teknibank.....	34
Frost & Sullivan International.....	28	Teradyne Inc.....	47
Fujitsu Microelectronics Inc.....	43	Texas Instruments Europe.....	40, 43
Gartner Group Inc.....	28	Texas Instruments Inc.....	47
GEC Marconi Communications.....	24D*	Thinking Machines Corp.....	22
German Aerospace Society.....	25	Thomson CSF.....	24D*
Harris Semiconductor.....	14	Timeplex Inc.....	34
Hewlett-Packard Co.....	4, 28	Toshiba America Electronics Components Inc.....	14
IBM Corp.....	4, 24H*, 28	Toshiba Corp.....	25
In-Stat Inc.....	26, 43	Unisys GmbH.....	28
Ing. C. Olivetti & Co. SpA.....	24H*, 28, 43	Unix Systems Laboratories Inc.....	21
Inmos Ltd.....	24H*, 25	Videologic Ltd.....	24H*
Intel Corp.....	47	VLSI Research Inc.....	47
Intel Scientific Computers.....	22	VLSI Technology Inc.....	43
International Data Corp.....	22, 28	Watkins-Johnson.....	47
Italtel.....	43	Wavetracer Inc.....	22
ITT Defense International.....	24D*	World Semiconductor Trade Statistics Inc.....	43
John Fluke Mfg. Co.....	16	Xilinx Inc.....	43
LeCroy Corp.....	16	Zenith Data Systems.....	28
		Zenith Electronics Corp.....	40

*International only



ESTIMATE



CERTAINTY

There's more to electronics industry management than counting beans - much more. The typical electronics CEO wouldn't be typical in any other field. Unlike his colleagues in traditional industries, a career crunching numbers didn't get him that corner office - and neither did smooth-talking salesmanship. 71% of electronics industry management got to the top through

the engineering/technical side of the business - and once they've arrived they combine a current, experienced understanding of technology change

with the analytical business skills of a seasoned pro. They run their companies hands-on - and you need to reach them in the pages of **ELECTRONICS** if you want your hill of beans to amount to something.



Electronics

Business/Technology Perspectives For Global Electronics Management
A Penton Publication

REDMOND

DOS/WINDOWS IS FINE FOR NOW, BUT GROWTH IS IN APPLICATIONS HOW MICROSOFT PLANS TO GET IT ALL

BY JACK SHANDLE

Hheavy construction equipment pawing the soil on Microsoft Corp.'s evergreen-encircled campus in Redmond, Wash., provides visitors with a noisy reminder that at least one electronics company is not downsizing. Quite the opposite: the software juggernaut's expansionist policy mandates product offensives on a broad front over the next few years.

For starters, Microsoft's DOS/Windows cash cow will be joined sometime this year by New Technology, a 32-bit operating system designed to rival Unix in features such as preemptive multitasking but to outstrip Unix in features such as security. Unlike Unix, NT has—and will keep—its roots on the desktop and in the installed-applications base, says Carl Stork, NT's business manager. Microsoft will also ship a pen version of Windows this year, and advanced Windows services such as security, messaging, directories, and event notifications will be available in 1993.

Nevertheless, although Microsoft's revenue from systems software will grow, it is destined to contribute increasingly smaller portions of the company's total income in the years to come. Quite simply, there is more room for growth in applications software and Microsoft will settle for nothing less than the lion's share. President William Gates has never been one to temporize, and it seems clear that he wants applications packages and multimedia publishing titles to push his business upward faster than Windows, DOS, and NT can.

It's not as if Microsoft is starting from the rear. The company already controls 26% of the combined Apple and DOS market for applications software, up from just 4% six years ago. Its products already command wide market-share leads for Apple Computer Inc.'s Macintosh platforms, and Gates is exhorting his DOS product managers to increase their share.

Systems software will be a tactical

weapon in the applications offensive. By maximizing the system services offered by Windows and NT before the new versions are in beta test, Microsoft's applications group will have a clear edge over competitors. Mike Maples, vice president of the group, adds bluntly that "it is our intention to be on every relevant, popular graphical platform," and that "if anybody thinks we are not after Borland and WordPerfect, they must be confused."

Besides a steady stream of enhancements to Excel, Word, and Works, Maples's group, which has already pulled even with the systems group in revenues, will add a data-base program to compete with Borland's dBase III. Promoting a data-base standard that lets pro-

grams query the data bases constructed by other programs is a key element in the strategy laid out by Microsoft.

Work-group software that includes task automation will be another major thrust. "We have a development group [for work-group software] as large as our word-processing group," says Gates. "We will see it emerge as a set of products leveraged on advanced systems platforms. It will be based on rich electronic forms and we will be doing it for wallet-sized platforms as well."

The unifying vision in Redmond is an abbreviation that makes users appreciate the simplicity of DOS. The IAYF vision (for Information At Your Fingertips) views the PC of the future as a tetherless information appliance that can access many data types from a variety of platforms in an object-oriented fashion. Since it makes certain hardware assumptions, IAYF also has implications for Microsoft's business strategy. "IAYF," says Maples, "is a series of activities with other companies that will change the way people use computers."

Microsoft has always believed in partnerships, and a concept as all-encompassing as IAYF will require partnering in spades. Microsoft has already forged a strong link with Tandy Corp. of Fort Worth, Texas. Contrary to popular opinion, Microsoft and Tandy—not IBM—developed the Multimedia PC hardware specification published late in 1990. (IBM collaborated with Microsoft on the Media Control Interface, a software specification for handling multiple data types.) The company will continue to develop the relationship announced in November with Digital Equipment Corp. of Maynard, Mass., says Gates (see p. 16). The agreement integrates Microsoft applications into DEC's All-In-One marketing program for PC desktops, putting Microsoft back on an inside track for mini-computer platforms.

As far as Gates is concerned, the IBM relationship could—and should—warm as well, despite recent reports of

THE FUTURE ACCORDING TO GATES

SOFTWARE

Documents as objects
Pop-up menus
Drag and drop
Security, messaging, directories in OS
Event notification built into OS

HARDWARE

400-Mbyte hard disk
Inexpensive removable optical storage
CD-ROM drives standard
Writeable optical drives

DISPLAYS

Color whiteboard (6,144 by 4,096 pixels)
Standard color desktop (2,048 by 2,048)
Color notepad (1,280 by 1,024)
Color wallet size (640 by 480)

INPUT

Keyboard dominates
Mouse fades
Touch screens
Scanners
Voice

OUTPUT

Music
Speech
3-d graphics
Photorealistic images
Color printing
Animation
Motion video

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

THE PROTOTYPE DOESN'T WORK.

Six ASICs, fifteen PLDs and the whole thing's gone south. Maybe I should go south too. Yeah, hop a bus. Head for Mexico.

THE PROTOTYPE DOESN'T WORK.

Software? Could be. Hardware? Might be. So where do I start? At the beginning, of course. And just where is that, smart guy?

THE PROTOTYPE DOESN'T WORK.

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

THE PROTOTYPE DOESN'T WORK.

Wait. What about that glitch in the handshake on the first pass? Couldn't reproduce it. Maybe it just reproduced itself.

THE PROTOTYPE DOESN'T WORK.



These are just a few of the reasons Tek makes a complete line of scopes, logic analyzers and signal sources. Instrumentation that can quickly get to the core of your prototype's problems. Whether they're digital, analog or software. Because even when your prototype doesn't work, Tek does. **TALK TO TEK/1-800-426-2200**

Tektronix

Test and Measurement

A1W-188146 Copyright © 1991, Tektronix, Inc.

CIRCLE 223
World Radio History

PENTON CONTINUES COMMITMENT TO RECYCLING



Penton Publishing's Camera Department started recycling chemicals from film wastewater 25 years ago... long before the ecologically-smart idea was widely recognized.

For almost as many years, the Penton Press Division has been recycling scrap paper, obsolete inventory, and printing press waste materials. In 1991, Penton Press will recycle some 5500 tons of paper, 9 tons of aluminum plates, and 3 tons of scrap film negatives. Furthermore, the Press Division has invested \$500,000 in air pollution control equipment.

Company-wide, the recycling spirit has spread from Cleveland headquarters to offices throughout the country. Penton employees are enthusiastic participants in expanding programs to re-use paper, aluminum cans, and other waste materials.

Penton Publishing believes these practices make a significant quality-of-life difference for people today... and will help create a safer, healthier environment for generations to come.

Penton Publishing

strained ties between the two. "We have good communication with groups in IBM so they know where we are going with Windows," he says. Gates also strikes a conciliatory tone regarding OS/2, IBM's troubled answer to Windows. "IBM is a big company and it is really hard to change your strategy when you are that large," he says. "It will have places for OS/2, AIX, Pink [the collaborative operating-system venture between Apple and IBM], and Windows. It is up to us to make sure IBM does not have to make a black-and-white decision on OS/2 and Windows because if we force the issue, it will be OS/2." Corporate partnering aside, Gates minces no words about where he is placing his bets. When asked who his strategic partners are, he ticks off the names of Microsoft's key software-development managers.

On the hardware side, Microsoft will, over the next three to five years, insulate itself from shifts in microprocessor popularity by providing multiple binary codes for Windows. Different versions of Excel, for example, will be packaged in the same box so that any platform running Windows (or NT) can run Excel in native code. "Executable binary is a small part of the bits in the box," says Gates. In addition to the Intel architecture, Microsoft has targeted MIPS Computer Systems Inc.'s R4000 and perhaps other RISC processors.

Interestingly, Gates predicts that the Intel 80586, which should be introduced this year, will offer the same performance as the R4000: a 50-MHz clock, which will rise to 100 MHz two years after introduction, and performance of 40 million to 80 million instructions/s as the processor runs through its revisions. One bit of important fallout that specialty chip makers should heed is that these microprocessors will be able to handle data compression and decompression in software.

Other key hardware specifications will include a 400-Mbyte hard disk and inexpensive removable optical storage in the 400-Mbyte range. Gates says CD-ROM drives will become standard with-

in three years. But writeable optical drives will compete as their price comes down, and the CD-ROM will eventually become strictly a publishing medium. Networking will move increasingly toward a choice between wireless and fiber. Flat screen displays will segment into four markets in the Sage of Redmond's technology vision five years out: a color whiteboard with 6,144-by-4,096-pixel resolution; "standard" color desktop (2,048 by 2,048); color notepad (1,280 by 1,024); and color wallet-sized (640 by 480).

Input systems will vary, says Gates. The keyboard will continue to dominate and the mouse will play a much diminished role as more touch-feely technologies, such as touch screens, improve performance. Scanners will also become more common. Voice and natural-language comprehension of plain text will make their appearance, says the company president. Output systems will be equally varied and include music, speech, 3-d graphics, photorealistic images, color printing, animation, and motion video.

In order to maximize the hardware's power and performance, Microsoft's system software will become richer and more consistent across platforms. Documents will become objects with all the attributes that folders have today, and functions such as pop-up menus and drag-and-drop will be used much more extensively. Operating systems will be able to handle security, messaging, and directories of users and resources. To accommodate the IAYF features of remote access and shared work-group applications, event notification will be built into operating systems. Whenever a file is modified, a message is sent and logged in the system without overhead on the system resources.

All this is heady stuff, but nothing unusual for Gates, whose track record, although blemished with a few embarrassments, is as good as any in the industry. The confidence is still intact, too. "We are immune to processor shifts," he says, "but we are betting on a specific OS." □

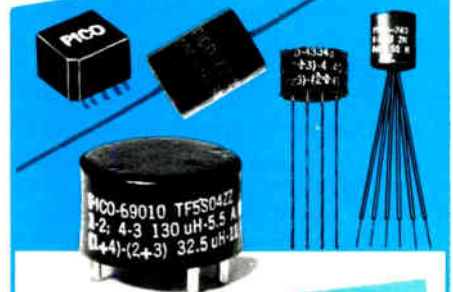
Addendum

In "Waging War on Intel: The RISC Crowd Moves In" [November 1991, p. 58], we mentioned two of MIPS Computer Systems Inc.'s chip-making part-

ners for the R4000 microprocessor. For the record, the list also includes, along with NEC and Siemens, Integrated Device Technology, LSI Logic, Performance Semiconductor, and Toshiba.

PICO Transformers & Inductors

**PLUG-IN
SURFACE MOUNT
AXIAL INDUCTORS
TOROIDAL
INSULATED LEADS**



TRANSFORMERS

QPL standards available
MIL-T-27/103-1 thru 16, MIL-T-27/172-1 thru 50,
MIL-T-27/357-1 thru 114, MIL-T-27/358-1 thru 123,
MIL-T-27/359-1 thru 147

- Audio Transformers ranging in size from 1/4" x 1/4" to 3/4" x 1 1/2". 20 Hz to 250 KHz. Up to 3 watts.
- Pulse Transformers .05μSEC to 100μSEC miniaturized construction.
- Ultra-miniature DC-DC Converter Transformers. 40 watts.
- Miniaturized Switchmode Inverter Transformers. 60 watts.
- 400 Hz Power Transformers. Primary voltages of 115V or 26V. Plug-in construction. Ultra-miniature
- Microphone/Transducer Audio Input.
- MIL-STD-1553 Interface Multiplex Data BUS Pulse Transformers.

POWER INDUCTORS

QPL standards available MIL-T-27/356-1 thru 63

- Inductance values to 20mH with DC currents to 23 amps

COMMON MODE INDUCTORS

HIGH "Q" INDUCTORS

See EEM
or send direct for
FREE PICO Catalog

**PICO
Electronics, Inc.**

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552

Call Toll Free **800-431-1064**

IN NEW YORK CALL **914-699-5514**

FAX **914-699-5565**

TO WATCH

TINY PC TIMER FITS IN A STEEL CAN

A complete timekeeping system for personal computers has been rolled into a small, surface-mountable package by Dallas Semiconductor Corp.

The DS1494 Time-in-a-Can module is among the first products based on the Dallas, Texas, company's MicroCan technology, which encases memory chips in low-cost stainless steel cans the size of watch batteries.

Using the DS1494, computer manufacturers can add

software to implement a stopwatch, alarm clock, logbook, time-and-date stamp, and event scheduler in one-fifth the space of present solutions for PCs.

The beauty of the device, however, is that it can be surface mounted. Previous solutions that depended on lithium batteries as their power source could not withstand the high temperatures of surface mounting. This product gets around that by surface-mounting the MicroCan and



Dallas Semiconductor's Time-in-a-Can offers a full-feature full-time clock in the industry's smallest package.

later snapping the memory chip and battery in place.

Since the DS1494 Time-in-a-Can is easily retrofitted on PCs, it can be used as a run-time meter to quantify reliabil-

ity or schedule maintenance. The product takes up 80% less space than present solutions. Available now, the DS1494 is priced at \$7.50 in quantities of 1,000. □

MIPS EASES R4000 SYSTEM DESIGN

MIPS Computer Systems Inc. is making it easier and faster for system vendors to design-in the company's R4000 microprocessor.

The Sunnyvale, Calif., company's ARCSys licensing program offers the ASIC chip sets, board designs, systems designs, and software needed for products compliant with the ARC (Advanced RISC Computing) specification. The R4000 is one of the microprocessors supported by the Advanced Computing Environment (ACE) initiative, and MIPS claims its licensing program will give ACE a boost.

Two options are available, a manufacturing kit, and a design kit, which allows suppliers to add value. Pricing includes fees and royalties and ranges between \$40 and \$60 per system shipped on a volume of 25,000. □

HARRIS UNVEILS 8-GHZ BIPOLAR PROCESS

Harris Semiconductor, long the leader in ICs for the military, is making a strong move toward preeminence in commercial-grade, high-speed signal processing with a new 8-GHz, silicon-on-insulator process and an array of new products.

The Melbourne, Fla., company's star performers include the world's fastest pin-driver IC for automatic test equipment and a pacesetter family of op amps.

The company's complementary bipolar DI UHF1 process will be used for both standard products and

ASICs. Its frequency range exceeds competing technologies by at least a factor of two.

The new 500-MHz pin driver, called the HFA5250, boasts a 1-ns rise time. It is available now in 28-pin SOICs for \$48 in 1,000-unit purchases.

Typical specifications for the entire family of HFA1100/20/30 family of op amps include 850-MHz unity gain bandwidth, 11-ns settling time, 0.04 dB gain flatness to 50 MHz, and 60-mA output current. Pricing on samples starts at \$10 each. □

TOSHIBA'S LCD PANEL IS THINNER, LIGHTER

A thin, black-and-white LCD screen from Toshiba America Electronics Components Inc. could change the look of future laptop and notebook computers.

The TLX-1832S-C3M is about 55% thinner and 60% lighter than most competitors, says the Irvine, Calif., company. The unit weighs 320 grams, boasts a 12:1 contrast ratio, and has a depth of 6.5 mm. Samples are available now priced at \$425. □

MOTOROLA PUTS FLASH MEMORY ON A 32-BIT MICROCONTROLLER

Automotive and other high-end industrial-electronics designers now have access to flash-memory technology on a 32-bit microcontroller thanks to Motorola Inc.'s 68F333.

The chip, which was designed by the company's Austin, Texas-based Micro-

processor and Memory Group, integrates 64 Kbytes of flash EEPROM, 512 bytes of standby RAM, 3.5 Kbytes of general standby RAM, an eight-channel, 10-bit A/D converter, and an intelligent 16-bit timer with 16 user-programmable channels.

The incorporation of flash

memory permits stored data or programs to be updated electrically in-system, on-board, or even from a remote site without removing the entire electronic module.

Samples will be available in the second quarter priced at \$199.95 each. A ROM-based version is set for mid-1993. □

The Microprocessor & License to Create Your Own Industry



Western Design Center backs you with the world's leading installed 8-bit microprocessors and the industry's most workable business arrangements.

The technology that started the personal computer and video game revolution.

The Western Design Center (WDC) W65C microprocessors are the core of some of the world's most popular microcomputers, peripherals and video games...and the heart of some of the health care industry's most important life preserving devices. In fact, with the largest installed microprocessor-based technology, WDC has been the secret to the success of many of the world's most

widely used products. Our leading edge technology is only one reason.

You can get a license to succeed.

WDC's unique licensing agreement guarantees you total control over product development, manufacturing and proprietary information – total control over your future. You have Freedom of Manufacturing. That means you can work with any one of several foundries throughout the world. Plus, you have the confidence of knowing your parts are second sourced. With a WDC license, you have the industry's most workable business arrangement because *you drive development.*

Investigate the real secrets to success.

Want the technology that can shift your product development into high gear? The license that can put you in the driver's seat? Send for more information about our 8-bit, 16-bit and 32-

bit microprocessors and microcomputers. Find out how to qualify for free device samples and a look at our innovative license agreements.

- High performance, low cost, low power, low voltage microprocessors
- Core standard product and ASIC product licenses
- Hi-Rel, scaled and worldwide manufacturing
- Freedom of Manufacturing
- Second Sourcing



"Founded in 1978, Licensing since 1981."

The Western Design Center, Inc.
2166 East Brown Road,
Mesa, Arizona 85213
602.962.4545
FAX 602.835.6442

FRONT

MANUFACTURING AID NEEDED

The federal government should take a stronger hand in keeping U.S. manufacturers competitive with rivals in the Pacific Rim and Europe, particularly by creating a "technology-friendly environment." That's one conclusion of a five-year study by the Office of Technology Assessment, the congressional research agency, that appears to sing a tune that's diametrically opposed to the Bush Administration's no-industrial-policy mantra.

The study, called *Compet-*

ing Economies: America, Europe, and the Pacific Rim, warns that American manufacturing has lost its competitive edge. It backs up that contention by showing that U.S. exports were 13.8% of the world total in 1970, but dropped to 10.3% by 1986. In the same period, the nation's share of imports rose to 17.5% from 12.9%. Furthermore, the authors say, American workers' living standards have not increased: "Real hourly wages of manufacturing workers peaked in

1978 at almost \$9.50 per hour; by 1990, they had sunk to almost \$8."

One of the ways the government could halt the slide is by smoothing the road for technology, suggests the report. To accomplish that, it sets out an agenda that should give the Democrats more ammunition in their battle against the Republicans over whether the U.S. should formulate an industrial policy [*Electronics*, September 1991, p. 41].

On the list is a recommendation for "improving the financial environment...by taking action to reduce capital costs and relieve pressure...to show high profits every quarter." The report also says that education and training of managers, engineers, technicians, and workers should be upgraded; information about technologies should be disseminated through extension services; and a strategic technology policy should be formed to "promote development of new technologies through collaborative ventures with industry." □

CLOCK SPEEDS ARE PUSHING GOOD OLD SCOPE TO THE FORE

Oscilloscopes are not the most glamorous pieces of electronic equipment, especially when compared to high-speed microprocessors. The ubiquitous instrument largely has been taken for granted for some time thanks to the simple logic of digital 1s and 0s that mask the complexity of analog signals. But the scope is having a rebirth of sorts as clock speeds of microprocessor-based systems zip past 25 MHz and logic designs have to interface to the analog world.

Now, two firms have rolled out scopes that play to those needs: John Fluke Mfg. Co. of Everett, Wash., and LeCroy Corp. of Chestnut Ridge, N.Y. The 200-MHz Fluke PM3090 is a \$3,500 analog model suited to finding analog anomalies in high-speed microprocessor designs as well as in high-definition TVs. LeCroy's is a \$5,000 digital storage oscilloscope, the Model 9300. It comes with a million-word signal-capture memory, vs. the usual 10,000 or less.

Why buy an analog scope? Hans Toorens, Fluke's director of marketing, displays a TV carrier modulated by a TV signal. On the digital scope the signal is unidentifiable; on the analog, clear.

Why buy a megaword of memory in an oscilloscope such as the LeCroy unit? Conrad J. Fernandes, marketing manager, says the word size is perfect to capture a complete frame of a TV signal, or to grab an entire track's worth of analog from a hard-disk drive. □

CREATING A TECHNOLOGY-FRIENDLY ENVIRONMENT

NEED

- Improve financial environment
- Upgrade education and training
- Diffuse technologies throughout the manufacturing sector
- Form strategic technology policy

GOVERNMENT ACTION

- Reduce capital costs; relieve pressures to show high profits every quarter
- Improve public education; help train workers and managers; educate manufacturing engineers
- Establish technology extension services; subsidize equipment leasing; ease access to technologies developed at government labs
- Promote promising new technologies through collaboration with industry

SOURCE: OFFICE OF TECHNOLOGY ASSESSMENT

DIGITAL AND MICROSOFT TEAM UP TO ENHANCE WINDOWS ON LANs

New software from Digital Equipment Corp. enables users of Microsoft Corp.'s Windows graphical environment to run those programs easily on personal computer local-area networks under Windows. The foundation for the new environment, called TeamLinks, is Pathworks, Digital's networking software that joins PC LANs with broader networks. Microsoft, based in Redmond, Wash., will integrate the leading Windows applications—Excel for Windows

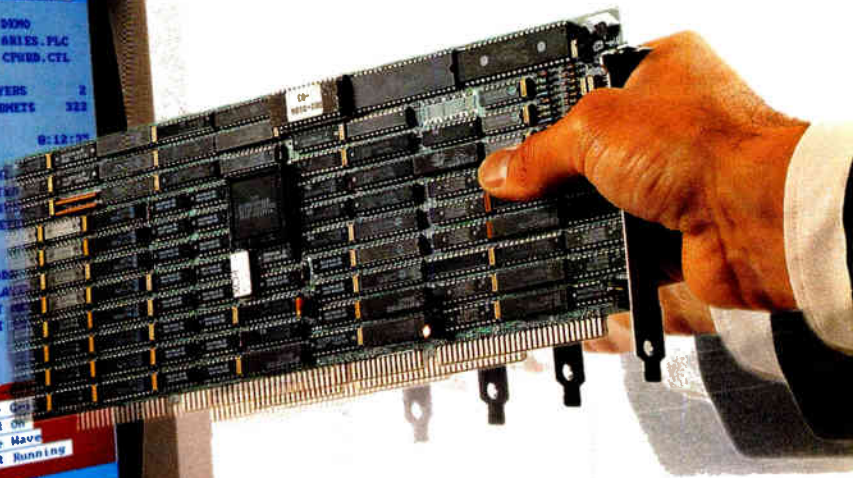
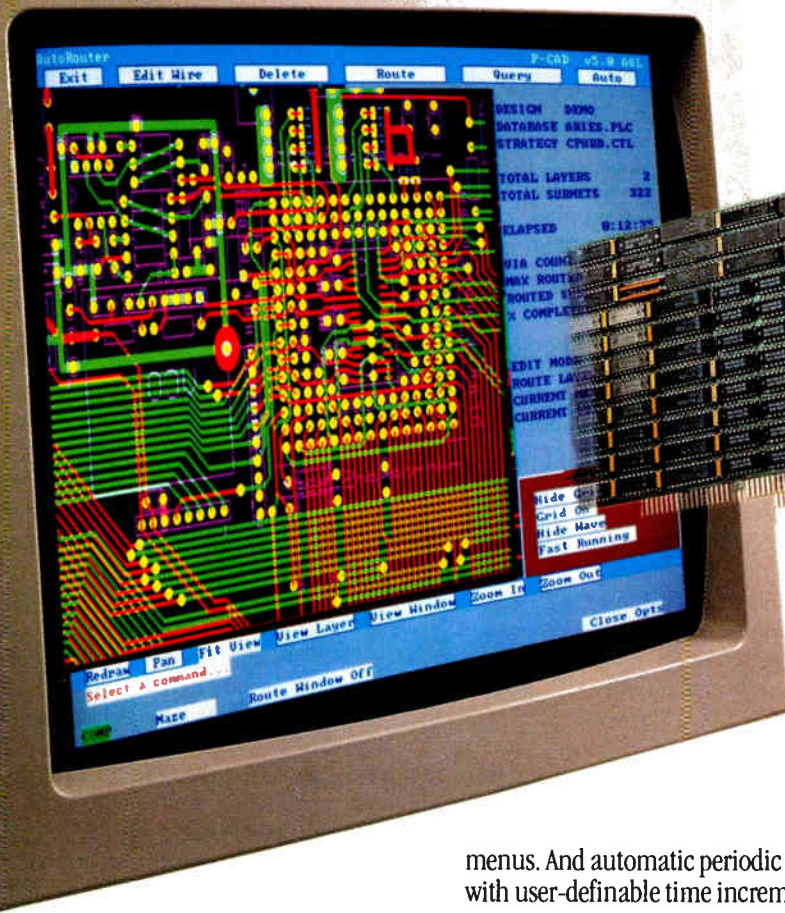
and Word for Windows—with TeamLinks so that users of the package can work with a single program.

Three packages make up TeamLinks: TeamLinks for Pathworks, TeamLinks Information Manager, and Pathworks Links. Digital, in Maynard, Mass., says the merged programs are the most comprehensive collection of applications available for Windows 3.0. Included are team communications, team information management, team administrative work flow,

team document management, and personal productivity programs.

At the same time, the two firms revealed that they have entered a new distribution relationship under which Digital, already a major reseller of Microsoft's LAN Manager networking software, will now manufacture and sell Microsoft Windows. Further, under a new support alliance, Digital will also offer 24-hour service on a number of Microsoft application-software programs. □

P-CAD Master Designer, the shortest distance from PCB design concept to reality.



Master Designer™ 5.0 is the shortest distance from PCB design concept to reality. And the fastest, most productive and reliable way to get your designs to market using an IBM® or compatible PC.

And now Master Designer 5.0 has been enhanced with more than 100 new features, requested by PCB master design engineers like you.

New features, more productivity.

Master Designer 5.0 shortens the entire design cycle with new features like extended memory for 4-times larger designs. Automatic real-time on-line design rule checking. User configurable

menus. And automatic periodic file save with user-definable time increments.

First with 20,000 PCB designers.

You can rely on Master Designer 5.0 for the quality and dependability that has made it the choice of more than 20,000 PCB designers worldwide.

Master Designer 5.0 gives you the interactive support of Master Layout™ to handle surface mount, analog, and digital technology. The flexibility of Master Schematic™, fully automated optional Rip-n-Route, and our optional Master Placer™. Not to mention the plus of a consistent menu-driven interface.

With Master Designer 5.0, you're backed by CADAM, the world's leading CAD/CAM/CAE software supplier, and

the international network of expert P-CAD® Value Added Resellers.

Your finished designs are a lot closer than you think and so is your free P-CAD Demo Disk.

Here's how to get all the details on Master Designer 5.0, and shorten the distance between your next great concept and reality. Just call CADAM toll-free today and we'll send your free Master Designer 5.0 Demo Disk absolutely free.



1-800-255-5710



CADAM
AN IBM COMPANY

World Class PCB CAD Productivity

Put Our List On Your List



Our list can help you do the other things you have on your list. Such as buy a car. . . estimate social security. . . start the diet. . . check out investments. . .

Our list is the *Consumer Information Catalog*. It's free and lists more than 200 free and low-cost government booklets on employment, health, safety, nutrition, housing, Federal benefits, and lots of ways you can save money.

So to shorten your list, send for the free *Consumer Information Catalog*. It's the thing to do.

Just send us your name and address. Write:

**Consumer
Information Center
Department LL
Pueblo, Colorado 81009**

A public service
of this publication
and the Consumer
Information Center
of the U.S. General
Services Administration



FACE

OFF

BRINGING WORLD TRADE INTO

The General Agreement on Tariffs and Trade (GATT) has proven itself in the past as a means to lower trade barriers on a global scale. After World War II, the noncommunist countries understood that trade protectionism had helped cause and deepen the Great Depression and, indirectly, pushed the world into war.

Successive rounds of GATT negotiations in the postwar years have reduced global trade barriers significantly and contributed to worldwide economic prosperity. Thanks to GATT, the average tariff on manufactured goods for advanced industrial democracies dropped from 40% in 1940 to 5% today. At the same time, worldwide exports have grown from a few tens of millions of dollars annually in 1950 to \$2 trillion five years ago and \$3 trillion today.

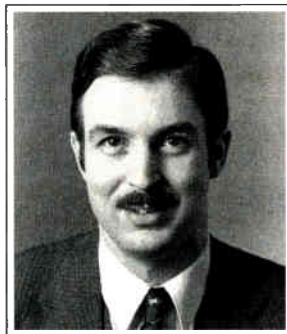
The current round of GATT talks, which have been under way since 1986, seeks to deal with a number of nontariff barriers that have been growing over the last decade. Agriculture is the most notable of these, since it is the U.S. and the European Community that most distort world agricultural trade with subsidies to their own products and trade barriers to imports. Both the U.S. and the EC want to go slow and continue to protect their own farmers.

The GATT talks broke down last year over this issue, while Congress has renewed the Bush Administration's negotiating authority through May 1993. There is a danger that if America does not get what it wants in agriculture, it will walk out of the talks. This would be a mistake.

The GATT agreement also seeks to open markets to trade in services and direct foreign investment, and to protect intellectual property rights, all of which would help America. The U.S. would be better off with a GATT agreement that contains these elements without complete free trade in agriculture than it would be if America and the developed

world were to lower their trade barriers to textile exports. What the U.S. must realize is that elimination of such barriers would not only help less-developed countries at America's expense; it would first and foremost help American consumers, who currently pay \$30 billion in higher prices for clothing and other products because of these trade restrictions. Participants in the GATT round usually speak of opening their own markets as "concessions" to other countries. In fact, the opposite is true: by opening their markets they help their own consumers first.

American policymakers also must remember that GATT is not the only way to open markets. A Free Trade Area (FTA) between two countries, defined in the GATT treaty, requires both nations to eliminate all tariffs and most nontariff barriers. The U.S. is phasing in such an arrangement with Israel and with Canada, and is currently negotiating an FTA with Mexico. There is no



EDWARD HUDGINS

reason why two countries should forgo the benefits of complete free trade simply because other countries are slow to recognize such benefits.

FTAs also put pressure on countries not included in such an arrangement to seek freer bilateral trade. Brazilian firms, for example, that are selling in the American market and paying a U.S. tariff would be at a disadvantage against Mexican firms selling in that market but facing no tariffs. Brazil would therefore have a strong incentive to seek membership in such an FTA.

GATT and FTAs both are weapons in America's arsenal for opening world markets. As the countries of Eastern Europe, Latin America, and others join the free world, free trade becomes more important now than ever. Producing a new GATT agreement—one with cuts in existing subsidies and trade barriers—is an urgent necessity.—*Edward Hudgins, Walker Fellow in Economics at the Heritage Foundation*

THE ECONOMY OF THE '90s

Fourteen months after the collapse of the Uruguay Round of world trade negotiations in Brussels, enormous political and technical problems remain before these talks can be completed. Amid glimmers of hope for the current talks, a larger danger looms: the assumptions and principles of the 44-year-old General Agreement on Tariffs and Trade have become largely irrelevant to the world economy of the 1990s—and to U.S. interests in that economy. As long as this goes unrecognized, nothing that might have been agreed to in Brussels, or might yet be agreed to in Geneva, will halt the erosion of U.S. support for the GATT.

Since the GATT's creation, major changes have occurred in the international economic system. First, the global economic preeminence of the U.S. has largely faded. Second, when the GATT's focus shifted from tariff cutting to eliminating nontariff barriers, members stumbled into intractable conflicts over their sovereign rights. Each nation understandably insisted on setting its own economic and social priorities and would not, or could not, give way to a more international vision. The U.S. should press immediately for a new set of talks to bring old trade rules into line with new international economic realities. Three sets of issues require special attention.

• The goal of freeing up world trade must be reconciled more sensibly with legitimate national regulatory practices. Today's trading system assumes that liberalization is more important than environmental protection, occupational safety, and other national regulatory objectives whenever these objectives interfere with international commerce. The results are predictable. Countries balk when trade negotiators seek to curb their right to set their own economic, social, and political priorities; they begin to disobey or ignore the rules; and cynicism about the value of

any trade rules at all begins to grow.

• Contrary to the assumptions of GATT's American founders, many signatories do not accept the principles of U.S. capitalism. Practices such as government support of selected industries and officially sanctioned anticompetitive behavior are pervasive facts of international economic life. They are also major threats to U.S. industry. No trade system can ignore these predatory practices and expect to retain broad U.S. support.

• Perhaps most important, the GATT's two central principles—"national treatment" (treating foreign businesses the same way as native businesses in a

host country) and "most-favored-nation" (which requires countries to grant equal trade concessions to all GATT members, no matter how restrictive their practices)—need to be re-examined. Because countries treat their own corporations in dramatically different ways, national treatment in particular disadvantages GATT's most open and liberal mem-

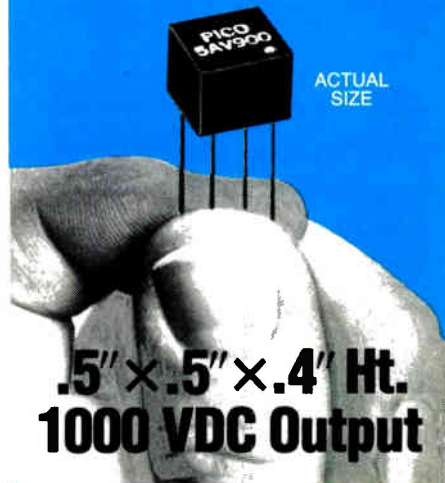
bers. When U.S. power was truly exceptional, this all could be masked. But with America in relative decline and GATT setting an increasingly broad and intrusive agenda, the real penalties resulting from liberalism and openness have been exposed—and with them, the weakness of GATT's original structure.

What is needed is a single standard—"GATT treatment"—that would help ensure that all members contribute fully to the system and play by the same rules. Achieving this may require creating a "super-GATT," a smaller group of like-minded countries willing to take on the new obligations. Most current GATT benefits would remain for nonparticipants. Continuing efforts to liberalize worldwide trade is vital, but preserving a particular system for doing so is not. The world trading system has to be brought into the 1990s.—*Robert W. Jerome, Fellow, Economic Strategy Institute, and Professor at the University of Maryland*



ROBERT W. JEROME

High Voltage DC-DC Converters



• **New Series AV—**
56 Standard Models

• **100 VDC to 1000 VDC**
Output

• **Ultra-miniature Size**
Weight: 4 Grams
0.1 Cubic Inch Volume

• **Standard Input Voltages**
5, 12, 24 and 28 Volts DC

• **Operating Temperature**
Standard: -25°C to $+70^{\circ}\text{C}$
Optional: -55°C to $+85^{\circ}\text{C}$

• **MIL-STD-883**
Screening Available

• **Isolated: Input to Output**
up to 1500 VDC

PICO also manufactures over 800 regulated and isolated DC-DC Converters and AC-DC Power Supplies and over 2500 standard ultra-miniature Transformers and Inductors.

Delivery—
stock to
one week

SEE EEM
THOMAS REGISTER
OR SEND DIRECT FOR
FREE PICO CATALOG

PICO
Electronics, Inc.

453 N. MacQuesten Pkwy. Mt. Vernon, N.Y. 10552

Call Toll Free **800-431-1064**

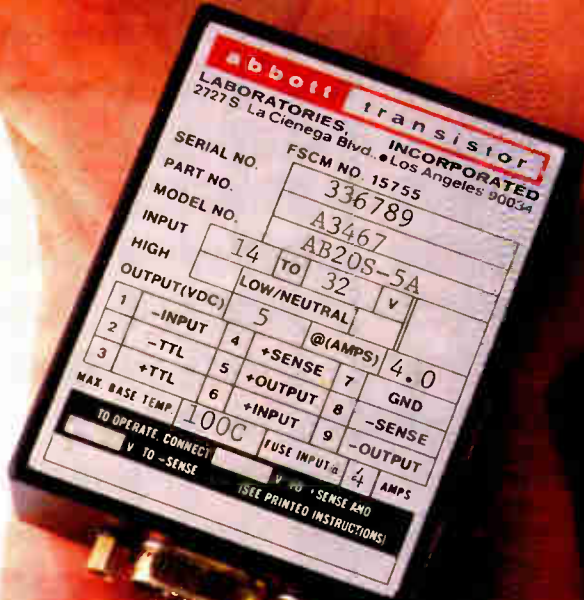
IN NEW YORK CALL **914-699-5514**

Actual size

Actual output

20 WATTS

Now AC to DC



Actually meets

- MIL-STD-2000
- MIL-STD-810C
- MIL-S-901C
- MIL-STD-461C
- MIL-STD-704D
- NAVMAT GUIDELINES

Mil/Pac™ high-density military power supplies.
 Now you can order Abbott's full mil-qualified compact power supplies in both DC and AC input models.
 Mil/Pacs come in 20W, 35W and 50W configurations, with single (5, 12, 15, 24, or 28V) or dual ($\pm 12V$; $\pm 15V$) outputs.
 DC-to-DC models accept input from 14V to 32V. AC-to-DC models accept 103.4 to 126.5V rms, 47-440 Hz single phase.
 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.
 Mil/Pacs are available with or without MIL-STD-2000. Either way, the specs are worth reading. Just write us at 2727 South La Cienega Bl., Los Angeles, CA 90034. Or call (213) 936-8185.

abbott
 WHEN RELIABILITY IS IMPERATIVE.™

CIRCLE 211

NEWS

CHIP MAKER MIPS IS STAKING ITS FUTURE ON A CONSORTIUM THAT MAY BE IN TROUBLE

BETTING IT ALL ON ACE

BY JONAH MCLEOD AND HOWARD WOLFF

If the Advanced Computing Environment consortium were a person, it probably would be working on its résumé. And that state of affairs should leave MIPS Computer Systems Inc., the Sunnyvale, Calif., microprocessor maker, just a little nervous.

That's because MIPS, a charter member of the nine-month-old consortium whose aim is a nonproprietary standards-based desktop computer, is betting its future on ACE's success. None of ACE's other major players—among them Acer, Compaq, DEC, and Microsoft—is so deeply committed; each easily could walk away and do something else. So even though the 200-member ACE has designated MIPS's R3000 and R4000—along with Intel Corp.'s X86 family—its standard central processors, the consortium still has no

common strategy as its members pursue their own strategic ends. This leaves MIPS, in effect, fighting to get attention from fellow members of a club they have joined mostly to hedge their bets.

It's not that MIPS isn't working hard. In the absence of a strong evangelist for the ACE gospel, the company is not just preaching the virtues of its chips but is offering a very tempting incentive to design boxes around it.

MIPS has seized on the fact that ACE members are not asked to choose between MIPS and Intel solutions, but to build boxes compliant with ACE specifications and let the customer select whichever of the competing architectures it prefers. So MIPS has decided to make the job easier with its ARCSystem licensing program (ARC stands for Advanced RISC Computing).

For the system manufacturer that

does not want to devote engineering resources to building a box, there is the ARCSystem 100 Manufacturing Kit. This is the lowest-cost method of testing the feasibility of the ACE platform at a minimal investment; with it, a system vendor can offer a box quickly.

The next option is the ARCSystem 100 Custom Design Kit. It gives the system vendor all the computer-aided-design data needed to change the board layout, as well as the BIOS for the operating system, to further differentiate its product from the competitors'. The system builder can purchase just the chips, central processing unit, chip set, or peripheral chips from MIPS or the five silicon vendors providing the MIPS processor. In this way, it need only provide marketing, sales, and distribution.

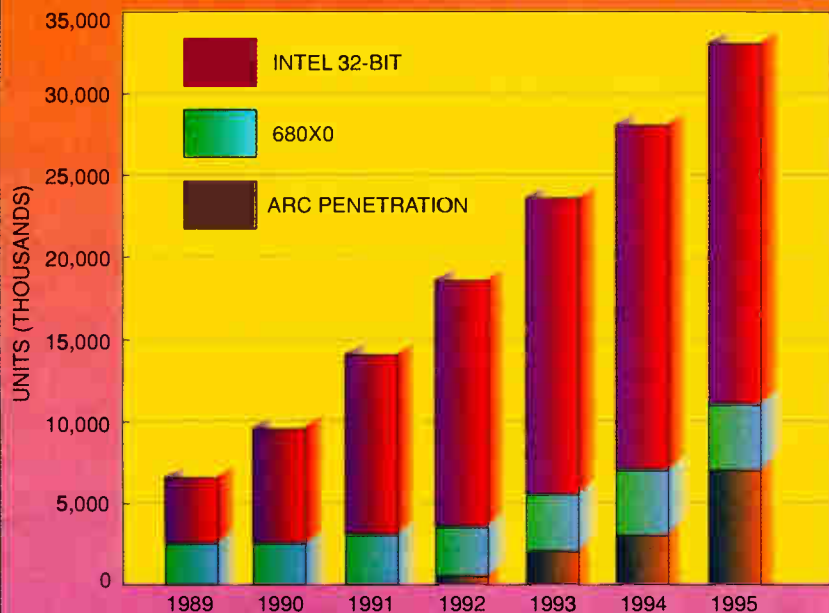
MIPS's strategy could work. "It's a slick move," says analyst Michael Gould of Open Systems Advisors Inc. in Boston. "It potentially gives Pacific Rim clone makers the means to pump out large volumes of machines. It lowers the entry cost [to the market] to next to nothing, and it relieves the independent system vendors of decisions about which architecture to use."

Meanwhile, back at ACE, there is a score of minor intrigues as members jockey for market position. For example, Microsoft Corp. is attacking Unix even as its subsidiary, the Santa Cruz Operations Inc., is promoting a Unix solution in competition with Microsoft's own Windows NT (see p. 12). Then there's Unix Systems Laboratories Inc., the Summit, N.J., operation spun out of AT&T Co. to set up, maintain, and promulgate the Unix International standard in the battle of the Unices. Unwilling to let Santa Cruz run away with a major market should ACE take off, the firm is getting into ACE to offer a second Unix option. But it is also cooperating with Santa Cruz to ensure software developers that they can create an application to play on Santa Cruz's or Unix Lab's version of Unix.

And if that isn't enough, MIPS and Intel are doing a little dance. Both offer ACE platform solutions, but Intel is not lifting a finger to involve itself in the consortium. It is counting on Acer, Compaq, DEC, and the rest to build 80486-based boxes first. But Acer, Com-

MICROPROCESSORS

THE ARC TARGET



SOURCE: IDC AND MIPS ESTIMATES

MIPS likes the potential market—nearing 10 million units annually by 1995—for systems compliant with its Advanced RISC Computing.

paq, et al., compelled to use the 486 because that was the plan for their next generation of PC, wouldn't mind seeing the MIPS box succeed so they could end their dependence on Intel, which has long controlled their fortunes by controlling the supply of today's standard desktop microprocessor. For this, they are relying heavily on MIPS to provide the design for an ACE-compliant, MIPS-based PC.

There are other questions to be decided, both within and outside the consortium. But the overriding concern right now is whether the group can survive the seeming disinterest of some of its members.

The way analyst Gould sees it, things could go either way. "There is a window for ACE," he says, adding that much depends on what DEC does with its Alpha RISC technology. Gould explains that "two, or three, or five years down the road DEC and its Alpha licensees will be building products that

compete with MIPS's ARC," a complication that MIPS could easily do without.

Not only that, but Microsoft's Windows NT is waiting in the wings, and there is a school of thought that expects to see that operating system take over first place from the venerable MS-DOS. Moreover, "In its workstation configuration, Windows NT has a shot at being dominant within ACE," says Gould. "If anything is going to have the chance to drive a large volume of MIPS machines it will be NT," he adds.

Seeing things in about the same light is Larry Jordan, vice president of marketing at Integrated Device Technology Inc. of Santa Clara, Calif., which is one of the five chip makers licensed to build the MIPS microprocessors. In his scenario, ACE will survive because high-performance PCs will be running Windows NT rather than MS-DOS by late this year. That, he reasons, could produce a new clone PC market based on the ACE computer spec. □

gling performance from new supercomputer systems coming from Seymour Cray's new operation—he's no longer associated with Cray Research—called Cray Computer and Supercomputer Systems Inc. and based in Colorado Springs, Colo. Goldfarb says that it plans a gallium-arsenide-based C-3 machine with a clock rate of 450 MHz, and an even faster C-4 to come later. "There are some very interesting things going on in that market," she concludes.

And she's revising her estimates of the size of the MPP sector upward. In mid-1991, Goldfarb pegged 1991 revenues from MPP systems at about \$221 million, growing to \$310 million this year. Her new numbers, based on greater acceptance of both Intel's and Thinking Machines' earlier models, jump to \$279 million last year and \$382 million in 1992. "The MPP sector is getting very competitive," she points out.

Intel's new system, the Paragon XP/S, costing \$2 million to \$55 million, can include as many as 4,000 microprocessor nodes. Each node comprises several chips, two of which are Intel i860 SX reduced-instruction-set-computing devices. The Paragon line's performance spans 5 to 300 gigaflops.

Meanwhile, Alliant is looking to its Campus 800 to stimulate lagging sales. Campus stands for clustered architecture, massively parallel unified-memory system, and it too uses the Intel i860 RISC

processor. As many as 800 of them can be ganged to deliver peak performance of 32 Gflops. An 800-processor Campus will sell for \$16 million; a typical 100-processor model is priced at \$2.5 million.

Finally, the next entry in the massively parallel sweepstakes is likely to be the KSR1—the first product from Kendall Square Research Corp. in Waltham, Mass. The five-year-old firm claims its system combines the performance of multiple CMOS processors with a traditional programming model (the Unix operating system, Cobol and Fortran compilers, and standard database software.)

Kendall Square has designed its own four-chip central processor, which is fabricated by Sharp Corp., and delivers peak performance of 160 million instructions/s and 320 million floating-point instructions/s in an eight-CPU version. The company has already delivered 16- and 32-processor models to a handful of customers. □

MAKERS OF MASSIVELY PARALLEL MACHINES ARE BASKING IN A LONG-AWAITED SPOTLIGHT WITH A NEW VIGOR

BY LAWRENCE CURRAN

When last we looked, fresh claims of astronomical speeds in supercomputer systems had befogged the fact that not many were being sold [*Electronics*, July 1991, p. 28]. But that may change in the wake of at least five major product introductions. Now, supercomputing—especially the niche reserved for massively parallel machines—looks as if it might outgrow its label as arcane technology sooner than expected as acceptance broadens.

The granddaddy of the business, Cray Research Inc. of Eagan, Minn., unveiled its Cray Y-MP C90 at November's IEEE Supercomputing '91 conference in Albuquerque, N.M. A 16-processor version of the system executes 16 billion floating-point operations/s (gigaflops), making it "the most powerful general-purpose supercomputer ever offered for scientific and engineering applications," Cray executives claim. In any event, this peak performance is four

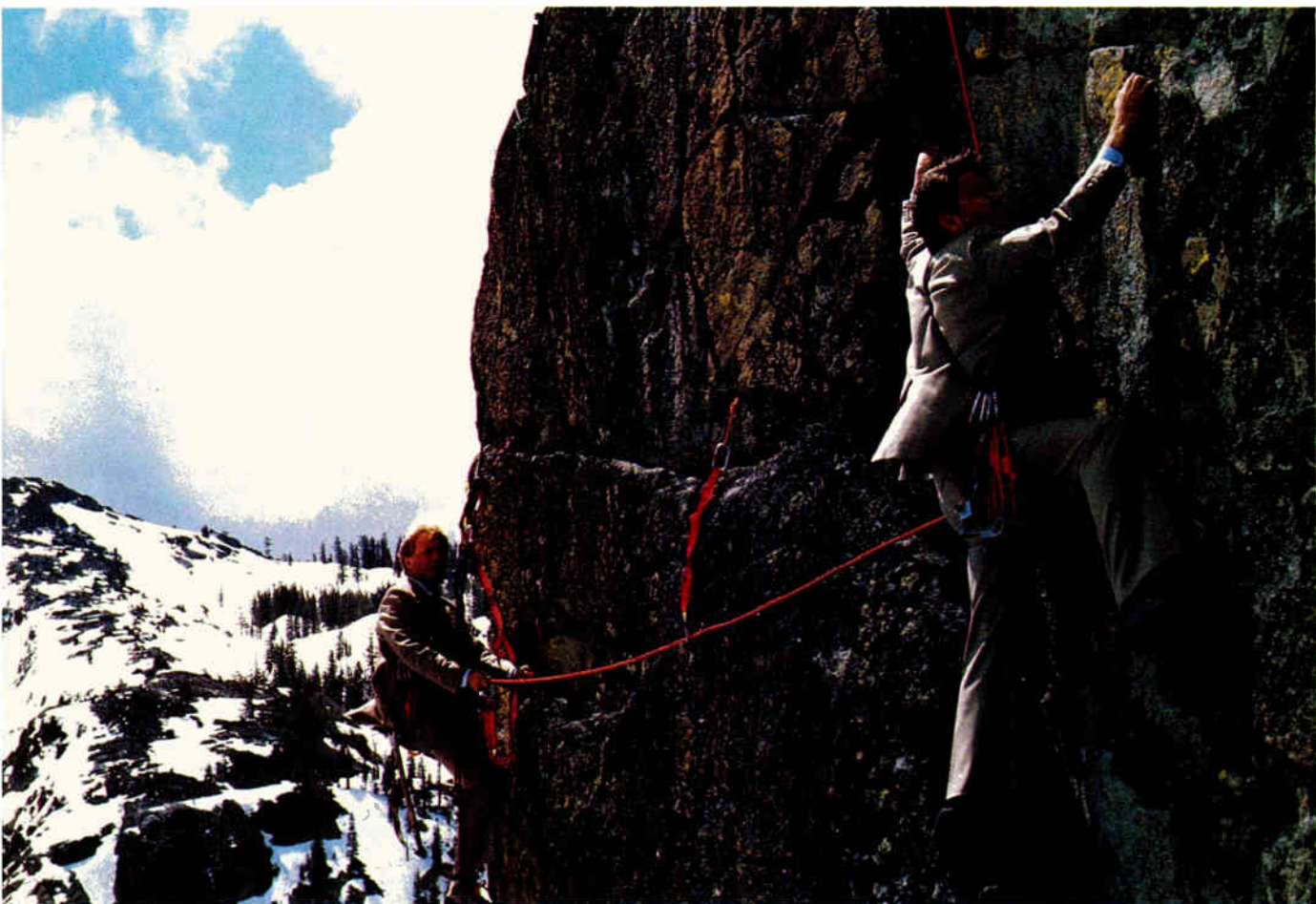
times the speed of any of the company's previous pacesetter supercomputers.

Two other entries also bowed at Supercomputing '91—the latest massively parallel processor (MPP) from Intel Scientific Computers of Beaverton, Ore., and another MPP from Alliant Computer Systems Corp. of Littleton, Mass. Earlier in November, Wavetracer Inc., a three-year-old Acton, Mass., startup, introduced what is an MPP novelty—a desk-side machine called Zephyr—that uses 4,096 or 8,192 custom microprocessors. And rounding out the five, Thinking Machines Corp. of Cambridge, Mass., brought out its latest model in the Connection Machine line, the CM-5, in late October [*Electronics*, December 1991, p. 27].

Debra Goldfarb, manager of high-performance computing at International Data Corp., the Framingham, Mass., market-research firm, says "there's still a lot of innovation in Cray's line." But she's expecting even more mind-bog-

SUPERCOMPUTERS

Risky Business



In today's competitive business climate, product development is a perilous journey. One slip can mean lost opportunity... or worse. You've got to plan intelligently, execute on time, and use the best available technology. If you don't, your competitors undoubtedly will.

Why put up with risks and shortcomings associated with obsolete power technologies... bulky, one-of-a-kind designs; program delays; agency approval cycles; last minute surprises; and unproven field reliability. Vicor's power component approach has been proven by thousands of users to be the fastest and most predictable path to successful power system development. And Vicor's complete line of "plug and play" power system building blocks offer unprecedented design flexibility and result in smaller, cooler, more cost-effective products.

Tired of power development cliffhangers? The solution is right at your fingertips... just give us a call.



Component Solutions For Your Power System



23 Frontage Road Andover, MA 01810
TEL: (508) 470-2900 • FAX: (508) 475-6715

INFORMATION CENTER

Electronics

2025 Gateway Place, Suite 354
San Jose, California 95110

(408) 441-0550.....(408) 441-6052FAX

Use the postage-paid card on the facing page; circle the number of each company you would like to know more about.

CAE/CAD

197 - P-CAD—Master Designer, the shortest distance from PCB design concept to reality—and the fastest, most productive, and reliable way to market using an IBM or compatible PC.

CHIP SETS

194 - Fujitsu—Finally, a Sparc chip set that comes equipped with everything you need for the Sun. It offers the most advanced, cost-effective solutions for Sun-compatible workstation designs and specialized, compute-intensive applications.

COMPONENTS

206 - Pico—High-voltage dc-to-dc converters measure 0.5 by 0.5 by 0.4 in. and have 1,000 VDC output.
206 - Pico—Transformers and inductors: plug-in, surface mount, axial inductors, toroidal, and insulated leads.

CONFERENCES

173 - Computer Quality and Standards Compliance Conference—Improve your computer quality, ensure ISO 9000 compliance: Feb. 12-14, Monterey Plaza Hotel, Monterey, Calif.

CONNECTORS

189 - AMP—Eurocard connectors, with global manufacturing and local support. No matter where in the world your product is designed, AMP has the connections you need to do it right.
190 - AMP—For connectors and help: from custom products to system design, this is AMP today.

LICENSING

214 - Western Design Center—The microprocessor and license to create your own industry. Backing you with the world's leading installed 8-bit microprocessors and the industry's most workable business arrangements.

LOCATIONS

228 - Nebraska—You'll find our new

study on locating in Nebraska nothing less than electrifying.

POWER DEVICES

211 - Abbott—Mil-pac high-density military power supplies now ac to dc; actual output 20 W. Now you can order Abbott's full mil-qualified compact power supplies in both dc and ac input models.

177 - Vicor—Why put up with the risks and shortcomings associated with obsolete power technologies when Vicor's power component approach has been proven to be the fastest and most predictable path to successful power system development?

PRODUCTION EQUIPMENT

181 - ASM Lithography—It's catching on: the new PAS 5500s, a new family of i-line and DUV machines worthy of annual awards, are becoming the steppers of choice all over the world.

TEST & MEASUREMENT

185 - GenRad—We are about to change your thinking about low-cost board test. GenRad's new Essential Test Collection, for example, brings you new ease of use in high-throughput board test.

219/220 - Photo Research—(219 for salesman; 220 for literature) Perform NIST-traceable, spectrally based photometric and colorimetric measurements anywhere, anytime with the battery-powered Photo Research PR-650 SpectraColorimeter.

223 - Tektronix—The prototype doesn't work? A complete line of scopes, logic analyzers, and signal sources that can quickly get to the core of your prototype's problems.

MICROWAVE

189 - Avantek—How to get a high-frequency product to market before the competition has a chance to develop.

Sal F. Marino.....Chairman and CEO
Daniel J. Ramella.....President and COO
James D. Atherton.....President, Electronics Group
John G. French.....Publisher

BUSINESS STAFF

Ken Long.....Research Manager
Kathy Torgerson.....Promotion Manager
Bob Clark.....Circulation Manager
Doris Carter.....Ad Serv/Production Manager
Brian Ceraolo.....Cards and Quick Ads Manager
Mary Lou Allerton.....Reader Service Manager

SALES OFFICES

Regional Vice Presidents:
David M. Woodward.....Cleveland
Chandler C. Henley.....New York
Richard B. Cutshall.....Chicago
Harmon L. Proctor.....Atlanta
George M. Horrigan.....Los Angeles

GENERAL MANAGER, EUROPEAN OPERATIONS:

John Allen
Four Seasons House
102B Woodstock Rd., Witney,
Oxford OX8 6DY England..0993-778-077 FAX: 44-993-778-246
SAN JOSE

Tina Ireland (N. California)
Blair Heath (N. California/Northwest/N. Canada)
2025 Gateway Place, Suite 354
San Jose, CA 95110.....(408) 441-0550 FAX: (408) 441-6052
LOS ANGELES

Chuck Crowe (S. Calif./Arizona/Colorado/Utah)
(Orange County/San Diego County)
16255 Ventura Boulevard, Suite 300
Encino, CA 91436.....(818) 990-9000 FAX: (818) 905-1206
CHICAGO (Midwest/Dallas)

Mark Kearney
2 Illinois Center Building, Suite 1300
Chicago, IL 60601.....(312) 861-0880 FAX: (312) 861-0874
BOSTON

John J. Fahy (New England/Eastern Canada)
400 5th Avenue
Waltham, MA 02154.....(617) 890-0891 FAX: (617) 890-6131
NEW YORK

Brian Ceraolo (Mid-Atlantic Region & Southeast)
(Direct Connection Ads)
611 Route 46 West
Hashrouck Heights, NJ 07604.....(201) 393-6060
FAX.....(201) 393-0204

JAPAN
Hirokazu Morita, Japan Advertising Communications Inc.
New Ginza Building, 3-13 Ginza 7-Chome, Chuo-Ku Tokyo
104 Japan.....FAX: 81 3 5718710

AUSTRIA, GERMANY, SWITZERLAND
Friedrich K. Anacker, Intermedia Partners GmbH
Katernberger Strasse 247
5600 Wuppertal 1, West Germany.....(02) 271-1091
FAX.....49 202 712431

FRANCE
Claude Briil, IDG Communications France
Cedex 65 92051, Paris LA DEFENSE-France.....(04) 9047900
FAX.....33 149 047800

HOLLAND
W.J.M. Sanders, S.I.P.A.S.
Oosterpark 6-P.O. Box 25
1483 ZG DeRyp, Holland.....(02) 997-1303
TELEX: 13039 SIPAS NL.....FAX: 31 2 997 1500


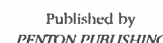

ITALY
Cesare Casiraghi, Via Cardano 81
22100 Como, Italy.....031/536003 FAX: 031/536007
KOREA

Young Sang Jo, President, BISCO
K.P.O. Box 1916, Seoul, Korea.....FAX: 82 2 7323662
TAIWAN

Charles C.Y. Liu, General Supervisor
United Pacific International, Inc.
No. 311, Nanking E. Rd., Sec. 3
Taipei, Taiwan, R.O.C.....FAX: 886 2 7169493

UNITED KINGDOM, SCANDINAVIA
John Maycock
Hunttons Bldgs., 146 West Street
Sheffield, S14ES, England.....742 759186 FAX: 44 742 758449

CHINA
CCI Asia - Pacific Ltd.
Ste 905, Garden House, 32 Oi Kwan Rd.
Happy Valley, Hong Kong.....FAX: 852 834 5620
Media Developments Ltd.
13/F Jung Sun Commercial Bldg.
200 Lockland Rd., Hong Kong

 Published by  

OBSERVER

ANOTHER SHOT AT SUPERCOMPUTERS

The groundswell of activity in supercomputers isn't limited to the U.S. and Japan. Now a number of European high-tech firms and institutes have teamed to develop supercomputers using parallel-processing technology for industrial applications. The members of the group, the European Industry Initiative, include the cream of the crop of Europe's industry.

After Germany's ill-fated Suprenum supercomputer project failed because of lack of software and little commercial success, the new group thinks that concentrating Europe's resources offers a good chance to be competitive on world markets. The goal is innovative products for industrial applications in pattern recognition, image generation and processing,

as well as other computationally intensive real-time and time-critical tasks.

Among the participants in the initiative are Germany's Daimler-Benz, maker of Mercedes-Benz automobiles and

trucks; AEG; Parsytec, the parallel computer builder; Inmos, the British chip maker; Cap Gemini, the French software house; the Spanish aircraft company CASA; the German Aero-

space Society; as well as Dutch, Greek, and Portuguese technology companies. Also participating are Germany's Fraunhofer Society and the Technical University of Munich. □

WHO'S WHO IN THE EUROPEAN INDUSTRY INITIATIVE

COMPANY	COUNTRY	MAJOR ACTIVITY	TO PROVIDE
AEG	Germany	industrial electronics	applications
Cap Gemini	France	software	technology
CASA	Spain	aerospace	applications
Daimler-Benz	Germany	motor vehicles	applications
Dornier	Germany	aerospace	applications
Fraunhofer Society	Germany	electronics R&D	technology
German Aerospace Society	Germany	aerospace	applications
Hitec	Greece	systems	technology
Inesc	Portugal	computers	technology
Inmos	UK	semiconductors	technology
Parsytec	Germany	parallel computers	technology
Piraiiki Patraiki	Greece	textiles	applications
Telefunken	Germany	systems	applications
TNO	Netherlands	research	technology
University of Munich	Germany	research	consulting

SIEMENS SIGNS RISC PACT WITH TOSHIBA

Broadening their agreement to develop semicustom devices, Germany's Siemens AG and Japan's Toshiba Corp. will work together in RISC processors based on the MIPS architecture. The accord involves development of the R3000 and R4000 standard processors, their derivatives, and peripheral components. The aim is a rapid expansion of the two companies' product lines.

The deal encompasses joint definition and development of RISC processors—mainly for PCs, workstations, and servers—as well as second-sourcing each other's products. The two will also function as silicon foundries, which means that either can make RISC chips for the other. □

A EUROPEAN GROUP COMMITS ITSELF TO A PLC STANDARD

Prodded by Philips Electronics NV of the Netherlands, a group of European suppliers and users of programmable logic controllers will meet in midmonth to establish PLCopen, an international organization backing IEC65B-WG7 programming languages for PLCs. The group considers the defined graphical and textual languages a strong basis for powerful PLC programming. PLCopen will not be a standards body. Rather, besides promoting the programming standard of the International Electrotechnical Commission, the organization will exchange software and experience among its members, issue an IEC-compliant products directory, and appoint a certification lab.

Among the benefits the

group sees in using IEC65B-WG7 are increased application portability, reduced training requirements, and the early availability of standard tools such as diagnostics and simulation as well as of optimally verified prod-

ucts. For independent software vendors and PLC vendors, there are lower development costs, improved product recognition, and easier interfacing with other products such as standard communication protocols. □

SIEMENS STEPS UP ACTIVITIES IN CHINA

Siemens AG's involvement in China continues to deepen. Now the Beijing International Switching Systems Corp. in China, a joint venture of Siemens and three Chinese partners, has started production of the German company's digital switching system EWSD for the Chinese market.

This adds significantly to Siemens's presence. It fol-

lows last summer's opening of the Beijing Technology Exchange Training Center and the earlier establishment of offices in Shanghai, Guangzhou, Dalian, and Beijing. The company's 1991 business in China came to about \$220 million. In addition to communications, the sales and marketing focus is on medical electronics and electrical technology. □

It's hard to see where '92 growth will come from

HOSTAGE TO A WORLDWIDE RECESSION, THE ELECTRONICS INDUSTRY MAY RISE JUST 6% OVERALL **BY JONAH McLEOD AND JACQUELINE DAMIAN**

Listening to worldwide electronics executives discuss the fate of their markets in 1992 is a little bit like reading Proust. Just as the hero of *Remembrance of Things Past* looks back longingly on the ineffable madeleine, so too do industry players wax nostalgic about the good old days of spiraling growth rates, annual rises that were always in the double digits. Those days, they say, are gone—perhaps forever.

"Nothing suggests the economy will come out of the recession," says Jack Beedle, president of In-Stat Inc., the Scottsdale, Ariz., market research firm.

"Even if the [U.S.] government cuts taxes, when will the cuts be effective?" he asks. "People say it's an election year and things are always good in an election year. Tell

me that to people who are unemployed and companies that are cutting back, with their profits being damaged. You're hard-pressed to find a business that hasn't laid off people. Car dealer inventories are bulging. There's a very unhappy, nervous population out there."

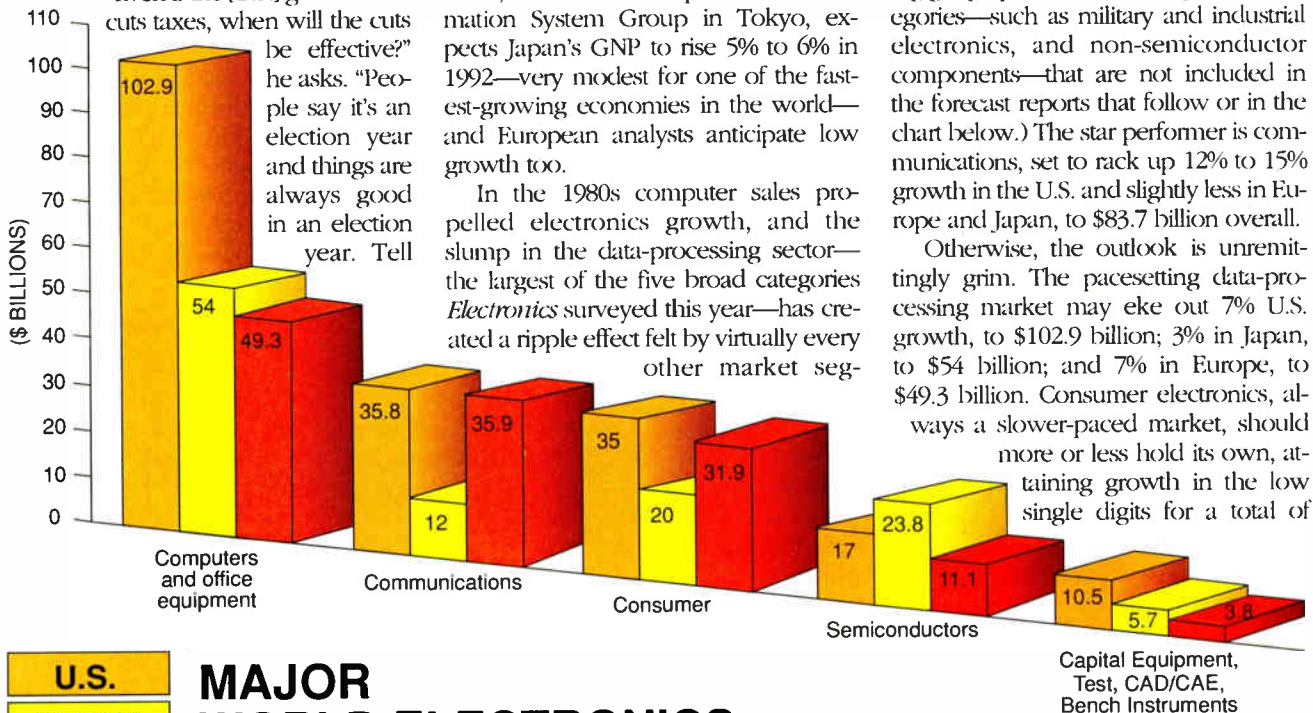
As one of the largest chunks of gross national product in the U.S., Japan, much of Europe, and many Far Eastern countries, the electronics industry is held hostage by a worldwide recession. The U.S. Commerce Department is predicting GNP growth of perhaps 2% to 3% this year, a far cry from the 6% and higher of the 1980s, and the picture is not much brighter elsewhere. Junichi Saeki, director of Dataquest Inc.'s Information System Group in Tokyo, expects Japan's GNP to rise 5% to 6% in 1992—very modest for one of the fastest-growing economies in the world—and European analysts anticipate low growth too.

In the 1980s computer sales propelled electronics growth, and the slump in the data-processing sector—the largest of the five broad categories *Electronics* surveyed this year—has created a ripple effect felt by virtually every other market seg-

ment save communications. Moreover, industry watchers are at a loss to find a big new product with the broad appeal of the personal computer to ignite the flagging market. Looking down the road, some see the oncoming merger of computing, communications, and consumer in multimedia-style products as the key. But the trend is not yet big enough to make an impact this year.

As a result, the *Electronics* forecast projects overall growth of just 3% to 6% in 1992, bringing worldwide electronic equipment and components markets to approximately \$673 billion at best. (That number includes \$152 billion in services and software plus \$73 billion representing geographic markets and product categories—such as military and industrial electronics, and non-semiconductor components—that are not included in the forecast reports that follow or in the chart below.) The star performer is communications, set to rack up 12% to 15% growth in the U.S. and slightly less in Europe and Japan, to \$83.7 billion overall.

Otherwise, the outlook is unremittingly grim. The pacesetter data-processing market may eke out 7% U.S. growth, to \$102.9 billion; 3% in Japan, to \$54 billion; and 7% in Europe, to \$49.3 billion. Consumer electronics, always a slower-paced market, should more or less hold its own, attaining growth in the low single digits for a total of



U.S.
JAPAN
EUROPE

MAJOR WORLD ELECTRONICS MARKETS IN 1992

(FIGURES REPRESENT CONSUMPTION)

SOURCE: ELECTRONICS

\$86.9 billion overall.

Still reeling from the slump in dynamic random-access memories, the industry's traditional cash cow, the chip business will rise less than 10% worldwide this year, to \$17 billion in the U.S.; \$23.8 billion in Japan (which may enjoy more robust growth than other nations); and \$11.1 billion in Europe. Finally, capital equipment—a category that includes the engineering tools and high-priced machines needed to build and test integrated circuits and other electronic products—will see a basically flat year.

Over the past 10 years the U.S. economy has been propelled by the huge service sector, representing nearly three quarters of the whole. It generated an incredible demand for computing equipment, which in turn rippled down the food chain to IC makers, design-tool suppliers, and vendors of semiconductor production equipment. But that sector is slowing, says Michael Metz, an analyst with Oppenheimer & Co. in New York. The U.S. has entered the 1990s with too many banks, hospitals, insurance companies, retail stores, fast-food restaurants, hotels, and transportation companies, Metz says.

And the bulk of these outfits have all the computers they need. The percent of fixed capital investment spent on computing in the U.S. has leveled off at about 7%, says McKinsey & Co., the New York consulting firm. And with no new sector of equivalent size coming along to make its own investments, the electronics industry finds itself in a state of overcapacity. Companies are trying to lure corporate buyers with value-added technology, but pricing pressure is eating

away at the profits those products might otherwise generate.

Many economists are looking to the consumer to let the good times roll. However, the U.S. consumer is in no condition to oblige. Consumer confidence is at its lowest point since the Gulf War, debt is at an all-time high, and pocketbooks are pinched: the Commerce Department says per capita disposable income is lower today than it was in 1988, 1989, or 1990. Industry's pell-mell race to downsize doesn't help, since it makes workers anxious about their jobs. "In a country where nearly every household has one or more TV sets, stereos, and VCRs, you can hardly expect them to buy another when the breadwinners are worried about having a job next year," says one industry watcher.

The shrunken demand for goods and services in the U.S. is making an impact on export-heavy Japan, where the economy is now slowing. Both Japanese and U.S. suppliers had hoped that a Europe on the brink of economic unification and enlivened by newly liberated Eastern consumers would be a good place to sell electronics. But Europe has caught up to the U.S. and Japan in most areas of technology and is singing the

recessionary blues as well. Even the gadget-starved East Germans have ended the buying spree that began with German reunification, and the rest of Eastern Europe lacks hard currency.

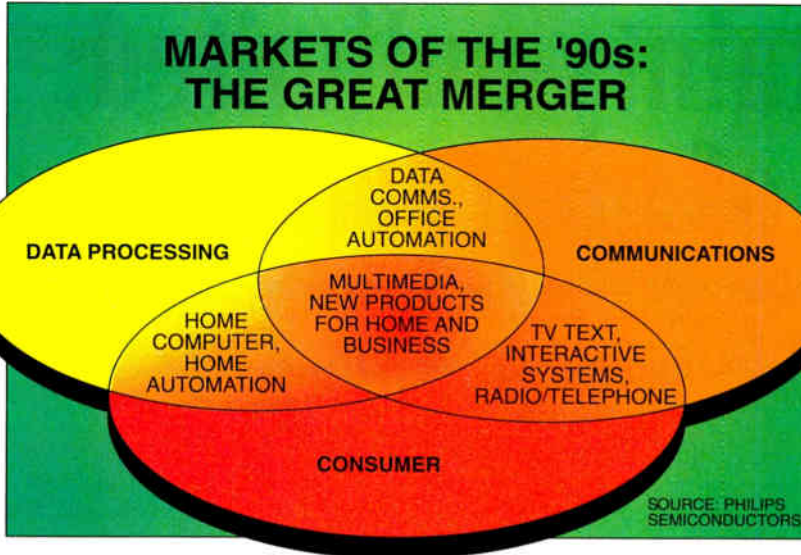
In short, "business investment spending has been reduced due to the already installed computing power and the lack of new applications," says Greg Sheppard, senior industry analyst at Dataquest in San Jose,

Calif. "In addition, the consumer is now justifying the purchase rather than simply buying the product, as in the past."

All of this has helped create a downsizing frenzy as the electronics industry reads the handwriting on the wall. And although the loss of jobs has serious repercussions in the marketplace, the trend is, paradoxically, creating a few opportunities. In consumer electronics, manufacturers point to brisk sales and high-double-digit growth rates for home-office equipment as laid-off workers begin freelancing or running small businesses out of their homes.

Also profiting is communications equipment, which gives corporate buyers a realizable return on investment along with increased productivity, says George Sollman, president of Centigram Corp. in San Jose. He points to the bankruptcy court presiding over Greyhound Corp.'s Chapter 11 proceedings, which approved the purchase of new telecom equipment. "The court realized that a moderate investment in communications could improve telemarketing sales," he says.

It's odd to think of hard times as a market niche. But as 1992 begins, that may be the best the world economy has to offer. □



The 1992 Electronics World Market Forecast drew upon the considerable resources of a number of organizations that supplied estimates of unit shipments and revenues, and we wish to thank those market researchers and trade groups for their assistance. They include: Associazione Nazionale Industrie Elettrotecniche ed Elettroniche, BIS International, Computer Intelligence/Infocorp, Couven & Co., Dataquest Inc., Electrical and Electronics Industry Association of Germany, Electronic Components Industries Federation, Electronic Industries Association, Elsevier Advanced Technology Ltd., Frost & Sullivan International, Gartner Group Inc., In-Stat Inc., International Data Corp., Nomos, North American Telecommunications Association, Oppenheimer & Co., Romtec plc, Semiconductor Industry Association, Telexbank, VLSI Research Inc., and World Semiconductor Trade Statistics Inc.

Uncertainty unlimited: a year of guarded forecasts

WORKSTATIONS REMAIN THE BRIGHTEST SPOT ON AN OTHERWISE GLOOMY COMPUTING HORIZON **BY LAWRENCE CURRAN**

The computer industry this year is expected to grow some 7.2% in the value of worldwide revenues from the major hardware segments—a number that is especially sobering when weighed against 1991's poor performance. Last year will probably come in with a growth rate of less than 3% above 1990's sales, which would normally prompt expectations for a more vigorous uptum. This year's 7.2% improvement will see the total value of worldwide shipments of the major hardware categories (excluding office equipment) inch up from about \$148 billion last year to \$158.5 billion.

Taking a much broader look at the worldwide value of all computer-related purchases—hardware, software, support, and services—one organization has a brighter outlook. Computer Intelligence/Infocorp, a market researcher in La Jolla, Calif., predicts growth of 11.5% to some \$359 billion this year, against less than \$320 billion last year.

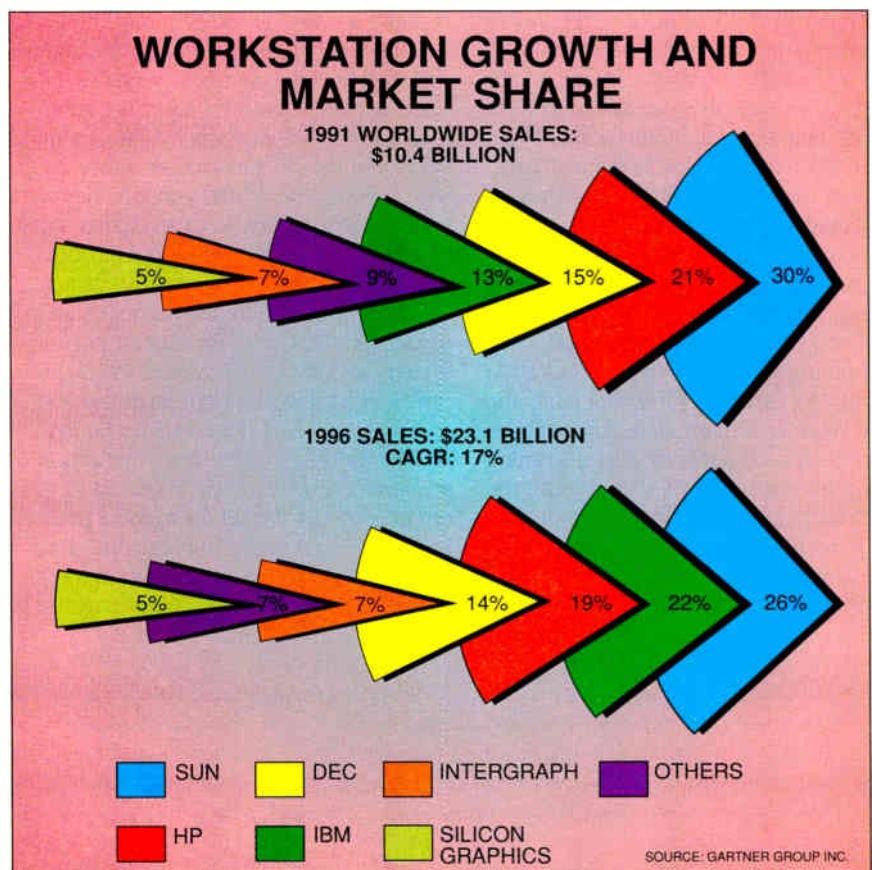
No matter how the industry is sliced, however, most planners are very guarded about the year ahead. IBM Corp. watchers say the Armonk, N.Y., giant will cut 20,000 jobs in 1992, hardly a vote of confidence in the economy. Likewise, the new president and chief executive officer at Compaq Computer Corp. can't get excited about the year ahead. The Houston company "looks at global economies, and in 1991, there was an across-the-board unfavorable situation," says Eckhard Pfeiffer. "The outlook for 1992 is not exciting. In the U.S., there's concern about a double-dip recession. We hope it won't come to pass, but the economy is not really coming on."

At Digital Equipment Corp. in May-

nard, Mass., the mood is equally subdued. "We're seeing a continuing softness in virtually every geographic area where we do business," says Brad Allen, manager of shareholder relations. "We don't see any sign of a pick-up, and I'm not fool enough to sit here and predict one." Uncertainty is the watchword as well at Data General Corp., Westboro, Mass. "We can't see where the decline in the U.S. will end, but the feeling is that things will be stable here for a while," says Stephen Baxter, vice president for corporate market-

ing. Not so for Europe, "where there's great uncertainty about the merging of the markets. Volatility there makes forecasting tough," he says.

Bill Rosser is a little less gloomy. He's vice president and director of industry service at the Gartner Group Inc., the Stamford, Conn., research and consulting firm. Although 1991 was a year of "dismal economic collapse in hardware systems," he says, there's a chance for "modest growth" this year. "From what I see and hear of people's plans, I look for continued tough pressures on the



The Management Collection

Books selected to help you approach difficult business situations more knowledgeably.

LEADERSHIP

R75 Surviving the Crisis of Change — Honing Your Management Skills

In today's fast-paced business world it is not always easy to find the best answers to difficult questions. This series of forty articles is a collection of Industry Week's best information dealing with change that affects managers' professional as well as personal lives. You'll learn how to gain control over difficult problems that you encounter every day. Articles include . . . Expand Your Career by Expanding Yourself; The Politic Game; Surviving a Takeover; When Values Collide; and many more.

124 page . . . softbound . . . \$22.50

R85 How to be a Better Leader

Frederick Herzberg, Daniel Yankelovich, Charles Day, Perry Pascarella and others in classic articles about the changing expectations of today's workforce and how to deal with them. Included are: Selecting Your Management Style, Dealing With Your Subordinates, Motivating Your Workers, and more.

98 pages . . . softbound . . . \$17.50

R09 Your Toughest Tests As A Manager

This book guides you in assessing your own management skills and helps you to develop the strong leadership capabilities you need to be a more effective manager. Articles include: Developing a Flexible Management Style, Motivating Without Manipulating, Handling Creative Staff Members, Dealing With Conflict, Delegating Without Losing Control, and many more.

57 pages . . . softbound . . . \$15.00

R87 The Unhealthy Executive and Some Practical Cures

Managing in an age of anxiety can drive executives into dangerous responses. This book keys on emotional awareness. It shows you how to recognize potential problems and how to deal with them.

72 pages . . . softbound . . . \$16.00

R89 Future Focus: Advancement and Leadership Strategies

Should you plan your career — or just let it happen? Are you using strategies that build success or deter advancement? These are a few of the topics you'll find discussed in a series of articles ranging from career planning to executive management skills.

117 pages . . . softbound . . . \$18.00

MOTIVATION

R88 Herzberg on Motivation

What can the manager do for himself and for his subordinates to overcome the "burnout" caused by the increasing abstraction of work and work relationships? Why is scientific management not the answer to increasing productivity? This book answers all these questions plus many more . . . from problems that might surface in trying to make participative management work to effective leadership in a period of psychological depression . . . this book has it all.

80 pages . . . softbound
third printing . . . \$22.50

LEGAL

R80 Right Off The Docket

This book is an invaluable reference source of more than 140 industrial accident and occupational illness claims. The index provides a cross-reference for each case by type of injury and the judicial ruling set forth so that you can quickly turn to those cases of particular interest.

130 pages . . . softbound . . . \$10.00

Order your review copies now!

Call toll-free

800-321-7003

(in Ohio 216/696-7000)

MANUFACTURING

R72 Strategic Manufacturing

This complete series of twenty-four articles analyzes some of the key issues management must face in developing effective strategies in the years ahead. The articles discuss "how" to link manufacturing with all of the functional departments of an organization so they work with a broad, corporate view of their goals. Articles include . . . Ten Ways to Mismanage Technology; Learning From Foreign Strategies; CIM . . . Walking Through Fire; Challenging Tradition; and much more.

94 pages . . . softbound . . . \$19.50



FINANCE & ACCOUNTING

X38 Managerial Accounting for Non-Financial Managers

You'll work as a company controller in this programmed learning course. You'll learn to properly record all the company's business transactions . . . sales, inventory purchases, operating expenses, depreciation, equity changes, disposal of assets. When the company's fiscal year ends, you'll prepare the annual report, balance sheet, income statement, and the statement of source and application of funds. When you've finished the course, you'll understand better the role of accounting and how to use the information accounting gives you to be a more effective manager.

Two volumes—course book and workbook . . . \$27.50

X29 How To Read a Financial Report

Written in programmed learning format, this book will review the accounting process, tracing the steps from the actual sale to the appearance of the transaction on the financial statements. Then you'll learn how to assess financial position and performance of your company through the use of ratio analysis—analyzing liquidity, activity, profitability, and coverage ratios.

140 pages . . . spiral bound . . . \$19.50

BUSINESS STRATEGY

R70 Strategic Management

Getting a fix on your competitive position. Establishing a clear purpose for the corporation. Meshing the corporate purpose with the individual goals of your people, and Getting their commitment. This collection of ten articles will help show you ways to foster greater vision of your corporate purpose and techniques for combining the human and technological factors needed for good decision-making.

34 pages . . . softbound . . . \$7.00

To order these books, just fill out the coupon below and mail to:

Penton Education Division
1100 Superior Avenue
Cleveland, Ohio 44114

Please send the books indicated. I understand that I can review them for 15 days and, if not satisfied, return them for full refund or credit.

Item #	Quantity	Item #	Quantity
R09	_____	R87	_____
R70	_____	R88	_____
R72	_____	R89	_____
R75	_____	X29	_____
R80	_____	X38	_____
R85	_____		

Orders under \$15.00 must be prepaid.

- My payment is enclosed for postage-free shipment in the U.S. and Canada.
 Bill my company and include postage and handling charges. My purchase order is enclosed.
 Charge my Mastercard Visa American Express Card

Account No. _____ Exp. Date _____

Name _____

Company _____

Address (not P.O. Box) _____

City _____ State _____ Zip _____

Signature _____

Penton Education Division
1100 Superior Avenue • Cleveland, Ohio 44114

[corporate] information technology budget, but with some improvement in the ability to spend what needs to be spent for tactical solutions," Rosser says.

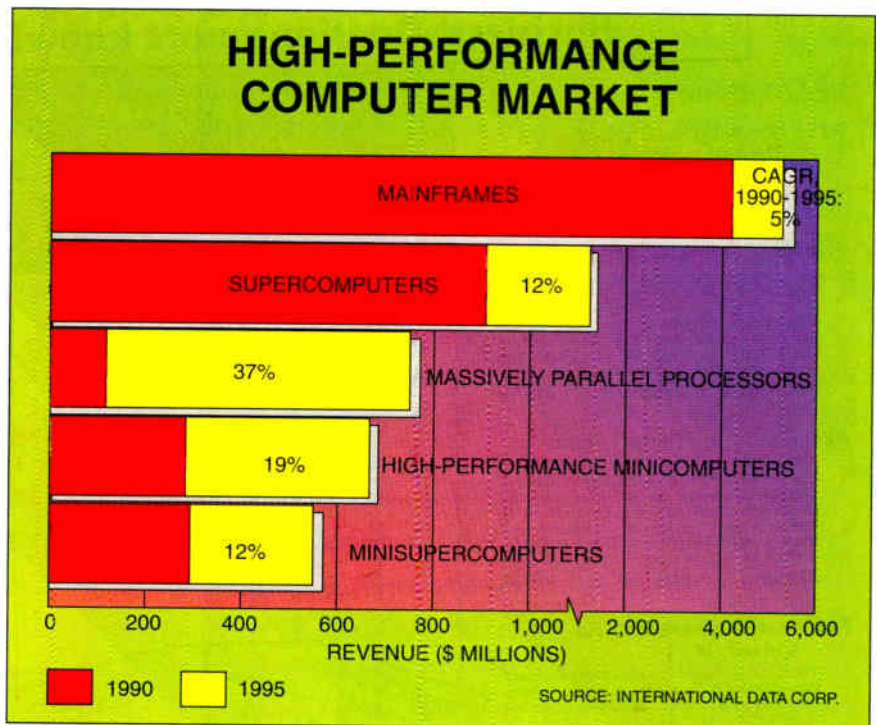
About the only place one hears anything resembling optimism is among workstation vendors. "Looking at the economy worldwide, we're clearly not in a very happy time for most of the industry sections we cover," says Mario DalCanto, director of technical markets development at Sun Microsystems Inc., Mountain View, Calif. "But computer companies have done well in economic crises, because most customers are looking for ways to do more with less." And workstations can now do the job of more expensive systems.

Indeed, the workstation sector is among the brightest in the computer business. International Data Corp., the Framingham, Mass., market research organization, estimates that worldwide equipment revenues from workstations and workstation servers will come in at \$9.24 billion in 1991, and will hit \$11.47 billion this year. Growth in unit shipments will zoom 46.5%, while revenues will grow 24.2% during the same time, IDC predicts. (The Gartner Group projects \$10.4 billion in 1991, with a 17% compound annual growth rate propelling the market to \$23.1 billion in 1996.)

The Sparc architecture pioneered by Sun continues to dominate the engineering workstation market, but keep an eye on IBM's Power RISC architecture. That's the advice of Nancy Battey, director of workstation research at IDC's Mountain View, Calif., office.

"Sun's momentum and market share are driving the Sparc market," Battey says, "and Sparc will continue to dominate the [workstation] market through 1995." But while the R3000 and R4000 RISC microprocessors developed by MIPS Computer Systems Inc. of Sunnyvale, Calif., have held the No. 2 position in reduced-instruction-set computing systems until now, Battey looks for that to change. She figures the IBM Power architecture will move into second place in 1993. "IBM is definitely serious about the workstation market," she says. "With the RS/6000, they've got products, graphics capability, and they're attracting the support of third-party application-software writers."

But workstations are an exception in an increasingly mature computer market, according to Dataquest Inc., the San



Jose, Calif., market research firm. That's bad news because it means shrinking growth rates. Robert Kidd, senior industry analyst in Dataquest's Business Computer Services section, reports that from 1986-90, the industry's CAGR was 9.6%. (Dataquest numbers count factory revenues for computer hardware and operating systems, but not revenues from other software or services.)

For 1991-95, Kidd projects a slump in CAGR to 5.7%, with the mainframe segment shrinking. (IDC, by contrast, sees mainframes chugging along at a 5% CAGR to mid-decade.) In Kidd's view, midrange systems will overtake mainframes in revenues this year, with the latter sliding from \$33.3 billion in 1990 to about \$28.4 billion in 1992.

At the same time, midrange systems, essentially comprising the old minicomputer category, will creep ahead slightly: from \$29.9 billion in both 1990 and 1991 to about \$30.7 billion this year. As "one of the more forgotten [computer] markets," says Kidd, the midrange sector "keeps reinventing itself as client-server computing continues to expand." Midrange systems are often used as servers in a network, he notes, and "servers continue to be needed."

While remaining a strong industry

niche, servers are also a source of confusion among buyers, says Gartner's Rosser. He notes that while aggressive price cutting is a fact of life in many sectors, he isn't convinced bargain-basement price tags will be enough to create growth in 1992. One reason is the need for a change in mind-set among corporate MIS managers regarding client-server, or networked, computing.

Those managers still aren't convinced of how fast they should shift from a central data-processing model to a client-server paradigm, Rosser says. "They're asking how fast they should get into client-server computing, and should they go all the way by taking all [application] software off the central system and distributing it onto servers." Without that foot-dragging, he says, "system price reductions would stimulate demand nicely."

Personal computers often form the client end in a client-server network, but PCs aren't doing nearly as well as servers. Bruce Stephen, director of PC hardware research at IDC, expects the value of worldwide PC shipments to reach \$80.94 billion this year—a 10% boost over his estimate of \$73.56 billion for 1991. He sees the 1991 growth rate coming in at about 9% better than 1990's total of \$67.46 billion.

Among PCs, he says, notebook com-

Workstations shine in an otherwise ho-hum year

puters are the hottest niche: "The notebook form factor has become the dominant one in that market." Further, says Stephen, the brand-new crop of pen-based PCs, "which are also coming on, use the same size and weight as the notebooks." Notebooks are one segment set for brisk growth: Stephen expects unit shipments to jump 56% this year—from 1,910,000 units in 1991 to some 2,980,000.

Even Stephen's modest estimate of 10% overall PC growth may be too high, according to some industry players. The weak U.S. economy "has fallen through to the PC industry," says Compaq's Pfeiffer. When 1991 totals are complete, he says, U.S. PC unit shipments may be up 3% to 5%—but revenues will be down because of aggressive pricing. For 1992, Pfeiffer looks for more of the same: unit growth of 5% to 6%, but revenues "slightly down in value."

While the PC market is sluggish, there's activity in the high-performance part of the computer business, which includes supercomputers and massively parallel processors (MPPs). The sector will be worth a little more than \$7 billion overall in 1992, up about 11% from last year's \$6.3 billion, estimates Debra Goldfarb, manager of high-performance computing at IDC. That isn't astronomical growth, but it's enough to make this sector one of the industry's hottest markets.

The supercomputer segment, dominated by the Minneapolis-based Cray Research Inc., will come in this year at about \$1.2 billion, up just slightly from 1991's \$1.1 billion. But Goldfarb says this market slice is "more dynamic than most people think." She adds: "Everyone is talking about Cray's demise, and vector supercomputers are mature. But Cray now has a 64-way parallel box, the C90, that runs production code at an impressive 16 gigaflops." It may infuse some new energy into this market.

But the hottest growth will come in the still small MPP niche, which Goldfarb says will see a 37% CAGR through 1995 and \$310 million in revenues this year. "MPP is still more innovative than vector computing, but it's no longer the lunatic fringe it once was," she says. "The people in MPP are now looking for new technology to see how it may fit true production environments." □

Take away workstations, and it's an empty 1992 for the worldwide computer community. For just as the workstation sector is the bright spot in the U.S., so it is in Japan and Europe, with sales of other computers fading.

Japanese manufacturers can expect growth of 20% in workstations shipped and 10% in revenue, says Junichi Saeki, director of Dataquest Inc.'s Information System Group in Tokyo. But that's one of the few upticks Saeki foresees in a data-processing market that will grow just 3% this year—from \$52 billion to \$54 billion. PC vendors in Japan are hurting. Two to three years of growth topping 10% will end, says Saeki. One reason: fewer machines will be shipped to the U.S. as political pressure to reduce the number of Japanese nameplates entering America compounds the effects of the recession.

Japanese workstation makers have just begun to build systems for the domestic market, because Japan has just started migrating to workstations. Where "the U.S. mainframe market is being attacked by a variety of different lower-cost computing alternatives, from PCs to workstations and servers," Saeki says, the Japanese mainframe business has not been affected as much by alternative computing platforms.

"Japanese DP/MIS managers are very conservative," he says. "The networked PCs and workstations common in the U.S. have not had as much impact as in the U.S.," Saeki maintains. But now most Japanese workstation vendors are building systems for the domestic market, including Fujitsu, Matsushita, NEC, Oki, and Toshiba.

In Europe, meanwhile, the outlook also is gray, with the computer business facing mostly hard times this year. That's especially true in Germany, where the rosy outlook that prevailed 12 months ago lost its glow around midyear. The only exception may be the UK, where growth expectations are more consistent

INTERNATIONAL

with previous recoveries from recession lows.

The formerly robust German market for data-processing equipment is weakening. While some analysts predict 1992 sales growth will reach 10%, others expect single digits, perhaps as low as 6%. Growth started slowing in 1991, which may turn out to be a below-10% year too, once all the results are analyzed. That would bring consumption in Germany to about \$24 billion, a figure that includes everything from laptops to computer-based office equipment and mainframes, as well as software and all computer-related services. Add an estimated 8% to that and the 1992 market will come to roughly \$25.9 billion.

For bright spots try the ubiquitous workstation, with sales of engineering models predicted to rise about 15% in terms of value. In computer graphic workstations, Germany will be the largest European market until the end of the decade, analysts say. Sales there should reach \$3.74 billion by 1994, rising to \$7.9 billion by 1999, according to market researcher Frost & Sullivan International. In addition, the business PC sector expects growth of about 20%, with laptops and notebooks leading the way. Multiuser systems are also expected to do well.

But for medium-size computers selling for up to \$100,000, growth will be about 5%. The sector is hard pressed by open systems and professional PCs selling at lower prices. The mainframe business, meanwhile, will cruise along at 8% to 9% growth, says Jochen Rössner, senior marketing analyst at Unisys GmbH in Sulzbach.

Several factors kept 1991 from reaching the 11%-plus growth that analysts predicted 12 months ago, including drastic price cuts for hardware and a changed buyers' attitude. Another drag on sales was what some companies see as poor results in Germany's five new formerly Communist eastern states. "The industry clearly overestimated the eastern market," says Rössner. Although

hungry for advanced hardware after 40 years of near-isolation, that region fell far short of the expected boom. The need for data-processing systems is enormous, he says, but their customers' lack of money is the problem.

Southern Europe's hottest information-technology segment will also be workstations. "The Unix workstation will grow in double digits in southern Europe," says Dataquest analyst Philippe De Marcillac.

"As in the U.S., we see that workstations are starting to move into new applications, apart from design," says Tim Nolte, market and business-planning analyst at Hewlett-Packard Co., who believes all the southern European nations will see vigorous growth. Engineering still drives the market, with automotive companies buying briskly to keep up with Japanese competition. "Renault, Peugeot, Fiat, and Spain's Seat are all investing heavily," Nolte says.

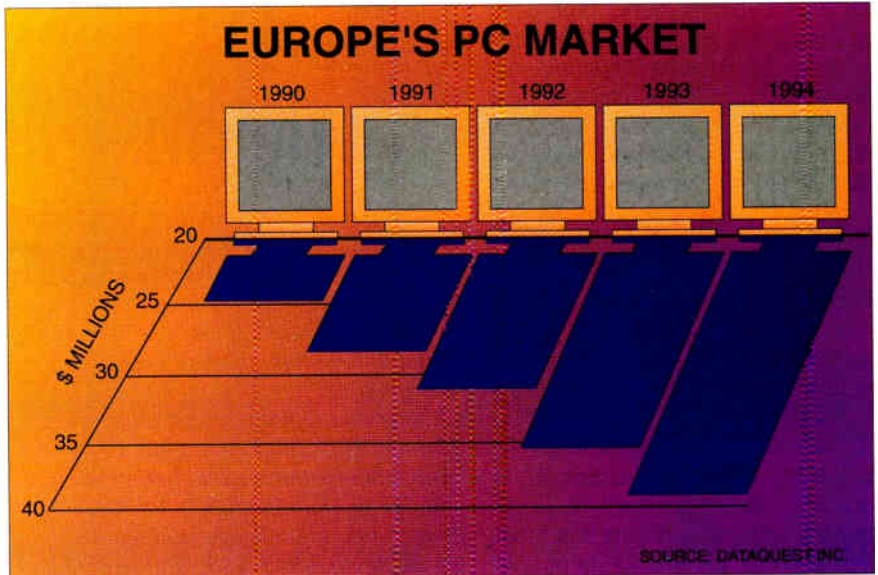
But Europeans are beginning to use workstations in commercial applications that had never seen them before. In Italy, for example, banks are using them to speed financial services, he says, and in back-office functions such as financial trading and modeling. "And small business is beginning to buy workstations for general applications," says Antonio Romano, an analyst with the Nomos consulting firm in Milan.

Financial applications are also a workstation driver in Spain. The market there will be worth \$86 million in 1991, up 24% from the year before, and it will jump another 35% in 1992. The French workstation market will be worth \$721 million in 1991, up 16%. In 1992 it will go up another 26% to \$850 million. In Italy, despite a depressed economy, sales will jump 10% to \$304 million.

The next two years also will show striking growth in portables in southern Europe, says Mary Tonnaire, an analyst with Zenith Data Systems. She says the French portable market will rise 20% in 1991 in unit shipments, and another 23% in 1992. Italy's portables market will jump 22% in 1992, and Spain's 25%.

Consumer markets are growing fast in Spain, as buyers become more aware of PCs and prices fall, says Jose Moro, a sales director with IBM Corp. in Madrid.

Italy, on the other hand, is a Unix



market, where Asian clones have finally begun to make inroads on a market that was once controlled by Ing. C. Olivetti & Co. SpA. That's the view of Simon Peels, PC analyst with International Data Corp. in London. The revenue derived from PC sales should decline in Spain because of price cuts and because of the recession, Peels says, but the decline in value masks a rise in unit shipments.

For minicomputers and mainframes in southern Europe, customers have been waiting for IBM to announce its new processors, according to IDC analyst Jonathan Portch. "This, along with the recession, has held up investment decisions." Portch sees a small decline of about 1% in 1991 for the high-end market in France, to about \$1.8 billion. It could fall several percentage points more in 1992. "But investors won't be able to wait forever," he adds.

In Italy, investment is slowing rapidly due to the recession, and high-end computing will suffer, says Romano of Nomos in Milan. "Even the government is hesitating to invest," Romano says, "because there has not been a clear commitment to either Unix or proprietary systems."

The UK is the only place where overall forecasts are optimistic, projecting a nice rebound from a soft 1991. Where revenues for all hardware—computer systems, peripherals, and office equipment—should increase only 9% from 1990-91, 1992 could be up 21% vs. last year. In dollars, that translates to \$4.4 billion in 1990, \$4.8 billion for 1991, and \$5.8 billion this year.

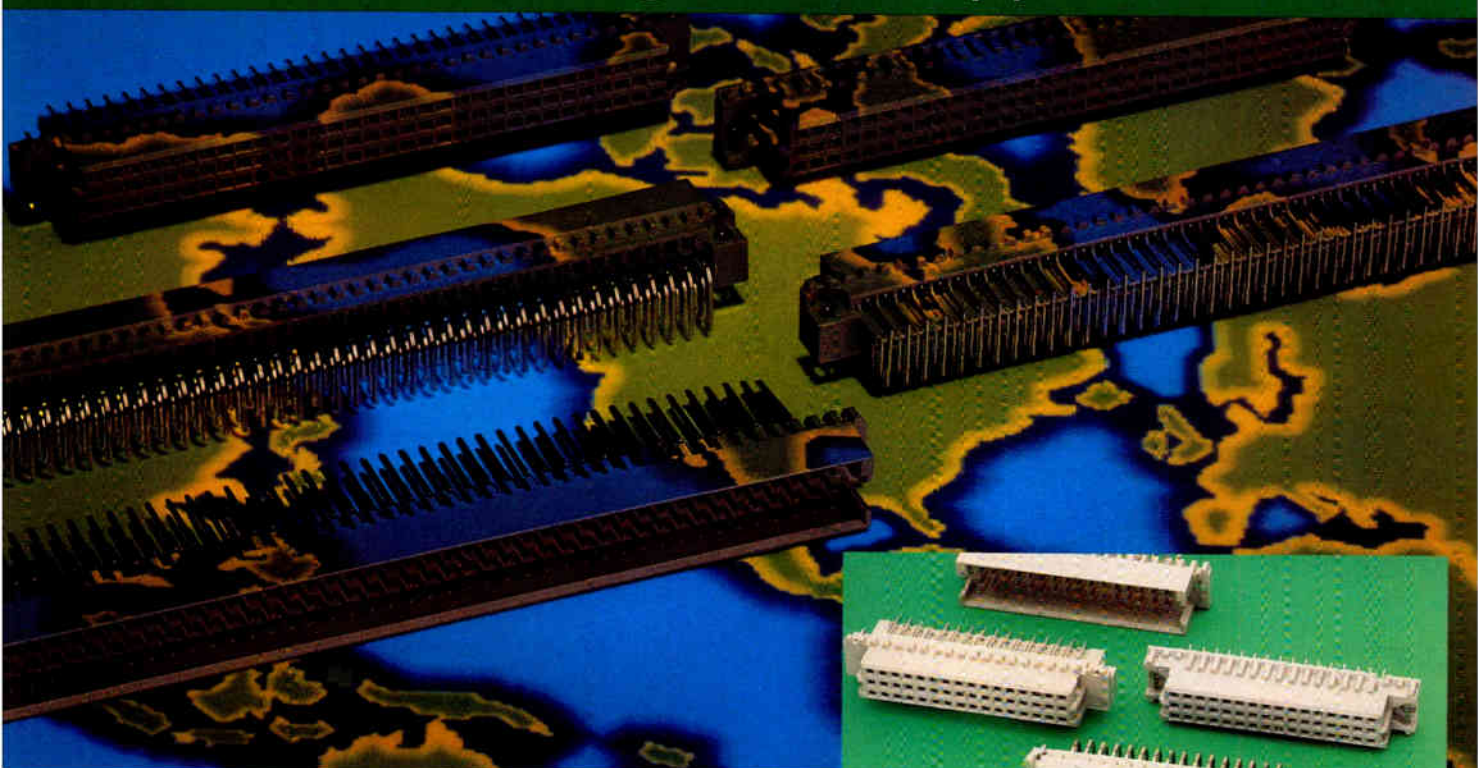
The computer-system portion of those totals is expected to jump by a healthy 25% this year—from \$3.8 billion to \$4.7 billion. That would be a resounding comeback from the mediocre 1990-91 growth of 11%.

As in other global markets, RISC-based engineering workstations are beginning to get some play in the UK, as are portable PCs and the Windows 3.0 graphical user interface. "A significant proportion of corporate sites are starting to buy workstations based on RISC architectures and running under the Unix operating system," says Jon Whiteley, a manager at industry analyst Romtec plc in Maidenhead. He reports, too, that "one in three corporate PCs will be running Windows by the end of 1992."

But the UK's major firms plan to stick with computers powered by Intel's 80386 processor next year, according to Whiteley. He points out that 52% of the corporate-purchased PCs will use the 386SX processor and 31% the 386DX.

Corporate customers will account for the bulk of the 1.3 million IBM-compatible computers that will be shipped in the UK during 1992, estimates Amit Chaudhri, senior data-processing analyst with IDC's European Research Center. At the other end of the scale, 69% of corporate customers will be setting out to equip their mobile executives with portable machines, which should account for around 25% of corporate purchases, Whiteley says.—Peter Fletcher, John Gosch, Jonah McLeod, and Andrew Rosenbaum

*Eurocard connectors from AMP.
Global manufacturing. Local support.*



THIS IS AMP TODAY.

No matter where in the world your product is designed, engineered, or manufactured, we have the connections you need to do it right.

Our AMP Eurocard connectors – compatible with DIN 41612 and IEC 603.2 standards – are made around the world, and marketed globally by local AMP companies. So you can be sure of the support you need to complete your design, and the deliveries you need to see it through production.

Available in types C, R, B, plus half-sizes and expanded 3-row versions, Eurocard connectors feature redundant contact receptacles, sequenced mating, and a choice of tail configurations – including our ACTION PIN compliant pins for reliable, economical assembly.

And all the help you need, from design assistance to full systems packaging support, is right around the corner from you, wherever you are.

For information, call 1-800-522-6752 (fax 717-986-7575). In Canada: 416-475-6222. AMP Incorporated, Harrisburg, PA 17105-3608. For design assistance, backplanes, and card cages: AMP Packaging Systems, 512-244-5100.

LANs keep humming and new niches are coming on strong

COMMUNICATIONS GROWTH MAY HIT 15% THIS YEAR, WITH WIDE-AREA NETWORKS, VSATs, AND CELLULAR RISING FAST **BY JACK SHANDLE**

The local-area network market, which has done a good job of immunizing the communications sector against the recessionary trends of the past few years, will start cooling off in 1992. But its slowdown is only relative. The 40%-plus revenue gains that LAN hardware posted in the 1980s should moderate into the high teens this year, and that growth is on a much bigger base.

With the LAN engine purring, wide-area networks growing fast, and several new technologies contributing excitement—if not billion-dollar revenues—the overall U.S. communications sector is likely to grow at about 12% to 15% this year, to \$35.8 billion. Star performers in niche markets include cellular phones, video conferencing, very-small-aperture satellites (VSATs), and the integrated services digital network.

The underlying strength of the U.S. communications marketplace can be traced to several factors, not the least of which is the ever increasing desire of businesses and consumers alike to “stay connected.” Then too, manufacturers are largely cushioned from the slings and arrows of the U.S. economy by dint of a healthy export market and significantly better profit margins than computer and semiconductor commodity products.

U.S. companies will continue to dominate hardware sales around the world as both Europe and Japan expand their interest in LANs and wide-area

networks. “We expect another strong year for the networking industry at large,” says Eric Benhamou, president of 3Com Corp., Santa Clara, Calif. He sees intermediate-speed LANs moving rapidly toward twisted-pair wiring as their primary transport medium.

The adapter-card market, which is 3Com’s traditional stronghold, will divide itself into low- and high-end segments, he says. High-end cards suitable for workstations and 80486 PCs will feature less latency, or delay, between the CPU and the network. About 10% of the adapter cards sold in 1992 will be high-end, Benhamou says, but they will account for 25% of revenue as price competition batters profitability at the price-sensitive low end. Although 3Com is looking for a 40% increase in all manufacturers’ unit sales worldwide, it expects only a 10% revenue rise.

In wide-area networking, which is sometimes known as the “connectivity” market, Benhamou is looking for 1992 to begin a sustained move away from

leased-line private networks to switched-service virtual networks. The major reason is an aggressive program by phone companies to provide digital, public-network products such as frame relay and standard megabit data service, or SMDS. The trend will reduce the number of modem ports corporations use to access their networks. These will be replaced by connections to LAN hubs inside the customer premises.

“The number of shadow networks [departmental LANs connected to the telecom world by modem] is very high,” says Jim Fiedler, executive vice president of Timeplex Inc., Woodcliff Lake, N.J. “Our studies show that as many as seven out of every 10 LANs are connected to a 56-Kbit/s line.” Just like personal computers five years ago, “LAN internetworking is getting out of control.”

So frame relay, which consolidates traffic under one umbrella and also offers a good way to handle both voice and the bursty data traffic of LANs, is becoming a strategic technology for corporate users. SMDS, on the other hand, is still in trials and most telephone companies have not filed tariffs.

Routers are key to this kind of internetworking, and Cisco Systems Inc., a Menlo Park, Calif., router specialist, expects strong 40% growth worldwide. The global internetworking market was pegged at \$600 million in 1991 by Dataquest Inc., says Ken Fehmstrom, Cisco’s senior product

SELECTED COMMUNICATIONS EQUIPMENT

REVENUE (BILLIONS OF DOLLARS)

	1991	1992	1993	1994	1995
Private branch exchanges	2.6	2.8	3.2	3.3	3.4
Central office switches	5.2	5.7	6.2	6.9	7.2
Key/hybrid phone systems	1.1	1.1	1.2	1.2	1.3
Telephone sets	2.1	2.2	2.3	2.4	2.7
Facsimile	4.4	4.9	5.3	5.7	6.4
Modems	2.7	2.8	2.8	2.8	2.6
Multiplexers	1.2	1.3	1.4	1.4	1.5
Fiber-optic equipment	2.3	3.5	4.3	4.9	5.8
Local-area networks	5.2	6.3	7.5	8.9	10.6

SOURCE: ELECTRONICS

Tap AMP.

For connectors and help...from custom products to system design. This is AMP today!



Product Information by FAX-24 Hours a Day

Need product specs? Drawings? Instruction sheets? Get all these and more, any time. Call our Product Information Center (1-800-522-6752) and choose the AMP FAX option at the voice prompt. All you need is a part or document number - the system will guide you from there, and fax the information you need in minutes!



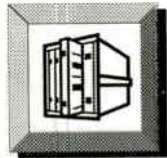
EADS Connector Library

Meet our exciting models! We have connector drawings and engineering data (AMPTIFF files), plus 2D footprint/panel templates and 3D CAD models (AMPIGES files) on ISO 9660-compatible CD-ROMs. Our Electronic Application Design System is a real time-saver. Call 1-800-522-6752. If you use SPICE, call for licensing details: Dick Granitz, 717-986-7119.



Precision Cable Assemblies

Controlled-impedance cable and cable assemblies are required for today's high-speed hardware. We know how to engineer solutions to high-performance applications, and put that knowledge to work for you. Check our hybrid cables for applications like Smart House, and our flat copper power bus assemblies, too! Jack O'Brien, 717-780-7349.



Backplanes and System Packaging

AMP Packaging Systems offers state-of-the-art capabilities, with expertise in advanced, high-speed systems design. We build custom and semi-custom backplanes, card cages, and enclosure systems - with complete design, characterization, and fabrication as needed, to your specifications. Call 512-244-5100 for details!



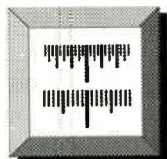
Application Tooling...and Our Support Hotline

The key to productivity? Connector and tooling designed together, to integrate into production. The key to *continued* productivity? Total support: installation and setup, training, and service. Your key to both? For AMP customers, the AMP Field Engineering Service Hotline, 1-800-722-1111. Help at your fingertips!



EXCELL-PAK Program

We're shipping in new package sizes and new styles - smaller lots, more unit packaging, anti-static materials, and ergonomic design. We've also eliminated the use of CFCs and loose fill, and we're putting standard recycling codes - and bar code logos - on all packaging. Ask for our brochure!



Inch or Metric?

Many of our most popular product families are available in both inch and hard metric sizes. If you're at all concerned with global marketing these days (and who isn't?), be sure to ask your AMP Sales Engineer for details. Or give us a call at 1-800-522-6752!



Design Analysis

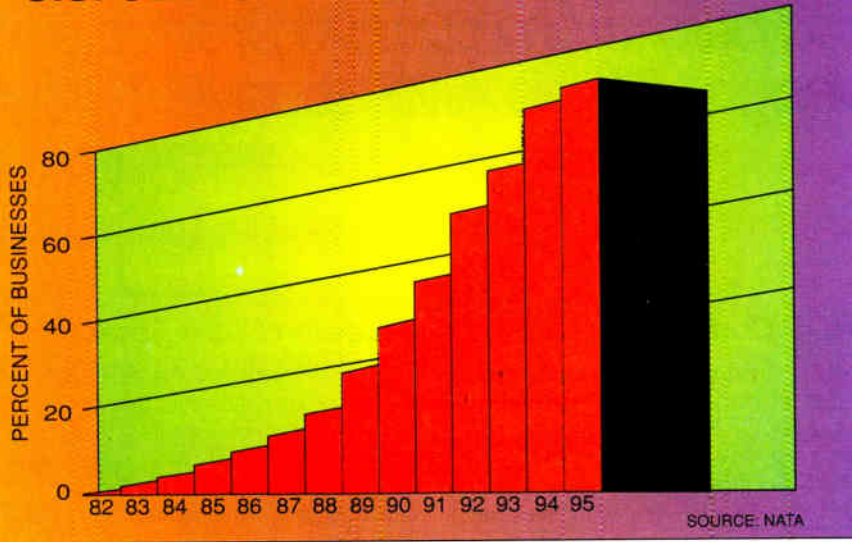
High-speed logic requires a new approach to interconnect design, and AMP Interconnect Systems delivers it. We provide a total systems solution, including analysis of your design, complete interconnect simulation and board assembly, card cage design and fabrication, power distribution/thermal analysis, and system fabrication. Fast time-to-market for fast silicon! Ben Bennett, 717-986-7824.



A.C.E.S.

Looking for value-added interconnect systems? AMP Cooperative Electronics Subcontractors (A.C.E.S.) are fully qualified to meet your needs. Trained partners offer high-tech assemblies, backplane systems, and more. They're part of a premiere network of local, regional, and national AMP distributors. For the distributor near you, call 1-800-522-6752.

U.S. CELLULAR PENETRATION 1982-95



marketing manager. U.S. firms have the lion's share, with Cisco, Digital Equipment Corp., and 3Com accounting for 76% of the total.

Some market segments that have traditionally been categorized as telecom, such as modems and multiplexers, are being hurt by the incursions of data communications technology. Still, the venerable telecommunications market will not fare badly in 1992. Mitchell Wander, market research manager at the North American Telecommunications Association, forecasts the telecom equipment business growing about 9% in the U.S. this year.

Largely driven by data communications and LANs, customer-premises equipment has recorded 23% growth rates since 1987 and is expected to continue the trend in 1992. Growth is fueled by the increasing popularity of technology-enabled practices such as remote data entry, credit-card validation, and point-of-sale terminals.

ISDN and cellular phone systems will help drive the network market, says Wander. Capital expenditures of cellular common carriers increased from \$234 million in 1984 to \$1.8 billion in 1990, he says, and should hit almost \$3.4 billion this year, sparking a surge in central-office switches. As cellular converts from analog to digital technology, the central-office market, which stagnated at \$5 billion in 1990, is expected to grow to \$7.3 billion by 1995.

Explosive growth is being seen in

cellular subscribers. Richard Siber, research director of mobile and wireless communications for BIS International in Norwell, Mass., expects their ranks to rise from 7 million in 1991 to 16.6 million in 1995. Beginning in mid-1992, the switch from analog to digital will begin to drive a new hardware market for hybrid cellular sets that can deal with either technology. "We will start to see new products for digital services in the second and third quarters," Siber says.

Joining cellular in fueling central-office growth is ISDN, which could generate \$10 billion in equipment sales—from telephone sets to PBXs to central-office switches—by 1995. This year will be ramp-up time, however, says Bill Wallace, ISDN product manager at Northern Telecom Corp., Nashville, Tenn.

In customer-premises equipment, ISDN growth will follow a curve similar to that of the PC, he says. Applications will be the driving factor, since the network's rich functionality needs a software/hardware interface to reach the user. "Because of the limited introduction," Wallace says, "ISDN will ramp up slightly behind the network side, but there will be substantial customer-premises equipment available at the very beginning."

The very beginning means March, when Northern Telecom rolls out its ISDN software in Bell Atlantic's territory. The software will be generally available in July. "Most of the operating compa-

nies are targeting major conversions to begin in 1993 and 1994," Wallace says. By 1994, 60% of all U.S. lines will be able to handle ISDN.

A handful of niche markets are also driving communications growth. In particular, VSATs are being deployed in the U.S. at a compound annual growth rate of about 26%; video-conferencing installations will rise 63% this year; PBX-to-computer links are growing exponentially; and an entirely new market for controller networks is poised to take off.

In VSATs, this year's launch of the Intelsat K satellite will give the industry a big boost, says Tom Chow, vice president of service development at Comsat in Washington, D.C. Intelsat K will provide enough transmitting power to make satellite communications cost-effective for many corporations.

Sales of video-conferencing systems—units that roll about from room to room—will more than double in 1992, to \$422 million, according to Cowen & Co. in Boston. The market will become even more attractive in late 1992 as video-conferencing boards for PCs become available, says Rob Mitro, marketing manager for PictureTel Corp., Peabody, Mass., a technology leader.

The target market for PBX-to-computer interfaces—which are fundamentally a software product—is the automated-call-distribution (ACD) centers that handle things like customer service and catalog sales, says Buzz Brooks, vice president of marketing for Aristacom International Corp., Alameda, Calif. Some 400,000 ACD seats are shipped each year, and the potential market for linking them to the computer data base via PBX could reach 2 billion by 1996, he says.

Right now, control networking is largely a low-cost technology that merges control and computer techniques so that various in-building systems—heating, lighting, fire safety, security—can be linked and monitored by a network manager. But Pradip Madan, director of product marketing at Echelon Corp., Palo Alto, Calif., forecasts a "hockey stick" growth path as existing uses slowly convert to the new technology. In the next phase, products will appear with the basic control building blocks embedded, Madan says. The third stage will involve increased use of the embedded applications and the appearance of entirely new ones. □

Consolidation holds key to Europe's growth

The outlook for communications markets in Europe and Japan is bright, but not as dazzling as the 12% to 15% growth forecast for the U.S. Japan's market will grow by about 7.5% to reach around \$12 billion this year. And although 1992 forecasts vary from country to country, the European market overall should check in at \$35.9 billion, representing 8.5% growth. Germany and the UK may see a healthy 8% to 12% rise, but Italy will be lucky to see 5% and France 6%.

The move toward data communications, particularly local-area networking, will account for the strongest percentage gains in both Europe and Japan this year. LANs also hold the most promise for the future, but deregulation in Europe will contribute to growth rates in communications that will exceed the industry average for several years to come. European Community members must deregulate totally by 1993, and most are well on their way.

In the UK, the telecommunications sector's 2% growth last year has buoyed an otherwise ailing electronics industry. It was just enough to pull the industry as a whole above the line, says the Electronic Engineering Association. For 1992, analysts see a real upturn and are forecasting 8% to 9% growth in telecommunications, bringing the market to an estimated \$9.5 billion, against \$8.8 billion in 1991.

A couple of factors could threaten that projected growth rate. British Telecom is near the end of a program to modernize its public telephone network, and will not sustain its past installation rate of 2 million lines a year of digital switching equipment. The military too is trimming back. But deregulation and technology advances have marketers heading into 1992 with a host of new potential customers for everything from fiber-optic data networks through digital cordless phones.

Furthest ahead in announcing plans are mobile communications operators, three of them startups planning to build

INTERNATIONAL

personal communications networks. Among them they will spend around \$4.6 billion on network infrastructure over the next seven years—if the market develops as the manufacturers wish.

In a move to provide competition in local-loop telephone and data communications, the British government has encouraged a raft of cable TV companies to build broadband networks that can offer telephony services as well as TV. By the end of 1991 it had let 135 franchises, but only 15 have services running to little more than 100,000 homes and business. As a result, forecasters are taking a less optimistic view of the value of their business.

The future is further clouded by uncertainty surrounding changes in U.S. telecommunications regulations. British cable TV companies are almost to the last one owned by Regional Bell Operating Companies such as US West, Pacific Telesis, and Bell South. UK observers are questioning whether these companies will divert investment from their European operations if, as seems likely, the RBOCs are given permission to operate similar networks in the U.S.

Other public phone network operators are expected to start operations in the UK over the 1992-93 period. They will need a range of equipment, but the emphasis is expected to be on fiber optics. The same applies in the private networks, where stabilization of the Fiber Distributed Data Interface standard is forecast to generate a boom.

In Germany, rebuilding the communications infrastructure of East Europe—particularly the former East Germany—will be the major factor contributing to above-average growth this year, to \$15 billion from \$14 billion in 1991. When tallies are completed, the incorporation of East Germany should push the 1991 market for some equipment—public telephone and data-switching systems, for example—to a whopping 20% growth rate. Consumption of other gear, such as private switches and fax terminals, is expected

to rise a respectable 10% to 15% this year, also partly a result of unification. "Modern technologies will be used to a large extent," says an executive at Siemens AG in Munich. That helps explain, for example, the anticipated 20% jump in fiber-optic systems in 1992.

Continuing efforts to digitize the nation-spanning array of switches should propel the country's 1992 market for communications equipment 8% to 10% over the 1991 total of about \$7.35 billion. Registering above-average growth next year will be new services and value-added networks as well as terminal equipment. For example, domestic sales of land mobile equipment, including base stations, shot up a spectacular 35% in 1991 as Germany's new digital cellular network became operational. Other mobile radio services doing well will be cordless telephones, the Euro-signal paging service, and private radio networks.

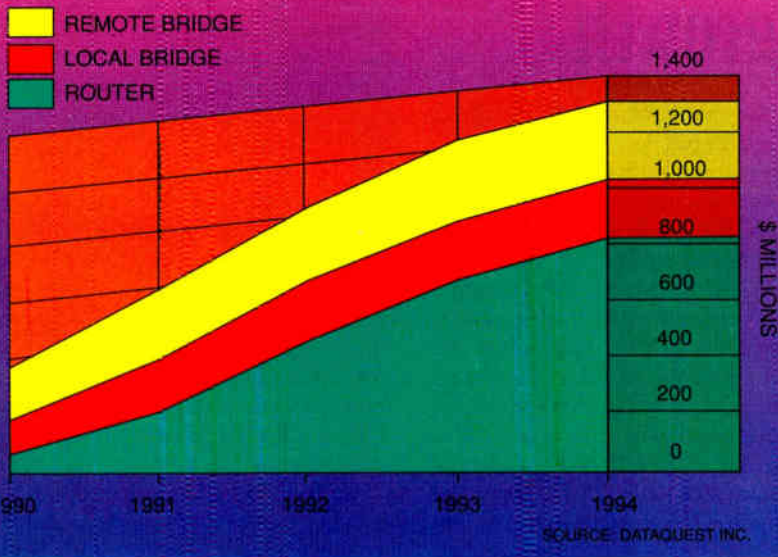
Unification and the opening of eastern Europe, including the Soviet Union, are not the only factors stimulating German growth. Deregulation in western Europe will supply another push, says Jürgen Siegler, manager of business development and market research at Stuttgart-based Standard Elektrik Lorenz AG, the German subsidiary of France's Alcatel NV Communications Group. "The greater competition that liberalization brings will enhance terminal equipment sales," Siegler says. (Public networks currently are still a monopoly of postal authorities.)

Once Europe chooses a common standard, ISDN should also provide a boost. "We are convinced that the passage of the Euro-ISDN protocol will end the wait-and-see attitude on the part of customers and suppliers," says Klaus Krone, chief of the Information and Communication Technology Group in Germany's Electrical and Electronics Industry Association in Frankfurt.

For hardware such as concentrators, modems, and multiplexers, which are used in data communications, the forecast is 16% for 1992, and for paging systems 11%. In the field of satellite earth stations, VSAT (very-small-aperture terminal) equipment will do fine, particularly in the new eastern states.

The terminal market will not only

WORLDWIDE INTERNETWORKING MARKET



bring joy but also sorrow. Its liberalization opens the market to massive Far East imports of inexpensive terminals such as telephone sets. So unless domestic firms turn to high-quality comfort or feature phones, the chances of their survival are slim.

In France, Italy, and Spain, the deregulation of the telecommunications industry will be the primary engine driving growth in business systems. Businesses are likely to take advantage of the price competition to upgrade equipment. Consumers, meanwhile, will see new products, and the analog portable phone will probably be the fastest-growing private telecom product. Declining prices and low market penetration make it a good bet for the future, says Frank Owen, technical marketing director at Texas Instruments Europe.

In France, for example, analog radio-telephones will grow 15% a year for 100-meter hand systems. France is committed to the CT2 (Common Air Interface) standard for these portable phones. But the EC's proposed Global System for Mobile Communications digital cellular system for international cross-border communications costs \$1,000 per handset, which restricts it to business use.

In the public network, the market for switching systems is flat in southern Europe but transmission is expected to grow, thanks to a move to Sonet (synchronous optical network). "I expect

transmission spending in southern Europe to grow at the rate of almost 9% a year," says Antoine Boivin-Champeaux, technology analyst at the Barclays de Zoete Wedd investment bank in Paris.

In Spain, deregulation plans are aimed at private telecom terminals in 1992. But the market may not be as big as some forecasters believe. "Businesses have been buying PBXs that are not government-approved for some time," says one analyst. Nevertheless, Spain's PBX market was worth \$165 million in 1990, says Terry Wright, Dataquest Inc.'s telecom analyst in London. He expects it to grow about 12% through 1992.

The market for private data communications is small, but growing as rapidly as the computer market. Changes in the laws governing wide-area networks—expected in the coming two years—should enable companies to work faster in constructing large private data networks.

Spain's market for transmission over the public network could grow faster than 10% per year. "It is the availability of private telecoms—a new and growing market in Spain—that is driving the public market," says John Dinsdale, a telecommunications analyst with Dataquest in London. Spain also has a trial Sonet system running now. Installed by Philips, it will be used to han-

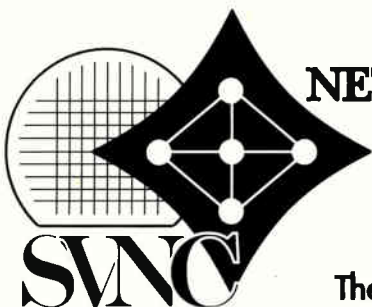
dle the load generated by the Barcelona Summer Olympics this year.

In France, the PBX market is expected to pick up after a year in the doldrums. From \$365 million in 1990 (excluding terminal devices), revenue declined 3% in 1991. Wright expects a return to traditional growth, adding 4% or 5% new lines a year. ISDN is strong in France, but Wright thinks 1993 will be the key year. Products such as Alcatel's ISDN telephone—which permits phone-list storage, caller identification, the use of two lines at the same time, and a computer connection—will be available this year. But analysts say the demand will be slow at first. Similarly, computer networking has not caught on in France in a big way. About 8% growth is expected in 1992, about the same as last year, and down from 10% in 1990.

In Italy, private telecom dealers will feel the heat of the recession. PBX market growth will slow, rising only 5% or so from \$230 million in 1991 and 1992. Although PC growth isn't high, LAN and WAN growth will be better, says Roberto Taranto, director of the Teknibank research and consulting firm in Milan. It jumped about 13% in 1991 and the same is expected for 1992. Taranto expects the boom for radio-telephony to continue. (In Milan today, it is possible to buy a wooden replica of an analog/digital telephone to use as a fake status symbol.)

The Italian government will continue to pump another \$1 billion a year into public telecommunications as part of the emergency "Europa" plan to modernize its network. This investment is fueling the switching market, which was worth \$250 million in 1991, Taranto says. "We expect it to grow at a 10% rate, despite the recession," he adds.

In Japan, analysts are predicting growth rates in communications between 7% and 8%, which will push the sector to about \$12 billion in 1992. Junichi Saeki, director of Dataquest's Information System Group in Tokyo, points out that many telephone services, such as voice mail, that are commonplace in the U.S. have not been as well accepted in Japan. By comparison, other communications technology, such as fax machines, are more ubiquitous in Japan than in the U.S.—Peter Fletcher, John Gosch, Jonah McLeod, and Andrew Rosenbaum



THE SILICON VALLEY NETWORKING CONFERENCE

APRIL 27 - 29, 1992

The Santa Clara Convention Center
Santa Clara, California

Keynote Speaker: Eric Benhamou, C.E.O. 3Com Corp.

The Silicon Valley Networking Conference is the only networking conference that focuses on the DESIGN of network related hardware and software. The conference venue consists of six half-day tutorials and more than 70 technical paper presentations. Topics will include:

- Distributed Processing, Sonet, HiPPI, FDDI, Internetworking, Wireless LANs, Network Management, Network Diagnostics, Frame Relay, X-Windows, Token Ring, Ethernet, ISDN

KEYNOTE PRESENTATIONS:

Dr. Gordon Moore, Chairman of the Board and one of the founders of Intel Corp.
Roger Ross, President, ROSS Technology, a subsidiary of Cypress Semiconductor Corp.

ADD THESE TO YOUR CALENDAR

The Silicon Valley Personal Computer

Design Conference focuses on providing solutions to key PC, Workstation, and Peripheral design and integration issues. Unlike other computer shows that are aimed at distributors and value-added resellers, SVPC is aimed at designers and strategic planners who are evaluating or designing the next-generation desktop and portable computer systems. The conference will provide eight half-day tutorials and over 100 technical paper presentations covering key design and implementation issues for desktop and portable systems. Presentations will cover:

- Pen-Based System Design, Portable System Design, Motherboard Design, Memory Card Interfacing and Control, Graphics and Video Subsystem Design, Display Technology, Multimedia Hardware Design, Mass-Storage Subsystem Design, Peripheral Design, Expansion-Bus Interfaces (AT, EISA, MCA, SBus, Turbochannel, others), Memory- and Cache-Subsystem Architectures, Data Communications (fax and modem design, network adapter design, and wireless LAN implementation), Integrating-in Graphical User Interfaces, BIOS and Operating System Implementation.and many other topics

SILICON VALLEY PERSONAL COMPUTER DESIGN CONFERENCE

AUGUST 10 - 12, 1992

The Santa Clara Convention Center, Santa Clara, California



These Conferences are a creation of SysTech Research. SVNC is co-sponsored by 3Com Corporation. Electronic Design and Electronics Magazines are co-sponsors of both SVNC and SVPC.

ADVANCE REGISTRATION APPLICATION (for applications postmarked by 3/6/92 for SVNC, 6/26/92 for SVPC)

	SVNC	SVPC	TOTAL
Tutorials only (one day registration)	\$250	\$295	\$ _____
Papers only (two-day registration)	\$350	\$395	\$ _____
Full conference (three-day registration).	\$450	\$495	\$ _____
Exhibits only pass.	\$ 25	\$ 25	\$ _____
Extra proceedings (add \$15/domestic mail; \$35/intnl airmail)	\$ 85	\$100	\$ _____
		TOTAL ENCLOSED	\$ _____

Note: Registration fees for either conference include coffee break refreshments, lunch, and one set of tutorial notes and/or conference proceedings

Name _____ Title _____
 Company _____ Mail Stop _____
 Address _____ City _____ State _____ Zip _____
 Telephone _____ FAX _____ Email _____

MAIL this completed form with payment (in U.S. Dollars) to: SysTech Research, 1248 Olive Branch Ln, San Jose, CA 95120; (408) 997-8265 (fax or phone)

Spotty outlook ahead for consumer electronics

BUT SOME SECTORS—NOTABLY, HOME-OFFICE EQUIPMENT—WILL BENEFIT FROM THE HARD TIMES **BY FRANCIS J. LAVOIE**

Total factory sales of consumer electronics products should hit \$35 billion this year, continuing a steady—if unspectacular—climb despite increased U.S. joblessness that cuts into consumer buying power and an economy that stubbornly refuses to improve. The Electronic Industries Association says last year's U.S. market will come in at just under \$34 billion, a 3.4% rise from 1990. And that trend, say industry seers, should hold for 1992, bringing the total to \$35 billion.

The mature audio and video segments will rise only slightly, analysts say, but a few hot sectors are growing like gangbusters. The advent of the 16-bit generation has pumped new energy into video games. The automotive sector is rising 10% to 15% a year. And the economic hard times are good news for the burgeoning home-office sector. "We feel very optimistic," says Nancy Colon, marketing manager for Sharp Electronics' Home Office Division in Mahwah, N.J. "Our business is up 32% over [1990] and we expect this trend to continue." Like most manufacturers, Colon sees the retail market—in the form of the office-equipment "superstore"—as the growth area of the 1990s.

One reason for the healthy outlook is, paradoxically, the sorry state of the overall economy. As more and more white-collar workers lose their jobs, they are turning to freelancing or consulting from their homes. This trend has fueled a demand for equipment that until recently had been marketed primarily to businesses.

In the more traditional consumer segments, new audio products are ex-

pected to make 1992 a somewhat better year than 1991, when sales, in dollars, were up just 2%. The continuing boom in compact-disk players and the introduction of new and upgraded audio products account for the optimism, says Mike Vitello, president of Sony Personal Audio Products Co. in Park Ridge, N.J.

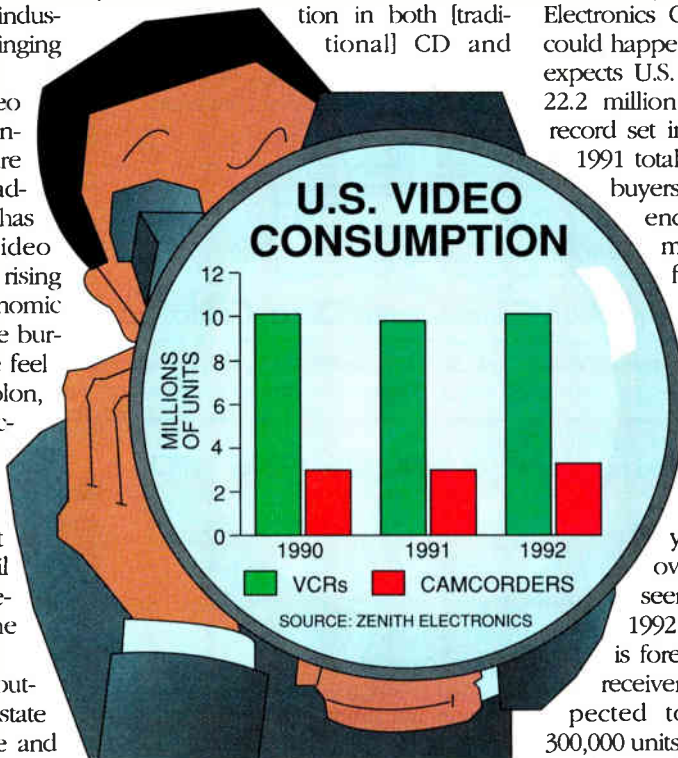
CD sales were up 40% in 1991, and Vitello expects more of the same this year. "We look for that kind of acceleration in both [traditional] CD and

about to fade. "DAT is the ultimate recording device," says Vitello, "and we expect to be marketing it aggressively." A DAT alternative, the Digital Compact Cassette, is also expected to land in 1992.

In video, manufacturers are counting on the replacement market to generate growth. "The trend to replacement of existing equipment may soon supplant second-set sales as the major buying factor," says a spokesman for Zenith Electronics Corp., Glenview, Ill. "That could happen as soon as 1993." Zenith expects U.S. sales of TV sets to reach 22.2 million this year, matching the record set in 1989 and outpacing the

1991 total of 20.8 million. First-time buyers are a diminishing influence. Sales to this market, made up mostly of newly formed households, are expected to be flat for 1992 and dip in the following year. Projection TV, a hot area not long ago, was expected to level out, but has shown unexpected strength, running at about 425,000 units last year. This is up about 6% over 1990 sales, and the trend seems likely to extend into 1992. An even brighter outlook is forecast for pocket LCD color receivers. Sales to dealers are expected to increase from about 300,000 units in 1991 to 400,000 in 1992.

The outlook for video cassette recorders is much the same as for color TV. VCR penetration is at about 75% in the U.S., leaving little room for growth; and analysts see first-set buyers as a diminishing market. First-set totals for 1991 were about 2 million, down sharply from 1990's 2.7 million, and the



boom-box CD players," he says. "Growth may be even higher as manufacturers finally catch up with demand, probably in the first quarter of 1992."

Meanwhile, digital audio tape will pick up steam this year as the bitter opposition of the recording industry seems

number will drop to 1.6 million in '92.

For 1992, Zenith expects the VCR action to center around four-head units and stereo capabilities. Stereo has not yet made the inroads into VCRs that it has in color TV, but it's coming on strong. Stereo was included in about a quarter of the VCR decks sold in 1991, and is likely to break 30% in 1992. VCR Plus programming capabilities will show up in more VCR decks, with at least four brands offering built-in VCR Plus in 1992.

Camcorder sales have leveled off after a boom year in 1990. In fact, unless things pick up, 1992 could see excess inventory, along with price cuts, analysts say. Some price chopping has already been reported. However, the camcorder sector is still considered virgin territory, with U.S. penetration estimated at about 15% in 1991.

Compacts dominated the camcorder field in the first three quarters of 1991, grabbing a lion's share of all sales—67%. This contrasts sharply with the first three quarters of 1990, when full-size models accounted for 55% of sales. This trend is expected to continue in 1992. Although the vast majority of sales will be to first-time buyers, the replacement market is expected to be double the 300,000 units sold in 1990. Also, a second-set demand is expected to develop, although it will be relatively small.

In the video-game arena, 1992 looks like the year of the 16-bit game, following a strong showing in the last quarter of 1991. CD-based games are expected to show a lot of activity, with Sega and Nintendo planning to join the battle with current participant NEC Corp. A good deal of CD-game hardware will become available in 1992, says Peter Main, Nintendo Co.'s vice president of marketing, but it will be a couple of years before "mainstream, broad-based product" will make its appearance. He cites the extended development time necessary for creating CD-ROM software.

In the automotive sector, strength stems from the expectation that by the end of the decade cars will have double or triple the number of microprocessors they have today, according to Mark Parr, senior analyst for McDonald Securities Inc. in Cleveland. "That translates to a pretty consistent 10% to 15% growth," he says. Sales of automotive electronic components grew 5% in 1991, despite a 12% drop in car produc-

tion, he says. This year, "if [car] production is flat, the electronics sector should grow about 12%. A 10% increase in car production would likely mean an 18% to 25% growth in electronics."

The home-office sector, meanwhile, is breathing new life into categories that until recently were not considered, strictly speaking, consumer. One major beneficiary is the fax machine. Manufacturers are upgrading their offerings for this market—Sharp, for example, recently introduced the first laser plain-paper fax machine for the home. "Only a year ago," says Colon, "introducing such a product to the retail market would have been unthinkable."

Fax sales are expected to grow 35% over the next three years, spread pretty evenly over that time. Analysts expect retail sales to reach 1.7 million units in 1992, a number that represents some 65% to 70% of total units sold. That's a 5% to 10% increase over 1991 results.

Copiers are likewise expected to make a greater penetration into the home environment. A recent EIA study found that more than 6% of the customers surveyed expected to buy a copier for the home in 1992. This trend has spurred manufacturers to upgrade their styling. Both Canon Inc. and Sharp, for example, have recently made styling changes.

But the star of the 1992 home office may well be the electronic organizer. "This is probably the fastest-growing market segment," says Sharp's Colon. "For 1992 we expect unit volume to reach 1.2 million." The steep growth rate is illustrated by the fact that 50% of consumers who bought these devices did so in 1990, according to the EIA. Sharp, which has 60% of the organizer market, expects 40% growth over the next three years. During that time, electronic organizers will become far more feature-laden, and capabilities will increase dramatically. □

Japan treads lightly while Europe falters

As might be expected, the international consumer electronics market suffered the ripple effects of the U.S. recession in 1991 and will continue to be weak in 1992. Except for Japan, bright spots on the gray landscape of the last few years tended to be driven by events such as the reunification of Germany and the upcoming Barcelona Olympics rather than underlying strength in consumer confidence and buying power.

Japan's consumer electronics manufacturers will continue to see strong growth due to the steady consumer spending expected at home, says Junichi Saeki, director of Dataquest Inc.'s Information System Group in Tokyo. The domestic Japanese market will grow 8% in 1992 to \$20 billion, he says. Japanese in the 20-to-30 age group are the primary buyers, particularly in audio and video electronics.

The export market is not as rosy. Japanese consumer electronics suppliers are looking with worried eyes at the

INTERNATIONAL

slowdown in spending in the U.S. and Europe, says Saeki. Manufacturers are looking for the next generation of electronic playthings to spur new growth, however, and many believe high-definition TV is the next likely candidate. HDTV will hit the Japanese market late in 1992, Saeki believes, but the U.S. market will lag.

In Europe, meanwhile, the German consumer electronics market will stabilize after a roller-coaster ride in 1990 and 1991. Driven by the addition of 16.5 million electronics-hungry East Germans, sales soared a whopping 18% in 1990. No one expected a repeat performance the following year. "That demand was largely satisfied by 1991," says Johanna von Ronai-Horvath, marketing research manager at Nokia GmbH, the Finnish Nokia group's German subsidiary in Pforzheim.

Germans bought 5.6 million TVs and 3.26 million VCRs in 1991, a drop of 4% and 3%, respectively, from the 1990 totals. In 1992, the market will contract a

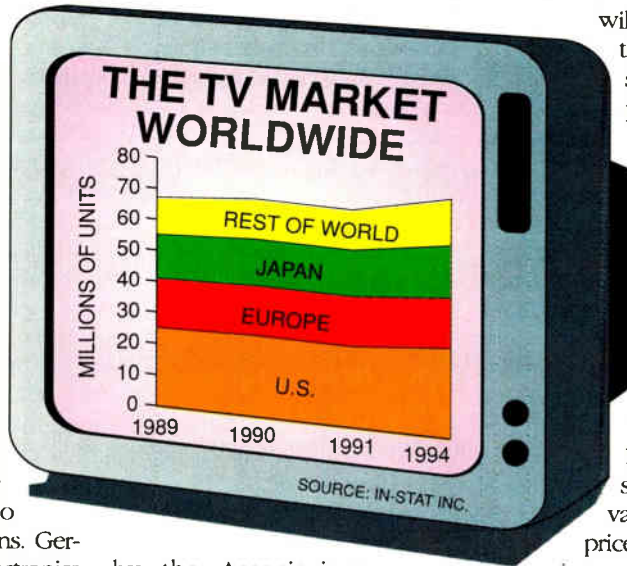
bit more, primarily due to continuing poor economic conditions in the five new eastern states, von Ronai says. She predicts unit sales of TV sets and VCRs will drop to 5.4 million and 3.14 million. Together with camcorders, TV sets and VCRs account for about 60% of the market for equipment the Germans define as entertainment electronic products. So 1992 should shape up as a so-so year, says von Ronai.

One thing that is worrying German producers is the deep inroads that suppliers from the Far East have already made into the country's new eastern regions. Germany's overall entertainment electronics market fell by about 1.5% in 1991 from the \$14.8 billion level that the industry reached in 1990. There will be another drop—around 2%—in 1992.

There are several reasons for the decline. For one thing, the economy will slow down in 1992. For another, taxes needed to get the run-down economy of former Communist East Germany back on its feet are rising. Deep market penetration for some products also inhibits growth, particularly TV receivers, hi-fi equipment, and VCRs in western Germany. In the east, however, the VCR penetration stands at only 21%, which means there's still room for sales to expand. Expansion is also in store for camcorders. Here, the penetration is at 8% in the west and 2% in the east.

In southern Europe, consumers are not stampeding to buy electronic equipment, and what they are buying is, as often as not, imported from the Far East or the U.S. Spending growth will hover around 2% overall, with Spain providing the most sparkle. Largely because of a late start and low market saturation compared with France and Italy, the Spanish market will grow by about 3% to \$2.5 billion. This follows a 2% rise during the Gulf war-plus-recession year of 1991, according to Ken Wilson at the market research firm Elsevier Advanced Technology Ltd. in Oxford, England.

In France, growth is expected at about 1%, up from about \$4.5 billion in 1990 and after a 3% fall in 1991. Italy, which is headed for recession, has the flattest consumer market in southern Europe—is valued at about \$2.5 billion



by the Associazione Nazionale Industrie Elettrotecniche ed Elettroniche (ANIE).

Across southern Europe, camcorders are easily the healthiest market. Unfortunately for European manufacturers, most are imported from the U.S. and Japan. The market for camcorders in Spain is expected to grow 5% in 1991 and in 1992, Wilson says. Spain is also remarkable for its large number of black-and-white TV sets. Their owners will be looking for color in time for the Barcelona Olympics next summer, say analysts. There are about 2 million color sets in Spain, Wilson says, and the market should grow 2% to 3% in 1992.

In France, camcorders grew at the rate of 7% last year, according to Sony France. Analysts say that buying will slow a little in 1992, but that a full 5% growth rate can be expected. Otherwise, France's consumer demand will remain stable, if not fall. Car stereos will perhaps be the sole exception, with about 1% growth predicted per year.

In Italy, color TVs and camcorders turned in strong performances from 1989 to 1990, and now the markets are expected to level out. The market for very large-screen TV is still a high-growth area, according to the ANIE's Ciro Frallicciardi. Sales could double in the next two years. Camcorders, once again, are the biggest growth area. Some 330,000 units were sold in 1990, and the number is expected to rise 13% in both 1991 and 1992. Car radio sales will remain level, though the market

will be boosted by Fiat's determination not to be a supplier. As a result, these units are imported or produced locally by small dealers.

In the UK, camcorders and compact-disk players are still hot items in shopping malls, with digital audio tape and the new Digital Compact Cassette waiting in the wings to become trendy purchases.

In the mature consumer markets, TV receiver makers are forecasting a rebound from last year, when sales dropped 10%. Some 3.4 million sets shipped in 1991 for a total retail value of \$1.9 billion. The average price per set sold, however, has been increasing as users seek out newer models with bigger screens and features such as teletext and Nicam digital stereo sound. This year, retailers expect to see an average price working out at around \$820, an increase of 6%. Stereo broadcasting began last year and opinion polls show that 30% of British consumers intend to buy a Nicam receiver when they next exchange their TVs.

The biggest disappointment for the UK industry has been a slower than expected market acceptance for satellite TV receivers. When satellite TV started in 1989, the industry forecast it would sell several million units in the first two years. Fewer than 800,000 units were sold in 1991, and the cumulative figure for the first three years is around 1.75 million. Moreover, 64% of the population reports having no or little interest in buying a satellite terminal. Marketers hope the 1992 Olympic games will drive that figure down.

Video players and cameras have low penetration rates and plenty of room for growth, according to Ferguson Ltd. About 30% of purchases are being made by consumers 55 and over. Price competition last year drove the total value to \$1.2 billion as the number of units shipped fell by 200,000.

Camcorders represent a bright spot, with sales up by 30%, although from a pretty small starting base. Last year around a half million units were sold for a total value of \$535 million. That's a rising trend expected to be maintained well into 1992.— Peter Fletcher, John Gosch, Jonab McLeod, and Andrew Rosenbaum

For chip makers, 'another year of blah growth'

DESPITE GAINS IN A FEW HOT NICHES, THE SEMICONDUCTOR INDUSTRY MAY NOT SEE 10% GROWTH OVERALL **BY SAMUEL WEBER**

At year's end, the worldwide semiconductor industry, hovering around \$60 billion, was basically on hold, waiting for something good to happen. With only a few exceptions, chip makers came through 1991 with growth that varied from negative to moderate and see no immediate prospects of improvement as they face the uncertainties of 1992.

The major problem stems from a lack of orders from their biggest customers—the computer makers. Systems builders struggle in a persistently ailing economy to maintain margins while their customers, in turn, face their own economic difficulties. And these are compounded by the transition point now being crossed by the computer industry—marked by the rise of rival architectures, new operating systems, and constantly improving price/performance ratios that tend to make potential

customers postpone buying decisions. Meanwhile, a glut of low-priced, previous-generation machines is holding up sales for the newer desktop models. Until this surplus works itself out, some say, new chip orders will be scarce.

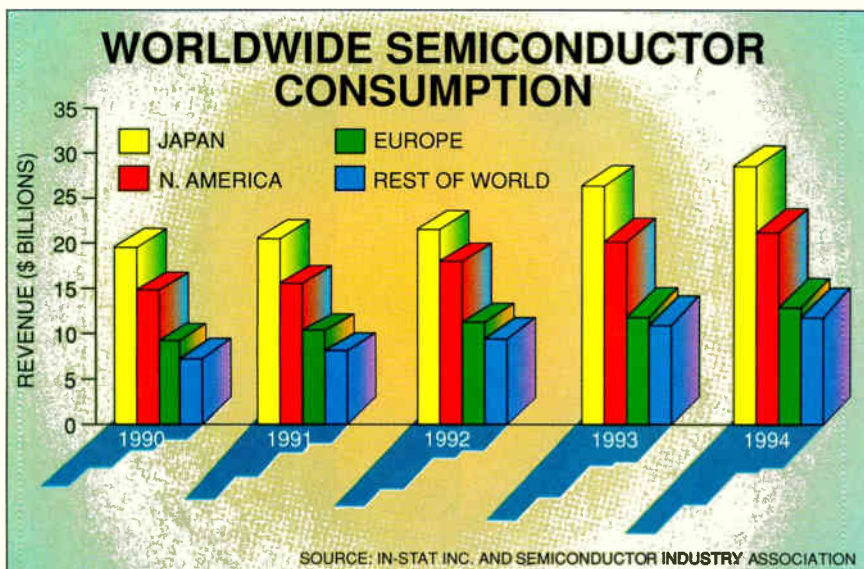
Industry analysts were fooled by what appeared to be a promising uptick in the first half of last year. As a result, midyear forecasts for 1991 were bright. Buoyed by what looked like an upturn in the economy, Dataquest Inc., the San Jose, Calif., market research firm, pegged worldwide chip growth at 13.7%. Even In-Stat Inc., a perennially conservative forecaster out of Scottsdale, Ariz., weighed in with a June forecast of 11.4%. But by the end of the third quarter, the economy had stalled and semiconductor shipments had dipped so severely that both felt compelled to revise their estimates.

Dataquest believes that last year ended not with double-digit growth but

at 9.3%. In-Stat is even more pessimistic: 5% to 8%. The firm's president, Jack Beechle, is unremittably gloomy. "We don't have an economy that's viable," he says. "The PC market will be up 8% in units and down 9% to 10% in dollars in 1991. Taiwan's a disaster right now, third-quarter bookings for Europe are down 14%, and that tells me [Europe] will be hard pressed to have any growth in the fourth quarter. If I had to give you a [U.S.] number for next year at this time, I'd have to say 11% is extremely optimistic. For the world I'd have to say 5% to 8% in 1992. It will be another year of blah growth."

Those early, optimistic 1991 forecasts were skewed by exchange rates that reflected a weak dollar, says Jerry Banks, director of worldwide semiconductor research at Dataquest. "The dollar has strengthened considerably since then, so that is contributing to the change in the forecast," he explains. "The first half was very strong in Japan and Europe," especially for consumer ICs, microprocessors, and microcontrollers. "Now things have slowed in Japan and really taken a dive in Europe." He says Germany is leading the decline because of the drain on its economy from the absorption of East Germany.

Despite the recession—and despite skepticism in many quarters of the industry—Dataquest is relatively bullish on 1992, predicting worldwide growth of 13.5% based on today's currency. "We're basing that on the very slow recovery that's beginning to occur," says Banks. North America will bounce back at 12% growth, he says. The Asia-Pacific region will continue its surge at 18.3%; Japan will rise 15.6%; and Eu-



rope will modestly rebound at 6.7%.

Late last year, the Semiconductor Industry Association projected 1991 growth very close to that estimated by Dataquest—9.8%. The figure was compiled by World Semiconductor Trade Statistics Inc. (WSTS), a reporting program whose participants include chip makers worldwide. But the SIA's forecast for 1992—14.5% growth—and Dataquest's of 13.5% have been generally greeted by disbelief.

"I read with amazement the forecasts for double-digit growth," says Steve Pletcher, vice president of sales for Signetics Corp. in Sunnyvale, Calif. "We're not going to spend money in anticipation of double-digit growth. It's hard to identify what's going to drive it. We may see a few percentage-points' gain, but we don't see a product that will pull us out of this recession."

James Magid, senior adviser at Needham & Co., a New York investment firm, emphatically agrees. "No one in their right mind believes the SIA forecast for one minute," he says. "No practical business planner expects that of the overall market—more like half that growth." Indeed, the days of 20% to 30% growth are gone, says Ben Anixter, vice president of external affairs at Advanced Micro Devices Inc. in Sunnyvale. Typical from now on, he believes, is 10% to 11%.

Because of differences in what's counted, absolute numbers from the SIA and Dataquest diverge, but the trends they show are similar. Both indicate a continuing decline in digital bipolar memory and logic, with growth gains in digital MOS components of around 17% to 20% next year. Although Dataquest shows only a 2% gain for MOS memories in 1991, Banks points out that this is a "tremendous improvement over last year's negative of 20%."

Banks says one worrisome segment is fast static random-access memories, normally a U.S. stronghold. With numerous offshore suppliers entering the market with SRAMs in the 15-to-20-ns range, average selling price has declined steeply. So even with unit growth forecast at 25%, 1991 revenue was basically flat, at slightly over \$1 billion.

Many chip makers are looking to the burgeoning notebook computer market as the catalyst for a resurgence in or-

ders. But this market may not live up to expectations, says George Alexy, vice president of Cirrus Logic Inc. in Fremont, Calif. "Depending on whom you talk to, they're forecasting 6 million units [in 1992], but it may be more like 4.5 million to 5 million units," he says.

The computer downturn has the industry turning its attention elsewhere. For example, LSI Logic Corp., the Milpitas, Calif., ASIC maker, is diversifying its portfolio to avoid total dependence on the computer business, which "has come to a screeching halt," says Brian Hall, senior vice president. Computer buyers are reluctant to make a choice among the many contenders for fear of backing the wrong horse, he says. "Some people say Sun is the way to go; others say let's stay on the Intel treadmill," Hall says. "Microsoft will drop OS/2 in here; uh-oh, OS/2 is late, let's look at these Unix boxes."

The heated competition in workstations, the new Apple-IBM alliance, and the emergence of the Advanced Computing Environment all contribute to the muddle, he says. And "with 75% of our eggs in the data processing basket, that's not a healthy sign." So LSI Logic is aiming at cable TV, teleconferencing, and image processing as hedges against the computer decline, Hall reports.

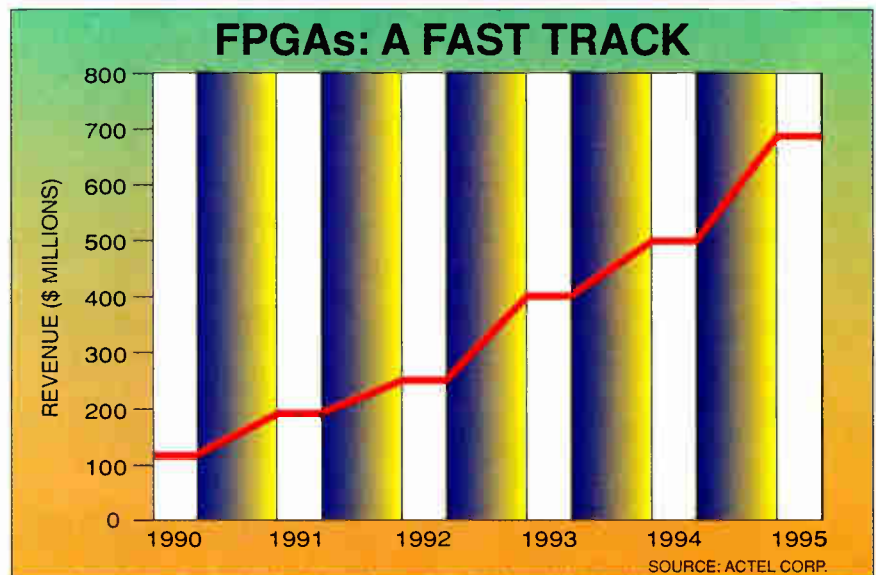
Rival VLSI Technology Inc. of San Jose is pursuing a similar course, says Dave Chavousti, vice president of sales and corporate marketing. "Everything we're doing is built around functional building blocks," he explains. "Most of

our strategy is toward specific markets driven around building cores that can be integrated within ASIC solutions."

Chip makers are hoping that such new strategies will pull the once flourishing ASIC business out of its slump. Activity was slower than expected in the second half of 1991, says Ed Barnett, director of ASIC marketing for Fujitsu Microelectronics Inc. of San Jose. Although design activity picked up, he says, actual production orders slowed significantly. He estimates the ASIC market rose less than 10% last year, whereas previous years had seen 20% to 30% growth. Fujitsu anticipates slow to moderate growth in the first half of 1992, with a faster pickup in the second.

Despite the gloom that pervades the industry as a whole, there are niches that continue to prosper. One of these is field-programmable gate arrays. One industry wag says FPGA really stands for "finally, a profitable gate array," referring to the fierce competition and price erosion going on in the masked gate array segment. The industry leader in FPGAs is Xilinx Inc. of San Jose, with a 75% share of the approximately \$160 million market. Both Xilinx and rival Actel Corp. of Sunnyvale, the runnerup in the FPGA market, are bullish about 1992.

"We doubled in 1990 over '89, and clearly we're not going to grow that fast this year, because the economy is not supporting that," says G. Wesley Patterson, the executive vice president at Xil-



For the industry worldwide, misery loves company

inx. "Our planning is based on growing another 50% [in 1992], which is respectable." Andy Haines, Actel's director of marketing, predicts that FPGAs could account for \$1 billion in sales by 1995. "I don't think our growth will stop regardless of the economy, because of the number of new adopters. We estimate our customers did about 5,000 designs in 1991—at a rate of three to five designs per year. That kind of adoption rate will promote further growth."

Small companies like Paradigm, Quality Semiconductor, and Sierra Semiconductor, all of San Jose, are examples of how specialized niches can bring growth in a down year. Paradigm and Quality aim at the very high-speed segment of the computer market. Both make very fast SRAMs, a market that hit \$410 million in 1991 and is forecast to grow almost 15% in 1992.

Paradigm, which was the first to introduce a 1-Mbit part with speeds of 20 to 25 ns, is planning a family of what it calls processor-specific memories; the first will interface with the MIPS Computer Systems Inc. R4000 CPU. A Sparc version is also due.

Though pricing pressure squeezes low-speed SRAMs, speedy 10-to-12-ns parts are doing well, says Bill Scharrenberg, Quality's director of marketing. The firm's high-speed focus means it's well-positioned as 40-MHz RISC and 486 systems come into the market. As a result, "1991 was a very good year," Scharrenberg says. "We went from nothing to a million a month in a year's time."

Sierra Semiconductor Corp., a supplier of mixed-signal chips, is shrewdly taking advantage of the huge base of PCs already out there that need upgrading. Diverting from the moribund disk-drive controller business, the company's big business now is in modems, a fast-paced market buttressed by demand from the notebook PC segment, says Don MacLennan, marketing director.

One ray of hope for chip makers is the state of customer inventories. "Our surveys show that although inventories will continue to burn low for the next few months, we're starting to see some normal buying patterns," says Dataquest's Banks. And "any slight turn could have a multiplying effect," says Don Beadle, a senior vice president at National Semiconductor Corp., Santa Clara, Calif. □

If U.S. chip makers are looking glum, at least **INTERNATIONAL** says Junichi Saeki, director of Dataquest Inc.'s Information System Group in Tokyo. Rather, these high-density devices are finding their way into workstations and servers, he says, but those machines account for a much smaller unit volume. Some 20 million PCs were shipped worldwide in 1991, Saeki says, compared with 350,000 workstations.

Japan continues to wrestle with declining prices for dynamic random-access memories and sluggish demand for the 4-Mbit versions—devices for which Japanese vendors made large capital investments that are not yet paying off. Despite that turmoil, U.S. analysts expect the Japanese industry to grow perhaps 15% in 1992, to nearly \$24 billion.

European suppliers, meanwhile, saw revenues increase by just 5% or 6% in 1991 and anticipate a slight improvement this year: 8% to 10% growth, to \$11.1 billion. Like their U.S. brethren, they face severe cutbacks in orders from their best customer, the computer industry. However, the market is somewhat buoyed by growing demand from telecommunications, auto, and consumer electronics manufacturers. This is especially true for Germany, where the big demand for communications equipment in the five new eastern provinces will push device sales.

The global economic slowdown has hurt, but even with a healthier economy, "the clays of big step increases are well and truly gone," says Jean-Philippe Dauvin, research chief at SGS-Thomson Microelectronics in Paris. "The [chip] industry worldwide is tending toward the steady state. It is so much larger in absolute terms than at any time in the past that percentage variations will be less, and there will be less scope for the dramatic growth rates we have seen."

In Japan, most semiconductor makers had expected the 4-Mbit DRAM to be in higher-volume production by now. Instead, manufacturers are sitting with unused capacity that was built in 1989 and 1990 in anticipation of a migration by personal computer makers from 1- to 4-Mbit DRAMs—a migration that never occurred.

PCs just aren't using the 4-Mbit parts,

Despite this lag, most Japanese DRAM makers were turning out 4-Mbit devices in high volume as 1991 began. But by midyear, they started cutting back on production to concentrate instead on the 1-Mbit parts. Unfortunately, falling 1-Mbit prices and lower demand have eaten into margins.

Now, says Saeki, some vendors are pinning their hopes on the emerging 16-Mbit DRAM. Others believe the PC slump will ease and computer makers will start buying 4-Mbit parts as the Intel 80486 becomes the PC platform of choice. If that happens, demand could quickly outstrip supply and the price of DRAMs would rise accordingly.

Meanwhile, semiconductor vendors selling to the German market enjoyed an 11% growth spurt in 1991 but are ratcheting down for what they believe will be a much slower 1992. The prediction from Germany's trade group, the Association of the Electronics and Electrotechnical Industry, is for a mere 3% rise, which would bring the country's semiconductor market to about \$3.1 billion.

On the plus side, German suppliers expect the price erosion in DRAMs, though still problematic, to be less severe this year than last. Siemens AG, Europe's only volume producer of high-density DRAMs, mustered the same revenue from these memories last year as in 1990 even though unit shipments were up significantly. This year's price decline will be "more moderate," predicts Karlheinz Weigl, the Munich firm's director of chip sales in Western Europe. "The Japanese are now realizing

that drastic price drops aren't helping them either."

As in the U.S., growth in ASICs will moderate slightly throughout Europe, analysts say. In Germany, for example, 1991's robust 18% rise will slow to around 13% in 1992, partly because of the declining demand for emitter-coupled logic gate arrays in mainframes.

In the past year and a half, Europe's consumer electronics sector checked in as a top buyer of components, fed by demand from Germany's 16.5 million new eastern-state consumers. That gave a big boost to IC sales, with some companies reporting gains of more than 30%. However, the easterners' appetite for consumer products appears to have been largely satisfied.

Fortunately, the telecom sector is now shaping up as a big customer. Forty years of Communist neglect has left the communications infrastructure in eastern Germany in a desolate state. To bring networks up to Western standards, the Bonn government has earmarked \$30 billion to \$36 billion to be spent during 1991-97 for new buildings, cables, and equipment. Some semiconductor vendors are already chalking up 50% gains in sales to the communications sector. Another push will come from Eastern Europe.

Elsewhere, Spain is emerging as southern Europe's fastest-growing market. Starting from a small base—about \$190 million today—semiconductor consumption should jump 10% there this

year, says James Eastlake, a Dataquest analyst in London. Particularly brisk, he says, are the telecom and consumer sectors. "If Telefonica [the national provider] maintains its investment goals, we can count on double-digit growth," says Marco Landi, Texas Instruments Inc.'s European vice president.

France, meanwhile, anticipates a 7% gain in the chip market this year, Italy between 5% and 10%, and the UK 9%. Suppliers are largely counting on telecom demand to produce growth; they're also taking aim at some robust niche markets, like automotive electronics and smart cards.

European carmakers are using considerably more electronics every year, and the total dollar value per car is now close to \$80, says SGS-Thomson's Dauvin. The European Community directive requiring catalytic converters in every car after 1993 is one reason; the high profit margin on automobile options is another. That means semiconductor sales to the southern European automobile market should jump 8% in 1992. "France, Italy, and Spain all boast major car manufacturers, and their spending on components is rising rapidly," says Roberto Schisano, the president of TI Europe at Velizy Villacoublay in France.

The market for smart cards is increasing throughout the South, and France is the biggest buyer. The French Health Ministry has decided to equip the entire nation with smart cards to save on paperwork for health insurance (which is state-run). That means an eventual minimum of some 50 million cards, so "the

\$90 million market is bound to move fast," Dauvin says.

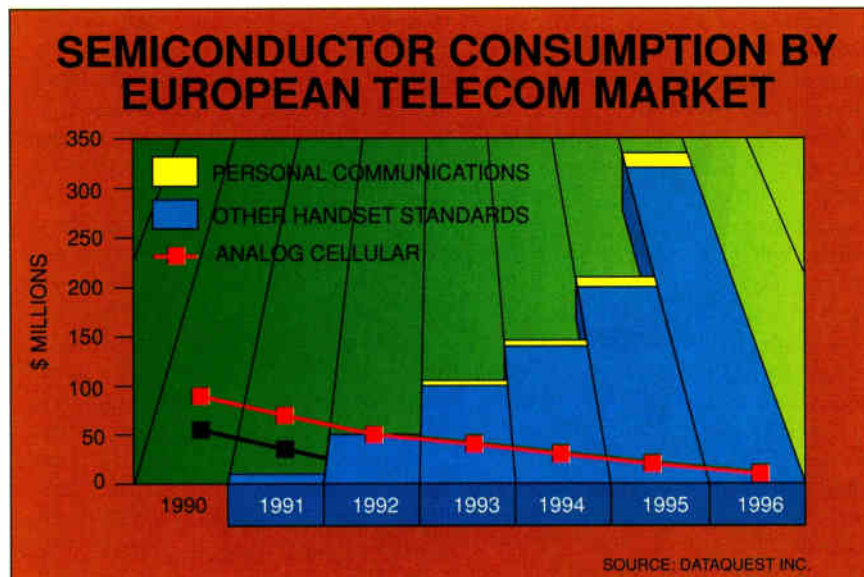
France saw a 5% rise in semiconductor consumption in 1991, to \$1.3 billion, and anticipates 7% growth in 1992, says Dauvin. Consumer spending enjoyed a light rebound after the Gulf War, though it has now slowed. A pickup is expected in March, he says, "when consumers have regained confidence after the recession." Automobiles will lead, and Dauvin expects an uptick in computing, too. He sees telecommunications as staying flat—France is already well-equipped with electronic exchanges.

Because of its dependence on computers, Italy is expected to be the slowest of the South European nations. Its \$1.2 billion market, which remained flat in 1991, will rise 10% at most this year, analysts say. Semiconductor makers there derive 39% of their sales from computers, and computers in Italy mean the financially shaky Ing. C. Olivetti & Co. SpA. Analysts say computer-based chip sales in Italy fell 20% last year.

But telecom is still a thriving sector, with STET, the national service provider, investing about \$1 billion a year in new switching. Italtel, Italy's largest telecom supplier, "bought a lot of chips in the first part of the year, and we expect them to need new provisions toward the end of 1992," says TI's Landi.

In the UK, the Electronic Components Industries Federation (ECIF) is predicting 9% growth in 1992, to \$730 million, off a flat 1991. IC sales rose 3% last year, but that gain was overshadowed by a massive 14.5% drop in discrete device markets, says Ray Ambrose, head of statistics gathering at the ECIF. But even the zero growth of 1991 beat the tally of the year before, when recession bit deep, the market declined 6.6%, and the UK electronics industry laid off 20% of its work force.

Such upturn as there is will be fueled by new PC activity. PCs absorb around 20% of the semiconductor devices sold in the UK, and the recent switch there to the 80386 accounts for a large part of the increase in IC sales. That trend is boosting memories as well, Ambrose says. All told, "It won't get worse," he says, "but it won't get better quite so fast as [it did] after earlier recessions."—Peter Fletcher, John Gosch, Jonah McLeod, and Andrew Rosenbaum



Forget 1992: equipment makers look ahead to '93

DEMAND WILL START TO BUILD, THEY HOPE, FOR 16-MBIT DRAMs; BUT TEST AND EDA ARE HOLDING THEIR OWN **BY JONAH McLEOD**

Like anxious sailors on a becalmed sea, U.S. suppliers of capital equipment are looking for an economic wind to fill their sails. But until the middle of 1992 there's not a breeze to be found, and even into the third quarter suppliers are predicting at most only a slight gust to blow them into 1993.

In semiconductor production equipment, only a handful of chip manufacturers, mostly American, are making purchases. The rest are holding back, largely because of lack of demand for dynamic random-access memories. As a result, the sector worldwide will rise just 8% at most. Automatic test equipment should do somewhat better, gaining perhaps 12% over last year as manufacturers that previously spent on production gear catch up at the ATE end.

Even electronic design automation, once the industry's hot segment, is slow-

ing. Where this sector once bounded along at 25% annual growth rates, 15% is the most to expect this year. However, within this category, certain design tools will do very well indeed, especially logic synthesizers and simulators for high-level description languages.

The capital equipment industry is very cyclical, says Robert Klimm, director of marketing at Eaton Corp. in Beverly, Mass. The boom of 1984 and 1985 gave way to a downturn in 1986 and 1987, and the high times of 1988-89 have given way to the bust of 1990-91. The cycle is tied to the production of DRAMs, and sluggish demand has most chip makers delaying or canceling purchases of additional capacity. As a result, suppliers are fighting for business from a mere handful of buyers.

Chief among them is Intel Corp., which earmarked \$1 billion for capital expenditures in 1991 and will likely

spend as much this year. Other active buyers are Motorola Inc. and Texas Instruments Inc., says G. Dan Hutcheson, president of VLSI Research Inc., a San Jose, Calif., market research firm. TI has opened or is about to open four major fabs worldwide, reports Larry Woodson, worldwide strategic marketing manager for the Dallas company's Semiconductor Group.

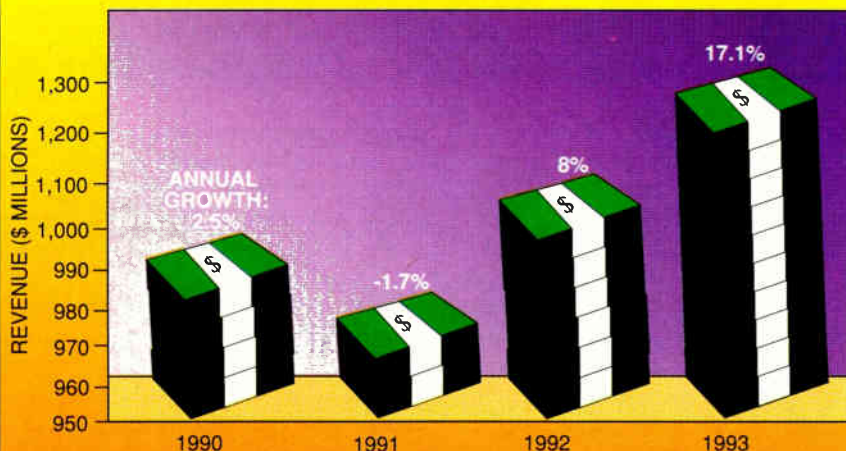
But the vast majority of chip makers are pulling in the reins. Burr-Brown Corp., for example, spent \$12 million on capital equipment last year but plans to downscale to \$8 million to \$10 million worth in 1992, says Robert Switz, vice president and chief financial officer at the Tucson, Ariz., company. Of that amount, says Switz, most is for improving or enhancing existing capacity.

But if 1992 will be slow, "1993 should begin to pick up," says Ron Lessack, vice president of the commercial group at Watkins-Johnson, Palo Alto, Calif. "You will get investment starting for [the next generation of] 16- and 256-Mbit DRAMs." Also, he says, equipment will be purchased for a fast-growing product niche: flat-panel displays. "Currently, most manufacturers are building their own equipment or using heavily modified commercial equipment," Lessack says. "Eventually, commercial vendors will replace this in-house equipment" with production units.

Industry watchers also predict that by the end of 1992, the computer industry will be coming out of its slump. Faster CPUs plus software that demands higher-capacity DRAMs means a fresh demand for next-generation CMOS processing equipment. That onrush could push 1993 revenues ahead 17%, to \$1.23 billion, says analyst Hutcheson.

The 1992 outlook is less grim in ATE,

SEMICONDUCTOR PRODUCTION EQUIPMENT



Slowdown is seen in Japan and Europe, too

where worldwide sales could rise 12.5% to \$1.35 billion, says Fred Van Veen, vice president of corporate relations at tester maker Teradyne Inc. in Boston. ATE spending has lagged for 10 years as everyone bought production equipment, Hutcheson says. But now manufacturers find they must test the devices rolling off their new production lines—and the installed ATE base is simply not up to the job.

Many of these units are four to five years old, and not designed to handle the narrower line widths of today's fast ICs. The majority of IC testers, for example, are built for 20-MHz parts. Today's state of the art is 30 to 40 MHz, with some devices reaching upwards of 200 MHz, says Van Veen.

Meanwhile, the 1992 market for EDA tools will harbor pockets of high growth amid a slower overall picture, says Ron Collett, director of ASIC/EDA research at Dataquest Inc., the San Jose research house. He anticipates 15% growth—to \$1.1 billion—a rate that would cause rejoicing in some electronics markets but one that is a disappointment in EDA, accustomed to a run of 25% or 30% years.

Sales to the U.S. and Japan were soft in 1991, and the once booming European market is leveling off, says David Chen, vice president of marketing at EDA leader Mentor Graphics Corp., Wilsonville, Ore. Nonetheless, Chen believes EDA has room to grow. Device and board complexity keeps rising as time to market shrinks, so EDA tools are no longer a luxury but a necessity.

Also helping is the shift to top-down design using high-level description languages and behavioral synthesis to convert designs to silicon. Designers using synthesizers are experiencing up to four-to-one productivity gains, says Chris Sheldon, vice president of marketing at Racal-Redac Inc. in Reading, England, and that's a compelling reason to invest in EDA tools.

In addition, multichip modules—packages that provide higher frequency and higher gate density than boards or chips alone—are fueling demand too. Neither ICs nor boards, modules require a unique set of design tools. As their popularity grows, it creates new opportunities for suppliers. □

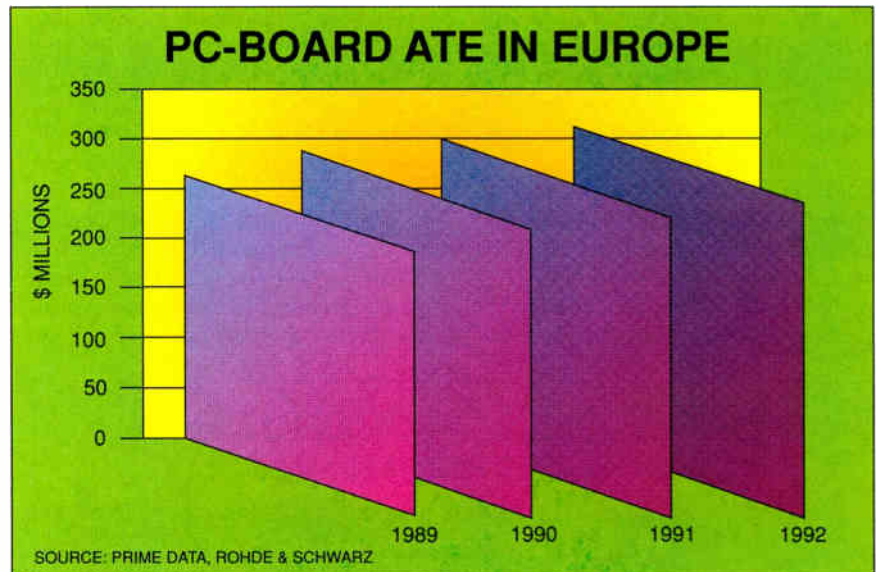
With Japan cutting back on capital expenditures and Europe tapering off its once robust buying, the international outlook for semiconductor production equipment, test and measurement tools, and electronic design automation is somber.

Stung by the slump in DRAMs, Japanese chip makers are postponing purchases of equipment for 16-Mbit devices until they get a payback from their investments in 4-Mbit production, says Junichi Saeki, director of the Information System Group at Dataquest Inc. in Tokyo. And with the continent-wide economic slowdown and the uncertainties stemming from unification on their minds, European producers too are

INTERNATIONAL

Germany has long been Europe's best customer for production gear, generating annual growth rates of 10% or more. But this year only a few sectors are expected to do at all well, among them the still small market for surface-mount-device placement machines. This niche should rise 10% to \$143 million, says Harald Bollen, sales director for surface-mount technology assembly lines at Siemens AG in Munich. The European surface-mount market overall, which came to \$273 million last year, will be slower.

In T&M, analysts agree that the German market will remain flat or, at best, rise 1% to 2%, to just under \$600 million. If it weren't for the "new" states in the

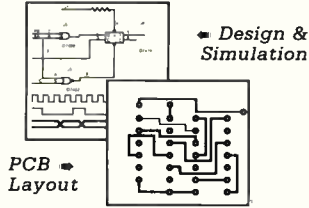


holding back on big-ticket purchases.

The DRAM battering isn't Japan's only problem. So is cost of capital, says Ron Lessack, vice president of the commercial group at Watkins-Johnson, Palo Alto, Calif. Where it once enjoyed a 3% cost-of-capital rate, he says, Japanese industry is now looking at 7%. Moreover, the \$700 million cost of building a new fab is enough to sober even the wealthiest company, Lessack says. Until the DRAM situation sorts itself out, analysts expect little movement.

country's eastern part, where big telecom projects are creating a demand, growth would be negative, one expert says. In ATE, Europe's market will rise just 4%, to \$311 million. Sales are mostly in small systems priced under \$300,000, says Herbert Hönle, a product engineer in the test systems marketing and sales group at Rohde & Schwarz in Munich. "The military market, which until recently accounted for much of the sales of big systems, is shrinking," he says.—John Gosch and Jonah McLeod

Low Cost CAD Software
for the IBM PC and Compatibles
Starting at only \$99



- * Easy to use schematic entry program for circuit diagrams (SuperCAD)—Only \$99. Includes large library, netlister and dot matrix printer output.
- * Powerful, event-driven digital simulator (SuperSIM) starting at \$99.00. Operates directly from SuperCAD menu and displays waveforms in built-in "logic-analyzer" display.
- * Circuit board artwork editor and auto router programs, starting at \$99 each.

Write or call for free demo disks:

MENTAL AUTOMATION, INC.

5415 - 136th Place S.E.
Bellevue, WA 98006
(206) 641-2141

MENTAL AUTOMATION, INC.

CIRCLE 138

CUPL
PLD/FPGA Design Software
Now Featuring Mach™ Support



Get the popular CUPL development software with the newest and latest features for PLD/FPGA logic design and shorten your time to market. CUPL's powerful "C-Like" syntax allows you to develop custom logic design quickly. CUPL starts at \$495.

Call your order in TODAY - Start customizing Tomorrow!

1-800-331-7766
or (305) 974-0967.

LOGICAL DEVICES, INC.

LOGICAL DEVICES, INC.

CIRCLE 145

**ACCELERATION, PRESSURE,
AND LOAD SENSORS IN STOCK**

Entran miniature sensors for acceleration, force, and pressure with associated power supplies, amplifiers, and meters. Chosen for ordering convenience and prompt shipment, the large selection offers solutions to a variety of commercial and military applications.



ENTRAN DEVICES, INC.
10 Washington Avenue
Fairfield, NJ 07004

CALL TOLL FREE (800) 635-0650
FAX 201/227-6865

ENTRAN MILITARY

CIRCLE 132

EPROM PROGRAMMER

\$750

8 ZIFs

20 Key Keypad

20x4 LCD

- Quick pulse pgms. eight 1 Mbit EPROMs in 40 sec.
- Stand-alone or PC-driven
- RS-232, parallel in & out ports
- Binary, Intel hex, & Motorola S formats
- 00 user-definable macros
- Information, call (916) 924-8037
- 1 Megabit of DRAM
- Made in U.S.A.
- A9 Identifier
- 2 year warranty
- Single pgmr. \$550

NEEDHAM'S ELECTRONICS

4539 Orange Grove Ave. • Sacramento, CA 95841

(M-F, 8-5 PST)



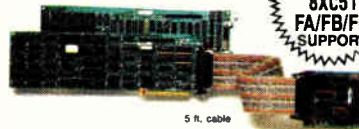
NEEDHAM ELECTRONICS

CIRCLE 123



"The Best 8051 Emulator"

FULL 8XC51 FA/FB/FC SUPPORT



8051

SEE EEM 91/92
Pages D 1300-1303

PC based emulators for the 8051 family

8031, 8032, 8051, 8052, 80C152/154/321/451/482/51FA/51GB/51S/51T/535/537/552/562/562/561, 80532, 83C451/552/552/751/752/851, 8344, 87C451/552/751/752, 8751, 8752, DS5000 • CMOS ... more.

- PC plug-in boards or RS-232 box.
- Up to 33 MHz real-time emulation.
- Full Source-level Debugger w/complete C-variable support.
- 64 bit wide, 256k deep trace, with time stamp.
- Bond-out/hooks pods for 8051, 83C552, 83C451, 83C652, 83C751, 80C515/80C517, 83C752, 8XC51FA/FB/FC, and more.

Prices: 32K Emulator 8031 \$1790; 4K Trace \$1495* (US only)

CALL OR WRITE FOR FREE DEMO DISK!

Ask about our demo VIDEO

nohau
CORPORATION

51 E. Campbell Avenue
Campbell, CA 95008
FAX (408) 378-7869
(408) 866-1820

Call 408-378-2912
Nohau's 24-hour
information center to
receive info via your FAX

NOHAU CORP.

CIRCLE 161

IEEE-488

Hardware and Software Solutions

COMPUTER PLATFORMS

PC/XT/AT, EISA, PS/2, 386, Macintosh, Sun-3/4 and SPARCstation, DEC/VAXstation, IBM RISC System/6000, HP/Apollo

BUSES

VMEbus, MULTIBUS, SBX, STD, SCSI

DRIVER SOFTWARE

DOS, Windows 3.0, OS/2, XENIX, UNIX, 386/ix, Domain/OS, SunOS, Macintosh OS, VMS, ULTRIX, AIX

SUPPORT

Analyzer, Extenders, Expander, Converters, Controllers, Buffer, Switch Box, Cables

(512) 794-0100
(800) IEEE-488



NATIONAL INSTRUMENTS

CIRCLE 136

**VOLTAGE SELECTABLE
INTERNATIONAL SYSTEM**



Z-LINE TPC 884

The TPC, a voltage-selectable power distribution and control system, can have either 120 or 240 volt input and output. Designed with IEC-, UL-, CSA- and VDE- approved components, operating up to 16 amps in Europe and 20 amps in North America. Size: 19.0" x 1.75" x 7.0". EMI/RFI filtering, spike/surge suppression and overload circuit breaker protection are standard. Remote on/off is optional.

Pulizzi Engineering, Inc.

3260 S. Susan St.,

Santa Ana, CA 92714

714/540-4229 FAX: 714/641-9062

PULIZZI ENGINEERING

CIRCLE 129



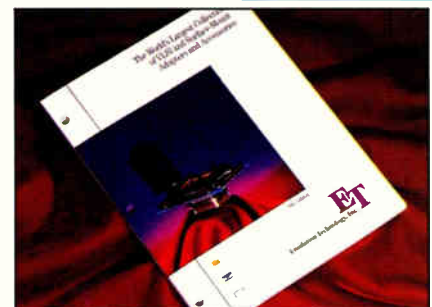
OPTICS CATALOG

Free 130-page catalog from largest supplier of "off-the-shelf" optics. Product descriptions, photos, data, graphs, ordering information for lenses, prisms, optical flats, reticles, mirrors, etc.

ROLYN OPTICS, 706 Arrow Grand Circle, Covina, CA. 91722-2199 (818) 915-5707, FAX: (213) 915-1379.

ROLYN OPTICS CO.

CIRCLE 143



Free Catalog

The World's Largest Collection of Adapters & Accessories for VLSI/Surface Mount Devices

- Emulator Pods & Adapters
- Debug Tools
- Programming Adapters
- Socket Converters
- Debugging Accessories
- Prototyping Adapters
- Custom Engineering

Emulation Technology, Inc.
2344 Walsh Ave. Santa Clara, CA 95051
Phone: 408-982-0660 FAX: 408-982-0664



EMULATION TECHNOLOGY

CIRCLE 144

SOFTWARE

RELIABILITY PREDICTION SOFTWARE

ARE YOUR ELECTRONIC PRODUCTS RELIABLE?

RelCalc 2 automates MIL-HDBK-217E on your IBM PC!
Very easy to use. Try our Demo Package today for \$25.

T-CUBED SYSTEMS 31220 La Baya Drive, #110
(818) 991-0057 Westlake Village, CA 91362
FAX: (818) 991-1281

CIRCLE 258

Looking for
MANAGERS
Across the OEM
Marketplace?

more than

85,000

read

Electronics

Every Month

To reach them with a
recruitment ad Call

Penton Classifieds
at 216-696-7000
ext.2520

Don't Wait . . .
**FAX YOUR
ORDER NOW!**

To reserve space, FAX
your order to
Penton Classifieds,

FAX: (216) 696-1267

Advertiser's Index

Abbott Electronics.....20	Nohau Corporation49
AMP, Inc.....33, 35	Nebraska Public Power District.....2
ASM Lithography3	P-CAD.....17, 17a*
Conference Manager Computer	Philips Semiconductors24E-24G**
Quality, Standards ConferenceCov III	Philips Test & Measurement.....39**
Cypress SemiconductorCov IV	Photo Research12
Deutsche Messe AG.....24I**	Pico Electronics, Inc.13, 19
Electronic Trend Publication8**	Pulizzi Engineering49
Emulation Technology.....49	Rolyn Optics49
Entran Devices.....49	Siemens AG.....24B-24C**, 24K**
Fujitsu, LTD24A**, 24L**	SysTech Research.....39*
Fujitsu Microelectronics.....5	Tektronix, Inc.....11
GenRad, Inc.29	Vicor23
Graphica Computer Corp.....9**	The Western Design Center.....15
Logical Devices, Inc.....49	
Mental Automation49	
National Instruments.....49	
Needham's Electronics.....49	

* Domestic only

** International only

The advertisers' index is prepared as an additional service.

ELECTRONICS does not assume any liability for errors or omissions.

INDEX

IT ISN'T EASY TO FIND GOOD NEWS FOR THE NEW YEAR

As the year ended, we were basking in the glow of Terry Anderson's release, wincing at the sensationalism of the William Kennedy Smith rape trial, and pondering the implications of a stalled economic recovery. For their part, electronics industry watchers were scanning the globe for evidence of a recovery, if any, in 1992. Confounding the process were the unknowns: new twists in government domestic policy, election year politics, and the collapse of the Soviet economy. In sum, the bad outweighs the good.

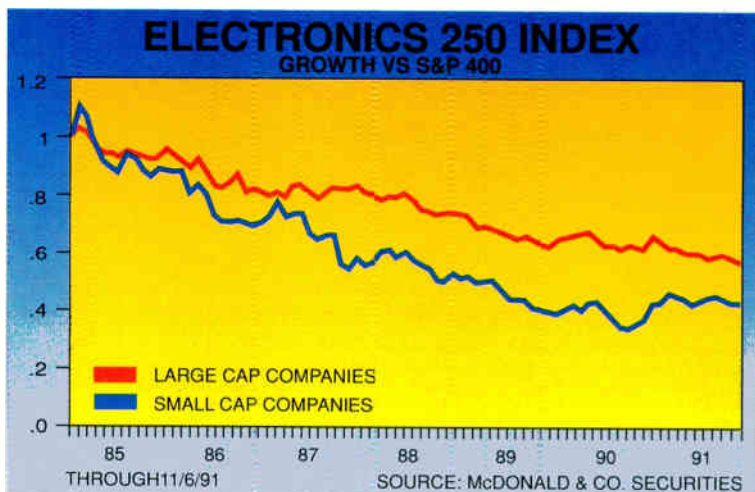
The computer outlook has been permanently damaged by the commoditization of the market. With hardware prices hitting new lows almost monthly, new-product design will likely shift to cost-reduced models that maximize the utility of existing software. It could be several years before the computer industry can return to a consistent growth mode. And an upturn in capital equipment demand may be delayed until September by the continuing lack of durable-order strength.

European and Far Eastern trends appear to be worsening as well. Higher taxes in Germany to fund unification have dramatically reduced growth prospects. Weaker demand for Japanese exports and stronger competition from the Four Tigers have also stalled the once invincible Japanese growth engine. Further, recent advances in consumer electronics are creating more confusion than demand.

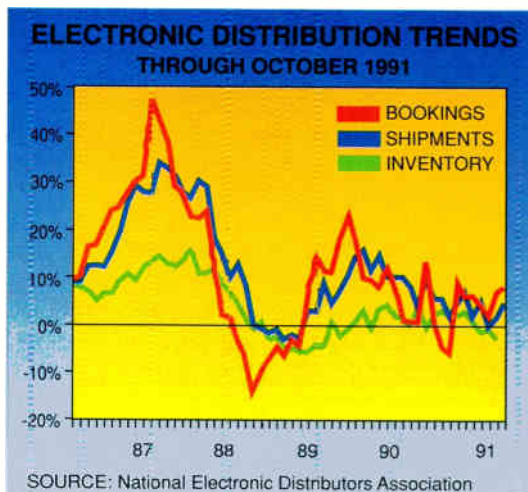
But there is some good news. Despite weak overall demand, inventories remain in excellent shape, and October and November distributor order patterns showed modest improvement over last year's numbers.

So it appears that 1992 earnings improvements for electronics companies will be more a function of cost reduction than momentum. □

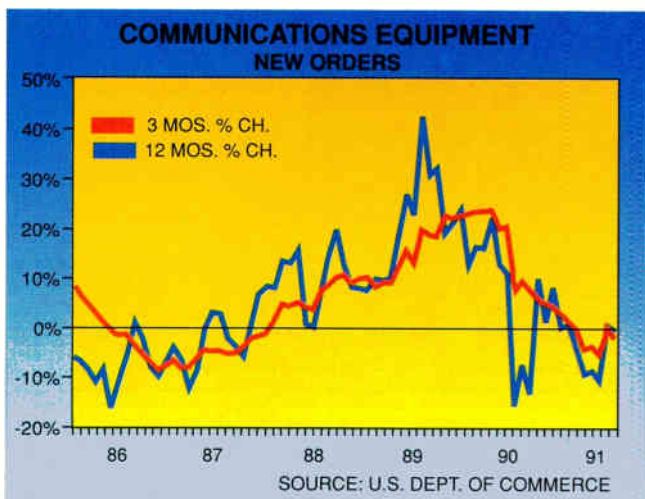
By Mark Parr of McDonald Securities Inc., Cleveland (216-443-2379)



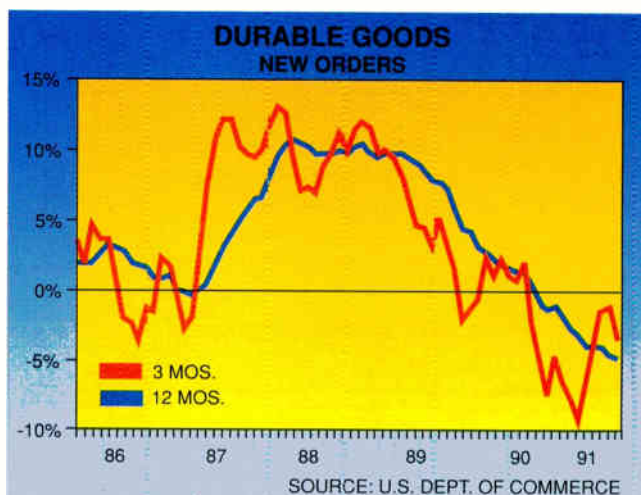
The index comparing growth of electronics shares to the Standard & Poor's 500 continues to slide as the new year begins.



Distributor orders in the last quarter showed some gain over last year's similar period.



Communications equipment orders dipped at the end of the year after displaying some strength.



Orders for durable goods showed the same recession weakness as most of the rest of the economy.

LAST WORD

EXPECT NO CHANGE IN THE FIRST HALF

As of last month, this became the longest postwar recession on record. It entered its 17th month, compared to the 16-month recessions that occurred in 1973-75 and 1981-82. You have to go all the way back to the Great Depression to find a longer one.

Nonetheless, the performance of the economy has been puzzling not so much because the recession has dragged on, but because economic activity is so flat: real growth is neither rising nor falling. Industrial production has been stagnant, along with employment and retail sales. The economy is no better or worse.

Since the economy has never faced a situation like this, 1992 forecasts are based on a foundation of quicksand. Nevertheless, for the first half I think the status quo will continue, which means virtually no change in production, employment, or sales. Since population and the labor force will keep rising, the unemployment rate will indeed increase, probably to 7.5% by midyear; thus most articles will suggest that the recession is deepening. But in fact the economy will remain stagnant.

Consumer spending should be separated into two groups: big-ticket items that require additional debt, and everything else. Consumer credit outstanding has been declining, and will continue to do so in 1992—and possibly for many years into the future. So sales of new cars and houses will remain quite depressed.

Other consumer spending, however, probably hasn't declined at all. The most reasonable explanation here is that it is prices that are declining, not volume: this doesn't necessarily mean that stores are marking down their merchandise, though that is taking place. But the phenomenon I have in mind here is that people are buying less expensive items—or buying the same items at wholesale-type stores and discount malls.

The way inflation is measured, prices have not gone down at all. But consumers are spending more on these small-ticket items and keeping the economy from sliding ever further over the edge, even if the government doesn't know about it. By comparison,

the volume of sales for houses, cars, and other big-ticket items continues to decline no matter how prices are measured.

The latest round of layoffs has led to some stability in profits, which had been falling sharply for the past two years. For the third quarter of 1991, corporate profits were 23% below year-earlier levels. However, I expect they will be level with year-earlier levels in the fourth quarter and then rise in 1992. That means fewer layoffs, less reduction in inventory stocks, and stable instead of declining capital spending. Note that I do not look for any of these to increase; merely stop declining. I still think that a tax cut will be passed by the end of the first quarter, with checks mailed out to consumers sometime early in the following quarter. That will boost growth from zero in the first half to 2% in the second half, as consumers spend those extra checks. However, they still won't go back into debt to buy big-ticket items.

Once the economy does begin to respond to the tax cut, the unemployment rate will stop rising, although it probably will not decline very much if at all in the second half. After all, 2% growth is hardly a major boom. The modest gains in employment stemming from positive growth will be just about enough to balance the continued rise in the labor force. So the upturn in 1992 still won't be a recovery as we usually define it.

The key to survival and prosperity this year is thus not to concentrate solely on cost-cutting, since in most sectors sales will pick up in the second half. However, those able to cut costs will be at an even bigger advantage than usual. But producers, distributors, and retailers will think the recession actually worsened in 1992.

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

THE PUZZLE IS NOT THAT THE SLUMP IS DRAGGING ON, BUT WHY THE PICTURE IS SO FLAT.



REGISTER EARLY. LIMITED ATTENDANCE.

Improve Your Computer Quality, Ensure ISO 9000 Standards Compliance

2-1/2 DAYS OF INTENSIVE DISCUSSIONS TO HELP YOU:

- * Improve customer satisfaction
- * Increase product revenue
- * Reduce development, manufacturing costs
- * Reduce defects, RMAs
- * Improve global competitiveness
- * Increase profits

The industry's first Computer Quality and Standards Compliance Conference will help component, subsystem and computer manufacturers focus on vital quality issues, strategy options and ISO 9000 quality standards.

The conference will help you differentiate your products...lower manufacturing costs...improve quality...and keep customers happy.

More than 40 sessions specifically tailored to help senior computer industry manufacturing executives address the critical issues of manufacturing quality, ISO 9000 standards, customer acceptance and global competition.

SPEAKERS

- * ISO Committee Members
- * Canadian, European, American Compliance Officials
- * Baldrige Award Winners
- * Senior Executives of Major Computer Manufacturers/Service Organizations
- * Key Decision-makers from Computer Reseller Firms
- * Market Researchers
- * Key Decision-makers from Large Corporate Computer User Firms
- * Others Who Will Address the Impact of ISO 9000 and the Demand for Quality on Computer Manufacturers, Resellers and Users

WHO SHOULD ATTEND

Computer component, subsystem and system manufacturing/marketing presidents and senior executives concerned with designing, producing and delivering quality products and systems on a global scale.

LIMITED ATTENDANCE

Limited to 200 computer industry executives to ensure that attendees receive maximum benefit from the conference. Conference fee will be \$975 per attendee.



Date, Location

February 12-14, 1992
Monterey Plaza Hotel
Monterey, California

For more information, contact:

Conference Manager Computer Quality, Standards Conference
c/o Marken Communications, Inc.
3600 Pruneridge Ave., #130
Santa Clara, CA 95051
Phone: (408) 296-3600
FAX: (408) 296-3803

Conference Sponsor: DiagSoft, Inc., world leader in PC quality assurance and diagnostic software.

A REVOLUTIONARY ADVANCE IN SPARC MULTIPROCESSING.

The industry's first integrated SPARC® multiprocessing solution — the CY7C605 Multiprocessing Cache Controller/MMU.

High-performance systems designers have migrated to RISC in a race for performance. Just as rapidly, there is a movement to multiprocessing, which represents the most cost-effective way to load more power into a single system.

Multiprocessing RISC design is not simple. There are substantial technological challenges, particularly in the area of multi-level memory systems.

Now we offer a breakthrough to help you implement multiprocessing systems rapidly.

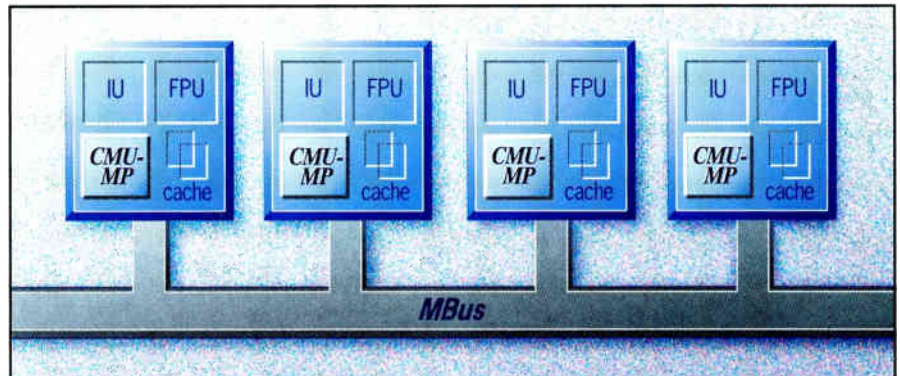
Cache coherency without stealing processor cycles — a leap in performance.

Maintaining cache coherency is one of the biggest problems to solve in shared memory multiprocessing systems.

This approach solves it.



Pin compatible with our CY7C604 Uniprocessing Cache Controller/MMU, this new device lets you cascade to build cache size to 256K.



SPARC multiprocessing is now enabled. Now you can design-in multiple high-performance SPARC chipsets. Our revolutionary Multiprocessing Cache Controller and Memory Management Unit (CMU-MP/CY7C605) provides memory management facilities and a unique cache architecture for higher performance. Our complete SPARC chipset solution shortens your time to market.

It is the only VLSI solution that performs concurrent bus snooping and processor execution.

Our unique dual cache tag directories provide for simultaneous bus snooping and processor access to cache. No other cache management unit provides dual tags on-chip.

As a result, your system maintains cache coherency without stealing execution cycles from the microprocessor.

You get multiprocessing with the most efficient cache coherency protocol available, allowing data to pass from CPU to CPU in a single clock cycle. That translates directly to higher performance systems.

MBus compliant.

MBus compliance means you have a SPARC-standard, plug-and-play route to even more powerful, higher performing systems.

An integrated part of the industry's highest performance SPARC chipset.

Our chipset approach simplifies the complexities of multiple CPUs working together in a shared memory system.

This VLSI solution means you don't have to design and pay for boards full of logic to accomplish fast multiprocessing.

It is all available now.

For more information on the industry's most complete multiprocessing solution, please call for our literature package today.



Multiprocessing Information Hotline:
1-800-952-6300.*
Ask for Dept. C9V.



*(32) 2-652-0270 in Europe. © 1991 Cypress Semiconductor, 3901 North First Street, San Jose, CA 95134. Phone: 1 (408) 943-2600, Telex: 821032 CYPRESS SNJ UD, TWX: 910-997-0753. SPARC is a registered trademark of SPARC International, Inc. Products bearing the SPARC trademark are based on an architecture developed by Sun Microsystems, Inc.