# **CAD/CAM Industry Service Newsletters**

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-23

#### SILICON COMPILATION COMPANIES: MISSIONARIES, MERCHANTS, AND DESIGN BROKERS

In Dataquest's CCIS Research Newsletter, "Silicon Compilation: Market, Myth, or Methodology," we discussed how, despite many misconceptions, a cell-based design methodology called silicon compilation is entering the integrated circuit (IC) CAD market. We defined two types of silicon compilation capability: silicon compilers and compiler generators. The increased support required by users of this unfamiliar methodology often blurs the roles and responsibilities of those companies providing design tools and design services and those companies actually fabricating the chips. Does silicon compilation consist of design tools, design libraries, design services, or finished silicon? To address this dilemma, this newsletter will focus on the following issues:

- Commercially available compilation products
- Compilation vendors and their role in the market
- Dataquest's analysis of related issues

#### PRODUCTS

Dataquest defines silicon compilation as two basic types of design tools: silicon compilers and compiler generators (see Figure 1). These two product types differ functionally in the level of silicon expertise required of users and also in their targeted markets. And, as the markets for these products mature, vendors are more clearly delineating product offerings to express these differences.

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Silicon compilers such as Chipsmith from Lattice Logic, the Concorde C3 and C4 from Seattle Silicon Technology (SST), and Genesil from Silicon Compilers Incorporated (SCI) are targeted at the system engineer who is a novice chip designer. Such tools allow system engineers the ability to automatically design application-specific integrated circuits (ASICs). Silicon compiler programs offer a user access to design "data books" or libraries containing the process rules, primitives, simulation models, and physical design information.

To design the chip, users select the desired functions from a menu and fill in a form with their design-specific requirements. The modified functional blocks are then either manually or automatically placed and routed. Ideally, users will be able to "shop" their designs around, comparing costs and design output of different foundries.

We have observed that compiler vendors Lattice, SCI, and SST target their products at system houses and ASIC houses. Additionally, for those companies with in-house IC designers wishing to expand compiler libraries, these vendors offer compiler generator tools, such as SCI's Genesis and SST's Concorde C5, which contains SST's SLIC design language. Lattice offers Shapesmith, mask data preparation software, as an adjunct to its compiler.

In contrast, compiler generator tools offered by SDA Systems and Silicon Design Labs (SDL) are aimed directly at the silicon-sophisticated IC designer in either the system house or semiconductor company. This user's goal is more efficient IC design. To such a user, compiler generators represent a more evolved IC design methodology than that of polygon pushers. Compiler generators geometry-based, offer many improvements, such as providing the structural means of capturing the original intent of a design for future reuse by a compiler. Compiler generators facilitate library development, and, in contrast with polygon pushers, are unique in their ability to combine electrical and geometric The design information is in a more intelligible, information. accessible, and recompilable format than designs completed with traditional IC CAD systems. (When we refer to compiler generators aimed at the hard-core IC designer independent of front-end silicon compiler considerations, we mean such products as SDL's GDT and SDA's ChipEdge.)

Both GDT and ChipEdge allow design specification through either schematics or language. SDL's GDT consists primarily of a design layout language called L, a hierarchical data base, and L-sim mixed-mode and behavioral simulator. SDA Systems offers its SKILL design language to control the leaf-cell structure compiler of ChipEdge.

Figure 2 lists the major compiler products and vendors. Profiles of the six major vendors of commercial compilation products can be found in Tables 1 through 6.

#### **COMPANIES**

Probably more confusing than the concept of silicon compilation itself is figuring out who the compiler players are and how they fit into the overall IC CAD market. Are they CAD vendors or design brokers? For example, SCI, SDL, and SST have alliances with EDA vendors Daisy, Mentor, and Valid. The marketing objectives of some compiler companies have undoubtedly undergone revision, as their products find their way to customers.

Some silicon compiler vendors offer design services in addition to the usual customer support. SCI and SST, for example, each consider design brokerage to be a substantial component of their businesses, and Seattle Silicon has even conceptualized it as its first silicon product. SST, which began business as a design house, refers to the design service portion of its business as First Silicon Services. However, Dataquest considers silicon compilers and related technology libraries to be the primary business of these companies.

VLSI Technology Incorporated (VTI), an ASIC house and standard cell market leader, sells compilation tools based on its own cell libraries in addition to its design and manufacturing services. VTI's tools include compilers and libraries of standard cells and compilable cells. We believe that a company such as VTI would have no reason to market compiler generator capability. Other foundries, such as Cirrus Logic, Gould-AMI, and LSI Logic, offer silicon compilation capability only as a design service that they themselves perform.

We classify SDL and SDA as primarily compiler-generator vendors, although SDL markets some libraries created with its compiler-generator tools. SDL's announced strategic direction, however, is toward the eventual offering of a full-fledged silicon compiler. SDA, in contrast, currently sells no libraries, only the tools to develop them. SDA views its business as providing a wide range of IC CAD tools, such as a layout editor, automatic place and route, and design rule checking, in addition to its compiler generator.

#### DATAQUEST ANALYSIS

The growth of the ASIC market is fueling the demand for more automated IC CAD tools. However, questions of design responsibility and guarantees of manufacturability remain problematic for both IC manufacturers and end users. IC companies want to know who will guarantee a compiler's design library. End users wonder who should provide design support.

Almost by definition, silicon compilers stand as the interface between silicon manufacturers and end users. At present, chip manufacturers foresee nothing but problems with users supplying their own layout. And, unquestionably, compilation is limited by the silicon expertise available to the silicon compiler company. The designs available on compilers have necessarily been generalized to guarantee working silicon. Efficiency in terms of speed and silicon utilization has also been sacrificed as part of this generalization.

Dataquest believes that relationships with IC companies are absolutely critical to the success of silicon compilation. Close links between the chip manufacturers and tool vendors will mean reasonable guarantees of manufacturability to end users without sacrificing speed or silicon utilization. We can easily foresee more players addressing this problem. It is not difficult to envision a market niche opening for library development companies supplying foundry-specific and/or technology-specific compiler libraries.

Support remains a critical and cost-intensive part of a compiler company's business. Branching out into design services may seem to be the only logical business alternative to operating in the red. However, Dataquest believes that if compilation is to move from a visionary methodology to a commercially viable product, the tools themselves will have to fulfill their original promise and stand on their own. In our opinion, this means increasing degrees of automation and more specific design expertise incorporated in the tools themselves.

Tony Spadarella

# Figure 1



COMPILER GENERATORS AND SILICON COMPILATION

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Source: Dataquest September 1986



#### SILICON COMPILATION VENDORS AND PRODUCTS



Source: Dataquest September 1986

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# LATTICE LOGIC LIMITED

Readquarters:	Edinburgh, Scotland (U.K.)
Founded:	1982
Origins:	University of Edinburgh
Funding:	Not disclosed
Participants:	East of Scotland Investors (ESII), Investors In Industry (III)
Compiler Products:	Chipsmith
Delivery:	Turnkey or unbundled
CAD Alliances:	VIA Systems
IC Alliances:	European Silicon Structures (ES2), FELA (Switzerland), Ferranti, Hughes (U.K.), IMP, Lasarray, Newmarket Micro Systems
Hardware Platforms:	Apollo, Digital, IBM, Sun, Whitechapel
1985 Revenue:	\$1 million

Source: Dataquest September 1986 Т

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# SDA SYSTEMS

Headquarters:	Santa Clara, California
Founded:	1983
Origins:	National Semiconductor and University of California at Berkeley
Funding:	1983\$6 million (industrial sponsors), \$4.5 million 1986\$8.3 million
Participants:	Alain Patricof and Associates, Applied Technology Partners, Continental Capital Ventures, Sand Hill Financial Company
Industrial Sponsors:	General Electric, Harris Corporation, L. M. Ericsson Telephone Company, National Semiconductor
Compiler Products:	ChipEdge
Delivery:	Turnkey or unbundled
CAD Alliances:	None
IC Alliances:	None
Hardware Platforms:	Apollo, Digital, Hewlett-Packard, Masscomp, Sun
1985 Revenue:	\$2 million (includes all products)

Source: Dataquest September 1986

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# SEATTLE SILICON TECHNOLOGY (SST)

Bellevue, Washington
1983
Boeing Aerospace
Through 1984\$7 to \$8 million Through 1985\$6.2 million Through 1986\$6 million*
Canadian Enterprise Development Corporation, Hambrecht and Quist, the Hill Partnership, Norwest Venture Capital, Paragon Partners, Prudential-Bache High Technology Research Fund*, Rainier Venture Partners
Concorde Blue Chip Series: C3 (design entry), C4 (compiler), and C5 (compiler generator); First Silicon design services
Software only
Mentor Graphics, Tektronix-CAE, Valid Logic
IMP, Motorola, NCR, Orbit, VTI
Apollo, Digital, Sun
\$1 million (includes OEM and design services)

\*R&D funding; nonequity position

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Source: Dataquest September 1986

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# SILICON COMPILERS INCORPORATED (SCI)

Headquarters:	San Jose, California
Founded:	1981
Origins:	Intel, California Institute of Technology, Scientific Calculations
Funding:	1981\$1 million 1983\$13 million
	1985\$6.3 million
Participants:	General Electric Venture Capital, Kleiner Perkins Caulfield and Byers, L. F. Rothschild, Morgan Stanley, Robertson Colman Stephens
Compiler Products:	Genesil (compiler), Genesis (compiler generator)
Delivery:	Turnkey
CAD Alliances:	Daisy Systems, Mentor Graphics
IC Alliances:	U.SGeneral Electric, Gould-AMI, Honeywell, IMP, Mosis, Motorola, National Semiconductor, NCR, SEEQ, VTC, VTI EuropeAMI-Austria, Matra, SGS
	JapanKicon
Hardware Platforms:	Apollo, Digital
1985 Revenue:	<pre>\$10 million (includes design services)</pre>

Source: Dataquest September 1986

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#### SILICON DESIGN LABS (SDL)

Liberty Corner, New Jersey

Headquar	ters:
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Founded: 1984

Origins: ATT/Bell Laboratories

Funding: \$10.9 million

Participants: Menlo Venture Partners, Welsh Carson Anderson and Stowe, Technology Venture Investors, Battery Ventures, Merrill-Lynch Venture Capital, Technology Funding Inc., Crown Advisors

Compiler Products: GDT (compiler generator development tools), SDL2000 (microprocessor compiler)

Delivery: Turnkey or unbundled

CAD Alliances: Daisy Systems, Mentor Graphics, Tangent (Intergraph)

IC Alliances: Not applicable

Hardware Platforms: Apollo, Digital, Sun

1985 Revenue: Less than \$1 million

Source: Dataquest September 1986

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VLSI TECHNOLOGY INCORPORATED (VTI)

Headquarters:	San Jose, California
Founded:	1979
Origins:	Synertek
Funding:	\$10 million (publicly held)
Participants:	Bendix, Hambrecht and Quist, Olivetti, Rothschild
Compiler Products:	Datapath, logic, and cell compilers; megacell libraries
Delivery:	Software only
CAD Alliances:	Mentor, Daisy, Hewlett-Packard, SCI
IC Alliances:	Fairchild, VTI
Hardware Platforms:	Apollo, Digital, ELXSI, Hewlett-Packard, Ridge, Sun
1985 Revenue:	\$20 million (includes design services and NRE)

Source: Dataquest September 1986 \*、

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-21

#### THE 23RD DAC: SO WHAT'S NEW?

#### INTRODUCTION

The relative maturity of the electronic CAD/CAM (ECAD) industry demonstrated at this year's Design Automation Conference (DAC), and the seeming lack of flash, overhyped new products, led many attendees to ask: "So what's new?" What's new is precisely this maturity, represented, in our opinion, by the nature of what was shown and announced. There were a large number of announcements relating to the broadening of product lines by means of increased functionality and new hardware and software platforms, as well as synergistic agreements relating to joint marketing and development, and to technology transfers.

This newsletter highlights major announcements by exhibitors at the 23rd DAC. We present the companies who were at the DAC in alphabetical order. We have also included a floor map of the show as a graphic illustration of the ECAD Industry in 1986.

(For a complete analysis by Dataquest of the significant trends and directions evidenced at the show, please refer to newsletter No. 20, "ECAD Industry Settles Down to Business, Not Las Vegas," dated July 1986).

#### COMPANIES

#### AIDA

Newcomer AIDA Corporation unveiled its AIDA Design System and ATPG automatic test pattern generator at this year's DAC. Aimed at designers of large, complex multiboard and multichip systems, AIDA Design System is an end-to-end turnkey product, offering facilities for design and analysis, rule checking, test, and fault simulation. AIDA claims its system can handle more than 250K gates at 5 million evaluations per

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second. The AIDA System Simulator Accelerator incorporates logic simulation that operates on a levelized compiled code basis and is event-driven. The AIDA Design System currently runs on an Apollo workstation and, including the CoSimulator Accelerator, is priced at \$140,000. An upgrade for Apollo users is available at \$85,000.

#### Analog Design Tools (ADT)

ADT, in addition to demonstrating its Analog Workbench software on Apollo, HP, IBM PC AT, and Sun workstations, made the following announcements at the DAC:

- ADT introduced Smoke Alarm, a new module for automatically evaluating the operating conditions of all circuit elements, including passive components, semiconductor devices, and power supplies, warning designers if any components fall outside safe operating areas. Smoke Alarm is based on ADT's SPICE PLUS simulation software and runs on all versions of the Analog Workbench. Available now, the Smoke Alarm's price is \$10,000 on Apollo, HP, and Sun hardware, and \$6,000 on the IBM PC AT.
- ADT and linear ASIC developer Micro Linear Corporation signed a joint marketing agreement, whereby Micro Linear will integrate both its micro and macro cell libraries with ADT's Workbench product.
- ADT signed an agreement with Data I/O Corporation's FutureNet division, under which FutureNet will license ADT's PC Workbench design software, and will market the new DASH-Analog Workbench based on it, beginning in third guarter 1986.

ADT's agreement with FutureNet, as well as its numerous agreements with companies such as Hewlett-Packard, reflect the company's strategy of increasing its distribution channels by adapting its products to industry standard hardware and software platforms.

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#### Apollo Computer

Apollo announced a new, four-tiered Solution Supplier Program designed to deliver third-party applications to Domain System users. The program is structured as follows:

 Software/Hardware Supplier Program: Allows the supplier access to discounted Apollo development and demonstration equipment, Apollo sales leads referrals, field technical support, entry into Apollo's catalog of applications and summary updates, referral in sales training, and other marketing resources.

- Impact Program: Allows suppliers to share in features of the Software/Hardware Supplier Program and to participate in Apollo's corporate advertising, corporate technical support, and other joint marketing and promotional activities.
- Impact-Plus Program: For suppliers who want to integrate their solutions within the Apollo environment. This program includes focused efforts in the areas of product integration, technology sharing with Apollo R&D, cooperative advertising, and other merchandising tools as described in the Software/Hardware Supplier and Impact programs.
- Foresight Program: Offers suppliers new OEM contracts, access to technical documentation and source code, expanded technical support, OEM sales training and communications, direct sales literature and distribution, joint marketing efforts, and OEM systems configurations.

Apollo highlighted more than 85 EDA packages running on the newest generation of Domain workstations including the DN3000 and the DN570. Applications shown included schematic capture, simulation, and verification for IC and PCB design.

#### <u>Applicon</u>

Recently reorganized Applicon introduced Bravo3 software, which includes schematic capture, analysis, and physical layout for PCB and VLSI applications. Bravo3 software components include the following features:

- Schematic capture includes a set of component catalogs and generic logic symbols, and allows the creation of user-defined libraries. It supports multiple levels of design hierarchy with multiple sheets and simulation data available at each level.
- Logic analysis includes an integrated logic, timing, and fault simulator providing network modeling at gate, functional, and behavioral levels.
- Layout can be performed using either the automatic or interactive capabilities, or a combination of the two. Tools include schematic analysis, gate packaging and placement, routing, and design verification.

Also demonstrated were the company's MCAE software which allows for mechanical analysis of electronic components without reentering data, and the Bravo3 4670 graphics terminal. The 4670 comes with 1,600 x 1,200 pixel resolution, 1,793 colors, 3D display list capabilities, and solids modeling and shaded image generation.

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#### Cadam

Cadam demonstrated the following recently announced products:

- The Military Electronic Devices Data Base provides comprehensive military specification device information with cross-reference indices covering parts by generic/industry, government, and NSN designations.
- The Discrete Semiconductor Data Base covers directed and suggested replacement information on more than 100,000 transistors, diodes, thyristors, optoelectronic devices, and microwave devices, and offers alternate source information for more than 100 manufacturers.
- The Integrated Circuit Data Base lists direct and suggested replacements for more than 50,000 devices provided by approximately 100 manufacturers as well as generic substitution details on 150,000 digital, interface, microprocessor, audio/video, linear, and memory ICs.

These three products are designed for use with either IBM 5080 graphic display terminals running CADAM or with alphanumeric display terminals.

In addition to the three data bases, Cadam also showed Thermal Analysis, a software package that provides computerized evaluation of thermal properties associated with the design of PCBs. The new package expands upon the foundation provided by Interactive Prance CADAM (IPC). Once IPC has completed placement, Thermal Analysis quantifies related heat dissipation characteristics.

The company also announced that it has expanded its software product offering with the addition of Digital Circuit Simulation, a product that applies computer modeling techniques to the testing and analyzing of electrical and electronic components. Digital Circuit Simulation integrates CADAT logic, timing, and fault simulation into the CADAM interactive graphics environment, allowing PCBs and ICs to be tested and debugged in software. Digital Circuit Simulation is driven by the standard CADAM user interface. It is also fully integrated with CADEX for schematic and wiring diagram extraction, and with IPC for PCB layout.

#### <u>Cadnetix</u>

Cadnetix introduced the GP Engine, a general-purpose accelerator based on the MIPS Computer Systems' R2065 Series component kit. The 8-megabyte single-card accelerator, designated the CDX-760, utilizes RISC technology and features a floating-point processor, cache memory, and facilities for parallel processing. Initial accelerated applications available on the GP Engine will be SPICE and data base compilation for \$29,000. Data base compilation is priced at \$5,000. The GP Engine and Data base compilation will be available in fourth quarter 1986. A UNIX operating environment with a C compiler and debugging utilities is priced at \$120,000, and will also be available in fourth quarter 1986.

The company also announced the new Analysis Engine processing node specific configurations including accelerated compilation. with simulation, and mass storage for data base management with up to a 280-Mbyte Winchester disk. The basis of the Analysis Engine is a chassis with a MC68020 processor and an Ethernet LAN interface. Preliminary configurations for the Analysis Engine include the bit-slice engine with simulation and the GP Engine with compilation for \$94,800; physical modeling and the GP Engine with compilation for \$84,800; and the bit-slice engine with simulation, the GP Engine with compilation, and physical modeling for \$127,900. The Analysis Engine will be available in fourth guarter 1986.

Cadnetix also announced a licensing contract with Sun Microsystems for Sun's Network File System protocols for the IBM PC family of products and compatibles. The new contract is a follow-on to an earlier agreement between the two companies that allowed the implementation of NFS on Cadnetix's proprietary hardware.

#### Cadre Technologies

Cadre demonstrated new real-time and structured design versions of its Teamwork computer-aided software engineering (CASE) products on a variety of workstations, including the Apollo, IBM RT PC, and Sun-2 and Sun-3. The new Teamwork products are:

- Teamwork/RT: A real-time system analysis environment that extends Cadre's original Teamwork/SA product to provide real-time or control flow analysis for engineering, process control, and embedded systems applications.
- Teamwork/SD: A systems design environment with enhanced coordination and communications during software design and coding.

Cadre is planning to offer its Teamwork products on a Digital Equipment workstation in fourth guarter 1986.

#### <u>Caeco</u>

Utah-based start-up Caeco Inc. made its debut at the 23rd DAC, demonstrating its schematic capture Caepac II package. Caeco's products run on Apollo DN570 and Sun 3/160C workstations. Caeco also announced the following two new products:

- The Layout Design System, a full-custom IC layout software package, offers a Process Definition File (PDF) that eliminates duplication throughout the data base.
- Real-time Design Rule Checking allows users to create design rule correct devices symbolically. It checks relational spacing between devices and interconnect as the designer works.

The company recently received \$2.6 million in venture funding from Kleiner Perkins Caulfield and Buyer along with Adler and Company. Caeco plans to use the funds to expand its product offering in the VLSI design market. έ.

#### Caedent Corporation

Caedent announced the Tegas-to-IntelliTest Interface, the first of a series of interfaces that will enable its interactive Intellitest design-for-test software. The interface reads TDL circuit netlist files and Tegas simulation output files. The data in these files are then processed and formatted by the interface. The interface outputs files containing the circuit information in a form that can be used by IntelliTest products. The Tegas-to-IntelliTest interface is available now as part of the IntelliTest software, priced from \$2,500 to \$5,000 for a personal computer-based system, and from \$20,000 and up for larger systems.

#### Calay Systems

Besides demonstrating the Calay VO4 PCB system with autorouting and the 2X100 PCB front-end design workstation product, Calay introduced the following two new products:

- The Calay Hardware Autorouter, which takes advantage of a special microprocessor to accelerate computer-intensive autorouting routines
- The Calnet for Ethernet communications

#### <u>Calma</u>

Calma introduced its new Board Series of PCB design products. The Board Series consists of three packages:

- Board Designer: Schematic capture, board geometry, autoplacement, back annotation, and interactive editing; has a parameterdriven constructive router, and a local rip-up and retry router.
- Board Editor: The same design and layout capabilities as Board Designer with the exceptions of routing and CAM; designed for use on the Apollo DN3000C, linked to the Designer for routing and CAM functions.
- Board Expeditor: A routing node users may use to off-load computationally intense tasks from either the Board Designer or Board Editor, freeing them for interactive work.

The Board Series is currently available for the Apollo DN660, DN3000C, DN570A and DFS90. Approximate prices are as follows: Board Designer, \$50,000; Board Editor Plus, \$40,000; and Board Expeditor, \$75,000.

The company also introduced upgrades to its GDSII IC Design System. The core GDSII system has been upgraded with a windowing capability that enables users to view portions of the physical design concurrently with the entire design. Other enhancements include:

- CustomPlus: A symbolic, hierarchical IC design package, that provides a netlist-driven layout capability that allows users to produce electrically correct physical designs directly from logical information. CustomPlus also includes a point-to-point router.
- TechPlus: An application package for the design of thick and thin film hybrids and analog PCBs that supports through-hole, chip and wire, reflow solder, TAB, cofire, flex, and microwave techniques.

Upgraded GDSII systems are available for 90-day delivery. A Data General DS4200-based GDSII/32 system with CustomPlus is priced at approximately \$100,000.

Calma announced an agreement with S-MOS Systems and General Electric Semiconductor whereby the latter companies' gate array and standard cell libraries that run on Calma's Logic Series workstations (formerly Tegas Station) will now be available through S-MOS and G.E. The S-MOS agreement features a gate array family, and G.E. has both array and cell products. The libraries provide schematic capture, functional simulation, and worst-case delay analysis.

#### Case Technology

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Case Technology announced product enhancements involving a new workstation platform, a new PCB router, and design rule check post processing. Case's Vanguard design system includes SCALD-based tools for schematic and PCB layout editing, logic and fault simulation, and timing analysis. The following are some brief highlights of the Case announcements:

- A new VAXstation II/GPX multitasking, color version of Case's Vanguard design system, available concurrently with the VAXstation II/GPX and priced at approximately \$9,500
- The CT2500 automatic printed circuit board (PCB) router from Academic Systems Incorporated



- PCB Design Rule Checker featuring netlist compare, spacing checks, and graphic error reporting
- An enhanced version of Vanguard's schematic editor that allows users to define their own electrical rules checks

All Case Technology products run on three hardware platforms, the IBM PC, Microvax, and VAX, and software pricing varies accordingly. The price of the Vanguard schematic editor Release 3.0 ranges from \$5,200 to \$12,500. Pricing for the CT2500 ranges from \$5,500 to \$15,000, and for the Design Rule Checker from \$500 to \$2,000.

#### Clarity Systems

Clarity demonstrated the SuperSet 5000 Computer Integrated Engineering (CIE) system for VLSI design. Besides employing an integrated data base approach, SuperSet 5000 includes the following application modules:

- StrucSet hierarchical schematic capture
- SimuSet mixed-mode, multilevel simulation
- TopSet hierarchical symbolic layout and compaction
- GluSet automatic generation of glue logic layout
- PlaSet automatic PLA generation
- GeoSet cell library layout design and verification

Clarity defines CIE as integrating design solutions around an integrated design data base, a network of state-of-the-art workstations, and an advanced interface. Clarity currently offers all Domain nodes from Apollo.

#### <u>Computervision</u>

Computervision introduced its new Autoboard software running on the recently introduced CADDstation. Autoboard is CV's PCB layout software with support of surface-mount technology, high-density digital placement and routing, and single- and multilayer routing. The new software was demonstrated as part of CV's complete PCB design package, which includes schematic capture, digital and analog logic simulation, and layout. The CADDstation is based on the Sun-3 family of workstations. Typical configurations come with 8 Mbytes of RAM, two 85-Mbyte disks, 1/4-inch tape drive, applications software, and library transfer and is priced at \$80,000 per seat.

#### Control Data Corporation (CDC)

Computer manufacturer Control Data announced its agreement with Gateway Design Automation Corporation to convert four digital logic design programs to run on CDC Cyber 180 Series computers. Gateway's products include: Verilog/Verilog-XL, a mixed-level simulator; Testgrade, a logic and concurrent fault simulator; and Testscan, an automatic test pattern generation program for large digital circuits.

In addition to its agreement with Gateway, CDC announced the following new agreements:

- An agreement with Endot, Inc., to convert N.2 applications software to run on CDC Cyber 180 computer systems. N.2 is integrated systems level design software that provides CAD support of complex hardware/software systems, including VLSI custom and semicustom chips, PCBs, and distributed multiprocessing systems.
- An agreement with Rockwell International to develop and market high-density silicon-on-sapphire integrated circuits. Under the terms of the agreement, a new gate array family will be marketed by Rockwell that includes built-in, self-test facilities based upon proprietary Control Data technology.

#### <u>Convex</u>

Convex Computer announced a patent cross-license agreement with Cray Research under which the companies will exchange all their issued and pending patents. The agreement permits both companies to use their patented supercomputing technologies in current and future products. Convex is a supplier of standalone computers, and the Convex C-1 is a 64-bit system with Cray-like architecture offering an estimated one-fourth the performance of the Cray 1-S at one-tenth the price.

# <u>Daisy Systems</u>

Daisy's presentations at this year's DAC featured the Board Master PCB design system, analog design products, and products aimed at a more open systems approach than previously demonstrated by Daisy. A number of enhancements, new products, and agreements were also announced, including the following:

The Personal Analog workstation: Performs design entry through analog simulation on an IBM PC AT-based system. Personal Analog comes with Daisy's DSPICE simulator, as well as a basic analog library of more than 30 components. The Personal Analog workstation plus DSPICE, Virtual Lab DSPICE user interface, 3.25 MBytes of RAM, a 30-MByte hard disk, a 80287 coprocessor, and Daisy DNIX sells for \$33,000, beginning in October.

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- The PLD Master: Performs design, test, and simulation of programmable logic devices (PLDs) on Daisy's Logician, Personal Logician, and Megalogician workstations. First shipments are scheduled for September 1986. The price, including ABEL, PALASM, and AMAZE compilers, is \$6,500.
- The PMX FastBoard: Enhances Daisy's Physical Modeling Extension (PMX) system by allowing designers to simulate systems using advanced components, such as Intel's 80386. PMX FastBoard plugs directly into all PMX chassis, and is priced at \$15,000, available in September.
- ACE and ACE PI: Previously announced new user interface, ACE provides an advanced schematic editor graphics interface for creating and editing schematics, as well as ACE PI procedural interface to Daisy's schematic data base. ACE with the Daisy Logic Simulator DLS II will begin shipments in October. The ACE PI price, including a support package, is \$50,000 for a site license, also beginning in October.
- The VX Server Node: A file and peripheral server including design management and operating support for Daisy-DNIX applications and Digital Equipment VAX/VMS applications. Prices for the VX Server start at \$35,000, including a MicroVAX II and Daisy's Design Manager software. It will be available in October.
- The Analog Verification Software (AVS): Allows designs to both compile and simulate analog circuitry using Daisy's DSPICE circuit simulator. Bundled with a MicroVAX II, AVS is priced at \$50,000 for single-user and \$65,000 for multiuser configurations. Its availability date is October.
- The IC Layout Verification Software (IVS): A complete set of postprocessing layout verification tools from ECAD, Inc., including both DRACULA I and II packages, as well as various mask data generation formatters. Its price, with MicroVAX II, is \$85,000, available in October.
- Daisy and linear ASIC developer Micro Linear Corporation announced an agreement whereby Micro Linear will port its array cell libraries to Daisy workstations, thereby expanding Daisy's series of analog simulation tools.
- Daisy and Motorola announced a gate-array design kit called the HCA62A00, featuring automatic place and route using Motorola's 2-micron HCMOS gate arrays. Motorola will market the kit for \$1,000 beginning in September.

#### Data General

Computer manufacturer Data General Demonstrated its Technical Electronic Office applications platform. The company was also showing CEO, its office automation software, as well as DG/STAGE, a user-configurable windowing environment and menu manager shipped with all DS/7000 workstations. Applications software demonstrated included:

- Electronic design automation software that uses an object-oriented data base and features interactive logic simulation
- CADAT 5 integrated logic, timing, and fault simulator by HHB Systems
- AutoMate, a CAD system for designing hybrid substrates and PCBs by Royal Digital Systems
- BLOCKS, a layout tool for interactive placement and routing of complex ICs by DeNies Resources, Inc.
- Cameo II, a productivity management CIM system for semiconductor manufacturers by Cameo Systems, Inc.

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These applications will be supported by Data General systems including the high-end ECLIPSE MV/Family superminicomputers and DS/Family workstations.

#### Digital Equipment

Digital announced an agreement with Case Technology, Inc., to market cooperatively Case's EDA software for Digital's VAX family of computers. Case Technology's products available under the agreement are the CT4000 for the monochrome VAXstation II, and the CT5000 for the VAXstation II/GPX color workstation. Both are part of the Case Vanguard Design System series.

Digital also announced a two-screen configuration of the VAXstation II/GPX workstation. The new configuration consists of two consoles running on a single MicroVAX II processor with a floating-point unit, 5 Mbytes of memory (expandable to 9 Mbytes), a 71-Mbyte disk (expandable to 3 disks), a 95-Mbyte streaming tape drive, an Ethernet controller, Ultrix-32m and Ultrix32-w software license, (two) 8-plane graphics coprocessors, two 19-inch color monitors, two mice, two keyboards, and (two) 25-foot monitor cables. It is priced at \$48,700 and will be available in August 1986. Upgrades to the two-screen version will be available in August for \$14,450 per additional screen.



Software supplier ECAD's big news at the DAC was its move into more core application areas, including symbolic IC layout and printed circuit board (PCB) CAD.

At the show, ECAD announced its new SYMBAD product, which consists of a block place and router (SYMBAD/BPR) and symbolic layout software (SYMBAD/XTR). SYMBAD/XTR allows IC designers to sketch transistors in a manner similar to the way circuit designers, using schematic capture, place and wire components. Compaction and productivity increases result from allowing IC designers to work at the symbolic device level rather than at the polygon level. SYMBAD employs a symbolic data base, and accepts both GDSII and CIF input files, and works with DRACULA for design rules verification.

ECAD also announced an OEM agreement with Intergraph Corporation for marketing rights and technology transfer of ECAD's newly developed automatic place and route software for designing printed circuit boards. Dataquest sees this move by ECAD out of its traditional verification niche and into layout as a strategic effort to broaden its product offerings towards more core design applications. Although the details of this joint effort were not disclosed, we estimate that the PCB offering will be available sometime in first quarter 1987.

ECAD also was showing its peripheral applications products, including the following:

- A new hierarchical version 3 of the DRACULA design and electrical rules checker (DRC/ERC)
- LAYDE layout verification system (LVS)
- SIMON circuit simulation

SYMBAD/BPR, priced at \$90,000, is available now; the SYMBAD/XTR price and availability will be announced later. At the DAC, SYMBAD was demonstrated running on the MicroVAX II with a Tektronix graphics terminal, but it also uses Seiko terminals and runs on all of Digital's VMS-based products.

#### <u>Elzsi</u>

Elxsi demonstrated its parallel processing System 6400 hardware that accelerates various electronic design applications. Elxsi supports three operating systems: EMBOS VMS-compatible, UNIX System V.2, and UNIX 4.2 Berkeley Standard. These three operating systems can be parallelized to run concurrently on Elxsi's multiprocessor architecture. Elxsi offers various configurations of up to 84 MIPS processing and 768 Mbytes of main

#### <u>ECAD</u>

memory. Elxsi announced both availability and support for versions of the following software packages optimized for either parallel or multiprocessing on Elxsi System 6400:

- Parallel HSPICE circuit simulation from Metasoftware (\$64,000)
- Parallel DRACULA IC design verification software from ECAD
- Parallel DVS (Design Verification System) from Silvar-Lisco
- Multiprocessing MERLYN-S standard cell layout system from Tektronix-CAE Systems Division

Elxsi also announced major performance increases in its Systems 6400 product, including a new high-speed processor and internal memory expansion to 768 MBytes. System 6400 computers based on the new processor are priced from \$399,000 to \$3 million. Production shipments will begin in October. Elxsi also announced plans to offer 2 gigabytes of physical memory next year, using 1-megabit RAM chips.

#### **FutureNet**

Data I/O Corporation's FutureNet division, the market leader in PC-based EDA, demonstrated its new DASH-4 Schematic Designer, the DASH-CADAT PLUS circuit simulation product, the DASH-SPICE analog simulation product, and the programmable logic design system called Personal Silicon Foundry. FutureNet also made the following significant announcements:

- An agreement with Analog Design Tools (ADT), under which FutureNet will license ADT's PC Workbench design software and will market the new DASH-Analog Workbench based on it
- A new system for gate array design called the DASH-Semicustom Development System
- Additional libraries from Motorola (macrocell arrays), Gould-AMI, and National Semiconductor

#### <u>Genrad</u>

Genrad's Design Engineering Group demonstrated the HILO-3 logic simulator, HICHIP hardware modeling system, HITAP testability analysis software, and HIPOST tester interface software. Genrad's products run on a variety of hardware platforms. HILO-3 allows ASIC, PCB, and full system designers to verify both functionality and test coverage. When HICHIP is used with HILO-3, engineers can use actual IC devices as simulation models.

#### Hewlett-Packard

Hewlett-Packard was in full swing at this year's DAC, introducing its HP DesignCenter product environment. The DesignCenter is an entire environment that integrates the following products:

- HP Electronic Design System (digital and analog schematic capture and simulation)
- HP 64000-UX (microprocessor development system)
- HP Printed Circuit Design System (PCB layout)
- HP 3065 (board test system)
- HP 1631 (logic analyzer)
- ME Series 10 (mechanical 2D design and drafting)
- ME Series 90 (structural test)
- Technical office automation products

HP also announced a number of new links between these products, the most significant of which were the links between PCB design and HP's board tester, and between simulation and HP's new Precision Architecture computer (HP 9000 Series 800 Model 840).

For a more complete analysis of HP's electronic CAD/CAM strategy and product offerings, please refer to our July 1986 newsletter "Hewlett-Packard: Turnkey Company or Software Catalog Vendor?"

#### HHB Systems

HHB Systems was demonstrating the CATS Accelerator with the CATS Dynamic Hardware Modeler. CATS DHM currently supports approximately 60 incorporated VLSI chip models, and the company plans to approach 100 physical devices by year's end. Other HHB products shown included a new version of the CADAT logic, timing, and fault simulator, and Personal CADAT on the IBM PC. Other introductions and announcements included the following:

 HHB's new BDL (behavioral description language) product creates high-level behavioral models. HHB's BDL will also generate source code for linking the model directly into HHB's CADAT simulator. BDL will be available in third quarter 1986, and the license fee is approximately \$7,500.

- HHB introduced the CADAT 5 integrated logic, timing, and fault simulator. CADAT runs on a number of vendors' mainframes, as well as in the VAX/VMS environment.
- HHB announced a joint product development agreement with Zycad Corporation to integrate HHB's CADAT Simulator and CATS Modeler with Zycad's Expedititor, Logic Evaluator, Fault Evaluator, and System Development Engine simulation accelerators.

#### <u>IBM</u>

IBM, having introduced its CIEDS (Computer Integrated Electrical Design Series) ECAD offerings via its agreement with software supplier Silvar-Lisco, continues to develop and expand this offering. At the DAC, IBM announced the following additional functionalities:

- CIEDS/Engineering Access Routes: Provides access to information stored within the design capture data base, allowing users to translate data base logic descriptions into specific netlist formats for automated simulation or layout tools.
- CIEDS/Interface: Provides an interface for the translation of logic descriptions into a sequential netlist either in Structured Design Language or sequential output file formats for use by design automation tools.

IBM is offering CIEDS/Interface for \$2,000 and CIEDS/Engineering Access Routes for \$5,000, both available fourth quarter 1986.

Additionally, IBM announced the availability of CIEDS/Design Simulation in the IBM 30XX and 43XX environments. Included are design simulation data base, and behavioral, logic, mixed-mode, and switched capacitor simulators, for \$37,500 to \$75,000. CIEDS/Design Simulation can either be executed in batch mode or interactively. Each of the four simulators uses common graphic display tools for output to an IBM 5080.

#### IKOS

Start-up IKOS demonstrated the IKOS 800 logic simulation hardware accelerator for high-speed ASIC simulation in either full-timing mode or unit-delay mode. The IKOS 800 consists of a series of linked hardware accelerators that are controlled by user-interface software running on a host computer. IKOS also offers timing templates, synchronization testing, and semicustom IC libraries. The base price is \$40,000 and shipments begin in September.



#### <u>Intel</u>

Intel introduced the ICE-5100/252 emulator for its 8051 microcontroller family. The emulator runs on an IBM PC XT, PC AT, or compatible running DOS 3.0 or later, and supports the 8051, 8052, and 80C51 families of microcontrollers. It also runs on Intel's own development systems, the Series III and IV. ICE-5100/252 is available now at a price of \$6,995, including an assembler for the 8051 and AEDIT, Intel's source code editor. A 44-pin plastic leaded chip carrier (PLCC) adapter will be available in September.

#### Intergraph

Perhaps the surprise of this year's DAC was Intergraph's dramatic announcement of its decision to continue to develop nonindustry standard hardware platforms. Intergraph introduced the \$25,000 InterPro 32C, a new workstation incorporating the Clipper chip set from Fairchild and claiming 5-MIPS performance, with the following features:

- UNIX-V
- Local area networking (Ethernet, IEEE 802.3)
- VAX terminal (VT 100/220) emulation
- 6 megabytes of main memory
- An 80-megabyte disk
- A 1.2-megabyte floppy disk
- Optional C, Pascal, and FORTRAN compilers
- Optional PC-DOS operating system

There is also a dual-monitor version called the InterAct 32C, described as a production-oriented workstation, as opposed to the "professional" model InterPro. Pricing for the InterAct 32C starts at \$40,000.

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The financial analyst community, normally outspoken in its demands for industry-standard everything and critical of proprietary hardware platforms from turnkey vendors, was surprisingly accepting of this announcement. Competitors, however, noted that while Intergraph is not a computer manufacturer, it is "an annoyingly well-managed company." It is perhaps the latter feature, personified by company president Jim Meadlock who made the 32C announcement, which gave financial analysts pause. Dataquest believes, however, that open architecture means more than offering UNIX and Ethernet; it means a wide range of applications from a variety of vendors running on a general-purpose workstation. The impact of the InterPro 32C may be greatest in application areas other than electronic design, such as mapping, where price/performance issues, as opposed to integration, are the primary consideration.

Intergraph also announced plans to expand its printed circuit board CAD offering by means of a marketing and technology transfer agreement with ECAD (see ECAD).

#### Integrated Measurement Systems (IMS)

IMS announced the Logic Master 2000, its second-generation product in the Logic Master line of ASIC prototype verification systems. The 2000 integrates into one system support for up to 480 channels, full DC parametric test capabilities, and 100-pico-second timing resolution for both data edge placement and comparison timing. The Logic Master 2000 is capable of handling ASIC devices in the 300-pin range, depending on the I/O configuration. Pricing starts at \$185,000 for a 256-channel system, and delivery is targeted for September. The 2000 can be expanded in increments up to the full 480 channels.

Additionally, IMS announced the availability of a DC parametric measurement unit (PMU) on the Logic Master series of prototype verification systems. The PMU is priced at \$19,200 for the 192-channel PMU-1001, and \$31,200 for the 384-channel PMU-2001. Standard Logic Master configurations with PMU begin at \$48,700.

#### Lattice Logic

Lattice Logic both announced and demonstrated its new Application Specific Engine (ASE), which, at \$24,995, is unquestionably the lowestpriced silicon compiler workstation on the market. The ASE includes:

- High-resolution graphics monitor
- 32-bit virtual memory CPU
- 2 megabytes of main memory
- 80-megabyte hard disk
- Chipsmith software
- MS-DOS and UNIX System V compatibility

Lattice is also offering an entry-level version of the ASE, priced at \$15,995.

Chipsmith is Lattice Logic's silicon compiler software that converts random logic to layout for gate arrays and standard cell designs. Designs are specified via user-modifiable forms or spreadsheets. Also being shown were Lattice's other software products, including the Shapesmith PC mask preparation product and the Exert switch-level simulator.

Lattice Logic also announced an agreement with VIA Systems whereby Lattice will be the exclusive distributor of VIA's products in Europe. VIA will also be integrating Lattice's Shapesmith, Logic Generator, Switch-level Simulator and plotting software into the VIA BuildingBlocks system. In addition, the two companies will jointly develop and introduce a set of function generators for memories, PLAs, and gate arrays.

The U.K.-based company, which recently formed a U.S. subsidiary, Lattice Logic USA, is both expanding and restructuring to accommodate more aggressive marketing and sales activities worldwide.

### Logic Automation

Simulation model supplier Logic Automation announced 1-Mbit memory models and models for Motorola's 68000 family. Logic Automation's approach to the problem of simulating system designs with large amounts of memory involves using a unique simulator memory allocation technique. Details of Logic Automation's announcements are as follows:

- SmartModels consists of logic simulation models for 1-MBit memory devices, including Intel's 27011 EPROM, plus several vendors' DRAMS, including Toshiba's TC51100XP family and Texas Instruments TMX4C1020. SmartModels include Logic Automation's Symbolic Hardware Debugger for pinpointing errors in design.
- SmartModels consists of logic simulation models for Motorola's 68000, 68010, and 68020. Both bus functional and full functional models are available.

All SmartModels are behavioral-level models. Prices on standard engineering workstations, available immediately, are \$750 for a 1-MBit EPROM and \$950 for a 1-MBit DRAMS. 680X0 SmartModels, available in September, range from \$1,500 to \$1,800 for bus functional models, and \$4,900 to \$6,900 for full functional.

#### Mentor Graphics

EDA market leader Mentor Graphics demonstrated its Idea Series, which consists of six engineering workstations based on Apollo's DN3000 and DN 570A platforms, Mentor HML (Hardware Modeling Library), and Mentor Compute Engine global accelerator. The company also made the following introductions and announcements:

- Development Station: A set of software development tools that allow users to build and maintain their own applications. Included in the tools are: C, FORTRAN, and Pascal optimizing compilers, a symbolic debugger, and two "librarians." Initial shipments are scheduled for October and prices begin at \$29,000 for one compiler on the DN3000-M. Bundled with Mentor's Compute Engine global accelerator, Development Station prices begin at \$105,800 for an Apollo DN570A and a 10-Mbyte Compute Engine.
- REMEDI (Responsive Mentor Debugging Interface): An automatic/ interactive schematic-to-layout debugging module that operates in conjunction with Mentor's Chipgraph custom VLSI layout editor and ECAD's DRACULA II layout verification package. First Beta site is scheduled for September and first shipments for fourth quarter 1986, priced at \$14,900.
- Mentor Graphics and SCI signed an agreement for the integration of Genesil on Mentor's series of engineering workstations. Mentor Graphics is now the only EDA company with agreements with all three major silicon compilation companies: SCI, SDL, and SST.
- Mentor announced a joint marketing agreement with Test Systems Strategies Incorporated (TSSI) under the terms of which TSSI will provide its Test Development Series (TDS) software for Mentor's IDEA series of engineering workstations. TDS takes simulation information directly from the Idea Station's data file and optimizes it for use in production testing through the automatic synthesis of an executable test program. TDS prices range from \$20,000 to \$40,000 for the Idea workstation, with TDS output for VLSI testers.

#### **Omnicad**

Omnicad's new product introductions at the DAC included:

 Omnipro PC, a PC-based schematic capture package, features schematic editing, symbol libraries and editing, design analysis, and formatted output. The software runs under MS-DOS in standard AT&T PC 6300 and IBM PC/AT Color Personal Computers.

- Omnicards Release 2.2 for PCB design features its new data base, Omnibase, for support of Surface-Mount Technology designs.
  Omnicards supports component placement for two-sided boards.
  Other features are automatic design rules checking, the expanded Omnicards Installation Library, and full compatibility with Omniroute, an autorouter that runs on a network compute server.
- The third-generation release of Omniroute, which has been enhanced to support Surface-Mount Technology designs, available with Omnicards software or as a standalone autorouting package.

In a related announcement, the company unveiled Omniroute on the DSP9000 Compute Server from Apollo Computer. Omniroute may be installed on the DSP9000 and connected into Network and Omnicards PCB design software, which is available for Apollo's complete line of workstations.

The company also demonstrated an interface between Omnipage, a PC-based publishing system, and Omnipro PC. The link enables users to create schematics in a workstation and to pass the data into the documenter's environment. The system can be used to merge drawings and reports into engineering specifications, training manuals, and other documents.

#### Personal CAD Systems (P-CAD)

PC-based software vendor P-CAD unveiled PC-CUPL for the design of PLDs using P-CAD's schematic capture program, PC-CAPS. PC-CUPL consists of CUPL, P-CAD's PLD design software; NX-CUPL, a netlist interface from PC-CAPS to CUPL; and a library of symbols optimized for PLD design. PC-CUPL is priced at \$1,895; NX-CUPL is \$900; PC-CAPS and NX-CUPL together are \$5,850; and the combination of PC-CAPS and PC-CUPL (PLD 1) is \$6,495.

The company also announced an enhanced version of PC-Route, its automatic PCB routing software. New features include automatic 45 degree diagonal routing and the ability to set routing priorities by netclass definition. PC-Route is included in two packages: PC-Route Standalone and PCB-3. For new users the enhanced version of PC-Route Standalone is priced at \$6,000 and the enhanced version of PCB-3 is \$15,950. For customers who are not on a maintenance contract the update is \$480 (free to maintenance contract customers). The enhanced version of PC-Route will be available in the fourth quarter.

Available now from P-CAD is the PAL Starter Kit, a joint development of P-CAD and Texas Instruments. The PAL Starter Kit contains four 12-nanosecond PLDs from Texas Instruments, P-CAD's CUPL software for these devices only, and assorted tutorial aids, manuals, and literature. The kit will sell for only \$49.95.

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#### Praxis Systems

Praxis demonstrated ELLA, an integrated toolset for IC design. ELLA consists of the ELLA Hardware Design and Description language and its compiler, the ELLA Simulator and the ELLA Application Support Environment (EASE).

#### Quantic Laboratories

Quantic exhibited its newly enhanced family of electronic design analysis tools, Greenfield2 and Phyllis. Greenfield2 is a boundary element method field solver for the calculation of electrical parameters for microstrip, stripline, multiwire conductors, and cables of general shapes. Phyllis is a physical load and line simulator that permits the arbitrary interconnecting and loading of lines. With Phyllis, ringing and crosstalk waveforms are displayed in the time domain as would be seen on a CRT. The one-time license fee for Greenfield2 is \$80,000 per system, and \$35,000 for a single-user workstation. Mainframe versions are planned.

#### <u>Racal-Redac</u>

Racal-Redac announced a new version of Visula, its electronic design system. Release 3.0 supports schematic capture, logic simulation, waveform analysis, and physical design, as well as NHB System's Cadat 5.1 simulator. The new release extends Visula's capability to accommodate manufacturing information while using surface mount devices for PCBs, and allows the utilization of mixed technologies on a single multilayered board.

Visula 3.0 is currently available on Digital's VAXstation II and Apollo Computer's Domain Series 3000 system. Turnkey system prices start at \$40,000. Release 3.0 is available at no cost to existing Visula customers.

The company also announced that it will have a new version of Visula for the IBM PC AT and compatible computers in September. The PC version will have the same capabilities as the company's high-end Visula system and will act as the front end to Visula PCB design capabilities. Sold as either a turnkey product or unbundled, an Opus 32-bit coprocessor board from Opus Systems is required. Software prices start at \$10,000.

#### <u>SDA</u>

SDA introduced its Standard Edge standard cell place and route system at the DAC. Standard Edge employs a rectangular macrocell methodology and runs on Masscomp 5600, Sun 3/160, VAXstation II/GPX, and on the DN660 and DN570A from Apollo. The software alone is \$75,000. SDA announced, but did not demonstrate, its new Macro Edge, a full-blown macrocell block place and router; Macro Edge's availability is scheduled for fourth quarter 1986 and no pricing has been set. Besides demonstrating its line of IC design systems for ASIC development, SDA also announced major contracts with Hughes Aircraft and Harris Corporation. The Harris contract is valued at \$8 million over the next three years. No valuation has been announced for the Hughes contract.

#### Scientific Calculations

Scientific Calculations introduced the Look Out Router as part of its Scicards Program for PCB design. Look Out features greater speed, a higher completion rate, and reduces etch length and via count. The new router is available to licensees of Scicards at no additional cost.

New enhancements to Scicard's autoplacement tools were also demonstrated. New functions include Autoplace and Auto Resolv, which solves component overlap, bounds, and void violations.

The company also announced the availability of its Micro Electronics Design System (MEDS) on Digital Equipment's MicroVAX II. The system is available in a single-user configuration and consists of nine Mbytes of main memory, 213 to 598 Mbytes of disk space, and the MicroVMS operating system. Pricing is from \$88,000 to \$111,000; the product is available upon order.

#### Seattle Silicon Technology (SST)

Silicon compiler software supplier SST announced that it has expanded and repackaged its product offerings to match end users. The new product series is called the Blue Chip family of compiler tools, individually called C3, C4, and C5. The missing integers in the series remain a somewhat provocative mystery and suggest expandability. The product name change from "Concorde" represents an attempt to present a more coherent product strategy, which Dataquest considers essential in moving the silicon compilation companies from a missionary sales effort to an established business. A description of the Blue Chip series is as follows:

- The C5 compiler is actually a language-based compiler generator tool for building custom compilers at the subtransistor level, and is targeted for the silicon expert.
- The C4 compiler is a novice system, aimed at the engineer with little or no silicon expertise wishing to design custom parts from a set of functional modules, both analog and digital.
- The C3 front-ends the C4 compiler, and is used to simplify and automate circuit definition, schematic capture, and simulation. The C3 is a companion product to the C4 compiler, and runs on the Apollo DN3000 from Mentor and Tektronix, and the IBM PC AT coprocessor from Valid Logic.
All Blue Chip products are available now. The C5 software package is priced at \$125,000, the C4 is \$80,000, and the price of the C3, which is sold only in conjunction with the C4, varies according to number of licenses.

# Shiva Multisystems/SimuCad

Shiva announced that it has acquired SimuCad, Inc., a logic and fault simulation supplier, describing the move as a strategic alliance. SimuCad will operate as a wholly owned subsidiary of Shiva. Shiva was founded in 1984 and introduced its first product, PowerSPICE, in 1985. PowerSPICE uses advanced algorithms and modeling and software engineering techniques, and is offered as part of Shiva's SX series of Balance 8000 computers with SPICEngines and Shiva hardware accelerators.

SimuCad was founded in 1980, and introduced the SILOS logic and fault simulator in 1983. SILOS-2 the current version of SILOS, and P-SILOS is the logic simulation-only IBM PC AT version.

### Silicon Compilers Incorporated (SCI)

Silicon Compilers Incorporated introduced an enhanced version of its Genesil Silicon Development System automated ASIC design tool. The latest version of the Genesil silicon compiler is referred to as Version 86. Among other SCI announcements were the following items:

- SCI and Mentor Graphics signed an agreement to integrate Genesil on Mentor's IDEA series of engineering workstations.
- SCI and International Microelectronic Products (IMP) revealed a strategic alliance agreement for the development of analog compilation capability for Genesil. Such functionality will allow the nonanalog circuit designer to create complex chips that incorporate both analog and digital circuits, and will round out SCI's currently digital-only ASIC compiler.
- SCI and Motorola have signed a cooperative ASIC agreement whereby SCI will support design using Motorola's 1.25- and 2-micron CMOS processes on Genesil, and Motorola will manufacture the resulting designs. Additional areas of cooperation are anticipated.
- SCI also announced a similar cooperative ASIC agreement with Ricoh Company Limited of Japan, by which SCI will support Ricoh's 2-micron CMOS and NMOS processes on Genesil.

SCI also presented an impressive array of satisfied customers who endorsed the Genesil Development System at a DAC press briefing. On the showroom floor, SCI demonstrated Genesil on Apollo and VAX systems.

# Silicon Design Labs (SDL)

Silicon compiler developer SDL took part in a significant cooperative development announcement involving SDL, NCR's Microelectronics Division, and Mentor Graphics for NCR's new VIGEN ASIC design system. VIGEN provides NCR gate array and standard cell generators developed in the GDT (Generator Development Tools) silicon compilation design environment from SDL on an industry-standard engineering workstation, the IDEA series from Mentor. VIGEN allows users to customize configurable cells from NCR on a Mentor workstation and to incorporate them into an applicationspecific integrated circuit (ASIC) design. SDL's tools consist principally of GDT, which allows IC designers to develop silicon compilers.

In addition to NCR's VIGEN announcement, SDL announced the following three new products:

- LBRIDGE allows semiconductor manufacturers to provide their users with the proprietary circuit generators (compilers) developed with GDT, in addition to their standard cell libraries.
- LSIM is SDL's unbundled mixed-mode, multilevel simulator running on Apollo and Sun workstations. The LSIM product is licensed at \$40,000 for a single-user workstation.
- LCELL is a library of generators, the first releases consisting of standard cell library with programmable pitch, transistor sizes, power bus, and logic functions.

SDL also unveiled release 2.1 of the GDT tools, whose enhancements include binary read and write, L data base access, and a compaction function.

# Silicon Solutions

Menlo Park, California-based Silicon Solutions demonstrated its new Mach 1000 Fault Accelerator (Mach 1000F). The Mach 1000F, a high-speed fault simulator, is used to develop comprehesive test vector coverage.

Besides demonstrating its Mach 1000 family of logic and fault simulation accelerators, Silicon Solutions announced an agreement with FutureNet to link the Mach 1000 to FutureNet's DASH-CADAT PLUS simulation software. Acceleration functionality would be accessed through the DASH-CADAT PLUS menus and would be transparent to the user. The DASH-Mach interface is scheduled for later this year.

Silicon Solutions also showed Calma's Fast-Mask Engine, which it designed and manufactures, and which Calma markets. The Fast-Mask Engine is a dedicated accelerator for integrated circuit layout verification and runs on Data General's Eclipse S280 and GDSII/32. The Mach 1000F with both fault and logic simulation is priced at approximately \$200,000, depending on configuration. A fault simulation upgrade for the Mach 1000 Logic Accelerator is priced at \$80,000. The company also manufactures the Mach 100 Logic Accelerator.

# <u>Silvar-Lisco</u>

Software vendor Silvar-Lisco (S-L) substantially broadened its product line with the announcement of several new products for simulation, test, and printed circuit board layout, as well as a new hardware platform. The announcements were as follows:

- The LOGIX-SL standard logic simulation interfaces with the company's GARDS gate array design product and CAL-MP standard cell design product
- The IZYCAD interface links S-L's SDS (schematic design system), HELIX (behavioral simulator), and LOGIX-SL (logic simulator) to Zycad Corporation's Logic Evaluator and Expeditor simulation accelerators, IZYCAD also automatically transfers schematic data from Silvar-Lisco's design and analysis products to Zycad's, and the results are displayed by S-L's waveform analyzer, LOGAN
- An interface between S-L's HELIX simulator and Test Development Series (TDS) software from Test Systems Strategies, Inc., enables design engineers to generate functional, executable test programs for new devices and systems
- The CAL-PC interactive, printed circuit board layout, available in September, is integrated with other S-L products, and its multilayer router handles up to 16 layers
- The porting of S-L's SDS (schematic design system) to the Sun 3-160 workstation

# <u>Silvaco</u>

Silvaco introduced UTMOST (Universal Transistor Modeling Software Techniques), which provides automated solutions for transistor characterization, parameter extraction, and device modeling. UTMOST contains BSIM (Berkeley short channel IGFET Model), a new submicron subthreshold MOS transistor model. BSIM was just released by U.C. Berkeley and is utilized in the SPICE circuit simulation program. The new product does parameter characterization based on actual physical measurements, and provides MOS characterization and modeling. UTMOST is available immediately, priced from \$15,000 to \$45,000.

# SimuCad

(See Shiva Multisystems.)

### Simulog

Simulog demonstrated its SuperSim family of hardware logic accelerators based on a special-purpose coprocessor that needs no host machine. Simulog's products consist of six SuperSim models with gate capacities ranging from 32 gates to 1048K gates. Simulog products claim between 10 and 200 giga logic gate evaluations per second, depending upon the particular model.

### Sun Microsystems

Standalone workstation supplier Sun Microsystems announced the following additions to its Catalyst third-party program:

- Vanguard CAE Design System from Case Technology, Inc. Vanguard will be available on the Sun-3 family of workstations starting at \$9,500 in the U.S. beginning in October 1986.
- Test Development Series (TDS) from Test Systems Strategies, Inc. TDS products work with information from a CAE workstation simulation data file to provide users with analysis of simulation waveforms for compatibility with a target tester. TDS is currently available on the Sun-3 family of workstations for \$25,000-\$40,000, depending on configuration.
- VLSI Technology (VTI). VTI offers its IC design software on the Sun-3 family of workstations. The software will be available to Sun customers for \$20,000 to \$140,000 in August.

Users of Sun's Network File System (NFS) will now be able to access Digital Equipment's VAX/VMS and MicroVAX/VMS transparently. The Wollongong Group (a supplier and consultant for networking products and coresident operating systems) has added NFS as an application-level product to its networking software product, WIN/VX (for Wollongong Integrated Networking/VAX). Wollongong's NFS option for WIN/VX will be available in October for \$5,000 for the VAX version and \$2,500 for the MicroVAX version.

Sun also introduced two new products, the Sun Integrated Personal Computer (SunIPC) and PC-NFS. SunIPC is a 10-MHz 80286 coprocessor board for Sun workstations that provides compatibility with the IBM PC AT, allowing users to run MS-DOS applications in a window under UNIX. PC-NFS allows the user to transparently access files and network peripherals via the Sun NFS on an Ethernet network. The SunIPC board is \$1,995 in single quantities, and accompanying software is \$395 for the single-user version. The multiuser version is \$995. In quantities of 100, PC-NFS is available for \$305 per unit. For software alone, the price drops to \$255 per unit. When bundled with an Ethernet interface and documentation, the 100 quantity price is \$995 per unit. Availability is 30 days from receipt of order.

# <u>Tektronix</u>

Tektronix announced the availability of its Designer Database and Schematic Capture (DDSC) software for the VMS version of Digital's new VAXstation II/GPX. Tektronix will offer DDSC on standard VAXstation II/GPX configurations for \$54,700, with deliveries beginning in August.

The company also announced that it will offer Apollo Computer's DN570A color graphics workstation with its WorkSystem family of electronic design software. Configurations with DDSC start at \$49,900. The DN570A PCB design and layout system is priced at \$90,000. The DN570A is available now through Tektronix.

New product introductions included:

- The design Verification System, which consists of four modules: logic simulation, fault simulation, test pattern generation (GenRad's HiLo3), and hardware modeling (GenRad's Hichip). All four modules will be available in August, with prices starting at \$11,000.
- 91DVS, the VLSI design verification software for the DAS 9100 Digital Analysis System, runs on an IBM PC. It controls up to three DAS 9100s via GPIB Interface and provides chip test capability. 91DVS software is available now for \$5,000.
- NEC's 1.5 micron CMOS gate array design libraries are on the WorkSystem family of design automation tools. NEC's library will be added to Tektronix's Connections program, and will be available in August from NEC.

### <u>Telesis</u>

Telesis introduced a new AI router for PCB design called Insight. The new router is a rule-based, expert system that uses an English-language description of a board's physical characteristics and required design rules to route PCBs. The Insight routing system was developed using PROLOG, and is part of Telesis' EDA-3000 PCB Design Application software. The new router will be available as an upgrade to maintenance customers, and as a license for new customers as part of the EDA-3000 software for \$17,500. It is available for use on the EDA-700 Workstation and the EDA-620 Routing Accelerator. Insight is now under beta test; shipments will begin in October. The company announced the VAX Networking Interface, which permits direct file transfer between Telesis workstations and the VAX. In addition, Telesis PCB drawing data may be transferred to the VAX for use in custom or third-party applications. Pricing of the VAX Networking Interface is \$3,500 with shipments scheduled for September.

Telesis also announced the signing of a licensing agreement with HHB Systems for the integration and remarketing of the CADAT family of simulation products as part of the Telesis EDA product line. Included in the agreement are the rights to market Personal CADAT, the CATS dynamic hardware modeler, and the CADAT 5 full-function simulation ported onto Telesis' 32-bit EDA-620 Analytical Accelerator.

## **Teradyne**

Teradyne demonstrated its new EDA products which all run with the company's LASAR Version 6 simulation system. These products consist of the following three components:

- DATAView is a PC-based design entry system for schematic capture, documentation, and communications facilities. This product was developed in conjunction with Viewlogic Systems and is an enhanced version of Viewlogic's Workview-100 that is both marketed and supported by Teradyne.
- DATASource physical modeling system provides physical references, as opposed to software models, for LASAR-6 simulations, with a maximum of 2,400 pins and up to 256,000 simulation vectors per pin.
- DATAServer simulation engine provides parallel processing for timing analysis and fault and mixed-mode simulation, and boasts from 5 to 25 times the performance of a VAX 780.

DATAView's pricing starts at \$4,500 and is slated for September delivery. DATASource prices range between \$40,000 and \$120,000, depending on the number of pins, and delivery is scheduled for fourth quarter 1986. DATAServer costs range from \$300,000 to \$700,000, which includes the LASAR-6 license, with its first delivery in fourth quarter 1986.

Teradyne also announced agreements with both LSI Logic and Fujitsu Microelectronics to provide gate array cell models for LASAR Version 6 users.

### Valid Logic Systems

Valid Logic announced the following products:

- Valid Graphics (VG): A proprietary graphics subsystem for Valid's IBM PC AT workstation, with a 15-inch 60-Hz color display with 1024 x 800 resolution. VG is positioned between the IBM Enhanced Graphics and the IBM GX display, and is available on all Designer AT platforms. Pricing is \$20,950 for the Entry Designer AT/VG; \$24,950 for the Logic Designer AT/VG; and \$29,950 for the Validation Designer AT/VG.
- SCALDsystem ST Series: Based on the 68020 microprocessor, the ST features a 19-inch monochrome or color graphics screen, UNIX, and Ethernet. Included are 4 Mbytes of RAM expandable to 12 Mbytes, and a 170-Mbyte hard disk expandable to 340 Mbytes. ST systems may be configured for two graphics design stations. All of Valid's digital and analog tools run on the ST. Pricing ranges from \$40,775 to \$56,450.
- ValidPFG: A Probabilistic Fault Grader integrated into ValidSIM logic simulator on Valid's 68020-based workstations. ValidPFG is compatible with Realfast and is priced at \$15,000.
- ValidEZLIB: A library development tool that uses a data sheet-like template file for specifications and that calculates delays and distributes them into the model. ValidEZLIB runs on SCALDsystem and SCALDstar workstations and is priced at \$5,000.

All products announced by Valid at the DAC will be available this quarter.

Other Valid products demonstrated at the DAC included the Analog Designer AT running on the IBM PC AT. The system consists of a graphics editor and a set of software-based analog test instruments coupled with an analog simulator (ValidSPICE). The single-unit price is \$31,950 and includes a functional generator, voltmeter, oscilloscope, and network analyzer. Software upgrades for existing IBM PC AT users start at \$10,500. Valid also announced a performance enhancement for the SCALDsystem 20 version of the Analog Designer: the AD881 floating-point accelerator, and enhanced ValidSPICE software.

Valid also announced support on Digital's VAXstation II and VAXstationII/GPX workstations for Valid's full range of design tools. Called the Logic Designer VX and the Validation Designer VX, both systems are complete Digital hardware configurations. Each includes applications software, 5 Mbytes of main memory, 70 Mbytes of hard disk, TK50 tape cartridge, and either a monochrome (Logic Designer VX) or color (Validation Designer VX) graphics display. The Logic Designer VX pricing begins at \$63,500. The Validation Designer VX pricing begins at \$75,500. Valid's software will be available to customers as an upgrade. Beta test site shipments are scheduled for July. Valid also announced that the company's Realchip Hardware Modeling System and Realmodel Simulation System will also be offered on Digital's MicroVAX II and VAXstation II systems. Called MicroVAX Realchip and MicroVAX Realmodel, the systems are priced at \$39,500 and \$95,500, respectively.

Valid's OEM agreement with Digital to remarket the MicroVAX II, VAXstation II, and VAXstation II/GPX workstations, announced at the DAC, is estimated at \$10 million over the next two years.

Valid also was demonstrating Fujitsu's line of gate array design software running on Valid's Validation Designer system. The Fujitsu gate array software includes cell libraries, simulation models, and translation utilities. The software is available free of charge.

### VIA Systems

VIA's product introductions included BuildingBlocks, an automatic IC place and route package, with a library of predefined functional blocks. VIA also introduced ChipTool-II, a cell editor and block generation package, as an option for BuildingBlocks. Pricing for BuildingBlocks is \$55,000 and for ChipTool, \$20,000. Availability is 60 days from receipt of order. VIA also announced the availability of an interactive top-down floorplanning manager, available as an option for the BuildingBlocks package, and priced at \$10,000. VIA also announced the porting of BuildingBlocks ASIC design tools to the DEC VAXstation II/GPX, in addition to Sun Microsystem's workstations.

VIA Systems signed an agreement with Lattice Logic whereby Lattice becomes the exclusive distributor of VIA's products in Europe. VIA will also be integrating Lattice's Shapesmith, Logic Generator, Switch-level Simulator, and plotting software into the VIA BuildingBlocks system. The two companies also plan jointly to develop and introduce a set of function generators for memories, PLAs, and gate arrays.

### Viewlogic Systems

Viewlogic made a number of announcements about product enhancements to its Workview product, marketing agreements, and new sales channels. Enhancements to its PC-based Workview system include analog and semicustom design capabilities, as well as a simulation accelerator link to Zycad's Expeditor. Also demonstrated was the PC to VAX link and terminal emulation via Ethernet communications and Viewsim, Viewlogic's proprietary 28-state logic simulator for programmable logic devices (PLDs) with waveform analysis. Viewlogic has design support agreements with a number of major ASIC vendors for gate arrays, standard cells, and PLDs. Highlights of Viewlogic's announcements are as follows:

 An agreement with Zycad for the continued development of links between Workview and Zycad's line of logic and fault simulation accelerators; a Workview user can now choose to simulate with Viewsim, a VAX/VMS system, or with Zycad's Expeditor

- A codevelopment agreement with Teradyne for an enhanced version of the Workview 100 to be marketed and supported by Teradyne under the name DATAView; this product will be integrated with Teradyne's LASAR simulator running on the VAX
- A new European headquarters located in the Netherlands and an agreement with distributor Marubeni HYTECH in Japan

Viewlogic offers four versions of Workview priced from \$4,500 to \$13,000, running on IBM PC hardware and compatibles.

### VLSI Technology Incorporated (VTI)

ASIC-house VTI demonstrated its IC design software and family of cell compilers that enable designers to create semicustom ICs, including gate arrays and cell-based designs. VTI manufacturing support for designs included a number of other DAC vendors, notably Silicon Compilers Inc. (SCI). VTI also announced an agreement with Sun Microsystems to offer VTI's IC design software on the Sun-3 family of workstations. The software will be available to Sun customers for \$20,000 to \$140,000 in August.

## <u>XCAT</u>

One-year old XCAT Incorporated of Minnesota introduced its new MX/MXT series of hardware accelerators for logic and fault simulation. XCAT is attempting to fill the need for low-priced, high-performance, multiuser hardware accelerators by starting the pricing of the MX/MXT at \$49,000. Prices range up to \$295,000 for the MXT-400. MX/MXT hardware interfaces with front-end design entry systems from Mentor and FutureNet. MX/MXT also interfaces to industry standard hardware platforms such as VAX, Apollo, and the IBM PC. The MXSIM software environment offers menus and help screens for compilation, simulation control, and output reports. Future product development includes an automatic test pattern generation system scheduled for introduction in late 1986.

### <u>Xerox</u>

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The Engineering Information Systems (EIS) Unit of Xerox unveiled the 6085-Expert Designer workstation for electronics and electro-mechanical designers. The 6085 runs Expert software for automating PCB design and layout, logic design and simulation, mechanical drafting and engineering publishing. With a personal computer option that adds MS-DOS software capability, Expert users can also run software written for the PC concurrently with 6085 applications.

The 6085 is based on a 16-bit-slice Mesa processor developed by Xerox that executes 48-bit-wide microinstructions at 8 MHz. The new workstation comes with either a 15-inch or 19-inch monochrome display. The standard 6085 includes a 40-Mbyte, 5.25-inch rigid disk drive, a 500-Kbyte, IBM compatible 5.25-inch floppy disk drive, 1.1 Mbytes of main memory expandable to 3.7 Mbytes, and an optical two-button mouse. The PC option board sells for \$750. MS-DOS operating system software is available for \$125. Pricing on the 6085 workstation ranges from \$7,000 to \$12,000, depending on configuration. Systems are available upon order.

Expert software offerings include the following applications:

- PCB Design (\$32,500)
- Logic Design/Schematic Entry (\$6,500)
- Logic Simulation and Hardware Description Language (\$14,000)
- Mechanical Drafting (\$14,000)
- Illustrator (publications) (\$6,500)
- ViewPoint (office automation) (\$375-\$1,200)

Xerox also signed a software development agreement with AWI, a company owned by Satellite Communications Inc. Under the terms of the agreement, EIS and AWI will jointly develop surface-mount software packages that run on Xerox EIS' workstations. Jointly, the two companies will build surface-mount parts to be included in an electronic software library accessible to expert users.

### <u>Zycad</u>

Simulation market leader Zycad demonstrated its family of specialpurpose accelerator engines, including the Logic Evaluator and the Expeditor, as well as announcing:

- A joint product development agreement with HHB Systems to integrate HHB's CADAT Simulator and CATS Modeler with Zycad's Expeditor, Logic Evaluator, Fault Evaluator, and System Development Engine simulation accelerators
- An agreement "in principle" with Endot Inc. for integration of Endot's N.2 front-end design environment with Zycad's Logic Evaluator and Expeditor logic and fault simulation accelerators

Additionally, Zycad took part in an announcement made by Silvar-Lisco for the latter's IZYCAD interface linking S-L's SDS (schematic design system), HELIX (behavioral simulator), and LOGIX-SL (logic simulator) to Zycad's Logic Evaluator and Expeditor simulation accelerators. IZYCAD automatically transfers schematic data from Silvar-Lisco's design and analysis products to Zycad's, and the results are displayed by S-L's waveform analyzer, LOGAN. IZYCAD is the result of a joint-development effort between the two companies.

Tony Spadarella
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# Figure 1

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-20

### CELL-BASED ICs IGNITE APPLICATION EXPLOSION

### EXECUTIVE SUMMARY

From educational aids such as "Speak and Spell" to Smart Cards, application-specific integrated circuits (ASICs) are transforming our lives. What will be the next IC application? How will it impact our lives? We are accelerating into another era of amazing electronic achievements, and Dataquest expects cell-based integrated circuits (CBICs) to play a leading role. System designers require "no compromise" single-chip system solutions. Cell-based ICs, with the aid of silicon compilation, meet this requirement. We foresee silicon compilation as the future design methodology for cell-based ICs. Dataquest believes that specialized compilers dedicated to end-use markets will become mainstream products and receive widespread user acceptance.

During 1985, semiconductor suppliers worldwide were formulating plans to capitalize on the high growth rates of the cell-based IC and gate array markets. This newsletter will investigate the issues surrounding the cell-based IC market and how it impacts the gate array market. We will also explore futuristic ASIC design methodologies. Key questions to be addressed in this newsletter include:

- How large are the cell-based IC and gate array markets?
- Why is the gate array market larger than the cell-based IC market?
- What is the relationship between production volumes and gate count for cell-based ICs?
- What is the status of silicon compilation?
- What are some of megacells or circuit functions required for single-chip system solutions?

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- + How will the Japanese companies impact the cell-based IC market?
- What will be the dominant design methodology in the 1990s for single-chip system solutions?

### **DATAQUEST** Definitions

Dataquest defines the terms commonly used in this newsletter as follows:

 Cell-based ICs (CBICs): Digital or mixed linear/digital integrated circuits that are <u>customized using a full set of</u> <u>masks</u> and that comprise precharacterized cells or macros (includes standard cells, megacells, and compilable cells)

The term "cell-based IC" is an outgrowth of "standard cells." Historically, IC cells had fixed heights and fixed widths and thus were called standard cells. Today's cell-based ICs have variable heights and variable widths, allowing for added dimensional flexibility far beyond that of "fixed" cells. The term "cell-based design" (CBD) is used to describe the methodology used to design cell-based ICs.

- Gate arrays: Digital or linear/digital integrated circuits containing a configuration of uncommitted elements. They are <u>customized by interconnecting these elements with one or more</u> <u>routing layers</u>
- Silicon compilers: A general term that applies to very sophisticated integrated circuit computer-aided design (IC CAD) systems employing a top-down, hierarchical design methodology that accepts high-level specifications and automatically generates the mask tooling. Included in this term are specialized IC CAD systems that work at the cell level
- Intracompany revenue: When an IC manufacturer sells a product line to both the merchant and captive markets, the revenue associated with the captive (internal) consumption is called intracompany revenue. The revenue from sales to outside companies is called merchant revenue. We do not count exclusively captive suppliers such as IBM or Hewlett-Packard
- NRE revenue: Nonrecurring engineering revenue, or simply the revenue associated with developing a device
- Shipment revenue: Dataquest shipment revenue equals the estimated production revenue plus the intracompany revenue plus the NRE revenue. (Note: we count only processed wafers with interconnect layers, not blank wafer sales, since this would lead to double counting)

# HOW LARGE ARE THE CELL-BASED IC AND GATE ARRAY MARKETS?

Figure 1 compares the estimated growth of the cell-based IC and gate array markets. The 1985 gate array market is more than five times larger than the cell-based IC market. However, the compound annual growth rate (CAGR) from 1985 through 1990 for cell-based ICs is 66.7 percent compared with 29.8 percent for gate arrays. The 1989 and 1990 cell-based IC shipment revenues are dependent on the success of silicon compilation.

### Figure 1



# ESTIMATED WORLDWIDE CBICS AND GATE ARRAYS

Table 1 contrasts rankings, revenue, and growth rates of the top five cell-based IC suppliers with those of the top five gate array suppliers in 1984 and 1985. It is interesting to note that the number one cell-based IC supplier had less revenue than the number five gate array supplier.

### Table 1

# WORLDWIDE ESTIMATES TOP FIVE CBIC AND GATE ARRAY SUPPLIERS (Millions of Dollars)

				Growth
1985 Ranking	<u>Cell-based ICs</u>	<u>1984</u>	<u>1985</u>	<u>(1984-1985)</u>
1	NCR	\$35.0	\$ 48.0	37%
2	VTI	16.0	38.2	139%
3	Gould Semi.	9.0	30.0	233%
4	TI	8.0	25.0	212%
5	Zymos	22.0	<u>17.3</u>	(21%)
	Total	\$90.0	\$158.5	76%
	<u>Gate Arrays</u>			
1	Fujitsu	\$188.6	\$257.6	37%
2	LSI Logic	84.5	140.0	66%
3	Motorola	40.4	91.2	126%
4	Fairchild	47.0	60.2	28%
5	NEC	<u>41,1</u>	57.9	41%
	Total	\$401.6	\$606.9	51%

Source: Dataquest July 1986

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### Why Is the Gate Array Market Larger?

The following factors have contributed to this condition:

- Gate arrays are cost effective for replacement of standard logic.
- Gate array pricing has sharply declined over the last two years.
- Cell-based IC NRE is inherently more expensive than NRE for gate arrays.
- Gate array software is user friendly and well accepted.
- Gate array turnaround times are shorter.

We will first analyze the consumption of CMOS gate arrays. Figure 2 shows that the majority of revenue in CMOS gate arrays is derived from devices with less than 2,500 gates. This revenue is driven by gate arrays replacing standard logic. Gate arrays are cost effective for sweeping up numerous standard logic functions onto a single chip. There are many gate array applications for replacement of standard logic that only require low gate count devices.

### Figure 2



ESTIMATED 1985 CMOS GATE ARRAY PRODUCTION (REVENUE BY GATE COUNT) Dataquest is currently tracking 67 CMOS gate array suppliers that all offer these low gate count devices shown in Figure 2. This large number of suppliers with comparable products has caused serious price erosions. The most popular gate array (CMOS, 2,000 gates, plastic package, in quantities of 5,000 to 10,000), took a sharp price-per-gate drop from between \$0.010 and \$0.012 in 1984, to between \$0.002 and \$0.004 in 1985. This decline in pricing has increased the cost effectiveness of gate arrays at the expense of cell-based ICs.

Nonrecurring engineering charges for cell-based ICs are inherently more expensive than those for gate arrays. Since cell-based ICs are customized using a full set of masks, average NRE charges range from \$60,000 to \$250,000 (this includes 12 to 14 masks at \$4,000 to \$6,000 per mask plus computer time). Gate arrays are customized using only the final layers for interconnect, so the NRE charges are much less (\$20,000 to \$80,000). In addition to lower NRE charges, most IC designers have found gate array software easy to use and a good way to get started in ASICs.

Turnaround times from postschematic capture to delivery of prototypes are also longer for cell-based ICs. Average turnaround times for cellbased ICs range from 10 to 12 weeks, compared with 6 to 8 weeks for gate arrays. Some gate array suppliers are quoting turnaround times as short as 2 weeks or less (see the Dataquest Research Newsletter "The Quick ASIC: Tomorrow's Prototyping Tool" dated March 28, 1986). Quick turnaround times are increasing in importance.

# What Is the Relationship Between Production Volumes and Gate Count for CBICs?

The preceding gate array advantages (competitive pricing, low NRE charges, user-friendly software, fast turnaround times) have pushed CBIC suppliers to compete with higher gate count devices and in higher production volumes. In the early 1980s, ASIC users used CBICs rather than gate arrays when production volumes reached 8,000 to 10,000 units a year, with little concern for the gate count of the device. Today, the crossover point is very dependent on gate count and device functionality. If unit production volumes are less than 15,000 units a year, gate arrays will capture the business unless the device has a high gate count and the CBIC supplier can offer increased functionality. Figure 3 shows the current relationship between unit volumes and gate count for each of the ASIC design methodologies.

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### Figure 3



# ESTIMATED 1985 ASIC PRODUCTION VOLUME (UNITS BY GATE COUNT)

# WHAT IS THE STATUS OF SILICON COMPILATION?

Silicon compilation is getting slow user acceptance. Silicon compilers are in the "early adopter" stage. Dataquest estimates that 99 turnkey silicon compiler systems were sold in 1985 compared with 12 in 1984. Successful designs are now being captured from these systems. However, the future of the CBIC market is dependent on widespread user acceptance of silicon compilers. Dataquest in not anticipating widespread user acceptance until the 1989 to 1990 time frame. During the next three years, we expect to see a growing cadre of users.

IC suppliers, silicon compiler companies, and IC CAD vendors are all trying to position themselves for long-term lucrative growth. Each player is currently experimenting with a variety of silicon compiler products and marketing strategies. Current silicon compiler products include turnkey systems, cell compiler generators, and software packages that include libraries with compilable cells. These products are being sold to a wide variety of users in different target markets. Key target markets include original equipment manufacturers (OEMs), IC suppliers, military users, and design centers.

What is apparent today is the trend for specialized compilable cells. IC suppliers are now offering compilable cells in their cell libraries. Compilable cells start with a standardized functional block or a standard product, such as a multiplier-accumulator, and then are altered by the user by inputting the desired cell specifications. These compiled cells are combined with standard cells and megacells to form libraries optimized for a specific end-use market. LSI Logic, the leading MOS gate array supplier, is one of the first IC suppliers to market a compiler system (MACGEN) with a specialized cell library dedicated for a specific end-use market (digital signal processing). The MACGEN generates complex megacells with functions such as multiplier-accumulators (MACs), multipliers, and adders. These megacells combined with compiler technology provide the DSP IC designer with new device functions and reduced design times. We believe that this is just the beginning and that other IC suppliers will follow suit with end-use cell libraries.

### WHAT CIRCUIT FUNCTIONS ARE REQUIRED FOR SINGLE-CHIP SYSTEM SOLUTIONS?

The end users will ultimately determine the functions required in the cell libraries. Most CBIC suppliers are analyzing the needs of the end-use markets (mainly the computer and telecom markets) and are offering the following types of cells:

- Microprocessors
- Memory blocks
- Linear/digital
- Compilable standard products

As sub-2-micron technologies emerge, these cells will reduce the part count and power consumption, improve reliability, and ultimately lower costs while improving performance.

- Microprocessor cells are some of the most important cells in designing systems for computer products. Most IC suppliers are building libraries that incorporate a version of Advanced Micro Device's 2901 bit-slice processor. The 2901 is popular because of its flexible architecture, small cell size, and fast speed. Other suppliers are implementing general-purpose microprocessors in cells such as the 6502, 80C49, 80C51, and the Z80. Today, microprocessors larger than eight bits are considered too complex for implementation as cells. This is not to say that you cannot design in a standard microprocessor with more than eight bits. However, most suppliers have simply found it uneconomical. Suppliers have found the most economical way to achieve 16- and 32-bit core processors is by stacking 2901s.
- Memory cells are the type of cell that most vendors have in common. Most all CBIC suppliers offer RAM and ROM in a variety of configurations. Some of the suppliers have also announced EPROM and EEPROM cells. For example, Sierra Semiconductor and NCR have both announced EEPROM cells. Other suppliers are expected to emerge with EEPROM cells that can be used in telecommunications circuits, smart cards, analog-to-digital converters, and voltage regulators.

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 Linear cells in combination with digital cells on a single chip are popular for digital signal processing (DSP) applications. Linear cells are surfacing in both CMOS and bipolar libraries. Common linear cells include digital-to-analog converters, operational amplifiers, wideband amplifiers, and voltage comparators.

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• CBIC suppliers will round out their libraries with compilable standard products. Most people think that companies such as AMD, Intel, Motorola, and National would have an advantage in this area over current CBIC suppliers because of their broad standard product lines. However, customizing these standard products to the end users' specifications requires very sophisticated CAD tools (cell compilers). Few companies currently offer compilable cells. VLSI Technology Inc. (VTI), the number two CBIC supplier, is a leader in this area. VTI's compilable cells include comparators, counters, flip-flops, multiplexers, PLAs, registers, ROMs, and RAMs. We expect other companies to follow this strategy as the market matures.

### HOW WILL THE JAPANESE COMPANIES IMPACT THE CELL-BASED IC MARKET?

During 1985, Fujitsu, NEC, and Toshiba entered the North American CBIC market. It almost goes without saying that most domestic suppliers are paying close attention to their progress after what has happened in the memory market. Historically, large, vertically integrated Japanese companies develop products for internal consumption, move down the learning curve, then offer the device to the merchant market at a reduced price. This was the strategy for memory products and gate arrays. Their advanced memory technology drives their technology in gate arrays and CBIC. Fujitsu, NEC, and Toshiba all offer products that incorporate advanced technology.

During October 1985, Fujitsu announced its 1.8-micron CMOS standard cell family, which produces gate delays typically averaging 1.2 to 1.4 nanoseconds. This family includes automatic place and route with user configuration RAM, ROM, and PLA. Fujitsu's compacted standard cells include macros that are logically equivalent to 4-bit micros (2901), USARTS (8251), internal timers (8254), and 12-bit microprogrammable controllers (2910).

NEC unveiled its standard cell family, which incorporates 1.5-micron CMOS technology. The family includes 130 megacells and can achieve densities up to 17,000 gates.

Toshiba announced a 2-micron CMOS standard cell family with RAM and ROM macros. The family includes approximately 200 megacells, and can achieve device complexities up to 10,000 gates. Technology is important, but the ASIC market is <u>not</u> driven by technology alone. How will the Japanese companies manage the following important issues?

- Software
- Short production runs
- Service

Today, Japanese companies are known for their production capabilities and not for their software. The merchant market is composed of a wide variety of users' needs and hardware configurations. Developing software that can meet the needs of the diverse merchant market is both costly and time consuming. How will the Japanese companies obtain silicon compiler technology? Dataquest believes that they will form alliances with domestic IC CAD companies.

The Japanese companies will also have to adjust to short production runs rather than the high-volume runs that they now dominate. This will require a change in production equipment and production control systems.

Service is one of the most important factors in marketing ASICs. Will Japanese companies be ready with design/support centers where customers can get the technical guidance they require? The cell-based IC market has a wide variety of users with a wide variety of needs which must be attended to in order to capture and maintain business in North America.

# WHAT WILL BE THE DOMINANT SINGLE-CHIP SYSTEM DESIGN METHODOLOGY IN THE 1990s?

Dataquest believes that cell-based ICs will dominate in the 1990s for high-volume applications as well as for applications that require large systems on a chip. However, silicon compilers must get widespread acceptance over the next four years for the CBIC market to reach its potential.

Let's look at the race for the ultimate single-chip system solution. Figure 4 shows the migration path of gate arrays and CBICs on their way to the ultimate single-chip system solution. Keep in mind that gate arrays are customized by the final layers for interconnect while CBICs require a full set of masks.

From a historical perspective, CBICs started with fixed-height and fixed-width cells in the late 1970s and early 1980s, and moved to variable-height and variable-width cells by the mid-1980s. Memory blocks were brought on-chip in 1982, linear/digital in 1984, and core micros in 1985. Silicon compilers started to emerge in the merchant market in 1984.

# Figure 4

# THE RACE FOR SINGLE-CHIP SYSTEM SOLUTIONS



urce: Dataquest July 1986 Gate arrays started in the early 1970s. Most gate arrays were used for replacement of standard logic until the early 1980s, when high gate count arrays emerged and made systems on a chip practical. Memory blocks were brought on-chip in 1984. Linear/digital functions were brought on-chip in the early 1980s. Core micros (2901s) emerged in 1985. Gate densities up to 50,000 gates became possible in 1986.

Both design methodologies will ultimately look very similar. Both will offer complex cells, and both will be a solution to single-chip systems. We believe that it will be difficult to tell a CBIC product from a gate array product by the early 1990s. Perhaps it will only be of historical interest how these products evolved.

### How Can Semiconductor Suppliers Prepare for Future ASICs?

Suppliers can prepare for future ASICs by:

- Anticipating end-use application
- Exploiting the state of IC CAD tools
- Building cell libraries with the end users in mind
- Providing outstanding service

We expect an IC application explosion to occur over the next three years. Today, device complexity and functionality are far ahead of the designers' abilities to find applications. (For example, what are the applications for a 50,000-gate array?) IC suppliers will not only be selling ICs, they will also be selling insight on applications. We believe that anticipating these future applications and directing the use of IC CAD tools and ASIC products in the end-use markets will be critical success factors.

IC suppliers must exploit the state-of-the-art design tools from the leading IC suppliers and IC CAD vendors. We consider these tools to be vital elements in the design of single-chip systems. The supplier who offers user-friendly integrated design tools directed at end-use applications will win. Today, those tools are widely dispersed and only a few companies have taken steps to link them together to form integrated design systems. How these tools are brought together and made available to the design community is very important. This leads us to conclude that the companies that want integrated IC CAD systems will need to develop or acquire all of the key elements. The right alliances between compiler companies and ASIC manufactures can make the difference between the leaders and the followers.

Building cell libraries that are intended for end-use markets is key. The cell library should bring new specialized functions to a particular market segment. Forming alliances or trading cells will help companies cut the cost of building cell libraries as well as position them to exploit end-use markets. Service is of critical importance in marketing ASIC products. Providing first-rate service really means two things. First, it means staffing design centers with personnel who are knowledgeable on system solutions as well as on specific end-use markets. Second, it means providing the fastest possible turnaround time during development and prototyping. We believe that the stronger suppliers will invest heavily in resources to provide short turnaround times.

End users' needs and IC applications are driving the cell-based IC market. Probing the end users for possible future IC applications is critical. Dataquest believes that the cell-based IC application explosion is creating a wealth of opportunity for both suppliers and users.

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Beth W. Tucker Bryan Lewis



# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-19

# ECAD SETTLES DOWN TO DESIGN AUTOMATION---NOT TO LAS VEGAS

### INTRODUCTION

At the 23rd Design Automation Conference (DAC), held in Las Vegas for the second year in a row, the vendors settled down to a routine. At this year's DAC, vendors got down to the business of demonstrating their design automation wares, whereas last year the high-rolling Las Vegas style prevailed. At that show, vendors' pitches were hard and full of hype. This year, the prevailing theme was "WYSIWYG," or "What You See Is What You Get." Product availability, for the most part, was shortened to immediately, or an acceptable 30 to 90 days.

This newsletter analyzes the state of electronic CAD/CAM and the underlying trends that prevailed at this year's DAC. These trends include:

- Standard hardware platforms--They are standard as long as they say Apollo, Digital, or IBM on the cabinet.
- The outlook for turnkey companies--Their success depends on unbundling software as an option.
- Personal computers--They are not a miracle, but are they a mirage?
- The role of the niche company in the integrated design environment--What is it?

Refer to CCIS Research Newsletter number 1986-21, titled "The 23rd DAC: What's New?" for a description and our opinions of the products shown.

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### STANDARD PLATFORMS -- HOW MANY CAN THERE BE?

Disregarding applications for a moment, clearly the big winners at the DAC were Apollo, Digital, and IBM. Apollo and Digital had booths demonstrating their latest and greatest computers running various software companies' products. IBM was busy demonstrating its own Computer-Integrated Design Series (CIEDS) line of design automation software. But the real thrust of the CAD computer giants was in the turnkey and software vendors' booths. Results of our informal survey reveal the following:

- Digital computers were in 15 booths
- Apollo computers were in 33 booths
- IBM computers were in 20 booths

Users want and expect continuity. Standard computers offer continuity between the past and the present, or between the installed base and new system purchases. To users, continuity implies an integrated design environment; to vendors, it implies the nightmarish reality of developing, selling, and supporting products for multiple computer platforms.

CAD vendors are quickly waking up to reality. Dataquest believes that those that refuse to face reality and continue to support only proprietary computers will face a losing battle. They must sell software solutions rather than hardware features.

### Software Ports

A more subtle case than proprietary computers is one in which a CAD vendor supports only one platform, albeit a standard platform. Apollo, Digital, and IBM dominate the ECAD segments, while Data General, Sun, and all others scramble for ECAD OEMs and software ports. The CAD vendor's decision involves which platform to make the second port but is clouded by the perception of losing business without the port.

Dataquest's Integrative Design Environment Concept puts this decision in perspective. (Refer to CCIS Research Newsletter number 1986-12, titled "Valid Restructures to Meet a Changing Industry" for the concept description.) The concept relates to standard platforms in the following ways:

- Users do not prefer to mix and match new purchases of core design products, such as PCB physical layout, within a given work or design group.
- Users will mix and match periphery products, such as simulation, analysis, libraries, or design rules checking.

Vendors with core design products, or those that are related to the design data base, can afford to stay with one computer manufacturer, for that one application. Their value added is in capturing and manipulating the actual data. Those same vendors, however, must also provide options for an integrative strategy for their periphery products. This strategy might encompass one or both of the following ideas:

- Run periphery software on other computer products
- Provide clean and comprehensive netlist extraction and interfaces to other CAD companies' programs

In the end, software provides the applications solutions. Will users' design environments be a hodgepodge of hardware? You bet, because users want freedom of choice.

### PERSONAL COMPUTERS -- ARE THEY A MIRAGE?

Personal computers were everywhere at the DAC. Interestingly, very few were off-the-shelf PCs. The vast majority required a coprocessor, i.e., UNIX and 32-bit, to function as a low-cost personal CAD workstation.

What is going to happen when the IBM PC-2, with the Intel 80386, ships in quantity? Or when Apollo increases the 3000's production to satisfy pent-up demand? Each system offers a window into the other's strength, as identified in the following statements:

- An operating system that supports CAD programs, such as UNIX
- An operating system that supports general-purpose programs, such as DOS
- Integrated design environment prerequisites
- Acceptable performance
- Acceptable price

These strengths spell neither personal computer nor standalone workstation. Combined, they spell the user's ideal computer. Yet, no single ideal computer exists because each meets its own set of user needs and requirements.

Dataquest believes that the personal computer will continue to be used as an ECAD platform as long as its price/performance ratio is advantageous. The PC's advantage, in most cases, is also its mirage--the coprocessor. We believe that it is the combination of the PC's mirage and DOS that makes it a viable personal engineering workstation.

### Computational Alignment

PCs force computational alignment, that is, aligning computer resources with application requirements. With a few exceptions, PCs are used mostly for logic design: schematic capture at the project level and simulation at the block/small design level. However, PCs raise design integration contradictions. By definition, schematic capture is a core application because it captures and manipulates design data. The contradiction occurs when a company sells PC-based EDA as a periphery application.

Two sets of companies, with two sets of problems and solutions, have vested interests in protecting PC-based solutions, as follows:

- Companies that offer a PC-based point solution for logic design, without back-end layout
  - The goal is to protect a product that approaches being a commodity.
  - The solution is to open the data base as wide as possible and develop clean and easy interfaces to other companies' layout products and simulators.
  - In this case, price becomes a more important competitive edge.
- Companies that offer both PC-based logic design and back-end physical layout
  - The goal is to protect both the logic and layout development efforts.
  - The solution is to deliver positively clean, data base-driven interfaces between the two.
  - In this case, integration and design manageability of the process becomes the competitive edge.

Dataquest believes that positioning and degree of integration determine the growth of low-cost solutions. Users do not confuse hardware features with application solutions and neither should the vendors.

### TURNKEY COMPANY OUTLOOK

Dataquest believes that companies in the turnkey business can continue to thrive. Of course, the shape of their businesses and the source of their revenue have changed forever. We believe that a turnkey system is just one of several ways to deliver a design automation solution.

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This change occurred for the following reasons:

- No single vendor is best at all design phase solutions
- No single vendor can configure products for all possible combinations of computers
- Some vendors cannot give the same discounts on computers that computer companies do
- Some users already have installed hardware

The precedent is set. At DAC, two of the three largest EDA vendors, Daisy and Valid, were demonstrating applications on proprietary hardware as well as on Digital and IBM computers. Although demonstrating is not equal to unbundling, end users will force the equality. We believe that more and more vendors that traditionally deliver turnkey-only solutions will also move to deliver unbundled software products.

As illustrated in Figure 1, Dataquest estimates that software revenue will increase from more than 35 percent of 1985 revenue to almost 44 percent of 1990 revenue. We believe that this increase is due not only to decreasing hardware prices, but also to unbundled software sales. Because computer companies vie for the elite position of the designer's hardware choice, turnkey companies can now turn their attention to their added-value applications solutions.

### Profitability Impact

What impact will this shift have on turnkey vendors? One significant impact is on gross revenue--computer sales boost gross revenue. Conversely, software-only sales and lower-priced computers decrease gross revenue. Figure 2 illustrates the average gross profit margin percent for turnkey and software-only companies, calculated by subtracting cost of goods sold from total revenue. Software-only companies have an impressive 17 percent higher gross profit margin.

Because turnkey companies will ship more software-only products, Dataquest believes that they will have to restructure to squeeze extra profit from increased software-only revenue. Unless they do so, their higher profits will be swallowed by their high operating expenses. Needed modifications include the following:

- Minimize expenses associated with the sale and support of OEM computers (Such options might include drop shipments, offloading all field engineering and computer training to the OEM, and tighter marketing and sales alliances with OEMs.)
- Use selective unbundling strategies, with minimum purchase requirements, stringent licensing policies, and well-defined support mechanisms
- Implement tighter discounting controls







Source: Dataquest August 1986

### Figure 2

# GROSS PROFIT MARGIN SOFTWARE VERSUS TURNKEY COMPANIES



Company Type

Source: Dataquest August 1986

Dataquest believes that, for the most part, turnkey companies own the major league, core design software. However, exposing the "software hiding place" by unbundling software leaves them in a financially vulnerable situation. Turnkey companies must act deftly and quickly to make a successful transition from a turnkey to software business.

### WHERE DOES THE NICHE COMPANY FIT?

Dataquest estimates that nearly ten vendors offer end-to-end solutions, with products for both IC and PCB design in each of the major design phases. Most of these vendors have strategies that call for substantial market share of at least 20 percent. Obviously, ten vendors cannot each have 20 percent market share, so not all will reach their goal.

The remaining ECAD vendors are niche companies. These vendors do not offer end-to-end solutions--they specialize in one or more related applications. For example, a horizontal niche company may specialize in simulation or accelerated simulation. A vertical niche company may focus on PCB design, offering both front- and back-end products. A niche company's product line is either horizontal or vertical--across or within IC or PCB design implementation (refer to Figure 3).







# Borizontal versus Vertical Niches

Companies with horizontal applications, such as Zycad, Logic Automation, and HHB, compete for periphery products. Due to standard platforms, turnkey companies that are unbundling software, and users who are picking and choosing periphery products, these niche players can force an integrative design environment by creating distribution pull for their products. Of course, channel pull assumes working, functional, and useful products. Creating a demand forces vendors with core products to open data bases cleanly, and it ultimately creates incentives to adhere to a standard, any standard.

On the other hand, vertically oriented niche companies, such as Cadnetix, Personal CAD, and Caeco, compete with core design products. They compete not only with other niche companies, but also with the end-to-end vendors. Their disadvantage is their size; with many vendors sharing small pieces of the market, revenue may not permit optimum development or sales efforts. However, size may also act as an advantage. Because the resources of small companies are not diluted across many product lines, they can concentrate their resources on a single narrowly, but strategically defined, product line.

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Whereas we believe that creating pull is an important strategy for a horizontal niche vendor, we believe that product definition, differentiation, and function is the most important strategy for vertical niche vendors. Excelling in defined product niches is the best way to compete against end-to-end vendors and to ward off other niche companies.

# **Consolidation**

How many vendors can survive? When will real consolidation occur? The number of new vendors continues to increase every year, while an equal number do not exit. We believe that this occurs because of technology. In the macro sense, design automation is still very young and the absolute winners and technologies have not yet been decided. Innovation is still the norm, not the exception. Because of the technology drive, we believe that strategic alliances rather than mergers and acquisitions will prevail in the short term. However, the design automation pot is not infinite, and thus the most common form of consolidation may be bankruptcy.

### DATAQUEST ANALYSIS

The 23rd Design Automation Conference was a good one--vendors settled down to the business of design automation. Where gaps existed, product lines were filled in. Although some early adopters complained that not enough sizzling new technology was introduced, we think most attendees felt secure with what was shown--secure in what you see is what you get. We even heard one demonstrator allude to the hype of last year's show by saying that although the company has been demonstrating this product for a year, it is only now available for delivery.

Only by emphasizing on filling in product lines and delivering products that work, can vendors move on to delivering process-oriented solutions to industries designing electronic products. In our opinion, the next product move requires a concerted effort on data base and design management with quantum improvements on user interfaces.

After all, the goal of all CAD/CAM systems is to automate product design and manufacturing. But first, the dust from the current generation of design automation systems has to settle.

Beth Tucker Romig

RESEARCH NEWSLETTER

> CCIS Code: Newsletters 1986-18

INTERGRAPH BUCKS INDUSTRY TREND---INTRODUCES PROPRIETARY WORKSTATIONS

#### OVERVIEW

Dataquest

The Dun& Bradstreet Corporation

At the Design Automation Conference held recently in Las Vegas, Intergraph unveiled two new 5-MIPS workstations based on the Fairchild RISC microprocessor. The new workstations are the Interpro 32C and the Interact 32C. With prices beginning at \$25,000 for a fully configured system, Dataquest believes that Intergraph has set a new price/ performance standard in the fast-changing technical workstation market. In our view, the real question is whether Intergraph's decision to build its own computing hardware is strategically sound, given a market that favors standard platforms on commodity products from computer vendors.

Currently, only Intergraph's electronic CAD applications run locally on the new workstations. Intergraph's core IGDS and DMRS software, which account for greater than 90 percent of its revenue, is not yet available for the new workstations since these applications are VMS based. However, the new workstations are capable of accessing Intergraph's core software through a terminal emulation feature.

This newsletter describes Intergraph's two new workstations and the underlying Fairchild microprocessor technology (e.g., the CLIPPER architecture). Dataquest also analyzes and projects the future evolution of Intergraph's product line as a result of this announcement.

### INTERPRO/INTERACT 32C

The Interpro 32C is a higher-performance version of its National 32032 ancestor. It is built around Fairchild's CLIPPER microprocessor, which can execute instructions at the rate of 5 MIPS. The Interpro 32C has the following features:

- 6 megabytes of memory
- 80 megabytes of formatted disk
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- 1.2-megabyte flexible disk
- 15-inch, 32-color monitor with 1,184 by 884 resolution
- Ethernet controller
- Three RS-232 ports
- 85-key, ANSI standard keyboard with 57 user-programmable membrane-type keys
- UNIX System V release 2 operating system
- Intergraph and VT 220 terminal emulation

The Interpro 32C configuration listed above sells for \$25,000, which is a tremendous value considering that there are many workstations in the market today costing twice as much with half the performance. However, delivery is not slated until November or December of this year.

pattern of this announcement is strikingly similar The to 1984 unveiling of the National 32032-based Intergraph's October Interpro 32; both workstations were announced before availability of the microprocessor. Dataquest views the microprocessor availability risk to be much less of a factor in the case of the Fairchild CLIPPER. The operating system snafus that Intergraph encountered during its National 32032 Interpro implementation are no longer problems under the Fairchild architecture because Intergraph has chosen to utilize Fairchild's own UNIX System V port as the base operating system. In addition, Intergraph's graphic terminal emulation capability is available upon delivery, which was not the case with the earlier, problem-plagued, 'Interpro 32. Therefore, at the very least, Intergraph's installed base could employ the new workstation as a graphics terminal device for applications running on the Digital VAX series of computers, although the 5-MIPS performance would not be realized in this mode.

The Interact 32C is a dual graphic display version of the Interpro 32C. It is packaged with the familiar Intergraph ergonomic features including a built-in digitizing tablet. Pricing starts at \$40,000.

Optional features for both workstations include:

- C, Fortran, and Pascal compilers
- PC-DOS operating system
- Interact terminal emulation
- Graphical kernal system (GKS) routines

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#### FAIRCHILD'S CLIPPER

The Fairchild CLIPPER is a full 32-bit internal and external architecture that consists of three chips: a CPU with on-chip floatingpoint execution and two combination cache/memory management chips, one each for instructions and data. The large, 4-kilobyte cache chips are linked to the CPU via a dual-bus architecture, with one 32-bit bus dedicated to instructions and the other to data. The large cache size yields a cache bit ratio of greater than 90 percent, which greatly improves the execution speed of the system.

The CLIPPER is designed to operate at 33 MHz and has the basic elements of a RISC architecture with 101 hard-wired instructions along with a macroinstruction unit containing 67 macros to assist program execution. Up to 2,048 macroinstructions can be added to ROM to create more complex operations from the basic hard-wired instruction set.

Of major importance to CAD/CAM vendors is the CLIPPER's unique on-chip floating-point unit. Placing the IEEE-754 standard floatingpoint unit on the CPU chip rather than using a separate coprocessor unit (e.g., Weitek) eliminates bus loading and bandwidth problems and allows much faster execution speed. At 33 MHz, the CLIPPER performs doubleprecision floating-point arithmetic at the rate of 2 million whetstones. This performance equals or exceeds most floating-point coprocessor implementations on the market today, although the Weitek 1164/1165 floating-point chips are capable of outperforming the CLIPPER.

There is some concern about whether the CLIPPER's design will accommodate any further performance migrations given its fast 33-MHz clock speed. Fairchild believes that it can continue to improve the CLIPPER's performance by improving the architecture, shrinking the line width, and speeding up the clock.

#### DATAQUEST ANALYSIS

A number of issues surround Intergraph's 32C workstation introduction. On the positive side, Dataquest offers the following observations:

- The 32C workstations offer excellent price/performance.
- At \$5,000 per MIPS, the Interpro 32C is the current workstation price/performance leader.
- Intergraph's older National 32032-based workstations are upgradeable to the new 32C architecture.

Without question, Intergraph's installed base will be elated with the new workstations provided that Intergraph can successfully move its applications to the new platform. Intergraph's large installed base of more than 15,000 workstations somewhat modifies the necessity for Intergraph to play by the same rules that govern other CAD/CAM vendors. Intergraph users we have spoken to generally feel comfortable with Intergraph's make-versus-buy approach provided that Intergraph provides an upward migration path for their applications and stays reasonably current in workstation technology.

On the negative side, we offer the following comments:

- Intergraph's core IGDS and DMRS software is not available on the 32C workstations. Dataquest expects, however, that Intergraph will soon introduce a new core graphics system called the Intergraph Graphics Environment (IGE) that will retain most of the IGDS and DMRS functionality and utilize an object-oriented data structure.
- Dataquest believes that Intergraph will find it difficult to continue to buck the industry trend toward standard computing platforms based on commodity products from computer suppliers.
- Dataquest questions whether Intergraph's hardware R&D organization is prepared to develop and deliver computing products that must offer a twofold increase in computing power each year.

Dataquest believes that Intergraph's decision to build rather than buy its computing hardware represents a significant strategic risk. We understand Intergraph's motive to protect gross margins, but question whether the new workstations will really prevent margin erosion or simply stall the inevitable. Because so many large end users are standardizing on Apollo, Digital, IBM, and Sun workstations, Dataquest believes that Intergraph could face a more difficult problem--that of an eroding market share.

David B. Burdick

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### RESEARCH NEWSLETTER

#### CCIS Code: Newsletters 1986-17

#### AEC SYSTEMS 1986--INDIVIDUAL VERSUS PROJECT PRODUCTIVITY

#### SUMMARY

The 1986 AEC Systems show held recently in Chicago, Illinois, was a showcase for many of the fortunes and uncertainties facing the CAD/CAM industry. We believe that one company in particular has had a major effect on both fortunes and uncertainty. That company is AutoDesk, which took a no-holds-barred approach this year and created its own exposition within the show. Those vendors who were part of the AutoDesk Expo received an enormous amount of attention because of the appeal of low-cost PC-based systems. The larger turnkey CAD vendors have understandably been nervous, wondering how to stave off the low-cost PC mania that has gripped the industry.

The booth layout and flow of attendees at the AEC Systems show strikingly resembled the graph in Figure 1. The higher-priced turnkey systems situated at the show entrance seemed to serve only as interference for the stampede of show goers attending the AutoDesk Expo. Some vendors we spoke to actually felt that the AEC Systems show was merely a sideshow to the AutoDesk Expo, which included approximately 70 AutoCAD add-on products.

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AEC SYSTEMS 1986

Cost of System Higher-Priced 2-D/3-D CAD Low-Cost 2-D CAD Number of Attendees Source: Dataquest 1986 Dataquest Incorporated July--Reproduction Prohibited

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This newsletter discusses our overall impressions of this important annual event and describes what we considered to be the major exhibition highlights.

#### INDIVIDUAL VERSUS PROJECT PRODUCTIVITY

We believe that the AEC CAD market is separating into two distinct submarkets based on levels of productivity:

- Individual productivity
- Project productivity

Individual productivity refers to the use of CAD to improve or extend the productivity of what an individual already does manually, such as drafting or documentation. Project productivity, on the other hand, refers to a CAD implementation that improves or extends the productivity of an entire project, from concept design through the as-built environment; the ultimate goal in this case would be one project, one data base.

All the disciplines (e.g., architect, engineer, and facility manager) responsible for a particular project would essentially use one data base, creating their respective portions of the project to be shared as needed across disciplines; several vendors' exhibits reflected this theme exactly.

The major implication from a CAD vendor's point of view is that PCs have essentially conquered the realm of individual productivity. One need look no further than the success of AutoDesk and its AutoCAD product for validation of this point. Judging from this company's astounding tripled revenue growth last year and its successful exhibition this year, it would appear that AutoCAD software is on the way to becoming a de facto standard for drafting using low-cost (mostly PC-based) workstations.

On the other hand, users who want to improve project productivity will find that PC-based CAD systems usually cannot accommodate this goal. We believe that larger-scale software systems from vendors like Auto-trol Technology, Calcomp, Calma, Computervision, Intergraph, and McDonnell Douglas are much better suited to handling the more complex applications and data-sharing tasks associated with increasing project productivity. We believe that most of these CAD vendors are banking on what many believe will be a shift away from the labor-intensive view of projects toward a more global view of how to improve the entire project life cycle. Most of these vendors demonstrated this theme through their show exhibits, some to a greater extent than others, and none without the presence of a personal computer.

In our view, one of the major opportunities for the more established turnkey CAD vendor (especially any of those named above) hinges on broad user acceptance of advanced applications (e.g., rendering, solids modeling, or analysis), rather than on offering low-cost, PC-based versions of their software. We believe that the vendors that have chosen to offer software on a personal computer platform will (if they have not already) face an uphill battle on the distribution front, due mostly to AutoCAD's tight grip on the low-end channels.

AEC Systems 1986 set the stage for what we believe will be an era in which data base management will play a much greater role in AEC system purchase decisions. The ability to manipulate and share information across an array of disciplines within a project is an impressive feature that was shown by several vendors, both the new and the more established ones.

#### INDIVIDUAL PRODUCTIVITY PRODUCTS

#### AutoDesk Unveils Release 2.5 and AutoSketch

AutoDesk announced a number of new and enhanced products in addition to holding its own public exposition on the floor of the AEC Systems show. The company introduced release 2.5 of AutoCAD. Release 2.5, as AutoDesk president John Walker put it, "cleans out our user wish list." It contains more than 50 enhancements, with pan and zoom operations running 5 to 10 times faster than in previous versions of AutoCAD.

AutoDesk also introduced a new low-cost PC-based CAD product called AutoSketch, which sells for \$79.95. AutoSketch is a general-purpose drawing tool for people who make simple drawings and sketches like flow diagrams and organizational charts. A potential problem in our view is that AutoSketch may replace the more expensive AutoCAD program and erode AutoDesk's revenue and profit growth.

#### Sigma Design and Skok Systems Introduce Powerful PC-based Systems

Capitulating to the adage "if you can't beat them, join them," Sigma Design and Skok Systems have expanded their roles as turnkey CAD suppliers and joined the ranks of others already offering PC-based AEC CAD systems. These companies' two new systems, however, are more than just limited subsets of their larger systems. They are exact replicas of their workstation-based programs at unbelievably low prices. And both programs go beyond the drawing-only functionality typical of most popular PC programs to incorporate relational data base management systems. Both companies' strategies are very similar in this regard, not to mention extremely aggressive in pricing.

Skok's system, in particular (called Drawbase), actually runs faster than its Hewlett-Packard workstation predecessor and offers additional, unique functionality for performing space accounting. Skok has implemented an interface to two popular spreadsheet programs, Lotus 1-2-3 and Symphony, another move to highlight the possibilities in completely automating a design practice.

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The Drawbase system lists for only \$4,995, with discounts of nearly 50 percent available for quantities of 15. If Skok can solve the distribution puzzle that plagues most low-cost CAD products, Drawbase could potentially become one of the leading PC-CAD systems because of the incredible level of functionality it provides at such a low price.

#### Holquin CAD on the IBM RT-PC

With more than 7,000 installed workstations and \$50 million in sales in 1985, 15-year-old Holguin unveiled an IBM RT-PC version of its AEC design and drafting system. This system is one of the best CAD implementations we have seen on the IBM RT-PC. In addition to very fast display speeds, the system has a refined user interface that allows both horizontal and vertical menu scanning. Although Holguin's main hardware platform to date has been based on Hewlett-Packard and Wang computers, we believe that the IBM RT-PC and forthcoming IBM products will account for a major share of Holguin's future CAD sales.

#### PROJECT PRODUCTIVITY PRODUCTS

#### Calcomp's Rendering System

For users who want to produce very lifelike architectural renderings, Calcomp's new color rendering software provides some of the most advanced functionality available. Calcomp's proprietary picture processor (found only in the 600 Series version of System 25) adds to the impressiveness of this new offering.

One feature in particular impressed us as being the coup de grace of this rendering package. The feature (to be released on September 1) allows for photographs or drawings to be scanned, using a color raster format, and then overlayed on a background scene and edited using different texture modification schemes. The output is a fully rendered image that is vastly improved in quality and detail over slow and costly hand-drawn artist's renderings. This capability is available through a Calcomp-developed interface program for \$2,500.

#### A Flurry of New AEC Products from Calma

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> David Burdick Eileen Lynch

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### RESEARCH NEWSLETTER

#### CCIS Code: Newsletters 1986-17

#### AEC SYSTEMS 1986--INDIVIDUAL VERSUS PROJECT PRODUCTIVITY

#### SUMMARY

The 1986 AEC Systems show held recently in Chicago, Illinois, was a showcase for many of the fortunes and uncertainties facing the CAD/CAM industry. We believe that one company in particular has had a major effect on both fortunes and uncertainty. That company is AutoDesk, which took a no-holds-barred approach this year and created its own exposition within the show. Those vendors who were part of the AutoDesk Expo received an enormous amount of attention because of the appeal of low-cost PC-based systems. The larger turnkey CAD vendors have understandably been nervous, wondering how to stave off the low-cost PC mania that has gripped the industry.

The booth layout and flow of attendees at the AEC Systems show strikingly resembled the graph in Figure 1. The higher-priced turnkey systems situated at the show entrance seemed to serve only as interference for the stampede of show goers attending the AutoDesk Expo. Some vendors we spoke to actually felt that the AEC Systems show was merely a sideshow to the AutoDesk Expo, which included approximately 70 AutoCAD add-on products.

#### Figure 1



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This newsletter discusses our overall impressions of this important annual event and describes what we considered to be the major exhibition highlights.

#### INDIVIDUAL VERSUS PROJECT PRODUCTIVITY

We believe that the AEC CAD market is separating into two distinct submarkets based on levels of productivity:

- Individual productivity
- Project productivity

Individual productivity refers to the use of CAD to improve or extend the productivity of what an individual already does manually, such as drafting or documentation. Project productivity, on the other hand, refers to a CAD implementation that improves or extends the productivity of an entire project, from concept design through the as-built environment; the ultimate goal in this case would be one project, one data base.

All the disciplines (e.g., architect, engineer, and facility manager) responsible for a particular project would essentially use one data base, creating their respective portions of the project to be shared as needed across disciplines; several vendors' exhibits reflected this theme exactly.

The major implication from a CAD vendor's point of view is that PCs have essentially conquered the realm of individual productivity. One need look no further than the success of AutoDesk and its AutoCAD product for validation of this point. Judging from this company's astounding tripled revenue growth last year and its successful exhibition this year, it would appear that AutoCAD software is on the way to becoming a de facto standard for drafting using low-cost (mostly PC-based) workstations.

On the other hand, users who want to improve project productivity will find that PC-based CAD systems usually cannot accommodate this goal. We believe that larger-scale software systems from vendors like Auto-trol Technology, Calcomp, Calma, Computervision, Intergraph, and McDonnell Douglas are much better suited to handling the more complex applications and data-sharing tasks associated with increasing project productivity. We believe that most of these CAD vendors are banking on what many believe will be a shift away from the labor-intensive view of projects toward a more global view of how to improve the entire project life cycle. Most of these vendors demonstrated this theme through their show exhibits, some to a greater extent than others, and none without the presence of a personal computer.

In our view, one of the major opportunities for the more established turnkey CAD vendor (especially any of those named above) hinges on broad user acceptance of advanced applications (e.g., rendering, solids modeling, or analysis), rather than on offering low-cost, PC-based versions of their software. We believe that the vendors that have chosen to offer software on a personal computer platform will (if they have not already) face an uphill battle on the distribution front, due mostly to AutoCAD's tight grip on the low-end channels.

AEC Systems 1986 set the stage for what we believe will be an era in which data base management will play a much greater role in AEC system purchase decisions. The ability to manipulate and share information across an array of disciplines within a project is an impressive feature that was shown by several vendors, both the new and the more established ones.

#### INDIVIDUAL PRODUCTIVITY PRODUCTS

#### AutoDesk Unveils Release 2.5 and AutoSketch

AutoDesk announced a number of new and enhanced products in addition to holding its own public exposition on the floor of the AEC Systems show. The company introduced release 2.5 of AutoCAD. Release 2.5, as AutoDesk president John Walker put it, "cleans out our user wish list." It contains more than 50 enhancements, with pan and zoom operations running 5 to 10 times faster than in previous versions of AutoCAD.

AutoDesk also introduced a new low-cost PC-based CAD product called AutoSketch, which sells for \$79.95. AutoSketch is a general-purpose drawing tool for people who make simple drawings and sketches like flow diagrams and organizational charts. A potential problem in our view is that AutoSketch may replace the more expensive AutoCAD program and erode AutoDesk's revenue and profit growth.

#### Sigma Design and Skok Systems Introduce Powerful PC-based Systems

Capitulating to the adage "if you can't beat them, join them," Sigma Design and Skok Systems have expanded their roles as turnkey CAD suppliers and joined the ranks of others already offering PC-based AEC CAD systems. These companies' two new systems, however, are more than just limited subsets of their larger systems. They are exact replicas of their workstation-based programs at unbelievably low prices. And both programs go beyond the drawing-only functionality typical of most popular PC programs to incorporate relational data base management systems. Both companies' strategies are very similar in this regard, not to mention extremely aggressive in pricing.

Skok's system, in particular (called Drawbase), actually runs faster than its Hewlett-Packard workstation predecessor and offers additional, unique functionality for performing space accounting. Skok has implemented an interface to two popular spreadsheet programs, Lotus 1-2-3 and Symphony, another move to highlight the possibilities in completely automating a design practice.

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The Drawbase system lists for only \$4,995, with discounts of nearly 50 percent available for quantities of 15. If Skok can solve the distribution puzzle that plagues most low-cost CAD products, Drawbase could potentially become one of the leading PC-CAD systems because of the incredible level of functionality it provides at such a low price.

#### Holquin CAD on the IBM RT-PC

With more than 7,000 installed workstations and \$50 million in sales in 1985, 15-year-old Holguin unveiled an IBM RT-PC version of its AEC design and drafting system. This system is one of the best CAD implementations we have seen on the IBM RT-PC. In addition to very fast display speeds, the system has a refined user interface that allows both horizontal and vertical menu scanning. Although Holguin's main hardware platform to date has been based on Hewlett-Packard and Wang computers, we believe that the IBM RT-PC and forthcoming IBM products will account for a major share of Holguin's future CAD sales.

#### PROJECT PRODUCTIVITY PRODUCTS

#### Calcomp's Rendering System

For users who want to produce very lifelike architectural renderings, Calcomp's new color rendering software provides some of the most advanced functionality available. Calcomp's proprietary picture processor (found only in the 600 Series version of System 25) adds to the impressiveness of this new offering.

One feature in particular impressed us as being the coup de grace of this rendering package. The feature (to be released on September 1) allows for photographs or drawings to be scanned, using a color raster format, and then overlayed on a background scene and edited using different texture modification schemes. The output is a fully rendered image that is vastly improved in quality and detail over slow and costly hand-drawn artist's renderings. This capability is available through a Calcomp-developed interface program for \$2,500.

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## RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-16

#### HEWLETT-PACKARD: TURNKEY SUPPLIER OR CATALOG VENDOR?

The memory of the 1985 Design Automation Conference (DAC) continues to haunt Hewlett-Packard. There, at electronic CAD/CAM's most prestigious trade show, and with a new line of workstations, HP seemed to be waiting for some software. Contrasted with the splashy display put on by Tektronix, another 1985 market entrant and an HP competitor, Hewlett-Packard was definitely at a low-water mark.

At DAC '86 (June 30 to July 3), HP had something more than blank screens to demonstrate. Coordinating a number of electronic CAD/CAM (ECAD) product announcements, HP attempted to demonstrate that it is in the market to play and to stay. But the question of how active a role HP will take in future application development remains tantalizingly unanswered. This newsletter analyzes HP's strengths and weaknesses, and addresses the following issues:

- HP's overall strategy and goals in ECAD
- HP's electronic CAD/CAM products
- HP's DAC announcements

#### STRATEGY

#### Reorganization

Following the dictum "structure follows strategy," Hewlett-Packard reorganized over the past two years, creating the Design Systems Group (DSG) to embody its corporate CAD/CAM commitment. Hoping to leverage its market leadership and experience in the test and measurement area, HP positioned the DSG as part of HP's Components, Design & Measurement Sector.

The DSG consists of three business units, spanning 11 components, and includes a partnering with a technical software group that manages all relevant third-party agreements (see Table 1).

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#### Table 1

#### RENLETT-PACKARD DESIGN SYSTEMS GROUP

Electrical Engineering Business Unit	Mechanical Engineering <u>Ausiness Unit</u>	Norkstation Business Unit	Technical Software <u>Center (TSC)</u>
Fort Collins Engineering Operation (FEO) Engineering graphic design systems and electrical engineering and physical CAD	Lake Stevens Instrument Division (ISID) Instrumentation for mechanical/ electronic test	Boeglingen Computer Division (BCD) Buropean manufacturing	Third-party software for engineering applications and technical office automation
Colorado Springs Division (CDL) Digital hardware test tools	(BBO) Nechanical CAD software	Fort Collins Systems Division (FSD) Engineering workstations, graphic systems, and associated products	
Logic Systeme Division (LSD) Nicroprocessor development systems		Corvallis Workstation Operation (CWO) Integrated personal computer, technical workstations	
Sait Lake City Operation (SCO) Advanced software tools, design data base language, object-oriented data base, and human interface (Cericor)		y	

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#### Cericor Acquisition

Part of HP's overall ECAD strategy has been acquisition. In June 1985, HP acquired an 11 percent share in Salt Lake City-based Cericor, a modest-sized EDA software house. In October 1985, it moved to fully acquire Cericor. HP then began to fold Cericor into its newly reorganized Design Automation group, referring now to the Cericor component as the Salt Lake City Operation (SCO).

Dataquest believes that this acquisition was neither due to Cericor's unimpressive economic performance of under \$2 million annual revenue nor did it represent the purchase of a "hot" successful start-up for mere public relations value. In Cericor's unique approach to a design data base and ongoing R&D in application development environments, perhaps HP recognized what it and, more significantly, the general market lacked: an integrative application software philosophy.

Cericor's products currently form the foundation of HP's front-end Logic Design System, and future HP product development will build off the following Cericor features:

- Object-oriented data base
- Human interface
- Application development environment

To these, HP adds an array of architectures from the PC level to mainframes, using industry standard networking.

Cericor's productized software at the time of acquisition included schematic capture, logic simulation, and timing verification packages, but its strongest cards were a powerful, object-oriented data base and an application development system. The Cericor data base provides transparent data translation at all levels of the design process, working off a central "core" data base with a structure that allows an engineer to work concurrently on multiple levels of the design process. Crucial to an integrative design environment approach, which HP professes to be selling, is Cericor's application software development environment, which enables users both to integrate and customize specific tools. It remains to be seen if HP intends to capitalize on the new announcements.

HP claims that Cericor provides the integrating paradigm for eventual offerings and the key to future development. In the current round of product announcements, however, we note that Cericor's procedural interface has not been fully utilized by HP. If Cericor is indeed the cornerstone of HP's development plans, we would expect eventual products aimed at programming productivity, such as an application development system.

#### Third-Party Software

HP's third-party software program is called the HP Plus program, which, in the electronic CAD/CAM area, includes software from the following companies:

- Analog Design Tools (ADT)
- FutureNet
- SDA
- VLSI Technology Incorporated (VTI)
- 🌒 🛛 Zuken

For those products specifically designated as DesignCenter products, third-party software is both marketed under HP's name and fully supported by HP.

#### PRODUCTS

HP is currently marketing a design environment, a combination of internal hardware and software offerings with third-party IC and PCB design tools. This design environment has been dubbed the HP DesignCenter, with products addressing electronic, mechanical, and software engineering design needs. HP's DesignCenter products also address the office automation and electronic test application markets. DesignCenter offerings are augmented by third-party packages. (For a description of DesignCenter CAD/CAM products, see Table 2.)

HP DesignCenter is based on networked HP engineering workstations, including both 16/32 and 32-bit microprocessors, the HP-UX UNIX V operating system, and HP peripherals. Hardware bases include the HP 9000 workstations series 310, 320, and 500, and, at the low-end, either HP's own PC, the Vectra Personal DesignStation, or IBM's PC AT outfitted with a 32000 coprocessor to support HP-UX.

#### Table 2

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#### HEWLETT-PACKARD DESIGNCENTER ELECTRONIC CAD/CAN PRODUCTS

Punction	Product	Description	Source
Logic Design '	UP Logic Design Systems 310 and 320	Design data base language, object-oriented data base, on-line DRC, documentation, design capture and varifi- cation, logic simulation, logic libraries with interfaces to Scientific Calculations, Calay, Recel-Redec, Computervision	BP
	HP Personal Logic Damign System	(Same as above, but simulation access only on HP VECTRA personal computer and IBM PC/AT)	<b>87</b> 9.
Simulation	RILO-3	Logic mimulation, timing verification, concurrent fault simulation	Genrad
Analog Design	EP Analog Géalge System	Analog schematic entry and simulation with links to HP Logic Design System	Analog Design Tools
PCB Physical Design	HP PC Design (ChB) Ayatam	Printed circuit board layout with on-line DRC, auto route, and links to HP Logic Design System	Bell Northern
Physical Modeling	BICBIP	Universal bardware modeling system	Genrad
Software Design	EP Software Design	Software/microprocessor development, systems integration, and analysis with emulators for 40 microprocessors (HP64000 workstation ported and linked to HP Logic Design System)	Щ₽
Project Planning	HP Teamwork/Structured Analysis	Software specification, graphic flow charting, and documentation system	# <b>P</b>

Source: Dataquest July 1986 -4

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#### DAC '86 ANNOUNCEMENTS

For this year's Design Automation Conference, HP made a flurry of announcements, including both new product introductions and product enhancements to its DesignCenter electronic offerings. The following is a brief list of HP's major electronic announcements, accompanied by Dataguest-supplied descriptions and analyses:

- Design System Manager: This enhancement provides design project management facilities, including data security, project monitoring via design check-in and -out, and revision control. The Design Manager also provides network file management and remote job processing. Dataquest considers this type of facility an essential ingredient of an integrative design environment.
- HP Printed Circuit Design System: This PCB layout system is a new addition to the DesignCenter and has links to HP's previously announced Logic Design System (LDS). (Also part of the DAC announcements were new LDS links to Racal-Redac and Computervision; previously announced were LDS links for back annotation purposes to Scientific Calculations and Calay.) HP licensed the source code for this product from Northern Telecom/Bell Northern Research in October 1985. HP then enhanced and integrated it for inclusion in the DesignCenter. Bell Northern also supplied IBM with its CBDS II PCB CAD product. The HP PCB Design System is also linked to HP's own 3065 board test family.
- HP Teamwork/Structured Analysis: HP describes this as a new computer-aided software engineering (CASE) product, aimed at the specification phase of software development. It contains facilities for developing a project library by means of data dictionaries and flow diagrams. Because the graphics features of this product are not presently linked to the source code, we dispute the use of the term "CASE" for it. Rather, it appears to be a viable structured software documentation tool, which may or may not form the basis of an eventual CASE offering.
- HP64000-UX: Integration of the HP64000 Software Design System into the DesignCenter UNIX operating environment. This announcement refers to HP's microprocessor development software being ported to the HP series 300 and accessible from the HP DesignCenter environment.
- LDS Enhancements: HP's schematic entry and simulation product has been enhanced to include links to HP PCB Design System, HP Software Design System, and HP Engineering Graphics System (EGS). Other enhancements include color display capability, GenRad's HICHIP physical modeling, links to various ASIC foundries including NEC and VTI, and data file compatibility with HP's Analog Design System. HILO-3 is now available on the HP 9000 series 500 technical workstation.

Dataquest notes that while HP's PCB Design System has an open design-file format with flexibility to accept inputs from a variety of front-end systems; it is not linked to HP's own front-end by a common design data base. Netlists and parts information can be transparently transferred between the two HP products, but the productivity gains of a common, concurrent design data base are bypassed.

While obviously able to leverage its market leadership strength in board test equipment, we believe HP has missed the point of a front-end link to its own LDS product. Tight integration of core application software has been sacrificed here for a modular approach. If you want to be an end-to-end supplier, you must provide unique and highly integrated end-to-end solutions, and not just fill in the blanks in your software catalog.

#### DATAQUEST ANALYSIS

HP's new announcements reveal a mixed and confusing strategy. On the one hand, there seems to be an attempt to offer end-to-end design solutions. On the other hand, there is an effort to have a large third-party referral software catalog running on HP hardware. A design environment aimed at integration has to mean a lot more than networked and compatible workstations. HP's current approach to CAD/CAM can be characterized as aggressively cautious (read tentative). It is a questionable practice to introduce a variety of products and then let the marketplace decide who you are.

Leadership in this market, rather, requires a greater amount of risk-taking and innovation than merely offering what everyone else already does, or porting every known software package to your workstations. HP has the advantage of a reputation for excellence, particularly for customer support, as well as a large and reportedly loyal installed base. It also has the resources and potential to expand its strengths in the board test market to become a major supplier of PCB CAD.

HP's disadvantages include its hardware focus (some would say myopia) as opposed to a focus on solutions to design problems. Ironically, its large installed base could actually be compounding HP's identity crisis, by compelling it to accommodate and support a wide range of competing design solutions, rather than concentrating on developing its own. HP's large sales force, unversed in selling applications, could also be disadvantageous here. In Dataquest's opinion, HP, like other giants entering this marketplace, will have to clearly identify its strategies and goals or risk dissipating its CAD/CAM marketing efforts. HP's dilemma, simply stated, is: Do we really want to be another Digital Equipment or Apollo, when we believe we have got the ability to be a major turnkey supplier? HP seems suspended in the process of deciding, and the spate of new announcements reveal attempts to be both innovator and market accommodator all at the same time. HP does not appear to be building on Cericor's innovative data base philosophy. Clearly, the Cericor acquisition bought HP the option of evolving an EDA business. What it eventually does this Cericor base, in our opinion, will provide the essential clue to its choice between being either a hardware or a design productivity supplier. In our opinion, HP wants it both ways and may or may not realize that these are conflicting, if not mutually exclusive, goals.

Tony Spadarella

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### RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-15

#### ASIC DESIGN CENTER CAD SURVEY

#### INTRODUCTION

ASIC design center CAD purchases are driven by the changing requirements of their customers. The lead indicator of a design center's CAD/CAM purchase plans is the ASIC customer rather than the ASIC house itself. Ultimately, the ASIC customer is the target for all ASIC products, both CAD and silicon.

This newsletter discusses the results of DATAQUEST's CAD/CAM Industry Service's design center survey. In compiling the results, we have identified three specific areas of controversy:

- Personal computers--engineering or office automation tool?
- Integrative design environment--is it possible in design centers?
- Bottlenecks--is the customer a bottleneck?

#### DEMOGRAPHICS

DATAQUEST polled 146 U.S.-based IC design centers, which is nearly 100 percent of the U.S. merchant ASIC design centers. Our survey tabulations represent a 50 percent response rate from 73 design centers.

The respondents primarily consisted of three types of design centers:

- Semiconductor vendor affiliated
- Distributor affiliated
- Independent/unaffiliated

These types of design centers accounted for 90 percent of the total responses. The remaining 10 percent were vendor-affiliated centers that typically received their funding from private sources.

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#### Designs

Cumulatively, there were 3,259 annual design starts in the sample, designed by 503 engineers. This translates into an average of seven design starts per engineer, and an average of seven engineers at each design center. Please refer to Figure 1 and Table 1 for information on the types of circuits being designed and the average number of gates.

#### PERSONAL COMPUTERS--ENGINEERING OR OFFICE AUTOMATION TOOL?

IBM PCs comprised nearly one-third of the nonturnkey-supplied CAD/CAM hardware. Yet, Figure 2 indicates that the PC's primary application is not engineering automation. PCs are used most often for office automation--even in such an intense engineering environment as an ASIC design center. Schematic capture represents the only engineering application for which the PC is used with any frequency.

We believe that the PC is so widely accepted because it also allows engineers to run office automation products. This suggests that vendors with PC or low-cost solutions must provide a path for end users to run general-purpose applications.

Purchase plans by product type are shown in Figure 3. Nearly 38 percent of the respondents indicated that they plan to purchase PCs. Standalone workstations plans, however, were even higher, at 46 percent.

We believe that engineers have a realistic attitude about the personal computer--by itself, it cannot run the computationally intensive applications that are typically run on a host or standalone computer. We expect personal computers to continue to be used for general-purpose applications and serve as a low-cost design entry nodes in networked engineering environments.

#### THE INTEGRATIVE DESIGN ENVIRONMENT

#### Software Perspective

Figure 4 shows the usage of analysis tools and the sources from which they were acquired. This figure suggests that in spite of the closed-door environment of ASIC software, there are a lot of commercially developed general-purpose analysis tools available on design center CAD systems. The most frequently cited analysis tool purchased from a software vendor is circuit simulation. This high response clearly contradicts the widespread myth that transistor-level simulation is not run on ASICs.

Although simulation tools are winning substantial design center acceptance, this is not the case with analysis tools addressing the

manufacturability issues such as design rules check (DRC), electrical rules check (ERC), and layout-versus-schematic. Even though a significant number of design centers stated that they purchased these tools from outside sources, these applications were also cited most frequently as tools developed in-house, indicating that customization to a particular manufacturing process is frequently required.

We believe that ASIC design centers will continue to purchase analysis tools for their customers' use rather than for internal use. CAD vendors' products must be integratable with ASIC companies' in-house tools. Process-dependent tools must be easily customized to meet the process-specific requirements of individual manufacturers.

#### Turnkey Perspective

Figure 5 shows the installed bases of the five most frequently mentioned CAD vendors. These top five companies comprise 47 percent of all systems cited in the survey. Another 21 vendors comprise the remaining 53 percent of systems.

Figure 5 also illustrates buying plans and repeat purchases. Clearly, no respondent is so committed to any one CAD vendor that it excludes that vendor's competitors. The relatively low repeat business rates do not necessarily reflect dissatisfaction with any one vendor. Rather, they mirror the nature of the design center business itself--to avoid excluding potential ASIC customers, design centers must provide support and completion of customers' designs on corresponding CAD systems at the center. Therefore, systems purchased by design centers are an indication of general ASIC design community demands.

#### IS THE CUSTOMER A BOTTLENECK?

ASIC customers are strongly involved in the design process. Figure 6 shows that nearly half of the responding design centers' customers are responsible for their own designs. The survey also indicates that 44 percent of the customers are responsible for simulation.

Figure 7 shows the distribution of time spent on each design cycle phase. Nearly 60 percent of the time it takes to complete a design is spent on logic creation and simulation or the phases in which customers are directly involved. Yet design centers identify one of their biggest bottlenecks as the customer.

It appears that the design centers, as well as the CAD vendors, have not yet completed the end-user education process. CAD and ASIC vendors are not acknowledging customers' steep learning curves and are expecting expert results from novice users.

#### DATAQUEST CONCLUSIONS

Personal computers are only a platform; survey results show that PCs are not perceived in the end-user community as low-cost end-to-end design automation solutions. Although engineers use personal computers for schematic capture, the major application for PCs is office automation.

Dataquest believes that CAD vendors must concentrate on positioning PCs as design entry nodes that are easily integrated into networked design environments. The acceptance of PCs is dependent on networking and its ability to run general-purpose programs.

Dataquest believes that achieving the goal of widespread acceptance of ASICS will require semiconductor vendors to release their physical libraries and layout programs. As novice users become more proficient, they will want more control over their designs, and therefore need more information. This, in turn, will require a higher level of customer support.

What clearly emerges from the results of the survey is an end-user mandate for CAD vendors and ASIC vendors to take responsibility for supporting their customers. Dataquest believes that CAD vendors need to structure profitable and effective customer service so that all users get the experience necessary to make their systems produce.

If the CAD vendors' training ends with the design center engineers, they are ignoring the actual end-user market--the ASIC users--where penetration is still very low. Using a design center CAD system may be a customer's first opportunity for hands-on experience with ASIC design automation. In reality, the existing CAD systems in a design center are a sales opportunity in disguise; every time a design center customer uses a CAD system, it is actually a real-world demonstration of that system's capabilities. As prices continue to decrease and it becomes feasible for more engineers to purchase design automation systems, it behooves CAD vendors to ensure that every customer who uses that design center's system is adequately supported.

The ASIC design centers' perceptions of their customers as one of their biggest productivity bottlenecks is a example of the semiconductor industry's discrete parts mentality. For the relationship between the design centers and their customers to change, we believe that it is necessary for the relationship between the design centers and the CAD vendors to become a customer service partnership, with each assuming responsibility for their common customer--the ultimate end user.

Kelly D. Leininger

### Figure 1







AVERAGE NUMBER OF GATES BY CIRCUIT TYPE

	Average Number			
Type of Circuit	of Gates			
Gate Arrays	1,930			
Standard Cells	1,879			
Handcrafted	1,058			
PLDs	283			

Source: DATAQUEST July 1986



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PURCHASE PLANS BY PRODUCT TYPE



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Figure 4

ANALYSIS TOOLS: USAGE AND SOURCES









Source: Dataquest July 1986



#### WHO DOES THE DESIGN?



Source: Dataquest July 1986 .

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#### AVERAGE DISTRIBUTION OF TIME PER DESIGN PHASE



Source: Dataquest July 1986

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# NEWSLETTER

CCIS Code: Newsletters 1986-14

#### ASIC: CROSSING THE APPLICATIONS THRESHOLD

"Adolescence is the awkward age when a child is too old to do something cute and perhaps too young to do something sensible."

--E. C. McKenzie

#### INTRODUCTION

The synergy between the application-specific integrated circuit (ASIC) and the electronic CAD/CAM (ECAD) markets is so intense that it is often difficult to differentiate between the two. The most important difference is that both ASIC manufacturers and users are target markets of the ECAD vendors. It is for this reason that we republish a joint newsletter from DATAQUEST's Semiconductor Industry Service and Semiconductor Application Markets service.

This newsletter summarizes a recent survey conducted by our sister services, and analyzes the trends in ECAD end-user markets.

#### AT THE THRESHOLD

It almost seems that the application-specific integrated circuit (ASIC) industry has crossed the threshold from youth to adolescence. Like the child who has grown and matured rapidly, who has seen his potential but is not sure how to achieve it, so too is the ASIC industry. Standing at the threshold, with great optimism, ASIC suppliers visualize end-use markets as opportunities and challenges. The ASIC industry knows it has a way to go, and believes it has the maturity, but it is not exactly sure what path to choose.

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This newsletter summarizes a recent analysis of end-use ASIC applications done by our Semiconductor Application Markets (SAM) service and the Semiconductor Industry Service (SIS). Our analysis shows three important points:

- ASICs have diffused into most end-use applications but still have a way to go.
- Design starts are fueling the growth of the ASIC market.
- ASIC suppliers are going to face a number of challenges and opportunities.

We take a closer look at some of the more common applications for programmable logic devices (PLDs), gate arrays, and cell-based designs (CBDs), and we conclude with observations that indicate the strategic direction for both ASIC users and suppliers.

As the youthful ASIC market captures a larger market share, we expect suppliers and users to develop new relationships. Today, only 14 percent of all integrated circuit (IC) revenue is ASIC, but by 1990 it will exceed 25 percent. Furthermore, as Figure 1 shows, all North American end-use markets are expected to use ASIC in one form or another. This means that suppliers will have to learn how to service the unique characteristics of each application. Users, in turn, will have to learn which design methodology is the most appropriate for their needs. The following sections expand on these issues and provide supporting data.

#### Figure 1

#### ESTIMATED NORTH AMERICAN ASIC END-USE CONSUMPTION (Millions of Dollars)



#### ASIC PENETRATION: A LONG WAY TO GO

DATAQUEST has just completed a major survey of 200 of the largest electronic businesses in North America. These companies have more than 500 semiconductor procurement locations and represent a diverse group of buyers, material managers, purchasing directors, and corporate contract managers. While profiles of this group do not include all electronic businesses, which number in the thousands, we believe they represent at least 55 percent of the total dollars invested in ICs. From the ASIC point of view, these companies represent the largest and most influential body of procurement management to be found in North America.

Perhaps the most startling finding is that ASIC penetration has yet to mature. This is because most users devote a major portion of their procurement budget to logic products and because only a fraction of the logic budget is currently devoted to ASIC. Figure 2 shows the end-use distribution of IC dollars subdivided into the five major product categories.

#### Figure 2

IC PROCUREMENT--1985 (Percent of Total)



Source: DATAQUEST June 1986



It is interesting to note that logic, which includes ASIC and standard logic, makes up a major portion of IC procurement in all the end-use segments. While ASIC is not currently consuming a major portion of logic, it does suggest its large potential. But the most important finding shows that there is a very large group of users that is contemplating using ASIC. Of all the system manufacturers that were polled, 57 percent said they were seriously considering ASIC, 33 percent said they were not, and 10 percent were undecided.

A corollary to the above finding is how ASIC procurement is distributed throughout the United States. Table 1 and Figure 3 show that ASIC purchases are concentrated in the Pacific area, followed by the Northeast and the Midwest. These findings reinforce our previous findings that most U.S. design centers are concentrated on the coasts and in the Midwest.

#### Table l

#### EXPECTED ASIC DESIGNS (Percent of Respondents by Region)

	<u>Atlantic</u>	<u>Midwest</u>	Northeast	<u>Mountain</u>	<u>Pacific</u>	<u>South</u>	<u>Total</u>
Gate Array	9.0%	13.4%	20,9%	7.5%	40.3%	9.0%	100.0%
Standard Cell	8.7%	13.0%	19.6%	6.5%	34.8%	17.4%	100.0%
PLD	6.3%	12.5%	25.0%	12.5%	25.0%	18.8%	100.0%
Full Custom	8.3%	25.0%	18.8%	2.1%	31.3%	14.6%	100.0%

Source: DATAQUEST May 1986 ş.

#### Figure 3

#### ASIC PROCUREMENT SURVEY AUDIENCE



Source: DATAQUEST May 1986

#### DESIGN STARTS--FUEL FOR ASIC GROWTH

There is another way to look at ASIC growth--by examining the estimated design activity from the user's point of view. Table 2 measures the estimated 1986 North American design activity. Respondents were asked how many designs they were planning and what percentage was planned per each design method. For example, for users who plan to do greater than 76 designs, the percentage that will be done using gate arrays is expected to be 60 percent. The other designs are expected to be done using CBD or full-custom design methods. The data shown in Table 2 suggest that regardless of the number of designs per year, most users expect to buy more gate arrays than any of the other design type.

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#### Table 2

Number of Designs <u>per Year</u>	Gate <u>Array</u>	PLD	CBD	Full <u>Custom</u>	<u>Total</u>
All Ranges	47.4%	5.1%	23.18	24.48	100.0%
25	47.0%	5.9%	22.4%	24.7%	100.0%
26 <del>-</del> 50	43.3%	2.5%	30.0%	24.28	100.0%
51-75	50.0%	-	50.0%	-	100.0%
76	60.0%	-	7.0%	32.0%	100.0%

#### ESTIMATED 1986 NORTH AMERICAN DESIGN STARTS (Percent of Total)

Source: DATAQUEST May 1986

We believe that this preference for gate arrays can be traced to two areas. It is fueled first by very user-friendly electronic design automation (EDA) and second by the proliferation of low-cost workstations. Most design centers now offer easy access to EDA, which, in turn, can interface with ASIC suppliers.

While Table 1 shows a small percentage of design starts for PLDs, we believe that the data do not truly represent their use. PLDs are purchased like commodity ICs and the number of designs done are usually not known by the buyer. Therefore, one cannot infer the true number of PLD designs from the table. Furthermore, it does not reflect the long-term potential of the PLD market. DATAQUEST believes that PLDs will become a very significant factor in applications that require low gate count, i.e., below 3,000 gates on chip.

The CBD segment shows significantly less starts than gate arrays, but each CBD start will generate three to five times the production revenue of a gate array. Thus, what seems like a low number of design starts does not imply less production revenue in the future. Also, remember that CBD EDA tools are not as mature as those found in gate arrays. As more sophisticated EDA tools emerge, we expect the gap in design starts to narrow. A factor that could fuel CBD growth is the full-custom category. The percentage of CBDs versus full-custom suggests that by the end of the decade, full-custom designs will be replaced by CBDs. This is because they are less costly to design and can be done in a fraction of the time. Therefore, we believe that CBDs have a very significant growth potential as better EDA tools emerge.
## OPPORTUNITIES AND CHALLENGES

Table 3 shows some very interesting insights into what could be both a challenge and an opportunity in disguise. This table shows the number of respondents classified by the six end-use categories and is further subdivided into ASIC users and nonusers. Note that industrial users and nonusers make up the largest segment. DATAQUEST believes that industrial applications are a good opportunity for suppliers that position themselves properly.

## Table 3

# ASIC USERS VERSUS NONUSERS (Percent of Total)

End Use	Users	<u>Nonusers</u>
Data Processing	278	22%
Communications	16	16
Industrial	35	45
Consumer	5	2
Military	16	15
Transportation	1	0
Total	100%	100%

Source: DATAQUEST May 1986

At the same time, the industrial segment provides most of the challenge. Industrial users are a large group, but they often buy low production quantities and are evenly distributed throughout the geographical regions. Thus, the challenge to the supplier is how to promote, educate, service, and capture designs from the user base. It appears that a well-positioned gate array or PLD supplier may have a competitive advantage in this market.

The findings are much different for the consumer segment. The number of North American buying locations is very limited, but they tend to consume very high volumes per design. It should be noted that most consumer procurement is off-shore and thus is not reported in the table. The ASIC users in the consumer segment prefer CBDs or full-custom, largely because they offer the lowest unit cost.

#### A CLOSER LOOK

The following discussion examines application trends for three growing markets: PLDs, CBDs, and gate arrays.

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## PLDs--Application Markets

DATAQUEST estimates that worldwide consumption of PLDs in 1985 was \$241.9 million, with more than 97 percent consumed in bipolar technology. We are estimating that worldwide consumption will be \$1,016.7 million in 1990 (a CAGR of 28.4 percent between 1985 and 1990), with CMOS products capturing 52 percent of the sales.

As with most ASIC products in North America, the data processing segment is the largest application market for PLDs. As noted in Table 4, data processing applications are expected to consume 77 percent of all PLDs shipped in 1986.

#### Table 4

End Use	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1990</u>
Data Processing	82%	76%	77%	738
Communications	7	7	7	8
Industrial	8	8	8	9
Consumer	0	1	1	2
Military	3	8	7	7
Transportation	0	0	0	<u> </u>
Total	100%	100%	100%	100%

# ESTIMATED NORTH AMERICAN PLD MARKET BY APPLICATION MARKET

Source:	DATAQUEST		
	May 1986		

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Among the more common applications mentioned for PLDs are the following:

- Replacement of control logic in computers
- Peripheral controllers
- CRT display systems
- I/O port decoders

Speed has always been a critical issue for PLDs because of their use in control path (decoding), data path (arithmetic logic units, storage applications), and interface applications. As CMOS technology advances and propagation delay times become closer to bipolar (25 to 35ns), we expect fundamental changes in the PLD market. For those data processing applications that constantly push for greater speeds, users will turn to ECL PLDs, which should reach speeds of 6 to 15ns. CMOS will find applications that require greater functionality and lower power, where speed is of secondary importance.

The primary reason cited for CMOS PLD applications has been the replacement of "glue logic," thus offering roughly a four-to-one savings in component count. The data processing segment has been the first and most active market in terms of pushing for reduced component count and power savings.

# CBDs--Application Markets

A closer look at applications for CBDs shows that these are young markets with bright futures.

## Data Processing

As shown in Table 5, during the 1984 and 1985 time frame, the data processing industry was by far the largest market for cell-based ICs. In the past, the emphasis on replacing TTL logic functions gave the first generation of the cell-based suppliers a window of opportunity within data processing applications. Most cell-based IC manufacturers believe that although the data processing application will continue to dominate the market, it will begin tapering off between now and the end of the decade because of the pervasiveness of other segments.

## Table 5

# ESTIMATED NORTH AMERICAN CELL-BASED DESIGN MARKET BY APPLICATION MARKET

End Use	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>19</u> 90
Data Processing	63%	60%	598	478
Communication	16	16	17	22
Industrial	8	8	8	11
Consumer	2	3	3	5
Military	7	8	8	8
Transportation	4	5	5	7
Total	100%	100%	100%	100%

Source: DATAQUEST May 1986

## Communication

There is a tremendous optimism about this market in the long term. We believe that because of expected high growth in communication equipment markets themselves and because of general opportunities for semiconductors within this sector, cell-based technologies will experience positive growth within the communication arena. Most applications come within telephony, modem, and PBX applications. Incorporating analog functions will also provide communication market opportunities because of filter and data conversion needs within the telecom market. However, there seems to be little use of the technology in central office applications.

## Industrial

We believe that industrial applications also provide opportunity for all sectors of the ASIC market, including cell-based products. Incorporating solid-state electronics in industrial applications traditionally has occurred slowly. Today, the emphasis is on replacing traditionally mechanical and discrete semiconductor functions.

Frequently cited applications are process and numerical control, robotics, and factory automation. The MAP program has provided clarity and emphasis on standards and communication protocol within the factory; thus, many semiconductor products are seeing a "more quantifiable opportunity" within the traditionally nebulous industrial market.

### Consumer

To date, our estimates for the consumer marketplace have been fairly pessimistic. U.S.-based production of consumer electronic equipment has fallen dramatically, and we believe that this trend will continue. The Japanese consumer marketplace has centered on gate array technology. None of the manufacturers we spoke to were placing major emphasis on the consumer sector.

Our belief in modest growth in this sector lies primarily in changing the design methodology. Consumer products will utilize semicustom solutions in early production volumes of new equipment. If the product is successful, then a full-custom design will be used.

## Military

DATAQUEST is optimistic about short-term prospects in the military market. We are, however, cautiously optimistic about the military markets' long-term opportunity because of political emphasis on cutting both the budget deficit and defense spending, coupled with a changing presidential administration in the near future.

The military market is a relatively small part of CBD consumption; possibly even lower than our current projections of 7 percent. Many manufacturers, however, are implementing military programs and product lines and are optimistic about stronger growth throughout the decade. Some manufacturers believe that the military will account for as much as 10 to 15 percent of their cell-based business within the next couple of years. Design-to-production cycles are lengthy, but once into production, military products tend to remain stable and experience long life cycles.

# Transportation

The automotive applications were perhaps the most eagerly discussed by the manufacturers with which we spoke. Major applications for cell-based products can be found in the dashboard, engine control, and safety-convenience features. CBDs not only offer cost advantages in large volumes, but can handle high voltage requirements and expand overall functionality.

One possible cloud on the horizon stems from the automobile manufacturers' general refocusing to reduce their semiconductor supplier base. DATAQUEST agrees with ASIC vendor observations that these reductions might impact the ASIC supplier base in particular. Nevertheless, a willingness to maintain historical alliances will probably prevail unless a rival ASIC vendor has substantial advances in technology, cost, and quality "to bring to the party."

# Gate Array--Application Markets

Many of the company representatives we spoke with earn the majority of their gate array revenue from the data processing segment. As shown in Table 6, we believe that this market sector withstood 1985 fairly well, but lost some market share to the military segment.

## Table 6

# ESTIMATED NORTH AMERICAN GATE ARRAY MARKET BY APPLICATION MARKET

End Use	<u>1984</u>	1985	<u>1986</u>	<u>1989</u>
Data Processing	53%	47%	48%	418
Communication	18	16	16	18
Industrial	12	12	12	15
Consumer	2	2	2	3
Military	15	22	21	22
Transportation	0	<u>_1</u>	1	<u> </u>
Total	100%	100%	100%	100%

Source: DATAQUEST May 1986 Telecommunications applications also represent a sizable part of the market today. We believe that telecommunications combined with industrial applications represent opportunities for gate array manufacturers. Here again, the small volumes typically associated with industrial applications makes gate arrays an attractive solution.

We have seen little activity in the consumer and transportation segments. We know of only one manufacturer that has gate array design revenue from the auto market, and evidence of any future growth in this market is not anticipated.

## WILL THE ADOLESCENT REACH ADULTHOOD?

The answer is an emphatic yes, but not without a maturing process. When DATAQUEST contemplates the issues discussed in this newsletter, the following conclusions become apparent.

## ASIC Has a Long Way to Go

There are major revenue opportunities in all ASIC market sectors. In effect, ASIC suppliers have not saturated any end-use markets. The fundamental question is: Will the suppliers see the opportunity and will they act on it? Each of these applications markets is very different-each places different demands on the supplier and each requires a deeper level of understanding of the application. For some of the nimble suppliers the answer is a definite yes. This means that they must develop in-house expertise in application markets and form alliances that foster and develop that expertise. Such changes can ripple through suppliers and affect business strategies. Thus the suppliers will require a marketing organization that understands the characteristics of the end market, an engineering organization that understands the technical requirements, and a top management organization that understands the strategic factors that influence the end market. Therefore, the maturing process involves understanding what the customer really wants.

## **Complex Procurement and Fewer Suppliers**

In reviewing the responses to our survey questions, one gets a clear message that many procurement managers are perplexed and overwhelmed by the rapid change in ASIC design methodology. On the one hand, they wish to narrow the base of suppliers and shorten the development schedule, while on the other hand they must seek out the very latest in technology, which may widen the vendor base. To make matters more complex, using ASIC requires an understanding of the caliber of each design methodology. Not only is the semiconductor technology critical, but the EDA tools are just as important. DATAQUEST believes that this complexity will force users to seek out suppliers that understand their end market and that are willing to develop close working relationships. Their commitment will narrow the supplier base, since most users will be willing to work closely with only a few suppliers.

# ASIC Suppliers Will Concentrate on Certain End Markets

It also seems inevitable that many of the smaller ASIC suppliers that cannot afford to be broad-line suppliers must focus on certain applications. They will tailor their process technology, EDA tools, and design centers toward those end-use applications that best match their strengths. For example, some suppliers will focus on data processing while others may aim at the communication or industrial sectors.

So, like the adolescent who ultimately does something sensible, ASIC companies will develop those important characteristics that will sustain them through adulthood. Each will draw upon its own natural attributes and develop its own unique personality.

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Beth Tucker Anthea Stratigos John Brew Dataquest BB a company of The Dun & Bradstreet Corporation

# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-12

# VALID RESTRUCTURES TO MEET A CHANGING INDUSTRY

## INTRODUCTION

Valid Logic is one of the original "three little guys" delivering design automation solutions for electronic products. However, its revenue growth has not kept pace with the other two companies--Mentor and Daisy; Valid fell behind the pack.

At DATAQUEST's Fifth Annual CAD/CAM Industry Conference, Valid's president, Ken Fine, described the EDA industry as in transition--from novelty to necessity. Two of Mr. Fine's points were applicable to the entire industry, as follows:

- The purchasing cycle is taking longer because evaluation is evolving from a technical decision to a corporate commitment.
- In serving the unpenetrated EDA market, a transition is occurring--from a task orientation to an integrative process.

This newsletter discusses how a recent strategic change at Valid could help Valid grow its business from one of novelty to one of necessity. It examines two points:

- Valid's recent formation of a marketing department and commitment to marketing efforts
- Valid's adherence to industry standards and its striving toward an integrative design environment

### FROM WEAKNESS TO STRENGTH

Valid delivered its first products about the same time as Mentor and Daisy. Valid was also right up there in the vanguard of technology, delivering products such as IC CAD, silicon compilation, physical modeling, and accelerators. Yet, its 1985 revenue amounted to roughly 40 percent of Mentor and Daisy's combined revenue. Why the disparity?

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DATAQUEST believes that the primary difference between Valid's revenue growth and those of Mentor and Daisy is due to Valid's early myopic focus. While Valid was concentrating on the technical capabilities of its products, Mentor and Daisy were building images, developing markets, and hard selling their products.

## Figure 1



DAISY, MENTOR, AND VALID (Quarterly Revenue Percent Change) (1982-1986)

Source: DATAQUEST June 1986

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## New Marketing Structure

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> Feeling the heat from being in the number three market position, Valid has begun to learn from its competitors. Within the past eight months, it has built and staffed what we consider a classic marketing organization. Figure 2 illustrates the structure of Valid's new marketing group.

> Although this organization is relatively new, DATAQUEST believes that Valid is already benefitting from it in the following ways:

- System packaging, with the names of product lines following design solutions, focus on the integrative process.
- The cradle-to-grave responsibilities of product marketing managers with up-front market and product planning-focus on the business of EDA as a corporate commitment.

# Figure 2

# Valid Logic, Inc. NEW MARKETING ORGANIZATION



### DATAQUEST'S INTEGRATIVE DESIGN ENVIRONMENT

Valid's clearest strategy is a commitment to an open systems environment, at least within the Valid product lines. By supporting three hardware platforms, Valid has joined the vanguard of an industrywide movement. Moving the market from novelty to necessity means adapting CAD solutions to the specific design environments of individual customers. This requires both flexibility and an integrative environment.

DATAQUEST does not strictly adhere to the "stereo component" analogy. We do believe, however, that CAD users will continue to buy the best software and hardware to meet their needs, but that the software is restricted to "periphery" software, not "core" software. Each type is defined below:

- Core software is data base and graphics related, having to do with data creation and management.
- Periphery software is the analysis and manipulation of data that have already been created.

Figure 3a illustrates the concept of DATAQUEST's integrative component approach, while Figure 3b illustrates the concept with application examples. We believe that the integrative approach meets the following user needs:

- Process integration, project management, and design control
- Choice of best application solution
- Use of installed or favored computer systems

We believe that users will continue their current practice of purchasing the best periphery software to meet their needs. This software does not have to be supplied by the same vendor as core-related applications, because it is not capturing or managing design data. Instead, it is performing an operation on the data.

On the other hand, we believe that users will continue to carefully pick and choose their core software, which captures and manages the data. It is these products that must meet long-term design needs.

We believe that the large and successful ECAD vendor's product development will represent a more integrated approach to design capture, analysis, and layout. An integrated data base refocuses the user's attention on the business of product design rather than on correlating individual CAD products and tasks.

To date, Valid's open systems strategy centers primarily on openness of the hardware rather than the software. The company achieves flexibility by running core software on proprietary and IBM PC platforms, while allowing users to run periphery software, either from Valid or a vendor of their own choosing, on a Digital or IBM host.

# Figure 3a

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# INTEGRATIVE DESIGN ENVIRONMENT CONCEPT





INTEGRATIVE DESIGN ENVIRONMENT EXAMPLE



Source: DATAQUEST June 1986

# DATAQUEST CONCLUSIONS

While it can hardly be said that the electronic CAD/CAM market is in a mature stage of its life, it certainly has grown up. Design automation products are no longer novelties, they are a competitive necessity for the worldwide electronic industry.

DATAQUEST believes that Valid's early commitment to user-accepted standards will help position the company for the transition from novelty to necessity. From the beginning, Valid rigorously adhered to useraccepted standards, resulting in an open systems design environment.

Valid is not alone in recognizing the value of pursuing an open and integrated environment. But with its most recent commitment to marketing as a necessity rather than a novelty, DATAQUEST believes that Valid's position as the number three EDA vendor has been secured--at least for the present. Now that all ECAD vendors face the threat of the three big vendors--Hewlett-Packard, IBM, and Tektronix--the ability to market technically sound products is becoming the single most important factor in running an ECAD business.

Beth W. Tucker

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Dataquest

# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-11

# MECHANICAL COMPUTER-AIDED ENGINEERING--A NEW MARKET AWARENESS

The mechanical computer-aided engineering (MCAE) application is the fastest-growing area of mechanical CAD/CAM, with an expected 40 percent revenue growth rate in 1986. The MCAE market CAGR of 31 percent through 1990 is significantly higher than the expected 21 percent growth of the total mechanical market. Figure 1 illustrates the strong growth in MCAE software-only revenue. This dramatic market expansion is expected to almost double the worldwide revenue figures twice in the next 5 years.

# Figure 1

# WORLDWIDE MCAE MARKET FORECAST--SOFTWARE ONLY



June 1986

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To better understand the impact of MCAE, the topic was featured at DATAQUEST's recent 1986 Annual CAD/CAM Conference. A user panel of industry experts shared viewpoints and experiences with the standing-room-only audience. The driving issues and trends discussed at the conference are presented in this newsletter, along with DATAQUEST's definitions, market forecasts, and market analysis.

# DEFINITION

The basic MCAE application definition is straightforward. It encompasses the computer-aided tools that are required to assist the working designer or engineer. In general, MCAE in this analysis is limited to the computer graphic tools that have been developed to aid the product design and analysis process. The specific computer graphic tools vary by industry, type of user, and type of computing resource utilized. Word processing, spreadsheet, and other administration software should also be considered in a <u>complete</u> review of computer-aided tools for the engineering professional, but will not be included in this analysis.

MCAE is now defined to include the design and analysis tasks of designers and engineers. Before a more succinct definition of MCAE can be given, some background information concerning the functional requirements of product design and analysis must be presented to enhance the interpretation.

# Product Design

Product design typically begins with some form of modeling. The modeling can be accomplished with 2-dimensional, 3-dimensional wire-frame/surfacing, or with solid modeling techniques. The design goal determines the level of sophistication required for both the modeling process and the subsequent analysis. At the simplest level, several lines and arcs drawn to scale can represent an object and provide the designer with enough information to make a decision. For more complex problems, more advanced computer-aided tools are used. Three-dimensional modeling, particularly solid modeling, is becoming the preferred modeling technique for complex problems and is receiving the lion's share of vendor development effort. The significant benefits of improved integration and automation derived from solids-based modeling is driving the development effort.

## <u>Analysis</u>

Analysis generates all of the information concerning the qualitative and quantitative aspects of the design. Shape evaluation, weight calculation, and clearance between parts are the most common forms of analysis. Contemporary MCAE products ordinarily include all of these functions. Analysis of mechanisms is usually performed with optional software, but the local computer has sufficient horsepower to perform the analysis. More complex analysis of mechanical and thermal stress require a more involved process using finite element modeling and analysis. The resulting analysis model describes the objects and procedure for analysis, which are then submitted to a background process for evaluation. Simple problems can be performed on a personal computer. Large-scale simulation of complex assemblies or rigorous calculation for aerodynamic analysis can take hours or even days to accomplish on supercomputers.

## MCAE Application

The design and analysis activities described above apply to product development in two areas, conceptual design and detail product design, more commonly referred to as computer-aided design (CAD). The functional requirements of conceptual design and detail product design are very similar. The need to share information back and forth between these operations is pushing the requirements even closer. DATAQUEST's definition of MCAE includes the application of design and analysis directed toward both conceptual design and detail product design. The documentation or drafting task associated with detail design is not included in either the definition or forecast calculations.

## TRENDS

DATAQUEST has identified a clear trend in MCAE to expand beyond conceptual design. This is expected to evolve into a complete design and analysis tool that will be applied across the full range of manufacturing operations. This trend implies that MCAE will be used to develop and maintain the corporate data base of product definition.

Correlation of design and analysis simulation with physical testing of prototype hardware is an essential part of the engineering process and is strongly associated with MCAE. DATAQUEST's analysis of the physical test market will be the topic of a future newsletter.

## Vendor Solutions

The general approach to MCAE has taken two paths. For the turnkey vendors, MCAE has evolved as a subset of offerings in documentation, design, analysis, and manufacturing applications. The MCAE software-only vendors started with strong analytical programs and have evolved into complete design and analysis tools. Both approaches have advantages in application integration and depth-in-analysis functions.

Theoretically, the turnkey approach has a better opportunity for application integration. By having control over the complete system, the vendor can ensure an easier to use and more complete exchange of data between the various modules of software. Realistically, this approach has proven to be less than ideal. Real-world analysis usually requires interface to one of the standard analysis codes such as Ansys or Nastran, forcing an interface to an external data base and user interface. In addition, the pre- and post-processing tools developed for the interface by the turnkey vendors are generally perceived to be inferior to the offerings of the analysis software vendors. Exceptions exist, but the general trend is there. The vendors with strong analysis tools are working to expand their operations to include a very close interface to design.

Vendors are showing a growing interest in providing MCAE tools in a network environment, with computational servers adding the extra muscle to increase productivity of the total system with a relatively low increase in price. This approach is being applied to networks with virtually all types of computers. An IBM PC AT networked with Ethernet to a Ridge computer is a good example of this trend. At the midrange, the 18-megaflop Culler Computer PSC plugged into the Sun Microsystems network is another strong example. A Cray-XMP/48 networked with a VAX 11/780 speeds up the analysis by a factor of a hundred or more, especially on large problems.

## The Users

Most design and analysis using CAD/CAM tools is performed by dedicated users who work on a system full time. These individuals are typically more junior designers or engineers working with design managers who look over their shoulders. The reason for this is twofold. The learning curve and effort to maintain a high level of productivity on most design and analysis systems requires a full-time commitment. The high cost of the system also encourages a dedicated usage. These two points, ease of use and cost, are getting the most attention from the vendors. MCAE products introduced in the last year have made significant progress in both areas. The casual user is the target market of the new products using the latest lower-price/higher-performance technology. For the casual user, overall productivity must be good enough to allow the system to sit idle 70 or 80 percent of the time.

# USER CONCERNS EXPRESSED AT 1986 DATAQUEST CAD/CAM CONFERENCE

Below are the primary concerns discussed by MCAE users at the DATAQUEST conference.

- Base of use is important so that the system can support casual users in an efficient manner. On-line tutorial and help functions were suggested as possible solutions.
- Networking must provide communications between systems and allow computational servers in network.
- Data base management with associativity between part geometry and data is necessary to maintain reliable design control and management.
- The cost of system purchase and operation must be low enough to allow widespread implementation on a corporate level.

- Flexible and complete geometric modeling functions are required. Solid modeling was perceived to be the preferred choice.
- Interactive performance is required for modeling, analysis, and display of results.
- The resulting data base must be suitable for later use as the engineering data base. This data base will support drafting, numerical control, and other manufacturing applications.
- Finite element analysis must be included with enhanced modeling and updating functions.
- Both high-precision and rough (very quick) analysis should be provided.
- Kinematic analysis is essential for development of mechanisms in product design.

### FORECAST

The forecast shown in Figure 1 represents worldwide software-only revenue. The 1985 market estimate and forecast to 1990 is based on reported 1985 company revenue and survey data. Revenue for both bundled and unbundled software products has been considered in the forecast.

The MCAE market CAGR of 31.2 percent is significantly higher than the expected 20.6 percent CAGR of the total mechanical CAD/CAM market through 1990. The 1985 to 1986 revenue growth for MCAE is expected to be more than 40 percent.

Table 1 provides a detailed software-only forecast for the world market. Total MCAE market revenue is forecast with the typical analysis by product type. Host computer-based MCAE products dominated in 1985, accounting for 87 percent of the market. The standalone-based offerings are expected to gain acceptance quickly and to overtake host-based products in 1989. Personal computer-based products represent a very small portion of the revenue in MCAE but supply a valuable resource for low-cost training and the basic design and analysis function. By adding board-level or network computational servers, the PC becomes a more competent assistant. The unit numbers indicate the total level of workstations required to support the distribution of software revenue. The number includes products sold bundled as turnkey products as well as the units required to support the unbundled software revenue.

Table 2 forecasts the distribution of MCAE software revenue by region. The North American market represented 45 percent of the total mechanical application revenue in 1985. The MCAE market is much more closely focused in North America, with more than 60 percent of 1985 revenue coming from that region. European usage of MCAE products represented 25.7 percent of the total, and the Far East and Rest of World represented 12.9 and 1.5 percent, respectively.

# Table 1

# FORECAST MCAE MARKET BY PRODUCT TYPE--SOFTWARE-ONLY REVENUE (Millions of Dollars and Actual Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	1988	<u>1989</u>	<u>1990</u>	CAGR
Worldwide							
Revenue	\$202	\$286	\$369	\$458	\$598	\$785	31.2%
Systems	4,847	8,308	15,563	25,198	39,202	58,648	64.6%
Workstations	10,696	15,926	25,037	35,142	50,057	69,424	45.4%
Standalone							
Revenue	\$ 21	\$ 44	\$107	\$200	\$349	\$568	92.98
Workstation	964	2,195	6,180	13,390	26,981	47,199	117.7%
Host-Dependent							
Revenue	\$176	\$234	\$246	\$235	\$224	\$191	1.7*
Systems	2,124	2,804	2,951	2,857	2,834	2,483	3.2%
Workstations	7,973	10,422	12,425	12,801	13,689	13,258	10.7%
Personal Computer							
Revenue	\$5	\$8	\$ 16	\$ 23	\$ 25	\$ 26	38.3%
Workstations	1,759	3,309	6,433	8,951	9,387	8,966	38.5%

# Table 2

# FORECAST MCAE MARKET BY REGION SOFTWARE-ONLY REVENUE (Millions of Dollars and Actual Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	CAGR
Worldwide							
Revenue	\$202	\$286	\$369	\$458	\$598	\$785	31.2%
Systems	4,847	8,308	15,563	25,198	39,202	58,648	64.6%
Workstations	10,696	15,926	25,037	35,142	50,057	69,424	45.4%
North America							
Revenue	\$121	\$171	\$219	\$271	\$352	\$460	30.6%
Systems	2,908	4,962	9,253	14,912	23,088	34,369	63.9%
Workstations	6,417	9,512	14,886	20,797	29,481	40,684	44.78
Europe							
Revenue	\$ 52	\$ 74	\$ 97	\$123	\$163	\$217	33.2%
Systems	1,243	2,162	4,111	6,757	10,669	16,202	67.1%
Workstations	2,743	4,145	6,614	9,423	13,624	19,178	47.58
Far Bast							
Revenue	\$ 26	\$ 36	\$ 47	\$ 57	\$ 74	\$ 96	29.98
Systems	625	1,060	1,966	3,152	4,854	7,190	63.0%
Workstations	1,379	2,032	3,163	4,395	6,198	8,511	43.91
Rest of World							
Revenue	\$ 3	\$ 4	\$ 5	\$ 7	\$ 9	\$ 12	31.94
Systems	72	123	232	378	590	888	65.5%
Workstations	158	236	373	527	754	1,051	46.1%

Source: DATAQUEST June 1986 •

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# Market Share Analysis

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The estimated mechanical computer-aided engineering market analysis for 1985 is shown in Table 3. The 1985 revenue data represent software and hardware revenue from both turnkey CAD/CAM vendors and software-only vendors selling unbundled products.

# Table 3

# ESTIMATED 1985 MCAE MARKET SHARE

	Hardware		
	and	Software-	
	Software	Only	Market
	<u>Revenue</u> *	Revenue	<u>Share</u>
IBM	\$252.1	\$ 57.1	28.4%
Computervision	104.2	23.6	11.7
McNeil Schwendler*	77.5	21.0	10.4
SDRC*	66.6	21.0	10.4
Intergraph	55.3	12.5	6.2
McDonnell Douglas	48.5	11.0	5.5
Swanson Analysis*	46.8	10.1	5.0
PDA Engineering*	34.9	8.8	4.4
Prime Computer	34.8	7.9	3.9
Applicon Inc.	33.4	7.6	3.8
Other	90.8	21.6	10.3
Total	\$844.9	\$202.2	100.0%

\*The if-sold value for hardware to support the unbundled software products has been added where necessary. Market share percentages are calculated based on software-only revenue.

> Source: DATAQUEST June 1986

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## DATAQUEST CONCLUSIONS

MCAE technology is an effective weapon in meeting the competitive pressures in the user environment. The rapid enhancements in MCAE are increasing its usefulness and attracting a larger base of users, which is making MCAE the fastest-growing segment of the diverse mechanical market. The major contributing factors to this growth are as follows:

- The balanced combination of dramatic advances in hardware performance and application software development is opening the door to new market opportunities for MCAE.
- The value of design and analysis performed on the computer is perceived as a valuable tool in many industries and is growing.
- Recent advances in high-performance graphics displays will directly support the MCAE application.
- Advances in computing hardware are improving the performance levels of every type of processor, from PCs to supercomputers. Networking is making high-performance computational servers available to distributed networks of host-based, standalone, and PC systems.
- The potpourri of esoteric analytical tools is being revised to provide easy-to-use basic analysis functionality for the novice. The more rigorous analysis tools for non-linear, aerodynamic, and composite material evaluations are also being enhanced with menu-driven user interfaces with tutorial assistance.
- Vendor focus in building easier-to-use MCAE tools will attract new users to the market.

Michael J. Seely

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-10

# 1986 DATAQUEST CAD/CAM CONFERENCE CITES REASONS FOR OPTIMISM

## OVERVIEW

The more than 250 attendees at the DATAQUEST CAD/CAM conference held in Monterey, California, in May expressed feelings of cautious optimism regarding the future outlook of the CAD/CAM industry. In general, participants believed that while growth has slowed, the CAD/CAM industry is in much better shape than other high-technology industries.

This newsletter summarizes the key issues and concerns raised at the conference. The MCAE and Silicon Compilation sessions are discussed in greater detail in DATAQUEST Research Newsletters entitled "MCAE: A New Market Awareness," and "Silicon Compilation: Market, Myth, or Methodology," both dated June 1986.

## DISTINGUISHING PERSONAL COMPUTERS FROM STANDALONE WORKSTATIONS

There seemed to be a good deal of confusion surrounding the DATAQUEST workstation forecast illustrated in Figure 1. Most of this confusion was centered on the distinction between a personal computer and a standalone engineering workstation. DATAQUEST defines a personal computer as having the following characteristics:

- Nonvirtual computing
- Single tasking
- 8- or 16-bit microprocessor

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# Figure 1

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# ESTIMATED CAD/CAM WORKSTATIONS BY PRODUCT TYPE

Standalone workstations have the following features:

- Virtual computing
- Multitasking
- 32-bit microprocessor

The single most significant distinction between a personal computer and a standalone engineering workstation is virtual computing. Because of the large size of many CAD/CAM data bases and applications, the ability to use a hard disk transparently as a memory extension device clearly distinguishes the level of functionality and performance found on standalone engineering workstations as opposed to personal computers. However, using the name standalone as a label for 32-bit, virtual engineering workstations is probably not appropriate anymore since most of these systems do not usually stand alone, but instead are networked together. A better set of labels for standalone and personal computer workstations might be distributed virtual and distributed nonvirtual, respectively. In any case, DATAQUEST believes that demand for nonvirtual, personal computers in CAD/CAM applications will slow dramatically this year, giving way to virtual, 32-bit engineering workstations.

It is important to note that by the DATAQUEST definition, the IBM RT PC is a distributed virtual workstation as opposed to a personal computer. In addition, forthcoming products based on the Intel 80386 would be classified as distributed virtual workstations instead of personal computers. Our forecast reflects this thinking.

DATAQUEST believes that distributed virtual workstations will also contain a high degree of compatibility with the personal computer environment by providing the ability to run MS-DOS programs. This feature clouds the distinction between a virtual and a nonvirtual workstation depending on the actual operating environment of the CAD/CAM application. For counting purposes, DATAQUEST will treat mixed-mode machines as distributed virtual systems.

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# THE CHANGING ROLE OF HOST COMPUTERS

According to the DATAQUEST forecast illustrated in Figure 1, the demand for host-dependent workstations will be flat through 1988 and begin to decline in 1989. This forecast, however, represents the demand for CAD/CAM interactive graphics application processing and does not reflect the use of host computers used as network, file, and/or computational servers. DATAQUEST believes that the role of the host computer will change from an interactive graphics computer to a server of distributed virtual and nonvirtual workstations. Future DATAQUEST forecasts will identify this compute server environment as an independent line item.

# HARDWARE PRICE EROSION--PROTECTING MARGINS

A key dilemma facing the turnkey manufacturer today is the declining price of computing hardware. As Figure 2 illustrates, the falling price of hardware is uncovering the real or hidden price of software. The danger here is that with falling hardware prices, standardized hardware platforms, and more experienced users, the vendors will be forced to unbundle their application software, thereby eroding margins. We agree with Leif Rosqvist, Vice President of Marketing at Calma Company, when he stated during his presentation that, "The CAD/CAM market is turning to a mix-and-match mentality and there is no room for two markups anymore."

## Figure 2





Laura Conigliaro, Vice President at Prudential-Bache Securities, offered some interesting observations on ways that a turnkey vendor can

Outsourcing workstation peripherals such as disk drives and printers

June 1986

- Building application accelerators
- Providing a wider range of application software
- Providing integration and support services

to some extent buffer the effects of price erosion by:

Ms. Conigliaro also likened the CAD/CAM market to doing the "3-2-3 dance step" or, in other words, going three steps forward, two steps backward, and three steps forward. In terms of this 3-2-3 analogy, she felt that the CAD/CAM market had taken two steps backward and was poised to take three steps forward but only on a selective basis and not until well into 1987.

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## MCAE--CHANGING FROM A BOUTIQUE MARKET TO A MAINSTREAM REQUIREMENT

Bradford Morley, Vice President at Structural Dynamics Research Corporation, conveyed a number of very interesting points regarding the emerging MCAE market. He presented some eye-opening statistics from research within his company's client base, which indicated that 85 percent of the committed R&D costs associated with mechanical designs are dictated by the first S percent of expended R&D dollars. His research also revealed that the cost of changing a design increases exponentially as a function of time. In other words, the further along a project gets in the design and manufacturing cycle, the more costly it becomes to make a design change. Therefore, the most critical time in the evolution of a design is in the early stages where MCAE tools can be used to simulate product performance.

## SILICON COMPILATION--IT REALLY WORKS

Four end users that have applied silicon compilation to real world problems strongly indicated that this technology not only works, but provides significant productivity benefits over traditional EDA methods. DATAQUEST believes that IC CAD workstations incorporating silicon compilation functionality will account for nearly half of all IC CAD workstation shipments by 1990, up from less than 5 percent in 1985. Revenue from the sale of silicon compilation-based CAD equipment are expected to reach \$520 million by 1990, enjoying a 157 percent CAGR from 1985 to 1990.

# ELECTRONIC DESIGN AUTOMATION --- NO NEED TO SELL THE NEED

As Ken Fine, President of Valid Logic, pointed out, the transition of the EDA market from growth to maturity is really the transition from novelty to necessity. Purchasers shopping for EDA systems today generally understand and appreciate the economic benefits derived from using EDA workstations. Mr. Fine also stated that the purchasing cycles for EDA systems are taking longer because the market is evolving from a technical decision to a business decision.

# PEOPLE--THE KEY SUCCESS FACTOR

Grant Heidrich, General Partner at the Mayfield Fund, pointed out that the three most important factors that dictate the success or failure of a business venture are people, people, and people. He emphasized that all companies are dipping from the same technology bucket and, therefore, the human element is usually the determining win or lose factor. Daniel Garms, Executive Vice President, and Dr. Daniel DeWitt, Psychologist, from CAD/CAM Specialists, also conveyed why having a positive corporate culture helps to hold a company together in a continually changing environment. They presented an extensive study that examined three corporate cultures in the CAD/CAM industry and found that the successful CAD/CAM culture must represent somewhat of a paradox. Companies must think small and specialized to react to market windows, but encourage expansion to meet rapid product demand.

## IBM BELIEVES THAT CIM WILL BE THE NEXT KEY MARKET OPPORTUNITY

Robert Teil, Director of Engineering/Scientific Market Development for IBM, shared IBM's perspective of the CAD/CAM industry. He noted the increasing emphasis that customers are placing on CIM solutions. Recognizing this trend, IBM's Federal Systems group will be piloting a project to help design and implement large CIM systems for organizations that wish to bridge data from many industrial disciplines. DATAQUEST believes that this group could represent a major competitive thrust for future sales of IBM equipment in the CAD/CAM marketplace.

Mr. Teil also alluded to the fact that IBM will be focusing most of its development efforts on hardware and integration services as opposed to application development. It is reasonable to expect, however, that IBM will be adding new third-party applications to its CAD/CAM product portfolio in the near future. DATAQUEST expects IBM to unveil a number of new application packages including a PC AT-based drafting system and a mainframe-based AEC system.

The new IBM RT PC was discussed along with the possible overlap of this machine with forthcoming 80386-based products. Mr. Teil felt that while there may be some overlap, the architecture of the RT PC would allow IBM to migrate the RT PC's performance well beyond that of the 80386. DATAQUEST believes that IBM will announce improvements to the RT PC's performance later this year, but prior to the announcement of 80386-based products in order to put some distance between the two products.

David B. Burdick

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**BB** a company of The Dun & Bradstreet Corporation

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-9

## SILICON COMPILATION: MYTH, MARKET, OR METHODOLOGY?

In 1985, the electronic CAD/CAM marketplace learned what silicon compilation is all about, from trade shows, published articles, technical sessions, and workshops. Despite this marketing blitz, many observers still consider silicon compilation too immature to be a serious contender in the IC CAD arena. One critic put it bluntly: Nobody wants it yet.

Well, somebody must. At DATAQUEST's recent CAD/CAM Industry Conference, four early adopters of silicon compilation testified to the design successes they have achieved. Furthermore, DATAQUEST estimates that silicon compilers accounted for \$8.8 million of 1985 IC CAD revenue, growing impressively from \$1.8 million in 1984. As silicon compilation technology becomes increasingly incorporated onto IC CAD workstations alongside competing design tools, we expect the demand for compilation functionality to soar (see Figure 1).

## Figure 1

# ESTIMATED IC CAD SYSTEMS WITH SILICON COMPILATION (System Revenue\*)



Source: DATAQUEST April 1986

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This newsletter:

- Defines silicon compilation methodology and product types
- Analyzes the case for and against silicon compilation
- Examines user attitudes expressed during our silicon compiler end-user panel
- Offers DATAQUEST's conclusions

### DEFINITIONS

# Distinctions

Some important distinctions have to be made immediately because silicon purists will object to our referring to this automatic IC design technology as "silicon compilation" rather than "cell compilation."

DATAQUEST believes that silicon compilation is the ultimately intended product and that the current generation of cell-based tools represents evolutionary steps on the way to true or fully automated IC design. We can see no competitive advantage in confusing end users with such academic distinctions at this time.

"True" silicon compilation, in the sense of artificial intelligencebased, design synthesis, may not be here yet, but the form of it that does exist is usable, and is being used, right now. A more significant way to distinguish the various products calling themselves silicon compilers is by the level of IC design expertise required to use them.

Silicon compilation currently exists as two types of design tools, one aimed at the non-IC designer and the other at the IC designer. DATAQUEST classifies these design tools, respectively, as silicon compilers and compiler generators. For example, Concorde from Seattle Silicon Technology (SST) and Genesil from Silicon Compilers Incorporated (SCI) are silicon compilers. GDT from Silicon Design Labs (SDL) is an example of a compiler generator. (A subsequent newsletter will examine in depth both silicon compiler market participants and specific products.) Silicon compiler companies offer design services in addition to these products.

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Silicon compilation as a design service is also being offered to customers by a growing number of ASIC houses, such as Cirrus Logic, Gould-AMI, LSI Logic, and VLSI Technology Incorporated (VTI). We expect the ranks of ASIC suppliers offering compilation to grow dramatically over the next year. Additionally, VTI offers compilation products based on its own cell libraries.

# Silicon Compiler

DATAQUEST defines a silicon compiler as a set of programs to automatically generate the physical layout of an ASIC. Silicon compilers generally employ a top-down, hierarchical design methodology that begins with a high-level specification (see Figure 2).

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## Figure 2

# TRUE SILICON COMPILATION



Source: DATAQUEST April 1986

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The user enters this specification using either a menu or a form, choosing from a pre-designed functional library and specifying the particular process, electrical characteristics of the functional modules, and foundry design rules. The functional library could consist of such less complex cells as ALUS, ROMS, RAMS, register arrays, and steering logic, or of more complex cells such as CRT controllers.

The silicon compiler translates this specification, creates the necessary cells, and generates a layout. The compiler coordinates routing and placement decisions. The user manipulates this layout and the specification until a satisfactory design is produced. Within the compiler are simulation, design and timing verification, design rules checking routines, and design data base management facilities--a fully integrated design solution.

## Compiler Generator

DATAQUEST defines a compiler generator as a system for creating the functional modules used by the compiler. Simply, it is a compiler development system. Compiler generators differ from silicon compilers in the way designs are entered, in design methodology, and in the level of IC design expertise required (see Table 1). In reality, compiler generators have more in common with handcrafted IC design systems, to which they represent an alternative, plus a migration path to automatic layout.

# Table 1

# COMPARISON OF EXPERTISE REQUIRED FOR IC DESIGN

	De:	si <u>gn Entry</u>		
Methodology	Schematic	Language	Form	Physical Layout
Compiler .	N/A	N/A	Logic	Novice
GA, SC	Logic	N/A	N/A <sup>(</sup>	Novice
Compiler Generator	Silicon	Silicon	N/A	Silicon
Handcrafted	Silicon	N/A	N/A	Silicon

N/A = Not Applicable

Source: DATAQUEST June 1986

Functional modules are described in algorithms by means of high-level programming languages such as C or LISP, or the logic itself. Compiler generation description includes a set of customizable characteristics in the modules or design primitives. These parameterized designs eventually become the functional model libraries of a silicon compiler and are the means that allow compiler end users to specify characteristics of the particular module, such as aspect ratios, register size, memory size, timing information, and other functional properties.

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### COMPILATION

# Benefits

From our end-user research, we have identified the following as the benefits of silicon compilation:

- Reduced design turnaround, compared with other methodologies
  - Integrated design solution
  - Greater design exploration/creativity
  - Enforced standard design practice
  - Automated layout

ASICs are, at present, most often designed by customers entering the design using schematic capture and running logic simulation. In the case of gate array or standard cell workstations, physical design is accomplished via automatic place and semiautomatic route programs. The resulting design is then passed over to the foundry either for physical design or for redesign, and for test. By and large, the tools used during the design process are coming from a variety of vendors and are often highly nonintegrated. This fragmentation within the design process can result in high nonrecurring engineering (NRE) costs, as the design moves from concept to manufacturable product.

Silicon compilation bypasses the time-intensive and error-prone schematic entry phase, and thus reduces costs both in-house and at the foundry. We think that users will find it strategically important to know their designs are manufacturable months before they get to the foundry.

Increased design creativity also results from freeing system engineers or non-IC designers from the time constraints of schematic entry and allowing them to work at a higher level of abstraction. Compilers allow users to explore a variety of architectures or floor plans, and their resulting layouts, before committing their designs. This expanded product development phase results in better designs because there are more opportunities to try out design alternatives.

Compilers assure design manufacturability by enforcing the standard design practices of the specified foundry. The design and test rules the compiler uses to accomplish this can be either a generalized set of design and process rules of supported foundries, or the highly specific manufacturing rules of a single manufacturer. In either case, the ultimate design benefits from having to conform to manufacturing design rules early in the design process. Turnaround time, both during design and at the foundry, also benefits from such enforcement of standard design practice, which translates into lower costs. That's the bottom line.

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The advantage of compiler generators is that they provide the means for ASIC houses and semiconductor manufacturers to capture their design experiences in libraries that are more descriptively and efficiently developed, as well as more easily maintained. This type of tool permits designs to be generalized and silicon expertise to be encapsulated. Redesign is expedited. For the IC designer, the compiler generator represents the freedom and creativity of designing at all levels of abstraction. For the users of silicon compilers, IC designers using compiler generators translates into having more cells to choose from or, in marketing terms, increased design flexibility.

In our opinion, the overriding advantage of both silicon compilers and compiler generators is to provide a shared method of satisfying the design demands of both system engineers and IC designers. These tools provide the means of communicating IC design methodology in terms understood by each class of user.

# NEEDS

From our end-user research, we have also identified the following shortcomings of current compilation products:

- Lack of automated test generation
- Limited number of functional design modules
- Limited number of supported IC manufacturers
- Inefficient silicon usage
- Low user comfort level or lack of user-friendly interface
- Few design successes

On the negative side, current silicon compilers do not include automatic test vector generation. DATAQUEST believes that to be ultimately successful, silicon compilation is going to have to solve the enormous problem of automatic test generation.

At present, the designer's choices, in terms of numbers of functional design modules to choose from, are limited. This is an area that will require close cooperation between CAD vendors and IC manufacturers in order to develop a richer functional module set.

Compilers necessarily employ block placement and routing of cells, often resulting in inefficient utilization of the silicon. This means expense. Better design compaction routines would result in a use of silicon real estate that is comparable to the efficiency of handcrafted chips. In any event, the trade-off between time-to-design and silicon efficiency must be reduced. The critics' most convincing argument concerns user reluctance to change their current design methods. Rhetorically, the case can be made either way. System engineers are being asked to think in terms of IC designers, and IC designers are being asked, not only to think in terms of logic designers, but also to become software engineers. Compiler vendors are going to have to provide migration paths to the new methodology. For example, they must either provide easier user interfaces that include on-line help and training facilities, or offer some synthetic mechanism for translating a schematic into the higher-level description required by a compiler.

There is only one way out of this to-change-or-not-to-change juggernaut, and that is when the cost of NOT using compilation tools begins to hurt competitively. Specifically, it's when the design successes and resulting productivity gains of compilation clearly outdistance the price of designing with older methodologies. DATAQUEST believes that the use of compilers increasingly will represent a significant competitive advantage, and that publicized endorsements of compiler design successes will fuel the demand for these products.

# SILICON COMPILER ISSUES AND END-USER PANEL

The following user comments are from the silicon compiler end-user presentations and panel discussion conducted during DATAQUEST's CCIS conference held in May. Included are brief DATAQUEST analyses of various silicon compilation issues. The panel itself consisted of three system engineers who are using silicon compilers and, amazingly enough, only one "tall thin IC designer," who uses a compiler generator product.

# Reasons for Choosing Silicon Compilation

"We needed a full custom design and we couldn't get the density in conjunction with the speed we needed from either standard cells or gate arrays. We know how to apply more logic, but more logic was prohibitively expensive."

"Obviously, anything that a silicon compiler can do could be put into a standard cell library . . [but] we couldn't find a standard cell manufacturer with all the cells we needed. It's simply a question of the size of the library versus the capabilities of the compiler. When you compare silicon compilers and standard cells, I expect you'll see silicon compilers eat up the definition of standard cells as silicon compilation becomes more tried and true. So we had to look at some form of silicon compiler."

DATAQUEST classifies chips designed by the current generation of silicon compilers as cell-based ICs. These cell-based designs satisfy a demand for something between standard cells and fully handcrafted ASICs. Full custom will ultimately yield to cell-based technology.

DATAQUEST's Semiconductor Industry Service forecasts that merchant sales of cell-based ASICs will grow at 59 percent CAGR between 1985 and 1990, faster than the 26 percent CAGR of gate arrays and, more significantly, faster than the negative 1.3 percent CAGR for full custom ASICs (see Figure 3). In our opinion, the demand for cell-based designs and cell-based design tools (i.e., silicon compilers) go hand-in-hand. (For more information on this subject, refer to our CCIS Research Newsletter, No. 91, entitled "Sharing the Expertise: The Semiconductor and Electronic CAD Markets Team Up for Automated Design.")

## Figure 3

# ESTIMATED MERCHANT ASIC MARKET (Billions of Dollars)



Source: DATAQUEST February 1986

# Process Independence

"During design itself, there's no visibility of the target foundry or process. You essentially compile out to all supporting foundries and decide, based on power, speed, and die-size--essentially yield--which foundry you'll go to."

"Process and foundry independence was key [in our choice of compilers].... We had a choice of four foundries and eight different processes."

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Process-dependent tools and products, in our opinion, do not offer users the design portability that DATAQUEST research indicates is a major user demand. The rule-of-thumb is the larger the customer, the more critical the need for second-sourcing. The VTI end user on our panel, however, disagreed; the assurance of manufacturability provided needed security in adopting a new design methodology. Another system end user predicted that the growth of ASIC design will eventually result in longer foundry queues, thus making the case for second-sourcing via process-independent design tools.

# Slow User Acceptance

"The problem is expectations . . . because we're not there yet. There's no totally automatic silicon compiler to automate the IC design process yet. It's still pretty much an interactive tool."

"System engineers don't really care to be bothered with layout. . . . There's a built-in reluctance to changing a design methodology."

"We're still going through the first generation of design successes using silicon compiler technology."

"We are not silicon designers. We couldn't spell silicon when we started this process using compilation and, more importantly, after finishing it, we still can't spell silicon . . . If it's not a one or a zero, we don't want to know about it."

"Just because we use handcrafted IC CAD workstations, don't assume we like 'em."

From these comments, it is clear that in order for silicon compilers to win widespread acceptance among non-IC designers, the human interface is going to have to be related to the logic level and no lower. From our primary research, IC designers themselves are actively pursuing both compiler generator evaluation and purchase decisions.

## Time to Design

"Our first two designs took ten months from CAD system delivery to working silicon. Our estimate of how long it's going to take to do parts in the future is around seven-and-a-half to eight-and-a-half months total."

"So, even with the one error we found . . . it took us about 15 months to get to production silicon from the idea of doing a silicon compiled chip, which is extremely good comparing it to another music chip from another company. They were at first silicon with a handcrafted chip the day that we started working on ours . . . They have still to get working silicon back from this handcrafted chip. The silicon compiler is a tremendous leverage tool."

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#### DATAQUEST CONCLUSION

#### What Are We Saying?

We are saying that not every IC design will require a compilation solution. Silicon-compiled chips are not yet quicker to design than gate arrays, nor do we expect that they will displace this popular implementation. Nor, for that matter, are compiler generators completely satisfactory for microprocessor development and other highly yieldsensitive designs. But we are saying that for a range of full-custom applications, compilers do represent a significant design alternative. For a long time to come, there will be an appropriate role for all three IC design methodologies: handcrafted, autoplace and route, and compilation.

Furthermore, we are saying that users will want the option of choosing the appropriate methodology on a per design, rather than on a per workstation, product basis. And this means offering the choice of methodologies on a single IC CAD workstation. The market for silicon compilation cannot be separated from the market for all IC CAD tools, because each one is a piece of the puzzle.

Silicon compilation is not a myth. It is a functioning IC design methodology in beta site, and the first reports, such as those presented by the panelists at our annual conference, are impressive. We believe that both early adopters and vendors recognize silicon compilation as the IC design tool the market has been demanding for quite awhile now: an integrative design solution.

We said earlier that 1985 was the year for market education. Well, 1986 is the year for endorsements and design successes. We believe that word-of-mouth endorsements from early adopters will snowball. From this point on, we expect silicon compilation to combine with, and eventually displace, competing IC design methodologies.

Tony Spadarella

Dataquest THE a company of The Dun & Bradstreet Corporation

# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-8

#### DAISY BREAKS NEW GROUND IN JAPAN -- FORMS ALLIANCE WITH TEL

#### SUMMARY

In response to the current trend of establishing wholly owned subsidiaries rather than joint ventures in Japan, Daisy Systems has recently created Daisy Systems International, Inc., in Tokyo to oversee the marketing and distribution of its electronic CAD/CAM products. Additionally, Daisy has appointed Tokyo Electron (TEL), an established and respected supplier of CAD/CAM and application-specific ICs (ASICs), to concentrate on selling Daisy's Personal LOGICIAN workstation based on the IBM PC AT. Seiko Instruments and Electronics will continue to sell Daisy's entire line of products.

DATAQUEST believes that Daisy's decision to establish more control in the burgeoning Japanese market was triggered in part by the fact that it is losing market share to Mentor Graphics (which has a wholly owned Japanese subsidiary) and Valid Logic, as illustrated in Figure 1.

#### Figure 1



1984/1985 DAISY, MENTOR, AND VALID

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#### DAISY'S MARKET PERCEPTION

Daisy believes that there are two types of prospective customers for electronic CAD/CAM products in Japan:

- Approximately 20 major semiconductor manufacturers
- An estimated 4,000 ASIC users (e.g., computer manufacturers and consumer electronics vendors)

While Daisy believes that it has done reasonably well selling to semiconductor manufacturers, it felt that additional steps had to be taken to penetrate the large ASIC user base. TEL was chosen to address that market opportunity on Daisy's behalf.

#### TEL'S MARKET PERSPECTIVE

TEL'S Computer Systems Divison has distributed Computervision's products in the mechanical market for many years, and more recently, it has been distributing SDA's automated ASIC layout tools. The Daisy products will not be sold through this division, but rather, they will be marketed through TEL's Electronic Components Division. This group also has responsibility for selling AMD, Fujitsu, and Motorola ASICs through TEL's design centers.

TEL believes that it will sell more than 1,000 Personal LOGICIANS over the next three years. It expects to be successful with this product for the following reasons:

- Many ASIC customers do not like to visit design centers simply to evaluate ASIC designs. Instead, they would like to be able to evaluate ASIC alternatives at their own sites using CAD tools, and use the design houses to facilitate the design and manufacturing implementation.
- The IBM PC-based Personal LOGICIAN is transportable and allows TEL'S ASIC sales engineers to carry CAD technology to the customer sites to assist the sales and ASIC selection process.
- TEL plans to offer Personal LOGICIAN evaluation units on a monthly lease basis for ¥300,000 (\$1,666).
- The ability to offer a wider range of design and manufacturing services (e.g., CAE training, consulting, and manufacturing) simplifies the process and reduces the cost of producing ASICs.

TEL currently has 30 IC design engineers serving as ASIC design consultants. The company has a major design center in Yokohama and plans to build two more in Osaka and Nirasaki by June of this year.

#### DATAQUEST ANALYSIS

We believe that Daisy's addition of TEL as a distributor will help strengthen the company's position in the Japanese market. However, it is reasonable to expect Daisy's competitors to counter by forming alliances with other Japanese ASIC companies.

We also believe that the window of opportunity in the Japanese CAE market is closing rapidly. Consequently, if other CAE manufacturers plan to make an impact on the Japanese market, they should take concrete measures to do so this year.

Japanese users have shown a greater tendency than their American counterparts to purchase products from vendors with the largest installed bases. This fact emphasizes the importance of quickly establishing a large user base. We believe that this is a key motivation behind Daisy's new independent venture.

It is becoming more difficult for a single CAD/CAM vendor to cover all applications. Consequently, many Japanese distributors are re-examining their largely U.S.-based vendor product portfolios and selecting products designed to address each application segment separately. TEL's CAD/CAM strategy is an excellent example of this trend.

Yu Vemura

a company of The Dun & Bradstreet Corporation

Dataquest

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-7

#### WORKSTATION VENDORS RUSH OUT THE GATE

#### OVERVIEW

The engineering workstation market has recently witnessed an unprecedented number of new product announcements, more than at any other time during this industry's brief history. As Figure 1 depicts, DATAQUEST believes that during the coming months, new products introduced from the industry front-runners (Apollo, Digital, and Sun) along with newcomer IBM, will be setting the pace for the entire workstation industry. More importantly, DATAQUEST believes that the engineering workstation industry will serve as a key barometer when measuring the health of the entire engineering computing industry as well as its major application--CAD/CAM.



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This newsletter will analyze each of the recently announced major workstation offerings and discuss each product's ramifications on the market as a whole. Their effect on the CAD/CAM marketplace will also be discussed and analyzed. #1

#### COMPETITIVE EVALUATION

Measuring the technical merits of one workstation versus another is a very difficult task compounded by:

- The lack of consistent standards
- A phenomenon known as "vendor specsmanship" whereby the vendor publishes only those specifications that make its products look good and ignores those that do not
- The subjective nature of many features
- The effect that applications have on weighing the importance of one feature versus another

A particular case in point is the often-used MIPS (Millions of Instructions Per Second) specifications. With today's simpler computing architectures employing microprocessor technologies and Reduced Instruction Sets (RISCs) the types of instructions that these computers are processing are very different from their mainframe ancestors. For example, a RISC computer that boasts 2 MIPS in computing performance may only produce a fraction of that speed when running a particular application due to the complexity of the operating software. Vendors are also guilty of quoting MIPS ratings on instructions that operate the quickest (such as an integer add) instead of advertising ratings that indicate performance over an average range of instructions.

Discussing the implications of quantifying workstation performance is beyond the scope of this newsletter. DATAQUEST believes, however, that workstation buyers generally evaluate four major technical categories when making workstation purchases:

- Computing
- Graphics
- Networking/interconnectivity
- Application software

Each of these categories carries with it a unique set of specifications that are weighted by their particular importance within a given application and/or environment. As Figure 2 illustrates, DATAQUEST believes that the two dominant environments emerging within the design automation community are for low-end 2-D and high-end 3-D workstations.

### **Figure 2**

#### CAD/CAM WORKSTATION MARKET



Source: DATAQUEST March 1986

- 1 megapixel of display resolution
- Up to 16 colors
- 600 to 1,000 double-precision whetstone performance
- Execution and storage of MS-DOS programs
- Engineering documentation and data entry applications

High-end systems generally contain the following features:

- Greater than 1 megapixel of display resolution
- Greater than 256 colors
- High-performance graphic processors to perform near real-time viewing and shading functions
- 1,500 to 2,000 double-precision whetstone performance
- Engineering analysis and simulation applications

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Tables 1 and 2 list a cross section of specifications for the leading machines for each of these environments. Tables 3 and 4 then rank each of the vendors from a technical standpoint across the low-end 2-D and high-end 3-D environments, respectively. It is important to note that these rankings represent a snapshot in time and that more than likely they will change as the workstation vendors continue to add more functionality and performance. The following paragraphs discuss and analyze each of the workstation offerings by environment.

#### Table 1

Vendor/Model	Apollo Computer <u>3000</u>	Digital Equipment <u>VAXStation 11</u>	IBM <u>PC RT 6150/910</u>	Sun Microsystems <u>3/52M</u>
Computing				
Alcroprocessor	N68020	DBC 78032	IBN RISC	N68020
Clock Speed	12.5	20	5.68	15
M1	1.3	0.9	1.5	1.5
Floating Point				
Std./Whetstones OP	N68881/685	DBC 78132/681		M68881/650
Opt./Nhetstones DP			Proprietary/200	
PC Competibility	Tes	No	X++	<b>300</b> ·
Graphics				
Resolution	1,280 x 1,024 (mono) 1,024 x 800 (color)	1,024 x 864 (mono) 1,024 x 864 (color)	1,024 x 768 (mono) 720 x 512 (color	1152 x 900 (mono)
Vector Drawing Speed	6,500	5,000	7,500	19,000
Graphics Tools				
Programming Aids	3-D GNR	I Windows	VOI	SunView
	3-D GBR	018		SunNindows
	Dialogue			
Standards	DONAIN/CDIE DONAIN/GES	GKS	Personal graphics GKS	SunCore SunCGI
Hetworking/Interconnectivity				
LAN Type	Proprietary Token	Bthernet	Proprietary PC-Net	Ethernet/NPS
LAR Speed	12 Mbits/sec.	19 Mbite/sec.	2/Mbits/sec.	10 Mbits/sec.
18H Interface(a)	DOMAIN/SHA	SNA	SMA	SunLink SHA
	AJE: #A5P/270/3780			SunLint 69C
	BCBAIR/PCI		-	
Digital Interface(s)	(FC Interconnect) DONAIE/VACCESS	DECHET		
Application Software				
Number of 3rd-party			•	
Applications	500+	600+	20+	250+
Humber of OEM and				100.
Software Vendorm	200+	40U+	10+	TAA+
Price	\$19,409 (color)	\$35,000 (color)	\$25,090 (color)	
	\$14,400 (mono)	\$29,640 {mono}	\$24,790 (mono)	\$13,900

## LOW-END 2-D WORKSTATION COMPARISON

Source: DATAQUEST March 1986 Table 2

# HIGH-BND 3-D WORKSTATION COMPARISON

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Vendor/Node3	Apollo Computer <u>OMSEQ</u>	Digital Byuipment <u>GPX</u>	184 PC 82 6150/5089	Silion Wighles	Sun Microsystème <u>3/160C</u>
Suputing					
Microprocessor	M68020	DEC 78032	ION RISC	M68020	M68020
Clock Speed	16.67	20	5.44	16.67	16,67
NI 26	1.5	0.9	1.5	1.5	1.5
floating-point					
Std./Whe <b>tstones DP</b>	M68881/774	DBC 78132/681			M688#1/790
Opt./WnetStones DP	Weitek/1,500		Proprietary/200	Weitek/1,500	Weitek/1,500
Graphics					
Resolution	1,200 x 1,024	1,024 x 854	1,024 x 1,024	1,024 x 768	1152 x 900
Vector Drawing Speed	100,000 (3-0)	70,000 (2-0)	70,000 (2-D)	86,000 (3-D)	50,000 (3-D)
3-D Graphics Acceleration.	108	No	ND	Yes	Yes
Gouraud Shaded Ploygons/Big.	25,000	Not Applicable	Not Applicable	2,200	1,000
Graphics Tools					
Programming Aids	3-D GMR	X Windows	VDI	IRIS Graphics Library II	SunView
	3-D GBR	UIS		IRIS Window Manager	Sunifindows
*	Dialogue				
Standards	DOMAIN/COEC DOMAIN/GES	GKB	Perional graphics GES	gr8	SunCore SunCG1 SunGKS
Notworking/Interconnect2vity					
LAN Type	Proprietary Token	Sthernet	Proprietary PC/Ret	Ethernet	Bthernet/NPS
LAH Speed	12 Moits/sec.	10 MDIts/sec.	2 Mbits/sec.	10 Mbits/sec.	10 Mbits/sec.
IBM Interface(#)	DOMAIN/SBA RJE: MASP/2700/3780 DOMAIN/PCI (PC Interconnect)	SHA		IBM Link Sunlink BBC	SunLink SNA
OBC Interface(s)	DOMAIN/VACCESS	000107			
Application Software Number of 3rd-Party					
Applications Number of ORM and	500+	600+	20+	60+	250+
software vendors	200+	400+	10+	40+	100+
Price	\$68,600	\$39,950	\$46,760	\$51,250	\$50,600

Source: DATAQUEST March 1986 ÷,

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#### Table 3

### LOW-END 2-D RELATIVE PERFORMANCE COMPARISON (1 = Best; 4 = Worst)

<u>Vendor/Model</u>	Apollo <u>3000</u>	Digital VAXStation II	IBM <u>PC_RT</u>	Sun <u>3/52M</u>
Computing	1	3	4	2
Graphics	1	3.	. 4	2
Networking	1	3	4	2
Applications	2	1	- 4	3

#### Table 4

### HIGH-END 3-D RELATIVE PERFORMANCE COMPARISON (1 = Best; 5 = Worst)

<u>Vendor Model</u>	Apo110 DN580	Digital <u>VAXStation GPX</u>	IBM <u>PC RT</u>	Silicon Graphics <u>3020</u>	Sun <u>3/160C</u>
Computing	3	4	5	2	1
Graphics	1	5	4	2	3
Networking	1	3	5	4	2
Applications	2	5	4	1	3

Source: DATAQUEST March 1986 ÷.

#### Low-End 2-D Environment

The low-end 2-D environment has historically been dominated by personal computers such as the IBM PC AT. DATAQUEST believes that the personal computer era in CAD/CAM will level off dramatically and eventually give way to the more powerful, low-cost generation of engineering workstations that were recently introduced. Our reasoning behind this prediction stems from our survey of CAD/CAM end users who suggested that 32-bit, virtual memory, engineering workstations were more desirable than personal computers. (See DATAQUEST newsletter #84 entitled, "CAD/CAM End-User Survey.") However, CAD/CAM end users also stated that price was ultimately the most important factor when considering workstation purchases, with \$20,000 being an important economic target. Now that the new breed of workstations has crossed this critical price/performance barrier, DATAQUEST expects rapid expansion of this market segment. Our findings are further substantiated by some of the large, low-end workstation purchases recorded by General Motors' EDS, Hughes Aircraft, and Schlumberger. In each of these instances, the

requirement for a 32-bit engineering workstation costing less than \$20,000 was the principal purchasing criterion. None of these purchasers considered a personal computer due to its limited computing, graphics, and networking performance.

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As Table 3 indicates, Apollo's 3000 series and Sun's 3/52 are technological leaders in the low-end 2-D environment capturing first and second place ratings in all categories except Applications, where Digital's VMS reigns supreme. In particular, Apollo's color 3000 series should be a big winner in this marketplace because:

- It meets or exceeds all required specifications for this market.
- No other vendor comes close to offering a color workstation with the 3000's performance for less than \$20,000.

Apollo is planning to ship 600 of the 3000 series workstations by the end of March. We believe that an additional 5,000 to 10,000 unit shipments of Apollo's 3000 series are possible this year.

Sun's recently announced 3/52 is a very close second to Apollo's 3000 series. The major deficiency that Sun has in this marketplace is the lack of a low-cost color offering. DATAQUEST expects a competitive response is forthcoming from Sun in the low-end color market some time during the next 90 days. Sun also needs to consider adding MS-DOS compatibility in order to round out its low-end offering.

Despite recent industry criticism surrounding Sun's IPO during this volatile time in the marketplace, DATAQUEST believes that the company is extremely well positioned and strategically sound for the following reasons:

- It has secured many large OEM relationships (e.g., Gould, Kodak, Schlumberger, Toshiba).
- It aggressively pursues market opportunities ignored by other workstation manufacturers (e.g., selling to computer companies, offering board-level products).
- Its commitment to supporting and proliferating standards is exemplary (e.g., NFS).
- While its products are not technological marvels in any one particular area, they provide an excellent balance of integration among the major functions of computing, graphics, networking, and applications at unbelievably low prices that OEMs can make money selling and end users can afford.

From a performance standpoint, Digital's VAXStation II is very comparable to Apollo's 3000 series and Sun's 3/52. The problem is that the VAXStation II is priced more than 90 percent higher than Apollo and Sun. Digital's VAXStation II could suffer an identity crisis in the marketplace in that it is too high priced for the low-end 2-D market, but does not have enough overall performance to compete in the high-end 3-D environment. DATAQUEST believes that Digital's OEM community will probably opt to use the MicroVAX II as a multiuser machine rather than as a distributed engineering workstation until Digital comes down in price or improves performance for the high end. In any event, Digital is virtually forcing its OEMs to get as much mileage out of the MicroVAX II as possible (whether they intended to or not) when it announced it would lower OEM discounts on its new 8200 and 8300 VAX 11/780 replacement machines.

Digital can currently demand a premium from the marketplace for its machines due to the large number of installed VAXs and the large library of application software available. Over time, however, DATAQUEST does not believe that Digital will be able to sustain its higher margin advantage on its workstation products based solely on its installed base or breadth of application software. We expect Digital to react with both a lower-priced version of its MicroVAX II for the low-end 2-D environment and to improve its graphics performance on the high end with product introductions during the third and fourth quarters of this year.

As shown in Table 3, IBM'S PC RT finished last in all four system categories. We are at a loss to explain why IBM chose to introduce a product for the "engineering/scientific, academic, and CAD/CAM" market that has only twice the power of a PC AT at three times the price. The PC RT is essentially an Apollo DN300 class of machine (now obsolete) that commands an Apollo 3000 class price tag on the low end and a DN570 price on the high end. Surprisingly, IBM did not announce support for its new token-based network on this machine. Instead, IBM offers the optional PC-NET, which is widely expected to be phased out when IBM's token-based network enters the market later this year.

computing and floating-point performance The poor (200,000 whetstones) of the PC RT could be improved by increasing the clock speed of the system from its current 5.88 MHz to 16 or 20 MHz. There is a school of thought that believes IBM is purposely holding down the performance of this machine so as not to interfere with forthcoming Intel 80386-based products expected early next year. IBM has cast a shadow of doubt, however, over the future of the 80386-based products due to the recent sale of its Intel stock holdings. In addition, DATAQUEST believes that IBM is extremely sensitive to protecting its 43xx line of shared-logic systems. After all, when you already have the biggest piece of the pie, it does not make sense spending time chasing after the other guy's crumbs.

Although the PC RT features PC-DOS program execution, it offers no performance improvement over the PC AT for programs running in DOS mode. Therefore, PC CAD/CAM developers with applications running under DOS are faced with the difficult decision of rewriting their software for the RT's AIX operating system, or waiting for the 80386 in order to improve system performance. DATAQUEST thinks that most PC CAD developers will choose to wait for the 80386. DATAQUEST believes that IBM shot too low in performance with the PC RT in order to significantly impact the CAD/CAM workstation marketplace. We look for IBM to announce improved networking and computing performance in the third quarter of this year.

#### High-Bnd 3-D Environment

The high-end 3-D workstation marketplace is driven by the need to push the interactivity of engineering applications such as solids modeling, PCB layout, and finite element modeling as close to real time as possible. While this segment of the market has experienced a high degree of user benchmark activity, DATAQUEST finds that high-end 3-D applications have had very little success within the end-user community due to the associated performance penalties. DATAQUEST believes that the new breed of high-end 3-D workstations that offer 1.5 to 2 times the performance of a VAX 11/780 at workstation prices will spawn a new awareness that 3-D capacity can in fact be accomplished productively. The software vendors have recognized this and have been converting their applications to take advantage of the 3-D display list capability of these new high-end workstations. This software conversion should allow 3-D applications to run much more efficiently by taking advantage of high-speed VLSI features on the 3-D machines and eliminate a lot of the algorithmic gymnastics that take place when the software alone is left with the task of simulating the 3-D image.

As Table 4 indicates, Apollo's DN580 and Silicon Graphics' 3020 are the leading machines from a technological standpoint in the high-end 3-D workstation market. Until Apollo's recently announced DN580, Silicon Graphics was virtually in a class by itself providing highperformance, distributed, 3-D graphics tightly coupled with a UNIX computing architecture.

DATAQUEST believes that Silicon Graphics is starting to gain momentum as a major force within the engineering workstation marketplace. The company more than doubled its revenue in 1985 to \$30 million from \$13.8 million in 1984. In addition, the company shipped more than 1,000 workstations in 1985 and has already secured a number of large OEMs this year, including Prime Computer, Raytheon, and Sperry. Although Silicon Graphics has fallen a bit behind Apollo technologically, DATAQUEST expects another evolution of the company's Geometry Engine is forthcoming and that it should push interactive graphics performance to yet another higher level of industry standard. Silicon Graphics is still the leader in providing 3-D application solutions in our estimation, since most of its OEMs and third-party software developers have written their applications to take advantage of the advanced 3-D capabilities of the Silicon Graphics workstations.

Sun's 3/160C, while providing an excellent platform for computing and networking, lacks the high-performance 3-D graphics horsepower necessary to effectively compete with Apollo and Silicon Graphics. Sun's Graphics Processor (GP) and Graphics Buffer (GB) will need to be improved by a factor of 2 or 3 times in order to bring it in line with competitive offerings. Sun's graphics tools, however, are very good and have been implemented to take advantage of NFS, which accommodates a fully distributed graphics file system.

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Digital's GPX falls short--primarily in the 3-D graphics area--of being considered a major league device. The GPX graphics architecture currently does not support 3-D display list operations such as viewing transformations and shading. DATAQUEST believes, however, that Digital's investment in its own custom GPX graphics chip set will continue and that it will produce a number of new products aimed at the high-end 3-D market. The company is in the process of assembling a workstation group in Palo Alto, California, to address the needs of this market.

Adage's new 6050 workstation, a high-performance alternative to Digital's GPX, incorporates MicroVAX II workstation technology. The 6050 has superior graphics performance via Adage's Ocean Graphics Engine, which performs 3-D vector drawings at the rate of 350,000 vectors per second and Gouraud shaded polygons at 30,000 per second. A complete system with a MicroVAX II is priced at \$50,500, which is very competitive with the similar Silicon Graphics and Apollo products. The only drawback is that the graphics architecture is not as tightly coupled with the CPU as Silicon Graphics, Apollo, or Sun.

IBM's PC RT with the 5080 attachment lacks the 3-D graphics and computing performance necessary to pose any significant competitive threat outside of the IBM installed base. The new 5085 Model 2 graphics controller has greatly improved transformation performance, but offers little in the way of shading and is not very well integrated with the PC RT. With the new Professional CADAM 2-1/2-D software running at only about half the speed on the PC RT/5080 as compared to a 43xx system, we think it is questionable whether the IBM CADAM installed base will spend between \$60,000 and \$70,000 for a PC RT workstation version of CADAM.

#### DATAQUEST ANALYSIS

The following analysis discusses how DATAQUEST believes that each faction within the marketplace will be affected by these recent workstation announcements.

#### CAD/CAM Vendors

CAD/CAM OBMs and third-party software developers will reap significant benefits from this recent flurry of workstation activity. On the low end, the Apollo and Sun products offer a powerful price/ performance alternative to the personal computer, while the new high-end 3-D products should create a new market awareness for 3-D productivity benefits. The only downside we see from the CAD/CAM vendor's standpoint is that the rapidly declining workstation prices are revealing the REAL software price. As Figure 3 illustrates, CAD/CAM vendors will have to justify (to the marketplace) its cost of software beyond the turnkey price when, as William Zarecor, vice president of marketing at Intergraph Corp., puts it, "the hiding place for software is uncovered." DATAQUEST believes that the uncovering of software costs along with the fact that workstation technology is no longer a mystery will put pressure on the turnkey CAD/CAM vendors to unbundle their software. Recent major unbundled workstation purchases at General Motors, Hughes, and Schlumberger suggests that unbundling is more than just an isolated incident and is, in fact, a major trend.

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Figure 3

# Cost Cost of Hardware Software Cost "Hiding Place" Time

#### THE TURNKEY SOFTWARE HIDING PLACE

Source: Intergraph Corp. DATAQUEST March 1986

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Other key issues we see affecting the CAD/CAM vendors as a result of these workstation announcements are:

- The workstation industry is consolidating into a handful of vendors, thereby allowing the CAD/CAM software developers to standardize on these surviving industry platforms.
- CAD/CAM vendors that still manufacture their own proprietary computing and graphics hardware will face even greater market pressure to move to industry standard platforms.
- Low-end workstations with the more functional and powerful turnkey CAD/CAM software packages will place considerable market pressure on personal computer-based CAD/CAM software vendors.
- It would behoove CAD/CAM software developers to ensure that their applications software is written to take advantage of the new 3-D display-list-oriented workstations.
- CAD/CAM vendors must be prepared to offer site licenses and engage in cooperative marketing and selling activities with the workstation hardware suppliers.

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#### End Users

End users are the major beneficiaries of these announcements. With prices steadily declining and performance continually improving, the workstation is fast becoming a commodity that will adorn the desk of every engineer. 1

DATAQUEST believes that end users are much more sophisticated today with respect to CAD/CAM tools and engineering workstations. The "black art" of packaging graphics applications with workstations is no longer a mystery to end users, which is why we foresee a trend toward unbundled application solutions. However, the turnkey vendors have a wealth of experience in computing, graphics, networking, and applications in the engineering environment and can provide valuable services in integrating these functions on a device or organization level.

#### Workstation Vendors

In general, the workstation vendors will be operating in a less competitive environment in terms of the numbers of vendors. However, the vendors who are competing are formidable. DATAQUEST believes that the workstation vendor must:

- Immediately capitalize on any window of opportunity it may have because the windows can slam shut at almost any time from competitive offerings
- Make sure that it offers a seamless migration path for its software and applications when introducing new hardware, even at the expense of introducing new technology
- Work cooperatively with its OEMs in order to jointly market applications and share commissions when appropriate

From the standpoint of each individual workstation vendor, DATAQUEST offers the following observations:

#### Apollo

- Apollo is the price/performance leader following its recent workstation announcements.
- Apollo will have to capitalize quickly on its current leadership by driving volumes on the low-end and pushing application developers to commit to its graphics architecture on the high end.

### <u>Digital</u>

- Digital needs to improve the GPX graphics performance to accommodate a 3-D display-list architecture on the high end.
- It will also need a low-cost, desktop platform to compete effectively on the low end.

# IBM needs to improve computing performance (especially floating-point) for the PC RT.

- It needs to offer comparable networking capabilities. DATAQUEST expects that a token-based system will be announced during the third quarter of this year.
- A more tightly coupled graphics architecture would also improve the PC RT's marketability outside of the IBM world.

# Silicon Graphics

- DATAQUEST expects that the soon-to-be announced improvements in the Silicon Graphics' display architecture will once again move the company into a leading position from a graphics performance standpoint.
- Silicon Graphics would also benefit by providing an MS-DOS compatibility feature.

<u>Sun</u>

 DATAQUEST expects Sun to announce both a low-end color workstation and an IBM PC-compatible workstation over the next 90 days.

David B. Burdick

# IBM

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-6

### DIGITAL ANNOUNCES NEW NUMBERBUSTER FOR GRAPHICS: THE VAXSTATION II/GPX

#### SUMMARY

On January 14, 1986, Digital Equipment Corporation announced the VAXstation II/GPX, Digital's latest high-speed answer to the popular technical graphics workstations manufactured by major vendors such as Apollo Computer Inc., Data General Corporation, and Sun Microsystems, Inc. This newsletter assesses the graphics performance of the GPX; another newsletter will follow that assesses its workstation performance.

This newest member of the VAX family is based on Digital's MicroVAX II computer and is driven by a new Digital-designed VLSI graphics coprocessor. It offers up to five times the graphics performance of leading workstations that have comparable configurations. However, DATAQUEST believes that the real significance of the VAXstation II/GPX is as follows:

- It is the first use of proprietary, in-house VLSI graphicsspecific integrated circuits (ICs) by a workstation or computer vendor.
- It represents a high level of integration of graphics and CPU power in an aggressively priced workstation, with much better graphics performance than that of Apollo, Sun, or Data General products.
- It is not, however, an advance in general graphics performance since several graphics vendors offer systems with much higher performance than the GPX system.

Four VAXstation II/GPX configurations are available, three in color and one in monochrome. Prices, which include the MicroVAX II computer, range from \$33,000 (for monochrome) to \$53,800. In 16- and 256-color configurations comparable to Apollo, Sun, and Data General products, the GPX is priced the lowest.

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#### THE VAXSTATION II/GPX

The graphics coprocessor produces fast image copy and vector drawing, pattern fill, clipping, scaling and zoom, and scrolling. The chip is optimized for rapid display of text. Its design results in equal performance for 8- and 4-plane systems.

Digital claims a unique feature for the VAXstation II/GPX, the network-based X-Window System. The X-Window System allows users to activate tasks on remote nodes that draw graphics on the local workstation window. Compute-intensive tasks can thus be offloaded to larger VAX systems on the network while running other tasks locally. Networking support includes DECnet (DECnet gateways allow communications with SNA and X.25 systems), TCP/IP, and Ethernet, all of which allow users a wide range of resources for their applications.

Color applications include VLSI design, printed-circuit board layout, simulation and testing, mechanical drafting, design and analysis, petroleum exploration, real-time control, molecular modeling, and weather mapping. Other applications in which monochrome may be preferred for high-quality text and graphics include image processing, mechanical and architectural drawing, technical publishing, and software development.

The VAXstation II/GPX was tested on Whetstone, Linpack, and Spice in comparable configurations of Sun and Apollo workstations and was found to be consistently superior. Table 1 compares selected workstations in comparable configurations.

Initial GPX shipments will begin in March. These units will support UNIX; VMS support will be available in early summer.

#### DATAQUEST ANALYSIS

DATAQUEST believes that the VAXstation II/GPX will have a significant impact on the workstation market. It represents the first fully integrated workstation from Digital; earlier VAXstation 500 products were not highly integrated, since they were just MicroVAX IIs placed next to Tektronix 4120 series graphics terminals. As such, they were not analogous to the fully integrated products offered by Apollo, Data General, Masscomp, or Sun Microsystems. The high level of integration of this new product is reflected in the fact that almost all of the workstation components, including the graphics processor and the 19-inch color monitor, are designed and manufactured by Digital. In addition to these firsts, the pricing of the products is very aggressive, based both on past Digital practice and the prices of the competing workstation

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products shown in Table 1. Furthermore, the level of graphics performance on the GPX is much higher than that of Digital's two biggest competitors, Apollo and Sun, and is at least equal to that of the GW series from Data General. The combination of aggressive price and high performance means that the GPX is the current price/performance leader in the previously defined graphics intensive market segments targeted by Digital for this product. The GPX puts pressure on Digital's competitors in these segments to lower their prices and, in the case of Apollo and Sun, to dramatically increase their level of two-dimensional graphics performance.

The GPX system is not invincible, however, since the availability of a VMS version is at least six months away and the product's new graphics processor uses a new set of commands for interfacing to application programs, or emulates the Tektronix 4010 command set. This means that the large body of scientific and engineering software that runs under VMS with the color raster Tektronix 41XX products cannot move immediately to the GPX system; and, when it does, each program will require a new set of graphics drivers. The GKS implementation of the GPX product will make this a less formidable task than otherwise, but will still take an investment of resources by the software authors. This is also true for the smaller body of such programs that run under Digital's ULTRIX, since some conversion work will be required to move to the new GPX drivers from the Tektronix/VAXstation 500-based products in existence today. As for applications running under the other vendors' UNIX versions, another level of conversion will be needed to go from one "industry-standard" UNIX to the other.

A final question that arises is the status of the VAXstation 500 product line. From a hardware viewpoint, the GPX product would appear to replace the VAXstation versions using the Tektronix 4125 and 4128, based on its lower price and its equal or better graphics performance. However, the VAXstation 500 that uses the Tektronix 4129 still remains viable since it offers solid modeling support for shaded pictures, which is not yet available on the GPX. But from a software viewpoint, the issue is clouded, since the GPX does not support full Tektronix PLOT-10/IGL emulation--just the older 4010 version. Therefore, the application software written for the VAXstation 500 line is also not supported. This lack of compatibility could cause users to pay the higher price for the VAXstation 500 and thus slow the success that we believe is inevitable for the VAXstation II/GPX.

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David Burdick Lew Brentano Karen Davis

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#### Table 1

#### TECHNICAL WORKSTATION PRICE AND PERFORMANCE COMPARISON

	Digital Equipment VAKstation II/GPX*	Digital Equipment VAXstation 500 *,**	Apollo DN560	Data General <u>GW 4000</u> #	<u>Sun-3/160 C</u>
Graphics Display					
List	Nové	128 Kbytes	1 Mbyte	128 Kbytes	None Std. (optional and included in price)
Pixel Memory	1,024 x 864 x 4 or 8	1,280 x 1,024 x 4 or 8	1,024 x 800 x 4 or 8	1,280 x 1,024 x 8	1,024 x 768 x 8
Vector Drawing					
Speed	$\approx$ 70,000/second	50,000/second 50 pixel vectors	20,000/second	60,000/second 40 pixel vectors	50,000/second ≈ 50 pixel wectors
Typical Price:					
16 Color	\$35,800	\$48,000	\$49,000	N/A	N/A
256 Color	\$39,950	\$54,000	\$53,500	≈ \$85,000	\$48,700

Note: Configurations include CPUs with 3 Mbytes of memory, hardware floating point, 71 to 80 Mbytes of disk memory, and a disk backup system, unless otherwise noted.

N/A = Not Applicable

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\*The VAXstations use the MicroVAX II as the CPU

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\*\*The VAXstation 500 graphics system is the 412X series from Tektronix.

<sup>1</sup>The Data General system can support up to four graphics displays simultaneously.

##The Sun-3/160C price includes 4 Mbytes of memory, hardware floating point, graphics processor, and 71-Mbyte disk and tape subsystem.

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Source: DATAQUEST February 1986 .

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# RESEARCH BULLETIN

CCIS Code: Newsletters 1986-5

#### DIGITAL RESTRUCTURES VAX PRODUCT LINE; INTRODUCES THREE VAX SYSTEMS AND VAXBI BUS

On January 29, Digital Equipment Corporation announced three new general-purpose VAX systems, which it calls second-generation VAX products. Two systems fill the void between the MicroVAX II and the VAX 8600, while the third is a dual CPU architecture positioned above the 8650. Digital is targeting two of the three systems for "computationally intensive applications" for engineers and scientists. The three new systems are as follows:

- VAX 8200
  - Offers a performance of 1.0 MIPS
  - Has a single board processor
  - Is based on MOS/VLSI technology
  - Offers 8 Kbytes of cache memory
  - Supports up to 16 Mbytes of main memory
  - Is priced between \$127,000 and \$154,000
  - Is available now in three prespecified configurations
- VAX 8300
  - Offers a performance of 1.9 MIPS
  - Is based on two tightly coupled 8200 processors and on MOS/VLSI technology
  - Supports up to 14 Mbytes of main memory
  - Offers processor support for 8 Kbytes of cache memory
  - Is priced at \$200,000
  - Will be available in 60 to 90 days
- VAX 8800
  - Offers a performance of 12 MIPS
  - Is a tightly coupled dual processor sharing 32 Mbytes memory
  - Has 64-Kbyte cache memory and integral floating point
  - Is based on ECL technology
  - Supports up to four VAXBI buses for up to 30-Mbytes-persecond transfer rate
  - Uses 27 custom ICs and 187 ECL gate arrays
  - Uses 60-Mbyte CPU-memory interconnect
  - Is priced at \$850,000
  - Will be available in 60 to 90 days
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All three systems support the new system bus called the VAX bus interconnect (VAXBI). The VAXBI is a single-chip, synchronous, 32-bit data, 30-bit address bus that is time multiplexed and runs at 13.3 Mbytes per second. Up to 16 VAXBI nodes can be connected on one bus. The VAXBI bus also has built-in multiprocessing capability. All the new systems also support a Unibus adapter, which provides a transition path for peripherals between other Unibus-based VAXs and the new systems.

The 8200 replaces the older VAX 11/780, which ran at the same speed as the 8200 but used a Unibus (1 Mbyte/second) instead of the VAXBI running at 13.3 Mbytes per second. This will greatly improve any application with a high degree of I/O activity. The 8200 also obsoletes the Unibus-based VAX 11/750 and 11/730.

The 8300 replaces the 11/785 introduced in 1984. The 8300 is similar to the now obsolete dual processor VAX 11/782. The real performance advantage the 8200 and 8300 systems have over the older processors is their I/O performance--the new processors run at the same speed as the older systems.

The 8800 is not a dual 8650 but is a new processor design. Its 12-MIPS performance is based on two CPUs, so a single job will probably run at 6 MIPS--the same as the 8650. However, applications with a large number of tasks or users will take advantage of the multiprocessor features and fast I/O bandwidth. This will be especially good for UNIX applications.

#### DATAQUEST ANALYSIS

Digital has replaced the older VAX 11/7X0 processors with processors of similar CPU performance (8200 and 8300), but using newer VAXBI bus and the 8600 architecture concepts to improve I/O performance. Prices for the 1.0- to 1.9-MIPS performance level have been reduced, however. The 8800 will give Digital a system that competes with larger IBM mainframes such as the IBM 3084.

We find it interesting that Digital has targeted these systems toward "computationally intensive applications." A single, large (one million lines of code) program will be allocated to a single CPU and will not take advantage of the second CPU. Thus, for a single task, the CPU performance of the new system is <u>equal</u> to the older system. For "multistream" tasks, however, the cumulative MIPS will increase the performance of the system as a whole.

Although Digital is initially targeting the engineering/scientific community, we believe that these systems will also be widely used in business applications where the high I/O performance will improve the efficiency of multiuser and COBOL applications. The VAXBI bodes well for I/O-intensive commercial environments.

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Dave Burdick Lew Brentano Brad Smith The Dun & Bradstreet Corporation

Dataquest

# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-4

#### TURMOIL AND TRANSITION SPELL OPPORTUNITY FOR CADNETIX

#### IN TRODUCT ION

The printed circuit board (PCB) application segment is characterized by turmoil and transition. For instance, a company such as Computervision, which enjoyed nearly 50 percent market share in 1980, has slipped to a 20 percent share of the market in 1984. On the other hand, Cadnetix Corporation, which was not even a glimmer in its founders' eyes in 1980, has grown from zero revenues in 1982 to \$25 million in 1985.

This newsletter examines various aspects of the printed circuit board (PCB) CAD segment and how Cadnetix dovetails its products and strategies with the market. (Look for the soon-to-be-published DATAQUEST corporate profile on Cadnetix for more information on the company, its financial statements, and its product lines.)

#### THE EVOLVING MARKET

The PCB segment has been a nightmare for some companies and a golden opportunity for others. The evolution brought about by the users' changing demands has been merciless. Where major turnkeys with a strong emphasis on mechanical design once dominated the PCB segment, the users now demand an even stronger emphasis on electronic product design.

Printed circuit board design is not an isolated, discrete design island, for it affects many different functional organizations within one company. Because of this, DATAQUEST believes that a CAD company must choose between the following two strategies:

- Comprehensive design, covering all major phases of PCB design
- Niche focus, excelling in one or more tightly related areas

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Cadnetix opted for the comprehensive design strategy. This strategy dictates that a CAD vendor provide options that address the following phases.

- Schematic capture with forward and backward annotation
- Full-range simulation
- Automatic layout with interactive editing capabilities
- Manufacturing output
- Test equipment interfaces
- Mechanical CAD systems interfaces

These functions cover the design of a board from conception through final product integration. Within each of the phases noted above is still more opportunity for providing solutions with products such as hardware modelers, accelerators, and different system architectures.

DATAQUEST believes that the market's current emphasis on the electronic rather than mechanical design aspect of printed circuit boards will be the primary focus of most major competitors for the next two to three years. We compare the disparate focuses--electronic and mechanical--because this is an excellent example of the CAD/CAM pendulum. It keeps swinging.

It swung from manual layout with awkward automatic routing to mechanical design because mechanical design was a strength of several major PCB CAD companies and was more easily leveraged than pioneering EDA applications. With manual layout mastered, at least by the CAD vendors, the pendulum swung back to an emphasis on electronic design. We believe that history will repeat itself. DATAQUEST expects that the next major move, besides improving and expanding existing electronic design functions, will be mechanical design integration including mechanical computer-aided engineering (MCAE). We believe that this integration, however, will probably come from interfaces to external mechanical CAD/CAM products.

In the meantime, however, primary opportunities exist in simulation, data bases, automatic placement and routing, and testing of the electronic portion of board design. PCB CAD vendors should focus their efforts on these opportunities.

Another significant strategic shift in the PCB segment concerns system prices and architectures. In 1983, Telesis Systems, Inc., pioneered the low-cost segment by introducing a single-user PCB system for less than \$100,000. Since then, prices have continued to reach new lows, while performance has been maintained or improved due to distributed processing architectures. Personal CAD Systems, Inc., was the first vendor to offer personal computer-based PCB CAD. Now, most major PCB vendors offer a wide range of price/performance system options.

#### THE CADNETIX FIT

We chose Cadnetix as an example of the current electronic emphasis because it is a young company with a broad applications focus.

Cadnetix calls itself a "systems" design company. We will not be so nebulous in defining a company or its application. After all, an IC can also be a system unto itself. Therefore, we will refer to Cadnetix as a printed circuit board CAD company with a broad applications focus, including EDA. Early on, Cadnetix recognized that in order to provide a comprehensive solution to companies designing printed circuit boards, CAD products must also address the needs of electronic engineers.

What makes Cadnetix stand out? Figure 1 shows the company's focus on logic design, simulation, and physical layout. Beneath these three applications lie a myriad of products to improve productivity. Cadnetix's productivity improvements include the following products:

- Routing, simulation, and graphics acceleration
- Physical device modeling for board-level simulation
- File and data base servers
- Local area networking
- Wide price/performance ranges

The company's focus is on neither physical layout nor logic design, but on providing solutions to all phases of board design.

Cadnetix is one of the few turnkey vendors still designing and manufacturing system hardware. While the company believes that it can manufacture the optimum system itself, DATAQUEST believes that this could prove to be a major long-term weakness of the company.

Until February 3, 1986, when Cadnetix announced the addition of software for the IBM PC, the company's entire product line was centered on its proprietary 68020-based workstations. The new PC software is used for schematic capture with net list extraction and an option for remote job entry via communications networks for simulation and layout.

We believe that Cadnetix's decision to support an industry standard platform was a sound strategic move. End users demand the security and comfort of familiar computers and operating systems. We think that Cadnetix responded to end-user demands, as well as competitive pressures.

Supporting other hardware is not without major concerns for the company. Cadnetix had to choose which hardware it would port to, as well as commit to support the port. Apollo's announcement of its Domain Series 3000 on February 19 made the decision even more complex. Compound this complexity with Digital's market position with its MicroVax II series. Nonetheless, Cadnetix's strategic decision to run on computer company hardware has been set in motion. We believe that the company will benefit from this decision in the long run.

#### **Figure 1**

CADNETIX'S PRODUCT LINE



#### Cadnetix Corporation March 1986

#### COMPETITIVE POSTURE

Based on DATAQUEST's primary research, users want the option to buy the best product to meet their needs, even if it means buying from several different vendors to solve a design problem. Because of this, we believe that it is vital for all CAD/CAM vendors to adhere to the following principles to achieve success:

- Exploit product strengths in both development and marketing
- Be one of the top three vendors in the particular application arena that is a product strength

The EDA vendors are entering the physical layout segment where traditionally they have had a strong presence in the engineering of boards. Layout vendors entered the EDA segment, some with only a fair to weak position in both layout and engineering design. The bottom line message is clear: Application solution choices are many, and vendors must have a dominant position in areas where their strengths lie.

How does this relate to Cadnetix? Thus far, the company has addressed most PCB application arenas (short of testing and mechanical design) and has been fairly strong in all. We believe that one reason it has been successful is the third ingredient for success. integration. In this sense, we define integration as the following:

- Core applications from one company
- Logical and physical data bases that relate to one another
- True implementation of distributed processing, aligning computational requirements and capabilities through the use of a wide range of systems, communications, and servers

#### DATAQUEST CONCLUSIONS

DATAQUEST does not forecast any radical PCB design technological breakthroughs that would leapfrog the current tools. Instead, we believe that development will continue to refine and expand existing technologies and methodologies and will encompass the following types of activities.

- Surface-mount devices
- Double-sided device mounting
- Hybrid design on the PCB workstation
- More efficient routing algorithms
- Higher completion routing accelerators

- More interactive accelerators
- Better automatic placement routines
- Better board-level simulation, including physical modelers where required
- Incorporation of microprocessor software models
- Test pattern development from the EDA data base
- Analog board design
- Two-way data base interfaces

Development activities must concentrate not only on the electronic aspects of board designs, but also on the data management aspects. Such activities include communications, networking, file and data access and transfer, and servers, all of which should be fairly transparent to the end user.

We believe that Cadnetix has established itself as a contender in electronic CAD/CAM segments. The challenges facing the company, as we see them, center around the following issues:

- Make global make-versus-buy hardware decisions--If the company continues to manufacture its own hardware, it must be prepared to match hardware R&D expenditures as a percent of revenue to that of the companies dedicated to pushing price/performance ratios.
- Continue accelerated R&D, leveraging its internal development staff to maintain leading-edge technology, and, equally important, make use of strategic alliances where appropriate.
- Continue positioning itself in the competitive arenas of all EDA and PCB companies.
- Manage its growth--The corporate environment of a \$25 million company is significantly different from the larger corporate environment toward which Cadnetix is headed. We believe that Cadnetix will have to decentralize and reorganize now in order to achieve the goals it has set for itself.
- Fully support its customers, products, and sales force--Ensure that every customer can turn out boards and that every sales person is backed by technical applications engineers. In this stage of the company's life, support is a critical do-or-die turning point.

Cadnetix is not alone in its strategies or challenges, but we believe that it is influencing the turmoil and transition in the PCB segment.

Beth W. Tucker

Dataquest a company of The Dun & Bradstreet Corporation

# RESEARCH NEWSLETTER

CCIS Code: Newsletters 1986-3

# IBM'S EDA ANNOUNCEMENT--BIG BLUE SOWS ITS CIEDS

#### INTRODUCT ION

IBM's long-awaited entry into the electronic design automation (EDA) segment came in conjunction with the announcement of the RISC Technology (RT) workstation on January 21. However, IBM only partly demystified rumors of its plans for the electronic CAD/CAM market. IBM's new product line, based on products from Silvar-Lisco, is called Design Capture; it is part of the Computer-Integrated Electrical Design Series (CIEDS, pronounced <u>seeds</u>).

We say partly demystified rumors because we consider Design Capture to be an entry-level product; it leaves many unanswered questions about IBM's full electronic product design strategy.

This newsletter discusses IBM's Design Capture, how it fits into the electronic CAD/CAM market, and what this deal means to both IBM and Silvar-Lisco.

#### IBM'S ECAD PRODUCT

IBM now joins the ranks of companies offering schematic capture products. (Notice the absence of mention of analysis and design verification solutions in IBM's announcement.) Design Capture is based on Silvar-Lisco's Structured Design System (SDS); it spans host-dependent, standalone, and personal computer platforms. Table 1 describes the features, availability, and pricing of the software running on each of the platforms. Table 2 lists the minimum required configuration for each of the platforms.

IBM has the exclusive right to sell the software on IBM platforms. Silvar-Lisco will continue business as usual and sell its products for non-IBM platforms, which include systems from Apollo, Digital, and Prime. Under the terms of the agreement, IBM will support Design Capture with its own application engineering force.

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# Table 1

# IBM'S DESIGN CAPTURE

	Host- Dependent	Stand- alone	Personal Computer
Description	<u>30XX, 43XX</u>	RT	AT
Schematic Capture/Editing	х	х	х
Standard Symbol Library	Х	Х	х
Netlist Extraction for			
Connectivity Checks	Х	Х	х
Hierarchical Design Expander	Х	X	
Netlist Translator for Design			
Automation Tools	х		
Interface to Non-IBM Design			
Automation Tools	х		
Engineer's Access Routines	х		
Structured Design Language	Х	Х	х
Data Base Utility Routines	X	Х	х
Interface to CBDS	Х	x	
Design Documentation Facilities	х		
Data Compatibility with IBM Industry-			
Standard Plotting	Х	х	
Interface to IBM Color Plotters	Х	Х	х
File Transfer Communications to IBM RT	х		х
File Transfer Communications to IBM AT	х	х	
File Transfer Communications to			
IBM 30XX, 43XX		Х	х
Availability	Q2 '86	Q3 <b>'</b> 86	Q2 '86
Software Pricing:			
Single License	\$75,000	\$8,000	\$6,000
Multiple License	\$52,500		
Multiple License Schedule		Available	Available
Recommended Capacity (in Gates)	> 25,000	<= 25,000	<= 5,000

Source: DATAQUEST February 1986 .₩ .

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#### Table 2

#### MINIMUM REQUIRED CONFIGURATIONS

			LOPI AL
<u>Requirement</u>	<u>30XX/43XX</u>	IBM RT	<u>(Model 099)</u>
Processor	4361+	RISC	80286
Memory (Mbytes)	6	2	0.64
Hard Disk (Mbytes)	50*	70	20
Floppy Disk (Mbytes)	-	1.2	1.2
Tape Drive	9 Tracks	Optional	Optional
Graphics	3270 or 5080	ACG**	ECD <sup>#</sup>
Operating System	VM/SP 3.1 + AIX	DOS 3.1	DOS 3.0
Other	VS FORTRAN, PHIGS		

\*50 Mbytes required to store Design Capture object code; additional storage required for the operating system and user data files \*\*Advanced Color Graphics display #Enhanced Color Display

> Source: DATAQUEST February 1986

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DATAQUEST ANALYSIS

#### IBM Perspective

The electronic CAD/CAM market comprises more than just schematic capture. It is comprehensive and extensive design automation for all phases of electronic product design. Design Capture touches only the very beginning of an electronic engineer's needs and of the design process. IBM now competes with a long and growing list of companies with schematic capture products.

Average selling prices for schematic capture software hover at the \$5,000 level. At \$6,000 and \$8,000 for AT and RT software, respectively, IBM's prices are only slightly on the high side. However, a closer look at functionality could leave the IBM PC AT Design Capture slightly on the short side. Specifically, we consider interfacing to analysis tools and layout software to be a critical component of schematic capture software. Without the ability to directly extract a netlist and format it for analysis of layout tools, we believe that it will be difficult for users to justify the expense of a partial solution on the AT. Concerned about the lack of functionality on the AT platform, we believe that IBM will push the RT more than the AT line. (See our Research Bulletin number 1986-2, "IBM Announces PC RT RISC Technology System Targeting Technical Applications," for details on the RT announcement.) If this were to happen, we believe that IBM would find itself outside of the \$10,000-to-\$20,000 price band for schematic capture software, especially when some competitors also offer simulation at that price.

We believe that IBM's host-dependent-based Design Capture is the most comprehensive of the three platforms. However, most current schematic capture products run on personal computers, or on the high-end, standalone workstations. Because schematic capture is interactive and graphics intensive, we question the market's tolerance for schematic capture running on shared-logic architecture.

In our opinion, Design Capture is the seed from which many IBM design automation products will grow. It is not yet certain that Silvar-Lisco will be the vendor selected for other design automation products. However, considering that the groundwork for the schematic capture product has already been laid, we believe that choosing Silvar-Lisco makes the most sense.

If we were to try to second-guess IBM and look at Silvar-Lisco's entire product line as IBM's potential electronic CAD/CAM offering, the cards then stack up differently in terms of product functionality. Table 3 shows Silvar-Lisco's current product line, which we believe is well rounded with design verification and automatic IC layout, excluding silicon compilation. (Refer to the Silvar-Lisco corporate profile dated August 29, 1985, in our Corporate Profiles binder for more information on the company and its products.)

With a line of simulators, including behavioral, gate, switch, and circuit levels, as well as gate array and standard cell place and route products, IBM's potential line could appeal to a broader range of designers with a broader solution set.

#### Silvar-Lisco Perspective

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For more than two years, market participants and watchers have speculated about IBM's entering the electronic CAD/CAM market with more than its CBDS printed circuit board layout product. Also, during this same time period, strategic alliances have grown in importance as technology and market demands have outpaced ECAD companies' capacities to deliver solutions.

We believe that Silvar-Lisco is the big winner. It has acquired IBM's thousand-plus sales force distributing products in 58 countries. Silvar-Lisco is well known in its own right for its ASIC design and simulation products.

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#### Table 3

#### THE IBM/SILVAR-LISCO FIT

Design Phase	Silvar-Lisco <u>Products</u>	IBM's <u>CIEDS</u>
Schematic Capture	SDS	SDS
Design Verification	Helix LOGAN ANDI SWAP BIMOS Zycad, Inc.*	
Layout .	Cal-MP GARDS Princess PCB NCA**	CBDS
Layout Verification	NCA**	

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\*Silvar-Lisco agreement with Zycad, Inc., to interface to Zycad's application accelerators \*\*Silvar-Lisco's acquisition of NCA Incorporated

> Source: DATAQUEST February 1986

Why Silvar-Lisco? We believe that it was chosen for three reasons:

- It is a software company and is not closely tied to any of IBM's competitors in the computer industry.
- Its strengths lie more in research and development than in marketing, thus providing IBM with technical capabilities while not strongly competing on the basis of company image.
- It has strong automatic IC design and layout products.

Silvar-Lisco is not without challenges though. Most importantly, if it is to continue selling directly to end users, Silvar-Lisco must maintain its own identity while capitalizing on exposure through IBM. With a lot of the pressure relieved from generating all of its revenue in the direct end-user business, it could become all too easy for the company to slip into a pure product-development mode.

#### Market Perspective

Through its announcements, IBM unveiled two factors that current vendors must face: the new RT platform and a new applications competitor.

The question is, Will ECAD vendors flock to the IBM RT as a supplement to and/or replacement for the current AT platform? We believe that a fair number of vendors will port software to the IBM PC RT. However, we do not believe that the decision to port is unanimous or even that all the votes have been cast. We believe that some of the major ECAD vendors will adopt a wait-and-see attitude, waiting for the market's vote as well as any IBM enhancements.

With regard to a new competitor, we believe that once IBM has acclimated itself to the ECAD market, it will be a major force in flushing out the weak and unstable vendors. And the vendors that are currently in a strong and secure position will feel a competitive pinch and will most likely part with some market share. In the long run, we believe that the ECAD market will become increasingly fragmented, and that it will be shared by many vendors, including IBM.

#### CONCLUSIONS

With IBM's name now on the vendor list, even more endorsement and credibility are given to the EDA market than the now-five-year-old start-up vendors have achieved. However, IBM cannot expect to gain the customer's acceptance and dollars overnight, for it, too, is not without stiff competition.

Competition has thus far dictated the fast rate at which new products are introduced. But the introduction rate has perhaps been too fast in the past, leaving many customers buying promises. IBM, though not immune to premature product announcements, seems to be setting a slower pace for introductions. We believe that if IBM is to compete in all electronic CAD/CAM market segments, however, a more robust product line is required, and it must come quickly.

Specifically, we believe that design analysis and verification tools must be available directly from IBM and that they must work as an integrated solution set. For IC physical layout, such products as GARDS and Cal-MP from Silvar-Lisco are required to complete the IC design loop. IBM must at least catch up to the current offerings from the leading ECAD vendors with products like physical modelers, software development tools, and application accelerators. Complementary products to CBDS or Silvar-Lisco's PCB product would further round out the product line.

IBM must have a full complement of simulation, analysis, and layout products to be considered an end-to-end provider. Surely it will not settle for the smaller portion of the market generated by schematic capture. **PB** a company of the Dun & Bradsteet Corporation

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# RESEARCH BULLETIN

#### CCIS Code: Newsletters 1985-Present 1986-2

### IBM ANNOUNCES PC RT RISC TECHNOLOGY SYSTEM TARGETING TECHNICAL APPLICATIONS

Extending its line of personal computers, IBM has launched four new products ranging in price from \$15,000 to \$23,000. IBM has targeted these systems for the engineering/scientific, academic, and CAD/CAM communities.

The IBM PC RT family consists of a desktop model, the 6151 model 10; and the floor-standing models, 6150 model 20, model 25, and model 25A. These systems have three to four times the performance of the PC AT, at a price that is approximately 35 percent higher for the desktop version.

The PC RT uses IBM's advanced interactive executive operating system (AIX), which is a multiuser, multitasking, demand-page virtual memory operating system that IBM claims is designed to take advantage of the system's 32-bit architecture.

The PC RT family offers two options for graphics. The first option offers a choice of three add-on boards that support monochrome and color displays with resolutions of 720 x 512 pixels or  $1,024 \times 768$  pixels. The bit-mapped raster graphics controller supports up to 16 colors from a palette of 64 colors. The second option enables the PC RT to connect to the 5080 graphics system via a serial line. Transfer speed between the 5080 and the PC RT can be up to 2 million bits per second (250K baud).

In addition to the PC RT, IBM announced the availability of a number of application software packages for CAE/CAD, accounting, and personal productivity.

Tables 1 and 2 list the features of all the PC RT models and the graphic display options. The 5080 graphic terminal can only operate on the 6150 Model 20, 25, or 25A and is priced from \$17,000 to \$28,000. All of the graphic options illustrated in Table 2 can be used with the 6151 and any of the 6150 series models.

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## DATAQUEST COMMENTS

We believe that these products will impact the high-end personal computer and low end of the technical workstation marketplaces. At the same time, we believe that the PC RT serves as IBM's endorsement of UNIX as the operating system of choice for technical applications. Forthcoming DATAQUEST Research Newsletters will provide additional details on the RT family and analysis of its impact on various markets.

> David Burdick Brad Smith Lew Brentano

# Table 1

## PC RT MODELS AND SYSTEM FEATURES

<u>System Feature</u>	6151 <u>Mođel 10</u>	6150 <u>Model 20</u>	6150 <u>Model 25</u>	6150 <u>Model 25A</u> ‡
Туре	Desktop	Desksiđe	Deskside	Deskside
Memory, Standard*	1 Mbyte	1 Mbyte	2 Mbytes	2 Mbytes
Hard Disk Storage	40 Mbytes	40 Mbytes	70 Mbytes	70 Mbytes
Floppy Disk	1.2 Mbytes	1.2 Mbytes	1.2 Mbytes	1.2 Mbytes
Price**	\$15,100	\$18,345	\$21,340	\$22,910

\*Expandable to 4 Mbytes maximum

\*\*Includes \$3,400 AIX operating system license fee

<sup>‡</sup>Includes 5080 graphics adapter

## Table 2

# GRAPHIC DISPLAY OPTIONS

<u>Graphic Peature</u>	Advanced Monochrome 6153	Advanced Color 6154	Extended Monochrome 6155
Monitor Size	12 inches	14 inches	15 inches
Resolution	720 × 512	720 x 512	1,024 x 768
Scan	46/92Hz Interlaced	46/92Hz Interlaced	60Hz Progressive
Colors	Monochrome	16 colors	Monochrome
Price*	\$1,385	\$2,900	\$2,600

\*Includes display adapter and display

Source: IBM Corporation

Dataquest a company of The Dun & Bradstreet Corporation

# RESEARCH NEWSLETTER

CCIS Code: Newsletters, 1985-Present 1986-1

## 1985 JAPAN CAD/CAM USER SURVEY

## SUMMARY

DATAQUEST recently completed its first annual CAD/CAM end-user survey in Japan. The purpose of the survey was to gain insight from users currently using CAD/CAM systems. The survey questions closely paralleled those asked in DATAQUEST'S U.S. survey administered early in 1985 (see DATAQUEST'S CCIS newsletter No. 84 entitled, "1985 CAD/CAM User Survey Results") and was designed to detect similarities and differences in the two geographical regions.

DATAQUEST surveyed end users using products from the following CAD/CAM vendors in Japan:

- C. Itoh Data Systems (U.S. affiliation: Calma)
- Cadam
- Fujitsu
- Marubeni Hytech (U.S. affiliation: Applicon, Ecad, Zycad)
- Mentor Graphics
- NEC
- Sekio Instruments & Electronics (U.S. affiliation: Daisy Systems, McAuto, Zuken)
- Technodia (U.S. affiliation: Valid Logic)
- Tokyo Electron (U.S. affiliation: Computervision)
- Toshiba

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In 1984, these ten vendors accounted for \$441 million in Japanese CAD/CAM revenue (60 percent of total 1984 Japanese CAD/CAM revenue) and 3,685 installed 1984 total workstations shipped in Japan (48 percent of total installed Japanese workstations).

The 1,200 questionnaires were mailed to the CAD/CAM system managers at these installations (sites), and 397 (33 percent) were returned and used in compiling the results. The sum of the workstations at these sites totalled 4,644 units.

## SURVEY FOCUS

DATAQUEST chose the following five major issues as the focus of this survey:

- Survey demographics--By industry classification, by type of applications, and by system usage
- Penetration--Number of workstations installed, percentage of trained users, trained users per workstation, number of engineers and draftsmen per site, engineers and draftsmen per workstation, the use of standalone workstations, and the use of color workstations
- Personal computer use in CAD/CAM
- Pricing expectations for workstations relative to the following parameters: main memory, disk storage, screen resolution, screen size, and preference for either color or monochrome screen
- Solids modeling in CAD/CAM

#### SURVEY DEMOGRAPHICS

## Industry\_Classification

Those surveyed were asked to identify the one industry classification from the following list that best described the type business in which their company was engaged:

- Aerospace
- Architecture/building
- Automotive
- Chemical and allied products

- Computers and peripherals
- Electrical/electronic machinery, equipment, and supplies
- Fabricated/structural metal parts
- Iron and steel
- Mapping

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- Metalworking
- Semiconductor
- Shipbuilding/plant
- Telecommunications
- Transportation (other than aerospace and automotive)
- Other (to be specified)

The distribution of respondents for each industry is shown in Figure 1. Electrical/electronic machinery, equipment, and supplies was the largest response group with nearly one-third of all responses.

## Figure 1

## INDUSTRY CLASSIFICATION (Percent of Respondents)



Source: DATAQUEST February 1988

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The only major difference in the CAD/CAM industrial distribution between Japan and the United States is the aerospace industry. The U.S. aerospace industry has been one of the largest and most aggressive groups to implement CAD/CAM technology. Without any appreciable number of companies in this area, Japan obviously does not have this market opportunity.

## Applications

Those surveyed were asked to check all applications from the following list that were being performed at their site:

- Architecture, engineering, and construction/2D (AEC/2D)
- Architecture, engineering, and construction/3D (AEC/3D)
- Mechanical/2D (MECH/2D)
- Mechanical/3D (MECH/3D)
- Computer-aided manufacturing (CAM)
- Printed circuit board physical layout (PCB)
- Integrated circuit physical layout (IC)
- Electronic design automation (EDA/CAE)
- Technical publications (T-Pubs)
- Mapping

The distribution of respondents for each application is shown in Figure 2. Table 1 shows the respondents for each application by industry. As expected, mechanical applications dominate, with more than 60 percent of the respondents indicating that they perform some mechanical CAD/CAM work. The distribution illustrated in Figure 2 closely parallels the U.S. application distribution.

Figures 3 and 4 segment 2D and 3D usage for mechanical and AEC applications, respectively. Surprisingly, the use of 3D in AEC (52.7 percent) and mechanical (55.9 percent) was nearly equal. Nevertheless, DATAQUEST believes that 2D applications such as drafting still dominate when measuring the total elapsed time spent on a CAD/CAM workstation.

# Figure 2

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APPLICATIONS (Percent of Respondents)



Source: DATAQUEST February 1988

Table 1

APPLICATIONS BY INDUSTRY (Percent of Respondents within Each Industry)

Industry	<u>AEC</u>	<u>CAM</u>	MECH	PCB	<u>1C</u>	EDA/CAB	<u>T-Pubs</u>	Mapping
Architecture/Building	875	38	201	01	05	01	09	01
Computers and Peripherals	01	259	639	50%	251	448	0%	01
Electrical/Electronic		_						
Machinery	71	378	43%	534	214	234	24	04
Fabricated/Structural								
Netal Parts	68	634	81%	68	04	01	0\$	0%.
Non-Electrical Machinery	10%	221	728	144	21	28	0%	08
Semiconductor	06	144	10%	71	741	55%	09	01
Shipbuilding/Plant	768	329	72	04	05	04	08	08
Transportation including								
Aerospace & Automotive	28	359	721	194	5%	128	01	01
Others	285	284	57%	218	194	134	28	114



# MECHANICAL APPLICATION USAGE



Source: DATAQUEST February 1986 .

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# System Usage

Respondents were asked to indicate system usage percentages among the four following system functions:

- Drafting/layout
- Design/modeling
- 🝽 👘 Analysis
- Manufacturing

Figure 5 breaks out the system usage categories across all respondents. Across the aggregate of respondents, drafting/layout represents an average of 53.2 percent of system usage followed by design/modeling (29.5 percent), manufacturing (9.6 percent), and analysis (7.7 percent). This usage mix is nearly identical to what was found among surveyed users in the United States. This is not unusual because a high percentage of Japanese CAD/CAM products are U.S.-sourced, and usage is highly dependent on system capabilities.



SYSTEM USAGE (Averages)



### PENETRATION

# Number of Graphics Workstations Installed

Survey respondents were asked to indicate the number of graphics workstations they had installed at each site. The distribution of respondents by number of workstations installed is illustrated in Figure 6. Greater than half of all CAD/CAM workstations are installed at sites with five workstations or less. The largest single distribution (17.3 percent) is found at sites with between 11 and 20 workstations.

Table 2 lists the average number of graphics workstations installed, by industry. The semiconductor and transportation companies have the largest average number of graphics workstations installed (16) while companies in the fabricated structural/metal parts group had the smallest average number of installed workstations (6).

## Figure 6



GRAPHICS WORKSTATIONS INSTALLED (Distribution of Respondents)

Number of Graphics Workstations Installed

# Table 2

# CAD/CAM WORKSTATIONS INSTALLED, BY INDUSTRY

Industry	Average <u>Number</u>
Semiconductor	16
Transportation including	
Aerospace & Automotive	16
Shipbuilding/Plant '	13
Electrical/Electronic Machinery	12
Non-Electrical Machinery	12
Architecture/Building	7
Computers and Peripherals	7
Fabricated/Structural Metal Parts	6
Others	13
Industry Average	12

Source: DATAQUEST February 1986

# Trained Users/Workstation

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DATAQUEST also asked survey respondents to indicate how many trained engineers and draftsmen share a single CAD/CAM workstation. The average number of users per workstation across the aggregate of respondents was 3.6. The distribution of respondents for the number of users per workstation is shown in Figure 7.

Table 3 lists the average number of trained users per workstation, by industry. The semiconductor industry has the highest number of users per workstation (4.3) while the fabricated/structural metal parts industry has the fewest number of users per workstation (2.3).

# Figure 7



# TRAINED USERS PER GRAPHICS WORKSTATION

Source: DATAQUEST February 1986

# Table 3

TRAINED USERS PER INSTALLED WORKSTATION, BY INDUSTRY

Industry	Average <u>Number</u>
Semiconductor	4.3
Architectural/Building	4.1
Shipbuilding/Plant	3.9
Electrical/Electronic Machinery	3.6
Non-Electrical Machinery	3.5
Computers and Peripherals	3.4
Transportation Including Aerospace & Automotive	3.0
Fabricated/Structural Metal Parts	2.3
Others	3.2
Industry Average	3.6

## Engineers and Draftsmen/Workstation Penetration

DATAQUEST asked survey respondents to indicate the total number of engineers and draftsmen (trained and untrained) per workstation at their site. The average number of engineers and draftsmen per workstation across the aggregate of respondents was 18. Figure 8 illustrates workstation distribution by the number of engineers and draftsmen.

Table 4 lists the average number of engineers and draftsmen per workstation and the corresponding market penetration by industry. The fabricated/structural metal parts industry has the highest penetration of workstations (12.5 percent) while the architectural/building industry has the lowest (2.6 percent). DATAQUEST believes that the Japanese architectural/building industry has a much lower level of market penetration (2.6 percent) than the U.S. architectural/building industry (6.0 percent).

## Figure 8

# TOTAL ENGINEERS AND DRAFTSMEN PER GRAPHICS WORKSTATION (Percent Distribution)



# Table 4

# AVERAGE OF ENGINEERS AND DRAFTSMEN PER WORKSTATION INSTALLED BY INDUSTRY

Industry	Average	Percent Penetration
Fabricated/Structural Metal Parts	9	12.5%
Semiconductor	10	10.0%
Computers and Peripherals	10	10.0%
Transportation Including Aerospace &		
Automotive	11	9.1%
Non-Electrical Machinery	15	6.78
Shipbuilding/Plant	20	5.0%
Electrical/Electronic Machinery	21	4.88
Architectural/Building	38	2.68
Others	19	5.3%
Industry Average		6.0%

Source: DATAQUEST February 1986

## Use of Standalone Workstations

Those surveyed were asked to indicate how many standalone 32-bit engineering workstations versus host-dependent, shared-logic workstations they have installed. Figure 9 illustrates the split between these two system architectures. Figure 9 does not account for the use of personal computers. Standalone workstations account for only 10.6 percent of all installed workstations. However, DATAQUEST believes that this number will rise dramatically in the future since the new 32-bit, workstation-based systems (e.g., Apollo, Sun, MicroVAX) are just now beginning to gain favor in the Japanese market.

Table 5 shows the percentage of standalone workstations out of all workstations installed by industry. The semiconductor and computer industries account for approximately 50 percent of the installed standalone 32-bit workstation population.

# Figure 9

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HOST-DEPENDENT VERSUS STANDALONE GRAPHICS WORKSTATIONS

Source: DATAQUEST February 1988

## Table 5

# STANDALONE GRAPHICS WORKSTATIONS INSTALLED, BY INDUSTRY (Percent of Standalone Workstations)

	Standalone
Industry	<u>Workstations</u>
Semiconductor	258
Computers and Peripherals	25%
Non-Electrical Machinery	15%
Shipbuilding/Plant	12%
Fabricated/Structural Metal Parts	128
Electrical/Electronic Machinery	78
Transportation Including	
Aerospace and Automotive	78
Architectural/Building	28
Others	68
Industry Average	118

## Use of Color Workstations

Those surveyed were asked to indicate how many color workstations were installed as a percentage of all workstations at each site. The survey revealed that 42 percent of all workstations installed were color units. This compares quite closely to the 40 percent figure in the United States.

Table 6 shows the percentage of color workstations installed by industry. The semiconductor industry has the highest percentage of installed color workstations (64 percent), while the shipbuilding/plant design industry has the lowest (24 percent).

## Table 6

## COLOR WORKSTATIONS INSTALLED, BY INDUSTRY

	COTOL
Industry	Workstations
Semiconductor	64%
Fabricated/Structural Metal Parts	538
Transportation Including Aerospace &	
Automotive	51%
Architecture/Structural	468
Electrical/Electronic Machinery	448
Computers and Peripherals	418
Non-Electrical Machinery	278
Shipbuilding/Plant	248
Others	318
Industry Average	428

Source: DATAQUEST February 1986

#### USE OF PERSONAL COMPUTERS IN CAD/CAM

Those surveyed were asked to indicate how many personal computers used for CAD/CAM were installed at each site. Additionally, they were asked who used the personal computers and whether or not they were networked. For those who did not have any personal computer-based CAD/CAM, we asked whether or not they had plans to use personal computers for CAD/CAM in the future. As Figure 10 illustrates, the findings indicate that 25.0 percent of the respondents are using personal computer-based CAD/CAM systems and an additional 44.7 percent are planning to use personal computers for CAD/CAM in the future. The 44.7 percent that plan to use personal computers in the future is much higher than the 30 percent who plan to use personal computers in the United States, which we found in our previous U.S. survey.

Figure 11 illustrates the types of professionals using personal computer-based CAD/CAM. Only 30.3 percent of the respondents indicated that engineers are using personal computers compared to more than 50 percent of those surveyed in the United States.

Table 7 lists our respondents' answers to personal computer use, by industry. The semiconductor industry leads all industry groups with a 90 percent approval rating for using personal computers. The fabricated/structural metal parts industry is least favorable toward personal computer-based CAD/CAM, with only a 50 percent approval rating.

## Figure 10

# PERSONAL COMPUTER USE IN CAD/CAM



# Figure 11



# ACTUAL PERSONAL COMPUTER USERS

Source: DATAQUEST February 1986

# Table 7

# PERSONAL COMPUTER USE, BY INDUSTRY (Percent of Respondents)

Industry	Planning to Use	Already Using	Total
Semiconductor	438	458	908
Shipbuilding/Plant	56%	32%	888
Architecture/Building	55%	28%	83%
Electrical/Electronic			
Machinery	488	258	738
Computers and Peripherals	418	29%	70%
Non-Electrical Machinery	418	14%	55%
Transportation Including			
Aerospace & Automotive	378	14%	51%
Fabricated/Structural			
Metal Parts	448	68	50%
Others	348	30%	64%

## PRICING EXPECTATIONS FOR WORKSTATIONS

Those surveyed were asked to indicate the graphics workstation unit price from the following price levels that would enable them to install one workstation on every engineer's desk:

- ¥1 million (\$4,200)
- ¥2 million (\$8,400)
- ¥3 million (\$12,600)
- ¥4 million (\$16,800)
- Others (to be specified)

The findings revealed that 64 percent of those who responded wish to pay ¥2 million or less, with 37.6 percent of the respondents indicating ¥2 million as the ideal price. Figure 12 illustrates workstation price levels across the aggregate of respondents.

Respondents also indicated what an acceptable workstation configuration would be at the price level they indicated. Nearly 70 percent of all respondents indicated that color was necessary.



Y4 Million 8.4% Y1 Million 22.6% Y3 Million 26.6% Y2 Million 37.8%

IDEAL PRICE FOR A WORKSTATION ON EVERY ENGINEER'S DESK

Figure 13 reveals the acceptable main memory capacity levels selected from the following memory capacity levels at ¥2 million:

- 0.5 Mbyte
- 1.0 Mbytes
- 2.0 Mbytes
- Others (to be specified)

Figure 14 reveals acceptable disk storage levels selected from the following disk storage levels at ¥2 million:

- 10 Mbytes
- 20 Mbytes
- 50 Mbytes
- 100 Mbytes
- Others (to be specified)

Figure 15 reveals acceptable screen resolution selected from the following resolution levels at ¥2 million:

- 512 x 512
- 640 x 512
- 1,024 x 1,024
- 1,280 x 1,024
- Others (to be specified)

Figure 16 reveals acceptable screen size selected from the following size levels at ¥2 million:

- 14 inch
- 17 inch
- 19 inch
- Others (to be specified)

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# Figure 13

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# ACCEPTABLE MAIN MEMORY AT ¥2 MILLION

Source: DATAQUEST February 1986



ACCEPTABLE DISK STORAGE AT ¥2 MILLION











Source: DATAQUEST February 1986



# ACCEPTABLE SCREEN SIZE AT ¥2 MILLION



Source: DATAQUEST February 1986

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The most frequent responses given for each of the features yields the following configuration:

Main Memory2.0 MbytesDisk Storage100 MbytesScreen Resolution1,024 x 1,024Screen Size19 inchColor or MonochromeColor

## SOLIDS MODELING USE

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Those surveyed were asked to indicate their solids modeling usage. Only 10.8 percent of the respondents are currently using, and only 42.4 percent are planning to use, solids modeling. This usage is much lower than the 25 percent who are now using, and the 37 percent who plan to use, solids in the United States.

Figure 17 illustrates the overall distribution of respondents for solids modeling use, while Table 8 breaks out the responses for solids modeling use, by industry. Table 8 indicates some significant market opportunities for filling the solids modeling void in the fabricated/structural machinery, metal parts, non-electrical and shipbuilding/plant industries.

Those currently using solids modeling indicated that they were using it on their sites for the following usages:

- CAD
- CAM

As illustrated in Figure 18, more than 70 percent of the respondents indicated that they are using solids modeling for CAD applications only.

# Figure 17

SOLIDS MODELING USE IN CAD/CAM



Source: DATAQUEST February 1988

# Table 8

# SOLIDS MODELING USE, BY INDUSTRY (Percent of Respondents)

lanning to Use	Already Using	<u>Total</u>
538	21%	748
468	218	678
638	04	63%
578	48	61%
498	48	53%
418	78	48%
358	128	478
178	218	38%
358	98	448
	53% 53% 46% 63% 57% 49% 41% 35% 17% 35%	Signature Already Using   53% 21%   46% 21%   63% 0%   57% 4%   49% 4%   41% 7%   35% 12%   17% 21%

Source: DATAQUEST February 1986 .

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# Figure 18

# SOLIDS MODELING USAGE



Source: DATAQUEST Februery 1988

## DATAQUEST CONCLUSIONS

- The 33 percent survey return of the questionnaires is a very high return rate. DATAQUEST believes that end users like to participate in sharing their thoughts and expectations to help vendors develop more cost-effective and efficient products.
- The application and usage mix of CAD/CAM systems by Japanese and U.S. respondents is nearly identical. Because a good deal of the Japanese systems are U.S.-based products, this is not totally surprising.
- The Japanese semiconductor industry appears to be the most progressive industry group in terms of accepting CAD/CAM technology. This group leads in average number of workstations installed (16), average number of trained users per workstation (4.3), standalone workstation installation percentage (25 percent), percentage of color workstation usage (64 percent), and most favorable feelings toward using personal computers (90 percent).

- Standalone workstations and personal computers are beginning to play an important role in Japan. Although respondents indicated that standalone and personal computer usage was quite low, DATAQUEST believes that these two architectures will soon dominate new CAD/CAM systems shipments.
- Overall Japanese market penetration (6 percent) is still very low. DATAQUEST expects that the Japanese market will grow at or above that of the United States over the next five years.

Yu Uemura

BEB a company of The Dun & Bradstreet Corporation

Dataquest

# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 96

## DATAQUEST'S SEMICONDUCTOR INDUSTRY CONFERENCE: SNAPSHOT OF AN INDUSTRY IN TRANSITION

#### SUMMARY

The shutter clicked and the moment was captured. The image: an industry in transition--technologically, economically, strategically, and philosophically. Ready or not, a basic shift in the nature of the business is occurring. Low-cost, high-volume ("jelly bean") manufacturing is being transformed into a value-based, service-oriented industry. Captive manufacturers are going merchant. One industry executive described this fundamental change in the market as "cost-driven to customer-driven."

An industrial community, emerging from bad times and eager to move forward, gathered in October at Tucson's Sheraton El Conquistador at DATAQUEST's eleventh annual Semiconductor Industry Conference. The goal was to try to understand both the changes taking place and the future directions to take. By the end of the conference, the mood had shifted to reaffirmed confidence in the strengths and resilience of this marketplace.

The speakers, from the industry, finance, and government, analyzed various aspects of this change. The following central themes were addressed by several of them:

- ASICs and future products
- Software
- Silicon compilation
- The economy
- Japan
- Semiconductor equipment and materials

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This newsletter summarizes the proceedings of the conference and discusses the common concerns of both presenters and attendees.

ASICS AND FUTURE PRODUCTS

The opportunity of ASICs is to take over from conventional electronic circuits. ASICs are a creativity tool and creativity is not a particularly Japanese characteristic.

K. K. Yawata Nihon LSI Logic

Alliances between system houses and semiconductor manufacturers will become commonplace as ASICs eclipse microprocessors. Standard cells offer the greatest flexibility and most effective and efficient use of silicon.

> Eli Harari WaferScale Integration

From the number of speakers addressing this issue, it is clear that application-specific integrated circuits (ASICs) represent more than just a fashionable trend. With more than 150 companies offering ASIC products, including the major IC firms, ASICs are the products of a transformed IC industry. All these companies offer a host of products that users can design to fit their particular applications. The advantages ASICs offer are:

- Reduction in system size
- Decrease in system power consumption
- Major savings in system cost

One speaker noted that customer service is now the major factor in determining ASIC market share. Most speakers acknowledged that ASICs are both design- and creativity-oriented and that the creativity comes from the users. ASICs have expanded the base of product innovation, spearheading the transformation of the IC market from one of high-volume, cost-based manufacturing into a customer-driven, value-based products market. Or, as Art Collmeyer, of Weitek, cnaracterized it, a transformation from "silicon cranks" to "think tanks."

ASICS also represent a significant competitive edge for the United States. A speaker from Japan noted that it would be a long time before Japan becomes competitive in the U.S. ASIC market, due both to the creative nature of ASIC design and to the substantial lead the United States possesses in CAD.

Future products were the subject of several presentations and panel discussions. Anthony Livingston, of Gigabit Logic, noted that a variety of gallium arsenide (GaAs) ICs are now migrating from the laboratory to the production environment. Because of their high-speed properties,

- 2 -

GaAs ICs are currently marketed primarily to the military and telecommunications markets. One conference panel discussed billiontransistor ICs and their potential for use in such real-time applications as simultaneous language translation during overseas telephone calls.

The discussion of future products underscored the need for the industry to examine new IC product definitions coming from end-use markets. Anthea Stratigos, of DATAQUEST's newly inaugurated Semiconductor Application Markets (SAM) service, sponsored a workshop at the conference to examine more fully semiconductor industry trends and issues from an application perspective.

#### SOFTWARE

Silicon design and system design will and must merge, (but) CAD advances are required to advance silicon design.

Dave House Intel

Product innovation is risky, as the market can only support a few winners. Partnering reduces this risk, spreads out the cost of development, and paves the way to industry standards, second-sourcing, etc.

Art Collmeyer Weitek

Currently available analog design tools lag two to four years behind digital CAD/CAE tools.

Alan Grebene Microlinear

From the several references to software during the proceedings, it became clear that the current generation of CAD/CAE tools significantly lags process technology and remains, for some, a major bottleneck in the design cycle. This appears to be particularly true in the area of automated IC design. For this reason, one speaker noted, CAD software applicability remains a more critical issue to users than price.

It is not only the IC companies that are in transition, but also those companies around them, such as CAD/CAE vendors. The CAE market faces enormous challenges in incorporating test, process, and design expertise into their application software, as well as in automating the entire design process. A few speakers suggested closer collaboration or partnering between IC and CAD companies as a means of developing the design tools required by system designers. The United States, however, significantly leads Japan in electronic design automation--by at least ten years according to one conference speaker.

#### SILICON COMPILATION

Silicon compilation is the automatic generation of full custom ICs from specifications provided by the user. It will drive the standard cell market. The challenge is user-variable circuitry; the ultimate goal is application standard architectures.

> Dick Gossen Silicon Design Labs

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Users want evolutionary tools, not revolutionary tools. Silicon compilation will be the major design methodology for ASIC design and possibly standard circuit design.

Douglas Fairburn VLSI Technology Incorporated

One of the conference's afternoon panel discussions concentrated on silicon compilation. This session was chaired by the Semiconductor Industry Service's Andrew Prophet, with representatives of the major companies in this market participating. DATAQUEST forecasts that silicon compilation will play a major role in the growth of the ASIC market, driving the standard cell and cell-based markets beyond the \$2 billion mark by the end of this decade. Panel members presented a brief overview of both their companies and products and attempted to define this new design methodology. Although the first-generation silicon compiler tools are available, vendors must still convince system designers to use them and to evolve the product offerings themselves towards true silicon compilation.

## THE ECONOMY

There is no reasonably acceptable way to reduce the deficits to acceptable levels without some tax increases. Whether they will affect your companies directly, or your customers, is something you ought to be looking at.

> Lawrence Chimerine Chase Econometrics

Large in the minds of many conference attendees was the state of the U.S. economy and its relation to the IC industry--that is, the fundamental ability of the economy to support the ongoing business of the semiconductor industry. Lawrence Chimerine, chief economist at Chase Econometrics, delivering what many attendees considered the best presentation of the conference, stressed that growth per se will not get the United States out of its current trade deficit problems.

Mr. Chimerine identified the two primary factors currently limiting economic growth as high interest rates and the overvalued U.S. dollar. In his opinion, the underlying reason for both remains the enormous and still-increasing federal budget deficit. He predicted that the federal deficit will remain at approximately \$200 billion per year through the remainder of the decade unless strong actions are taken with regard to both taxes and spending. He specifically recommended increasing taxes and cutting programs.

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Other speakers representing the financial community discussed U.S. venture capital versus Japan's low cost of capital, warning against a protectionist response to Far Eastern competition.

# JAPAN

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The Japanese tend to be production-oriented, emphasizing yield and maximized output. This is due to Japan's culture, educational system, and national focus, which all stress homogeneity and uniformity rather than creativity.

> K. K. Yawata Nihon LSI Logic

Several presentations dealt specifically or in passing with the Japanese semiconductor industry. A European speaker characterized the U.S. market as in danger of becoming "Japan allergic." There is no doubt that this competitive challenge remains a major preoccupation of many players in this marketplace.

Other speakers concentrated on the strengths of the U.S. semiconductor industry. The strengths most often cited were in the area of applications and value-based products, such as ASICs. Also mentioned was the significant lead U.S. CAD/CAE vendors have over their foreign counterparts in application software. A discussion of relative differences in patterns of long-term planning, government participation, and capital funding provided significant insight into Japan's competitive advantages.

Interestingly enough, it was a speaker from Japan who discussed Japan's disadvantages vis-a-vis the U.S. market. Discussing ASICs in Japan, K. K. Yawata, of Nihon LSI Logic, conceded that the U.S. advantage lies in "creativity" products and tools. In Japan, where yield is emphasized and output maximized, the creativity associated with ASIC design is often slighted in favor of production. Dr. Yawata also estimated that it would take at least a decade or two before Japan catches up with the United States in CAD/CAE. Design application software, therefore, remains the number one issue for the largely hardware-oriented Japanese.

Dr. Yawata also forecast that 8-inch wafers would reach the marketplace sometime in 1988, while downplaying Japan's role in their evolution. Several attendees, however, privately shared doubts that the Japanese electronics industry's philosophy of "kei-haku-tan-sho" ("lighter, thinner, shorter, or smaller") would preclude them from further 8-inch wafer development. Others felt that Dr. Yawata slighted Japan's creative powers in his presentation, perhaps out of courtesy to the largely American audience.

## SEMICONDUCTOR EQUIPMENT AND MATERIALS

As an adjunct to the main conference, DATAQUEST's newly launched Semiconductor Equipment and Materials Service (SEMS) held its first annual conference. One of the conference's main themes was the need for new equipment and materials to meet the challenges posed by the high-density, high-performance, submicron ICs. As devices go below 1 micron, manufacturers will run into physical limitations in materials, photolithography, and yields.

SEMS conference speakers noted that manufacturers are going to have to provide silicon wafers with much more stringent chemical characteristics. Also addressed were the problems associated with wafer dimensions reaching the absolute limits imposed by modern optics. Automatic inspection equipment, direct-write E-beam, and X-ray lithography were analyzed as means of resolving this problem. As process engineers push technology to its limits, yields are in great danger of falling, due to both contamination and variable process control. Thus, contamination control and wafer fab automation are viewed as absolute necessities for future evolution, a viewpoint also echoed by an SIS conference speaker.

#### DATAQUEST CONCLUSIONS

This is a historical year, the worst recession in semiconductor history. Downturns in the industry have been cyclical, occurring in 1975, 1981, and in the current year. Long-term planning is hindered by (short-term) lending policies. (However), we anticipate an upturn in bookings in fourth quarter 1985, with billings reflecting this in second quarter 1986. Howard Bogert

DATAQUEST

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The industry is undergoing a cost-driven to customer-driven transition. (It is necessary) to develop a willingness to change and change quickly to suit future conditions, particularly in customer relations. "Customer consciousness" involves responsiveness, integrity, and consistency.

F. Joseph VanPoppelen National Semiconductor

These two quotations best summarize the current state of the semiconductor industry's evolution. There was no attempt at the SIS conference to deny the severity of the economic events of 1985. All the messages were there for the taking. We believe that the bottom has been reached. It is time to pick up the pieces and move forward into 1986. The current period remains full of challenging opportunities, as reflected in the views expressed by both speakers and attendees at the conference. This is the time to build, buy equipment, be ready to ramp up, and form strategic alliances. Customers value service and responsiveness to their problems over marginal price/performance advantages. The customer is a sophisticated, highly-talented engineer who will require superior products and support. The new semiconductor industry is about creativity and synergy, not jelly beans.

(This newsletter was written jointly by DATAQUEST's Semiconductor Industry Service and the CAD/CAM Industry Service.)

> Tony Spadarella Bryan Lewis

Dataquest acompany of The Dum & Bradstreet Corporation

# RESEARCH NEWSLETTER

CCIS Code: Newsletter, No. 95

ADEE EAST SHOW: PARTNERS AT WORK

#### INTRODUCTION

The recent Automated Design and Engineering for Electronics (ADEE) Show East was held October 15 through October 17 in Boston. While attendance was disappointingly low at 3,300 people, vendor activity and announcements were numerous, varied, and on the positive side.

The ADEE showcased what we believe are significant deviations from already outdated business and product strategies. The ECAD business is maturing to the point where vendors are ridding themselves of the not-invented-here syndrome by forming strategic alliances that benefit not only their revenue figures, but also the end user.

This newsletter summarizes our observations at the ADEE in two parts: part one presents our major trends analysis and part two reports on the actual products.

## PARTNERSHIPS AND ANALYSIS

## Computer Systems

The most evident deviation from normal business concerned hardware platforms. We believe that the change will leave all parties involved feeling like winners, from the CAD vendor to the user to the computer manufacturer. The biggest computer manufacturer winners are IBM and Digital, with much attention paid to the PC AT and MicroVAX II at the show.

The migration to the IBM PC is not a new one, but we believe that the PC's posture and the user's perspective of it is changing. The PC is no longer a whiz kid's or hacker's toy, it has become a respectable and productive link in the design automation chain. This is certainly the case if the number of attendees in a PC vendor's booth is any indication of interest.

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The MicroVAX II introductions build on Digital's presence in the engineering market. Digital's operating system, VMS, is a tried and true operations system, and is supported by many engineering analysis programs. We believe that the inclusion of the MicroVAX II indicates the industry's recognition of the open system, including both hardware and software, as a viable means of doing business. The open system, or platform-free system, means that the end user is able to construct a custom design environment based on individual preference. This is significant because DATAQUEST believes that the ECAD market will remain fragmented, with a lot of companies operating on less than 25 percent market share. We believe that it is in a vendor's best long-term interest to port to, or at least interface, its products to the most sought-after and common computers. Ý

#### Software Products

Relationships between CAD companies and their software sources are increasing substantially. The most commonplace alliance is with software companies producing analysis products. In these cases, users are demanding access through either interfaces or ports to the products, thus creating pull for the products in the distribution channels.

Following the same reasoning as open hardware systems, software alliances offer users a choice of which products they want to use or interface. As the software portion of the market will also remain fragmented, we believe that these alliances will proliferate in the future.

## Making Money with Partners

Clearly, users carry clout in terms of which products they want to use. However, as turnkey CAD vendors continue to increase the number of partnerships, the question remains: Where is the profit?

DATAQUEST views partnerships as critical components of a CAD vendor's business. Users do not always want one-stop shopping, nor do they always want to beta test all of the latest and greatest products. However, OEM-type partnerships tend to increase the cost of goods sold. Profit, therefore, must come from the value and expertise of the vendor, which should be centered around targeted applications software, performance ennancements, application-specific hardware, integration, and support. Although they may wind up with attractive revenues companies that miss the profit target may also wind up in bankruptcy court.

Partnerships will continue to prevail in the ECAD business. However, we believe that behind closed R&D doors, current ECAD leaders are regrouping and focusing development on next-generation applications, performance ratios, data management, and user interfaces. Only in this way will they be able to control their profitability and destiny.

## EXHIBITORS AND PARTICIPANTS

The following companies announced or demonstrated products at the ADEE show.

## Analog Design Tools, Inc., Menlo Park, California

Analog Design Tools (ADT), which markets the Analog Workbench, a CAE product for analog design, announced that it has ported its software to the Hewlett-Packard 9000 Series standalone workstations to be distributed by HP under the HP Plus Distributed-Software program. Under the terms of the agreement, HP will resell ADT's product while ADT will provide applications and technical support. This agreement significantly expands ADT's distribution channel, which consists of three direct sales offices.

#### Applicon, Ann Arbor, Michigan

Applicon did not introduce any new products at the show. Instead, its major announcement was the relocation of its headquarters from Burlington, Massachusetts, to Ann Arbor, Michigan. Electronic CAD/CAM products will be available from two new entities. The Applicon entity, headed by Dick Mohrman, will be responsible for the mechanical and electromechanical products, including printed circuit board applications. The Electronic Design Automation (EDA) group, headed by Ken Jenkins in Scotts Valley, California, will be responsible for the IC CAD product lines. EDA reports to Schlumberger's Factron Division, which is responsible for automatic test equipment. Applicon reports to the Computer-Aided Systems group.

## Cadnetix Corporation, Boulder, Colorado

Cadnetix made seven new system platform announcements at the ADEE show, all incorporating the Motorola 68020 microprocessor. Four of the seven systems are color, and the 68020 is available either as an upgrade to existing systems or as a new system sale. It will obsolete new system sales based on the 68010, although Cadnetix will continue to support existing 68010 systems.

The company also formally introduced its CDX-1732 Technical Publications Package. Based on the Q-ONE word processing package from Quadratron Systems, Inc., the CDX-1732 integrates word processing with graphics data created on Cadnetix's CAE or CAD products for engineering documentation.

## Caedent Corporation, Colorado Springs, Colorado

Caedent, formed in February 1985, showed its back-end CAE products for fault grading, test vector generation, and testability analysis. The IntelliTest product runs on a full range of system architectures, including personal computers, standalones, and host-dependents. The company also has a circuit analysis product. Products are sold through OEM and direct sales channels.

## Calay Systems, Inc., Irvine, California

Calay, known for its 100 percent PCB routing system, announced the Calay V04, which is the company's next-generation PCB product, replacing the V03 system. The V04 is based on Digital's 11/73 computer with a proprietary routing and graphics processor. The technologies encompassed by the new system include surface-mount devices, digital, analog, and fine-line. The V04 is available as a new product or as an upgrade to existing V03 systems.

#### Calma Company, Milpitas, California

Calma, the dominant company in the handcrafted portion of the IC CAD segment, demonstrated its full line of electronic CAD/CAM applications. The company's product functionality includes the following:

- CAE applications, including behaviorial, logic, fault, and circuit simulation, timing verification, prototype verification, and simulation acceleration
- IC physical layout applications, including handcrafted, gate array, and standard cell methodologies
- PCB physical layout, including traditional board design, surface-mount devices, and hybrids; company also has electromechanical capabilities

## Case Technology, Inc., Menlo Park, California

Case announced that it ported its PC-based CAE software products to Digital's VAX and MicroVAX II. Using this new port, typical Case IBM PC users can also utilize the popular VMS/VAX line to run Case's full line of CAE software, with no need to relearn user interfaces and command structures. The Case schematic capture, timing verification, and logic simulation software is based on the Structured Computer-Aided Logic Design (SCALD) tools developed at Lawrence Livermore Laboratories.

#### Computervision Corporation, Bedford, Massachusetts

Computervision showed its traditional line of ECAD products; its only new introduction was the CADDS 4X graphics transfer interface. The new product allows schematic data to pass to a CADDS 4X system from either Case's Personal Engineer (IBM PC-based CAE product) or its CDS 3000 line (standalone CAE systems). Once data are passed, documentation and bills of material can then be created on the CADDS 4X system.
# Control Data Corporation, Minneapolis, Minnesota

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Control Data Corporation (CDC) announced two new simulation programs available through CYBERNET services. VERILOG is a behavioral-level simulator, facilitating logic analysis at various levels of hierarchy. AIDSSIM is a logic and concurrent fault simulator. Both products were developed by Massachusetts-based Gateway Design and are supported and documented by CDC.

CDC also announced OceanView, a logic simulator postprocessor that allows engineers to compare one simulation run to another, analyzing the differences. Also available through the CYBERNET services, the OceanView runs on PC-based systems.

CDC announced that its mainframe-based Modular Integrated Design Automation System (MIDAS) was enhanced with two new features. The Boolean Evaluation (BEV) simulates designs of up to 2.5 million gates. It works with design iterations or ECOs, rebuilding and rerouting only the parts of the design that are changed. BEV works with PATH TRACE, a timing verifier that checks every path.

## Daisy Systems Corp., Mountain View, California

As usual, Daisy made mega product announcements, one of which is a radical change from the company's previous build-versus-buy standalone workstation strategy. Daisy announced its OEM agreement with Digital and introduced the Logician VX and VX node MicroVAX II-based systems. Refer to DATAQUEST's Research Newsletter No. 92, "Daisy Systems Wraps Digital's VAX Products into Fold," for our opinions and analysis of this major introduction.

Other Daisy product announcements at the ADEE show included the following:

- ChipSIM, a circuit simulator from Daisy's Analog Design Automation Division. ChipSIM is supported by ADLiB (to add to or modify existing analog libraries) and the Daisy Parameter Extraction Program (compares simulation results with those from test wafers).
- Daisy Design Manager (DDM). This product addresses what DATAQUEST believes to be the largest overall ECAD implementation problem, that of design and data base management.
- Mega product line continuation. The MegaFault is an accelerated fault simulation workstation.
- DocuMaker. This product is a technical publications package that merges text and graphics, facilitating the documentation process.



- A productized EDIF net list interface, with demonstrations centered around HHB's CADAT simulator. DATAQUEST views this as a suptle, but significant product because through the standard interface, Daisy is opening its design data base to a host of non-Daisy supplied products.
- Personal Physical Modeling Extention (PMX) and Daisy Behaviorial Modeling Language (DABL). Both these products run with the IBM PC-based Personal Logician.

# ECAD, Inc., Santa Clara, California

ECAD announced a finalized OEM agreement with Daisy Systems, whereby Daisy will resell ECAD's DRACULA II layout verification software for CHIPMASTER, Daisy's handcrafted IC layout system. Daisy now joins the ranks of Calma, Mentor, Tektronix/CAE, Valid, and Via, companies that also OEM ECAD's DRACULA.

ECAD also announced new features for SIMON Simulator, its circuit simulation product developed by the ECAD-acquired SIMON Software. The new features include additional modeling capabilities as well as Ungrounded DC Sources, whereby the power used to drive a circuit may be variable.

#### FutureNet Corp., Chatsworth, California

FutureNet, one of the leading PC-based CAE suppliers, announced the expansion of its applications product line to include a printed circuit board design system called DASH-PCB. The new PCB product was developed by Vectron Graphics, which OEMs the product to FutureNet for integration and resale. FutureNet uses a 32-bit coprocessor board based on a National Semiconductor 32-bit microprocessor. Front-end design is accomplished using a DASH CAE system, including net list extraction for the automatic router.

FutureNet also showed its Personal Silicon Foundry, used to design and program programmable logic devices. It works in conjunction with parent Data I/O's PLD programmers.

#### Genrad, Inc., Concord, Massachusetts

Genrad announced a cooperative marketing agreement with Daisy, whereby Daisy will recommend HILO-3 as a simulation option, as well as list the product in its third-party software catalog. Genrad's HILO-3 will run on Daisy's Concurrent workstation line.

Genrad demonstrated its HILO-3 logic and fault simulator, as well as its HICHIP physical modeling product.

#### Hewlett-Packard, Fort Collins, Colorado

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Hewlett-Packard (HP) announced several new ECAD vendors to its multitiered third-party software program called the Distributed-Software Program. The new vendors in the tier in which HP sells both the hardware and software (the software vendor supports the application, HP supports the hardware) are listed below:

- Analog Design Tools, Inc., with its design automation products for analog circuits
- FutureNet Corp., with its design entry system
- VLS1 Technology, Inc., with its automatic IC design products
- 2uken, Inc., with its PCB CAD system, including analog boards and hybrid circuits

At yet another tier, HP signed SDA Systems to its HP Plus Referenced Software Program, in which the two companies will jointly market SDA's IC design software running on the HP 9000 Series, but HP sells and services only the hardware while SDA both sells and supports the applications software.

DATAQUEST views these HP announcements as its entry into the ECAD market. We think that HP's decision not to succumb to the not-inventedhere syndrome is a wise move on its part, especially considering the late timing of its initial market entry. We also expect more announcements of both the Distributed-Software and HP Plus Referenced Software program types. (DATAQUEST's revised HP corporate profile will be mailed in late November.)

#### HHB Systems, Mahway, New Jersey

HHB, developer of the CADAT logic, timing, and fault simulator, made several announcements at the ADEE show. The first announcement concerned the change in the company's name from HHB Softron to HHB Systems. We think that this name better reflects the business that HHB is in--that being simulation systems.

The CATS (Computer-Aided Test Simulation) Accelerator was announced at the show. The CATS Accelerator is a standalone or networked server based on a full-custom chip incorporating CADAT simulation functionality, depending on configuration.

The CATS Dynamic Hardware Modeler (DHM) was also shown. This is a redesigned version of HHB's Chip Checker. The DHM is a physical modeling product that allows actual ICs to be used during board-level simulation.

Other HAB announcements include the following:

- Release of CADAT 5
- EDIF support through a joint development effort with Daisy, whereby Daisy products will run CADAT
- An agreement with Omnicad to integrate CADAT 5 into the Omnicad product line; Omnicad will market the newly integrated product as OMNISIM.

#### Intergraph Corporation, Buntsville, Alabama

Intergraph was at the show with its PCB product and its new standard cell product based on TANCELL from Tangent Systems Corp. TANCELL is a place and route product with integrated timing verification. Logic design is accomplished through Intergraph's hierarchical schematic editor. RILO-3 and SPICE2 are supported for logic and circuit analysis.

DATAQUEST believes that for Intergraph to be a successful competitor in the ever-changing ECAD market, it must choose a more aggressive and flexible strategy and run with it.

## Mentor Graphics Corp., Beaverton, Oregon

Early in October, Mentor announced several major additions to its product line--Entry Station and its internally developed Compute Engine Accelerator. Both were demonstrated at the ADEE show.

The Entry Station is Mentor's response to the demand for low-cost IBM PC-based CAE products. It performs basic schematics capture and is linked to the company's Apollo-based products through a standard RS-232 interface for design simulation and analysis.

The Compute Engine is a general-purpose application accelerator that employs parallel processing and reduced instruction set computer technology. It is based on compiled applications software, and thus is able to accelerate more than one application. DATAQUEST believes that this unique accelerator technology has the potential to revolutionize the way in which future application accelerations are implemented.

At the show, Mentor announced its newly developed user interface, which is supported by its complete product line, including the IBM PC. The new interface is integrated with Mentor's documentation, graphics editor, and schematic capture packages. It features new menu schemes, such as popup, pulldown, and cascading, as well as mouse control.

#### Personal CAD Systems, Inc., Los Gatos, California

Due to its low-cost, PC-based products, Personal CAD (P-CAD) was one of the exhibitors at the show enjoying what little traffic there was. The company displayed its line of CAE and PCB products and made two announcements: PC-DRILL and a high-resolution graphics system. PC-DRILL is a software product that drives printed circuit board NC drilling machines from the P-CAD created design data base. The graphics addition is a 1,024 by 800 resolution monitor plus the graphics software driver. It is fully IBM-compatible.

## Phoenix Data Systems, Inc., Mountain View, California

Phoenix Data Systems (PDS) announced GEMstation, a handcrafted IC layout editor running on the IRIS workstation from Silicon Graphics. (Please refer to DATAQUEST'S Research Newsletter No. 39, "IRIS--The Integrated Raster Imaging System," for our opinions and analysis of the IRIS workstation.) PDS thus becomes the first ECAD vendor to make use of this high-performance color graphics workstation. MASKAP and LOGCAP, the company's mask output and mixed-mode logic simulator, also run on the GEMstation.

PDS announced that it has ported its ICAP line to the MicroVAX II. ICAP is a full-function IC design system, including schematic capture, logic simulation, geometry creation, and mask output.

#### Racal-Redac, Inc., Westford, Massachusetts

Racal-Redac (RR) featured its revamped product lines for CAE and PCB applications, both running on the Apollo workstation and the IBM PC.

Visula is Racal-Redac's Apollo-based PCB product, including schematics capture, automatic placement and routing, interactive routing, and an integrated, relational data base.

Racal's products are based on the IBM PC and cover a comprehensive range of CAE applications as well as physical layout. REDLOG, REDSIM, REDFAULT, and REDWAVE are the CAE applications products for schematics capture, logic and fault simulation, and wave form analysis, respectively. REDBOARD is the printed circuit board physical layout product, and is based on the same functionality found in the company's larger systems, including automatic placement and routing.

Racal made a major effort to develop its CAE product line and migrate its applications to the Apollo and IBM PC. We believe that the product line revitalization will help the company to protect or increase its share of the ECAD market.

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## Silicon Design Labs, Inc., Liberty Corner, New Jersey

Although Silicon Design Labs (SDL) did not announce any new additions to the product line that it introduced in May 1985, it exhibited at the show. SDL showed its Generator Development Tools (GDT), which are silicon generators used to create compilers. Please refer to DATAQUEST's Research Newsletter No. 87, "The Ultimate Design Tool Race Rages On," for more analysis of this product.

#### Scientific Calculations, Fishers, New York

Announcing release 85.01 of SCICARDS, Scientific Calculations (SC) has made significant enhancements to its mainstay product line. The new version of SCICARDS removes previous constraints on the number of data elements and supports true multilayer routing. The new version also supports a new hierarchical menu scheme called COACH.

SC also announced SCIDESIGN, its IBM PC-based CAE product. Although it presently supports just schematics capture, future plans include, among other functions, simulation and design analysis. Although SCIDESIGN currently lacks the necessary analysis tools for it to be a truly competitive CAE product, it is tightly integrated with SCICARDS, including true back annotation capabilities. We believe that the tight integration will make this an attractive product, certainly for SC's installed base.

SC will support SCICARDS on Digital's MicroVAX II. The company adds its own graphics devices, thus alleviating the shortcomings of the MicroVAX II's current graphics capabilities. SC also announced SCITHERM, a thermal analysis software product for printed circuit boards.

#### Silicon Solutions, Menlo Park, California

Silicon Solutions (SS) develops and markets two application accelerators: FAST-MASK for design rules and electrical rules checking, and the MACH series for logic and fault simulation. Distribution is through OEMs such as Calma and HHB Systems, respectively.

At the ADEE show, SS introduced the MACH 100 logic and fault simulation accelerator. Similar to the MACH 1000 in functionality, the 100 differs in the speed, capacity, price, and configuration.

#### Teradyne, Inc., Boston, Massachusetts

Teradyne demonstrated the latest release of LASAR, its simulation and test program generation software product. Version 6.2 runs on Digital's products and is available directly from Teradyne as well as from Valid Logic. The newest version supports behavioral modeling with mixed-mode simulation; wire and loading delays; timing verification with functional delay specifications, timing hazards, and minimum/maximum timing delays reflecting the similarity of propagation delays.

#### Tektronix, CAE Systems Division, Santa Clara, California

Continuing its theme of comprehensive end-to-end product design automation, Tektronix demonstrated its repackaged design automation products. Products are now logically grouped into WorkSystems, which comprise sets of applications products used to complete a particular phase of design.

Application WorkSystems include the following (for a more complete description, refer to DATAQUEST's corporate profile on Tektronix to be published in November 1985):

- DESIGNER'S WorkSystem
- GATE ARRAY WorkSystem
- FULL CUSTOM WorkSystem
- STRUCTURED CUSTOM WorkSystem
- STANDARD CELL WorkSystem
- PCB WorkSystem
- TEST AND MEASUREMENT WorkSystem
- SOFTWARE DEVELOPMENT WorkSystem

Tektronix also announced that the CAE Systems Division will market the MicroVAX II through an OEM agreement with Digital. While DATAQUEST believes that this move indicates a critical strategic direction for Tektronix, we think that it is another solid move on Digital's part to further strengthen its OEM position in the CAD/CAM market.

#### Valid Logic Systems, Inc., San Jose, California

Valid demonstrated several major additions to its product line, most of which were announced six weeks prior to the show. DATAQUEST believes that the additions and repackaging could play a key role in helping Valid maintain its position as the number three CAE vendor.

Valid's newest products include the following:

- Logic Design AT; an IBM PC AT-based CAE product. Following Valid's philosophy of using standards where appropriate, the Logic Design AT runs PC-DOS, a coprocessor with UNIX 5.2, and uses standard IBM G or GX color displays. It supports file transfer, remote log-in, and remote execution for simulation and analysis.
- MicroVAX II support for its analysis and background products, including the processing engine for the new PCB routing product.

- Board Designer, a newly announced PCB CAD product. It runs on a SCALDsystem and uses the MicroVAX II for the routing machine, which can then be used as a shared resource by many designers. Board Designer supports surface-mounted devices and fine line technologies with interactive, semiautomatic, and fully automatic placement and routing.
- Analog Designer, which supports design of analog board and circuits. It provides software functionality similar to a lab bench, including a voltmeter and oscilloscope.
- ValidSIM, a new logic simulator that addresses an area DATAQUEST considers one of the biggest problems in current simulation products--reducing the time to recompile a schematic and its net list for simulation.
- Realdraw, a graphics accelerator based on the Motorola 68020. It works with Valid's SCALDstar, a handcrafted IC layout editor to improve the graphics performance.

## Versatec, Santa Clara, California

Versatec demonstrated its Expert Engineer ECAD workstations. Based on Star architecture, the Expert Engineer includes CAE, PCB, and office automation applications. The Expert Engineer CAE systems' logic simulation operates directly from the design data base, with no need to compile a net list through lengthy postprocessing. The Expert PCB Designer was the first PCB system to incorporate gridless routing. The Expert Engineer office automation product includes much of Xerox's office automation software, including word processing, electronic mail, technical publications, calendar, and spreadsheet capabilities.

We believe that Versatec, with its highly integrated products, is one of the industry's sleepers.

# Viewlogic Systems, Inc., Marlboro, Massachusetts

Viewlogic, a PC-based CAE vendor, announced that it has signed an agreement with Practical Technology Marketing (PRATMA), an independent sales organization. PRATMA will market the line of Workview CAE systems, and extend Viewlogic's six existing direct sales offices. The company also announced that it has added a color graphics display.

#### VLSI Technology, Inc., San Jose, California

VLSI Technology (VTI), a leading ASIC supplier, announced that its IC design software for its own line of chips will now be supported on the HP 9000 Series 300 systems. HP will market VTI's full line of design software, including schematics capture, simulation, and place and route for standard cells and gate arrays. VTI will distribute its Megacell Library and compiler products, as well as support the products for HP customers.

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VTI also announced 250 new 2-micron double-metal CMOS standard cells including process dependent simulation and physical models.

# 2ycad Corp., St. Paul, Minnesota

Zycad's two announcements both concerned open systems, specifically, interfacing Zycad's application accelerators with other products. The EVENLink option allows the company's Logic Evaluator and Expeditor accelerators to exchange events with any system that accepts or outputs events. The HILO Translator interfaces directly with Genrad's HILO-2 or HILO-3 simulator product.

## SUMMARY

In our opinion, the IBM PC and the MicroVAX II stole the show. The bottom line is that hardware platforms are standardizing on the tried and true. Several years ago, DATAQUEST stated that hardware will become a commodity--it had to be a given. Vendors can now negate the users' hardware objections by not allowing hardware to be an issue.

ECAD vendors are also moving toward standardizing on tried and true analysis packages. End-user markets demand that their favorite simulation products work with schematic capture systems from the turnkey ECAD vendors. The result is the increased number of third-party relationships.

CAD users got what they wanted--alternatives. And, along with alternatives came innovations. DATAQUEST believes that the acceptance rate of new ECAD products will not be as high as that of their predecessors. We think that a higher comfort level needs to be reached with current products before users rush to absorb the rash of new alternatives. Vendors would do well to concentrate as strongly on customer support as on new product introductions.

Product acceptance will be slower than in the early 1980s. But standardization of hardware and software will ensure that it does happen.

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Beth W. Tucker



CCIS Code: Newsletters, No. 94

# COMPUTER-AIDED INSPECTION: MEASURING UP TO QUALITY

Dataquest

#### INTRODUCTION

Manufacturing companies in the United States and Europe have been rudely awakened by the Japanese to the importance of improving product quality. This has led to a drastic reevaluation of the quality assurance function in manufacturing. To achieve the level of accuracy and reliability in inspection that is now required, a wide range of automatic measurement aids have been introduced. These aids are usually referred to as coordinate measuring machines (CMMs).

Though CMMs have been around for over 20 years, a new generation of these machines is now emerging to cope with the challenge of computer integrated manufacturing (CIM). With the need to produce quality components at minimum cost, it is now required that these CMMs be capable of integration into fully automated, flexible manufacturing systems.

The demand for the more advanced programmable machines is rising, and one country, West Germany, seems to be taking the lead in the sophisticated application of these machines. The integration of inspection machines into flexible manufacturing systems and technology changes such as noncontact probes are just beginning to affect the manufacturing industry.

This newsletter examines the current market for CMMs, concentrating particularly on developments that will have to be taken into account by CAD vendors.

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#### CMM PRODUCTS

## Product Segments

Four tasks are involved in the control of quality in manufacturing:

- Design of measurement scheme
- Measurement of the component features
- Comparison of values with design data
- Interpretation of results and feedback to the manufacturing process

CMM products can be divided conveniently into the following three segments, based on how they achieve these tasks:

- Manual feature checkers
- Programmable full inspection machines
- Inspection cells

Figures 1 and 2 show the worldwide distribution of these segments, which are further described in the following paragraphs.

# Figure 1

# ESTIMATED WORLDWIDE CMM MARKET BY MACHINE TYPE--REVENUE



Source: DATAQUEST

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Source: DATAQUEST

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## Manual "Feature Checkers"

This segment consists of machines that are manually operated; all four of the inspection tasks are performed with manual assistance. These machines typically cost between \$18,000 and \$40,000.

## Programmable "Full" Inspection Machines

This segment consists of machines that are automatically driven through a measuring sequence, controlled by either microcomputers or computerized numerical control (CNC). The measuring scheme and the analysis tasks are performed manually. There is much variation in this segment, with the human effort involved in the manual tasks. These machines begin at around \$65,000, with the more sophisticated ones costing more than \$250,000.

## Inspection Cells

This segment consists of machines that are capable of integration into a CAD/CAM environment. Such a machine would ideally be capable of performing all four quality control tasks totally automatically. The development of this type of machine requires two links to be made. The first link would be between the CAD data base and the machine controller to allow the automatic generation of part programs; the second would be between the machine controller and the flexible system supervisor to allow automatic feedback of results to manufacturing. Machines in which these links have been partially established are available at prices greater than \$200,000. We have not included in our figures two special submarkets. One is for the use of a general-purpose machining center as an inspection machine by adding a probe. Olivetti is taking this approach to the market and has recently installed a flexible machining system (FMS) at Cessna Fluid Power. There are, however, problems of vibration and economics associated with this solution.

The other submarket employs very high-precision machines for tooling calibration. This submarket is small in volume of shipments but crucial to the implementation of the other machines.

## The Importance of Software

It is the quality of software accompanying the CMMs that distinguishes different machines. The growing demand for programmable machines is due to two major software developments:

- Innovative conversational (menu-driven) programming as an off-line capability
- Statistical analysis modules processing measurement data

In the inspection cell market, integration will be achieved largely through sophisticated software. A good deal of research and development (R&D) work has been initiated by combining the efforts of both CAD and CAM vendors to develop integrated software packages.

The benefits of a truly integrated CMM system at Toyota were reported at the recent CAMP '85 conference in Berlin. In this case, car body stamping dies were finished by hand under the computer's guidance using data from the CAD systems surface model in comparison with a specially constructed CMM. By integrating the CAD system with the CMM, a serious bottleneck in the production of new models was eliminated.

#### The CMM Market

DATAQUEST estimates that the world market for CMMs of all types will reach \$323.7 million in 1985. Figure 3 and Table 1 show the regional distribution of CMMs. Our research has concentrated on the European market, where Germany is using off-the-shelf machines in a most sophisticated way. The leading European vendors, LK Tools and Zeiss, are doubling in size and exporting significant volume to the U.S. market. Cincinnati Milacron bought LK Tools (which was previously associated with Rennishaw) earlier this year. The British company, Rennishaw, has a leading position in the probes. market and supplies both CAI machine users and machining centers. The only Japanese company to export significantly is Mitutoyo, which makes a range of smaller machines. DATAQUEST believes that these machines are going into the more straightforward The main U.S. vendors are Brown & Sharpe, Sheffield applications. Cordax, and Federal Products (formerly Boice).

# Figure 3



ESTIMATED WORLDWIDE CMM MARKET BY REGION--REVENUE

Source: DATAQUEST

# Table 1

# 1985 ESTIMATED WORLDWIDE CMM MARKET BY MACHINE TYPE

Segment	Europe	Japan	United States	Rest of World	Worldwide
Manual	600	1,000	1,500	200	3,300
Programmable	350	300	500	80	1,230
Inspection Cells	30	50	30	5	115
Total Units	980	1,350	2,030	285	4,645
Total Value (M\$)	\$82.2	\$92.8	\$129.0	\$19.7	\$323.7

Source: DATAQUEST

Within the European countries, DATAQUEST believes that national markets are dominated by local manufacturers: L.K. Tools and Ferranti in the United Kingdom, Zeiss and Leitz in the Federal Republic of Germany, Renault in France, D.E.A. in Italy, and Johansson in Scandinavia. The largest national market appears to be the Federal Republic of Germany, followed by the United Kingdom, and then France. The Federal Republic of Germany has a higher proportion of programmable machines than does any other European country.

## Linking CMMs to CAD

#### The Opportunity

With component design details already defined in a CAD data base, it should be possible to use this information to automatically generate the CMM part program. This would also allow a dramatic reduction in the time taken to measure a particular workpiece. At present, it is necessary to set a clearance plane well above the workpiece and move slowly down in "grope" mode. With an accurate model of the workpiece geometry, it is possible to move rapidly to a position near the surface before starting the "groping" action.

# The Problems

The dimensional information required to adequately inspect a component includes tolerance data. This data is often not stored in CAD data bases in an easily accessible manner. Also, there is no standard programming language for CMMs; therefore, a different post-processor is required for every different manufacturer's machine.

#### Available Solutions

A number of the major CMM manufacturers are now offering partial links to CAD systems. Typically, these take the form of three software modules:

- A module to allow the interactive generation of a machine neutral part program file
- A (set of) post processor(s) to allow the generation of a part program for a specific machine
- A module to convert the data obtained during measurement to a form readable by the CAD system to allow graphical interpretation of the results

To facilitate the integration of CAD to CMMs, efforts are being made to develop a standard specification for an interface between the two. This work is being done by CAM-I to define the Dimensional Measuring Interface Specification. When completed, it will be proposed as an international standard for future systems.

# Integrated Systems Available

A number of CAD-based products have recently arrived on the market. These include Computervision's Automeasure, which will link its CAD system to the CMMs of Brown & Sharpe, DEA, Sheffield Cordax, Zeiss, and Federal Products; McAuto's Unigraphics interface, linking to the same manufacturers as Computervision's Automeasure; and Calma's DDM/CMM package, presently for Zeiss machines only.

Table 2 and Figure 4 present the 1985 European CMM market by machine type and country, respectively.

# Table 2

# 1985 ESTIMATED BUROPEAN CMM MARKET BY MACHINE TYPE

Segment	United <u>Kingdom</u>	Germany	France	Rest of <u>Europe</u>
Manual	130	180	120	170
Programmable	60	150	50	90
Inspection Cells	6	10	5	9
Total Units	196	340	175 .	269
Total Value (M\$)	\$15.1	\$32.1	\$12.9	\$22.1

Source: DATAQUEST





ESTIMATED EUROPEAN CMM MARKET BY COUNTRY -- REVENUE

Source: DATAQUEST

#### DATAQUEST ANALYSIS

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The CIM ideal is still an unattainable goal at present. However, there is becoming available a range of systems that will increase the attainable level of integration. Those CMM manufacturers and CAD vendors who currently are not involved with these new developments will not be in a position to take advantage of this growing market.

Figure 5 shows how the Germans, with their strong national vendors, have already begun to outpace other countries in their introduction of programmable CMMs, although penetration there is low as well. According to the leading vendor in West Germany, the key issue today concerns which machine will provide the best measurement scheme. In the United States, it is still necessary to convince many companies that they need a machine at all. However, some corporations have heard the message, as evidenced by General Motors' announcement of a \$15 million program to introduce CMMs.

DATAQUEST believes that a largely unheralded benefit of CAD is the accuracy of the data in the system. In the mechanical CAD market, the data is routinely used to create numerical control tapes. CMM provides an opportunity to use the data again to check and improve quality. This will offer a real competitive advantage. DATAQUEST expects that the techniques will spread from the current defense, aerospace, and automobile industries into the small-batch production of what the Japanese call "Mechatronics."

Michael Evans

# Figure 5

# WORLDWIDE CMM MARKET SHIPMENTS



Source: DATAQUEST

RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 92

# DAISY SYSTEMS WRAPS DIGITAL'S VAX PRODUCTS INTO FOLD

#### OVERVIEW

Daisy Systems has expanded its product portfolio to include Digital Equipment Corporation (DEC) MicroVAX II products, accompanied by a number of product announcements and enhancements that are most significant both to those who provide CAE solutions and those who implement CAE technologies.

Within this newsletter, DATAQUEST will provide the following:

Details of the new announcements

Dataquest

- An analysis of the strategy behind the move
- The downside and the upside of the product portfolio expansions and enhancements

#### FOURTH QUARTER 1985

During this fourth quarter of 1985, DATAQUEST observes the following taking place:

- The microelectronics market is experiencing one of the worst downturns in its short history.
- The CAD/CAM/CAE markets are questionable and are, at best, the "little darlings" of the Wall Street crowd.
- The availability and acceptance of the personal computer within design automation disciplines has virtually changed the very nature of doing business within the CAD/CAM/CAE market segments.

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- The CAE industry is taking on a new identity, from one where "technology selling" and early adapters were once the proponents, to a new phase where success is based on strategic marketing and the fact that CAE tools are viewed as "competitive imperatives."
- The entire design automation marketplace is speculating on IBM's next generation of CAD/CAM/CAE tools.
- DATAQUEST has adjusted its CAE industry revenue growth forecast for the period 1985 through 1989 from a 47.5 CAGR to 33.6 CAGR (see Table 1).

#### Table 1

# ESTIMATED CAE REVENUES--1985-1989 (Millions of Dollars)

Segment	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	CAGR (1984-1989)
IC	\$157	\$ 181	<b>\$</b> 224	<b>\$</b> 298	\$ 408	\$ 571	29.48
EDA	276	442	701	1,042	1,387	1,798	45.48
PCB	<u>355</u>	392	525	<u> </u>	850	991	22.8%
Total	L \$788	\$1,015	\$1,450	\$2,019	\$2,277	\$3,360	33.6%

Source: DATAQUEST

## DAISY SYSTEMS' POWER PLAY

Reacting to the lightning-fast pace of change within the CAE environment, Daisy Systems has just executed a power play that includes the following:

- The completion of a \$50 million, 24-month OEM agreement with Digital Equipment for MicroVAX II-based microcomputers and workstation products
- Portability of Daisy Systems' entire applications software library to the MicroVAX II products
- The availability of two new general-purpose processor engines based on the MicroVAX II product platform:
  - The Logician VX, a single-user configuration for computation-intensive tasks
  - The VX NODE, a multiuser server that may be accessed by any of Daisy's workstation products, including the Personal Logician series

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- Availability of Daisy's application software, either à la carte (unbundled) or in a turnkey configuration
- Interconnectivity across the networked environment, including IBM PC ATS (Personal Logician), VAXS, and Daisy's own proprietary hardware, which includes a high-speed interconnect and a 10-Mb/sec Ethernet connection between the Personal Logician series and the Logician VX and/or VX NODE
- Development and availability of a multitasking concurrent operating system environment enabling users to execute DENIX and one other operating system (PC-DOS, VMS, or ULTRIX) simultaneously. Provisions also include:
  - Access of all applications via DENIX, therefore providing a transparent shell to end users who are working outside of their native environments
  - Access to non-Daisy applications software via a DENIX interface, permitting users to execute programs such as MAINSAIL, LISP, or other CAE software normally run on VAX processors but not provided by Daisy
- Provision of a network-wide data base manager, DDM (Daisy Design Manager), which may be accessed from any workstation within the network topology. Utilizing the DDM utility system, users can manage the movement of data across the network. This is especially significant when tracking design changes, and used properly it will provide a vehicle for design and configuration control.
- Availability of the Procedural Interface, or PI. With this new announcement, end users will have the ability to use their own customized software programs in an integrated manner with Daisy's application software. Acting as an applications interface, the PI becomes a tool for linking these customized programs directly with the available Daisy algorithms.
- With the VAX interfacing comes complete Digital Equipment VT-100 and IBM 3270G and 3270GX emulation on all Daisy products; emulation of specific Tektronix products is planned in the near future.

#### NOTES

DATAQUEST views the new announcements as most significant. The implications of the strategy are multidimensional, and we believe that they will affect a majority of those participating within the CAE environment.

In accordance with the new announcements, Daisy now offers a wide variety of both applications software and computational hardware platforms, ranging from personal computers, engineering workstations, application-specific processors, and networked servers to general-purpose architectures. In addition, we believe that the availability of this wide range of processing power combined with applications software will enable users to align the proper computer platform with the most appropriate applications, thereby creating a state of "computational applications alignment." The current products address applications within the realm of: t

- A shared-logic environment
- A computation-intensive environment
- An interactive environment

Aligning the proper level of computer power with the correct application becomes a critical issue in both the system throughput and the justification scenario for implementing these sophisticated design automation tools.

The migration of Daisy's application software to the VAX architecture provides a vehicle for penetrating the VAX installed base, not only within the design automation marketplace, but also with those accounts that have VAX-based products installed for other applications.

In addition, DATAQUEST believes that Digital Equipment has sold more than 5,000 MicroVAX II units within this environment since initial shipment in May 1985. Combined with the fact that there have been between 200 and 300 model 8600s sold, the total population exceeds 11,000 units within the design automation marketplace alone. In looking at the entire population of VAX products, DATAQUEST estimates that there are more than 30,000 units installed.

One additional key point of the "environment architecture" is the intelligent implementation of the concurrent operating systems. These systems permit the execution of multiple applications concurrently even though they are executed under different operating systems. Picture the following scenario: Sitting at the Personal Logician, an end user may access any application program across the network via a DENIX shell. The shell provides a transparent medium of access to non-Daisy applications software. Having picked a window via DENIX, the user may now enter the native operating system of an application such as VMS or PC-DOS. Once into the operating system, he or she may chose to execute a number of applications that may be accessed across the networked distributed data Rierarchical in nature, this system allows one to move onto bases. different levels of the operating systems environment depending on what is to be accomplished.

#### DATAQUEST ANALYSIS

DATAQUEST believes that the new positioning of Daisy's product portfolio will have multidimensional implications for not only its competitors in the CAE environment, but also for suppliers of computational hardware. In addition, there are the new alternatives provided for both the installed users of CAE technology and the future buyers of this ever-so-evasive automation technology.

With the evolution of the new Daisy platform, many significant factors come to mind:

- The number of consumer-accepted computer platforms will consolidate over the next 36 months. This is based not solely on Daisy's reinforcement of Digital's VAX product offering, but IBM personal also on the presence of the computer architectures. With the availability of both the MicroVAX II and the IBM personal computer, the majority of vendors have chosen to provide proprietary hardware only when the application demands computational power beyond the scope of a specific processor. Over the past 18 months, we have witnessed a tremendous change in the very nature of the CAD/CAM/CAE business. Total solution providers, once known as turnkeys, are now in a situation where they are evolving to applications software suppliers.
- The fact remains that in order to maintain success in such a competitive and chaotic environment as CAE, a company must be assured at all times that it is "riding the right horse" and, just as important, that the horse is headed in the right direction.
- DATAQUEST views the Daisy move as one designed to put additional pressure on those who are neither supporting nor providing low-cost solutions and general-purpose computational platforms.
- Regarding the question of margins, DATAQUEST believes that the availability of application-specific hardware platforms and the Daisy-specific utilities will temper the erosion of margins.
- DATAQUEST also expects the availability of the Logician VX and/or VX NODE with the Personal Logician to greatly reduce the average cost per seat within the Daisy environment.
- DATAQUEST has good reason to believe that IBM's next generation of engineering processors and workstations will be fully compatible with the existing PC architectures.
- To the best of our knowledge, because of the VAX platform and the integration modules developed by Daisy, virtually any piece of CAE applications software that is running on the VAX can now be executed within the Daisy environment.

The questions that remain are those associated with the management of the data across the network and the movement of the data between the networked distributed processors. Although Daisy announced the availability of both the Procedural Interface and the Daisy Design Manager to provide a vehicle for this complex issue of data management and transfer, DATAQUEST might ask, Is the hand quicker than the eye?

At a time when a majority of the players within the design automation marketplace are honing their competitive edges, there also comes the time when each participant is involved in an environment where mergers, acquisitions, consolidations, and bankruptcies are prevalent. In addition, the challenge of "making a buck" is becoming increasingly more difficult; so all companies are protecting their margins. This becomes even more arduous in an environment where IBM, Digital, and Apollo are providing hardware platforms at very aggressive and rapidly diminishing prices that are falling faster than a barometer during a hurricane, or in this case, perhaps it is the calm before the storm.

DATAQUEST views the Daisy announcements as a significant move to lower the barriers to entry for future implementors of CAE technology. As the business of CAE moves from an era of missionary work to an era of necessity, it will become increasingly more important to provide timely, cost-effective, and painless methods of adopting technologies that imply change.

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Jim Newcomb

CCIS Code: Newsletters, No. 93

SEARCH

# ENGINEERING WORKSTATION MARKET HEATS UP IN JAPAN

Paralleling the trend in the United States towards distributed, 32-bit workstations for engineering applications, the Japanese now appear ready to embrace this concept. As illustrated in Figure 1, DATAQUEST believes that Japan's share of the total engineering workstation market will grow from 6 percent in 1984, to 14 percent by 1989. Two major events signaling the trend toward more widespread use of engineering workstations include:

The Toshiba 1,200 unit workstation order

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 The Sumitomo Electric Industries (Sumitomo)/Digital Computer, Ltd. (DCL) Ustation E-20



#### Figure 1

ESTIMATED ENGINEERING WORKSTATION MARKET

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## THE TOSHIBA 1,200 UNIT ORDER

Toshiba and Sun Microsystems recently announced an agreement whereby Toshiba will purchase 1,200 Sun workstations over the next three years. DATAQUEST believes that Toshiba will use the workstations as part of a turnkey CAD/CAM system for both the mechanical and electronic CAD marketplace. DATAQUEST believes that Toshiba will also distribute Sun workstations on an OEM basis sometime next year.

# THE SUMITOMO/DCL USTATION E-20

Sumitomo and DCL have developed the first Japanese 68020-based engineering workstation, the Ustation E-20. Jointly developed and manufactured by Sumitomo and DCL, the Ustation E-20 contains similar price/performance characteristics to those found on the Apollo and Sun 68020-based products, including a UNIX operating system and an Ethernet local area network. In addition, the Ustation E-20 has Japanese processing features including a Japanese editor, a Japanese subroutine package, and a Japanese data base program.

The Ustation E-20 is a follow-on product to the 68010 E-10 workstation, which was introduced in October 1983. DATAQUEST estimates that Sumitomo and DCL have sold and installed more than 750 engineering workstations in Japan over the past two years. They expect to sell more than 1,000 new Ustation E-20s over the next 12 months.

#### DATAQUEST ANALYSIS

We offer the following observations regarding the market for distributed engineering workstations in Japan.

- DATAQUEST believes that the Japanese manufacturers have finally acknowledged that distributed systems are a credible and cost-effective alternative to shared-logic mini- and mainframe computers.
- The rush toward adopting a 32-bit, distributed platform is expected to produce an avalanche of cooperative associations between U.S. workstation suppliers and Japanese system integrators. We believe that the window of opportunity for vendors to get "designed-in" will extend through the fourth quarter of 1986.
- DATAQUEST predicts the transition from host-based systems to distributed workstations will happen much more quickly (12 months maximum) in Japan than it did in the United States (24 to 36 months).

Yu Uemura David B. Burdick

RESEARCH NEWSLETTER

CCIS Code: Newsletter, No. 91

# SHARING THE EXPERTISE: THE SEMICONDUCTOR AND ELECTRONIC CAD MARKETS TEAM UP FOR AUTOMATED DESIGN

Dataquest

#### INTRODUCTION

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Application-specific integrated circuits (ASICs) continue to represent significant growth opportunities for both electronic CAD vendors and semiconductor manufacturers. Although user demand for ASICs currently drives the IC CAD market and props up the custom-design segments of an otherwise ailing semiconductor market, the ASIC revolution is just warming up. When it really gets hot, we expect radical changes in the way both design and the business of design are done.

This newsletter, the first of a series examining automated IC design trends, analyzes the dynamics of the ASIC market, focusing on the following issues:

- The relationship between current economic conditions in both the IC and IC CAD markets
- The acceptance, application, and direction of ASICs
- The user demands driving the ASIC market

#### THE IC AND IC CAD MARKETS

The IC and IC CAD markets have historically kept pace with each other, with the IC CAD segment slightly trailing during the last few years (see Figure 1). This is reasonable, since design houses and semiconductor manufacturers were among the first eager purchasers of the new design tools and such purchases naturally follow successful earning The customer base then began to expand beyond IC periods. The newer customers, forming a numerically larger manufacturers. potential base, were the large computer system houses such as Apollo, Digital, and IBM. The IC CAD market began to chart an independent course that, should the design automation trend continue, will eventually ripple outward to include many Fortune 500 companies.

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Source: DATAQUEST

The reasons generally cited for the success of design automation are the shortage of designers, the resulting necessity for system engineers to do IC design, and the growing availability and sophistication of the design tools themselves. This situation continues to accelerate, particularly in the area of ASICs, with increasingly more areas of custom design being done by customers. Figure 2 suggests that the ASIC market is now both driving, and, in turn, being driven by the IC CAD market.

The current recession is not affecting IC CAD vendors to the same degree as the manufacturers of standard parts, according to our analysis, largely due to continuing customer demand for ASICs. Neither is the slumping semiconductor industry taking the entire IC CAD market along for the slide. Pressure on the CAD market is coming more from the halting computer industry, in terms of obsolete inventories and downward price spirals. Capital expenditure, estimated in early 1985 to be growing approximately 13.1 percent, is now looking more like 6 percent. Other factors include the offshore strength of the U.S. dollar's severely limiting export capability, and the effect of internal competition, represented by low-cost systems, on an already overpopulated marketplace.

Figure 2



IC CAD, ASIC, AND IC MARKET COMPARISONS

Source: DATAQUEST

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#### THE ASIC MARKET

#### Market Forecast

What we are witnessing is an anything but smooth transition from an IC market dominated by standard parts to one shared to a large degree with custom ICs. DATAQUEST forecasts that the \$3.3 billion 1984 merchant ASIC market will grow at a 25 percent CAGR to reach nearly \$10.2 billion in 1989 (see Table 1). The major requirement for this impressive growth is users' adapting to new ASIC design tools and methodologies, such as silicon compilation, which the electronic CAD (ECAD) vendors are offering. These are the design techniques we will be examining in depth in this series of newsletters.

By offering knowledge-based, highly automated design and layout tools, ECAD companies can extend their potential customer base beyond the system houses and computer manufacturers into the larger, general manufacturing marketplace. These products, however, are going to require that semiconductor manufacturers share more and more of their design expertise and process technology with both ECAD vendors and, ultimately, with customers.

This collaboration is not totally unwelcome. Most IC vendors will admit that their design business is neither as profitable nor as streamlined as it could be. These vendors see the new IC CAD tools as a way out of fab line bottlenecks. Customers see them as an effective way of reducing production time and the prohibitive reengineering or, to be precise, nonrecurring engineering (NRE) costs associated with custom design.

Customers' use of productivity tools, such as simulation accelerators that speed full-custom design turnaround, is now, in fact, being encouraged by the ASIC houses. From all aspects, the resulting synergy between IC foundry, ECAD vendor, and users promises increases in both productivity and profitability.

#### ASIC Design Methods and Implementation

DATAQUEST defines ASICs as semicustom and custom integrated circuits, designed for a specific application, for which one or more mask layers are changed. This definition includes programmable logic arrays (PLAs), gate arrays, standard cells, and full-custom or handcrafted ICs.

Each type of custom IC requires a different and increasingly more complex design methodology. To the system-level designer, the question of whether to produce a gate array or a standard cell should be largely irrelevant. Functionality, volume, turnaround time, and cost are the immediate issues. The ultimate goals are productivity and producibility. For these reasons, choice of implementation is a decision that must be shared with the IC vendor.

# Table 1

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# ESTIMATED WORLDWIDE CONSUMPTION OF APPLICATION-SPECIFIC INTEGRATED CIRCUITS (Millions of Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Total ASIC	5,938.4	7,609.7	9,167.3	10,514.0	12,958.4	16,134.1
Captive ASIC	2,596.0	3,063.3	3,614.7	4,265.3	5,033.1	5,939.0
Merchant ASIC	3,342.4	4,546.4	5,552.6	6,248.7	7,925.3	10,195.1
Total Semicuston	988.6	1,352.0	1,806.0	2,209.9	2,862.2	3,843.2
Gate Arrays	737.6	1,029.4	1,364.3	1,671.2	2,175.7	2,932.7
MOS	402.B	584.1	794.4	993.0	1,300.8	1,769.2
Bipolar	334.8	445.2	569.9	678.2	874.8	1,163.5
Programmable Logic	251.0	322.6	441.7	538.7	686.5	910.5
MOS	0.5	27.0	81.0	141.9	246.1	421.6
Bipolar	250.5	295.6	360.7	396.8	440.4	488.8
Total Custom	2,353.8	3,194.5	3,746.6	4,038.9	5,063.1	6,351.9
Standard Cell	122.9	255.2	482.0	862.7	1,463.2	2,401.9
Full Custom	2,230.9	2,939.2	3,264.6	3,176.1	3,599.9	3,950.0

Source: DATAQUEST Semiconductor Industry Service

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Today's designer is presented with a spectrum of choices. Each method represents a tradeoff between the time required to design the product and the development cost. Figure 3 shows the four major design methodologies that have emerged. At one extreme are the full-custom chips, which require handcrafted layouts. Here, the area on a chip is minimized at the expense of development cost. Generally, full-custom products are used in very high volume applications where chip cost is the critical factor. At the other extreme are the quick-to-program PLAs. The development effort for these is a matter of days, but the tradeoff is less efficient area utilization, which results in higher production costs. Between these two extremes are gate arrays and standard cells, or what is sometimes referred to as "structured logic."

#### **Figure 3**



## IMPLEMENTATION ALTERNATIVES

Source: DATAQUEST

ASIC design complexity, coupled with the now almost legendary shortage of IC design engineers, has created a vast market of opportunity for IC CAD tools. ECAD vendors are busily attempting to transfer the design process from IC engineer to system engineer, and the success of this shift is closely linked to design methodology.

For example, using CAD tools to design PLAs or gate arrays is comparatively easier than designing with standard cells, largely because of the relative ease of translating these designs into a physical layout. In the case of PLAs and gate arrays, CAD tools are concerned with solving only the routing problem, whereas, with standard cells, these tools must also address the placement of the cells in addition to routing. Predictably, there are more systems supporting gate array design than standard cell design. There are even fewer CAD systems that can perform true silicon compilation.

Most ECAD vendors see that their real opportunity is in attacking more and more of the design process, and they are therefore moving from the simpler implementations toward the more complex. The growth opportunities are most dramatic in the standard cell arena. The market for standard cells and other cell-based designs is expected to grow from \$122 million in 1984 to \$2.4 billion in 1989, and it is widely believed that silicon compiler CAD will fuel this growth.

#### THE IC CAD MARKET

ASICs have begun to gain market share over the standard parts, except for items such as memories, microprocessors, and floating-point processors. And the corresponding demand for highly sophisticated, custom design tools also shows no sign of letting up. DATAQUEST forecasts that the IC CAD market will grow to approximately \$570 million in 1989 (see Figure 4).

The ASIC market has, in effect, challenged both semiconductor and ECAD vendors to redefine their roles and product offerings. Certain semiconductor companies known as "ASIC houses," such as Gould-AMI, LSI Logic, and VLSI Technology Incorporated (VTI), have always referred to themselves as "design service businesses" and as "foundries." Others are only now beginning to restructure their businesses in a similar manner. The ASIC business is a service business and requires a different mode of operation from that required for the standard product business. As the ECAD vendors begin to offer automated, knowledge-based products such as silicon compilers that require specific foundries' standard cell libraries, and process technology variables, ASIC and ECAD vendors increasingly are regarding each other more as partners than as competitors for the custom trade.



IC CAD WORLDWIDE FORECAST

Figure 4

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#### USER DECISIONS

The most important and mysterious element in this market is the user or buyer. Will the user really be able to deal with the complexity of silicon design? Users believe that they can. Most likely, they will have to rely on design tools that are heavily experience-based, with design constraints that they may or may not recognize. Training, design centers, and application support will also have to increase to support these new design methodologies. The question still unanswered is, at what point will customers move over to employ these products? We believe that users are making definite decisions about ICs that carry implications for both sets of vendors. The following are some of the decisions we have identified:

- Minimize off-the-shelf solutions, except for cost-effective proprietary products such as memories, microprocessors, and controllers (devices not practical to redesign)
- Design unique, or proprietary, custom ICs wherever appropriate
- Use IC application design software that is process-oriented, transportable between different hardware platforms, compatible with other software, and produces quickly manufacturable designs (quick turnaround and lower NRE costs)
- Choose a design methodology that best integrates logical and physical design and that is most consistent with the user's own level or expertise, but as sophisticated as the best designer
- Maintain as much control over the project as possible by generating tests and simulation in-house, and retain production flexibility by avoiding getting locked into any IC vendor's manufacturing process and queues
- Get the product to market as fast as possible by choosing products that offer good "first silicon" techniques

The user is going to hesitate to commit monies to new design systems that are confusing or incompatible with current design tools. Automation of these tools and their demonstrated integration with existing systems and hardware would go further than education alone in ending buyer confusion. Vendor beware: The user is not interested in "products" so much as in systems solutions for designing and fabricating microelectronic circuitry in the most effective and efficient manner possible.
# DATAQUEST ANALYSIS

We believe that custom IC design automation includes many subtopics. The drive toward design of increasingly complex custom ICs with automated techniques has heightened the need for the market to address the following issues:

- Design methodology
- Array-based design
- 🔴 🛛 Cell-based design
- Silicon compilation
- Testability analysis and simulation
- Application accelerators
- Standards

The challenges presented by customers designing ASICs are formidable and take a different shape for each market. For IC vendors, it means sharing process rules and parameters and cell libraries with ECAD vendors. They will also have to adapt production to customer-supplied layouts. For ECAD vendors, it means providing users with ASIC design tools that integrate with existing design environments and incorporate the silicon designer's expertise.

These new design solutions must be knowledge-based, highly automated, fully integrated, and easy-to-use tools if ECAD vendors hope to appeal to a wider total available market and a new class of user than their present products allow. These tools will also have to demonstrate significant productivity gains by speeding the design's route to silicon. And they will have to be flexible enough to adapt to the next-generation design and production methods. Only if these conditions are met can everyone prepare to ride out the next technological wave: the era of the "superchip."

We believe that the collaboration between silicon foundries and CAD vendors in responding to users' demands, as well as to internal market pressures, is what will determine whether we are talking doom, gloom, or boom.

Tony Spadarella

# RESEARCH NEWSLETTER

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NEW 68020 WORKSTATIONS . . . RIGHT ON TRACK, BUT FOR HOW LONG?

Dataquest

#### INTRODUCTION

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Sandwiched between Digital's MicroVAX II unveiling and IBM's soon-to-be-released workstation, comes a flurry of Motorola 68020-based workstation announcements. The long-awaited 68020 is Motorola's full 32-bit microprocessor extension of its popular 68000 and 68010 chips. DATAQUEST believes that volume availability of the 68020 and its incorporation into the popular engineering workstations, is one of the last pieces of the puzzle ushering in the era of true 1-mip (millions of instructions per second) workstations. However, as Figure 1 depicts, it is not clear whether or not these new 68020 workstations will be able to hold off the charge of the MicroVAX II and the forthcoming IBM products.

Figure 1



Source: DATAQUEST

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This newsletter will focus on the recent major 68020 workstation announcements and our perceptions as to what effect these products will have on the engineering workstation marketplace.

#### COMPETITIVE OFFERINGS

Table 1 lists the 68020 upgrade prices and Table 2 lists the base configuration prices for Apollo Computer, Cadmus, Hewlett-Packard, Masscomp, Silicon Graphics, and Sun Microsystems. With the exception of Cadmus, all the vendors offer some type of board-level upgrade solution for their older, 68010-based workstation systems. Cadmus does not offer an upgrade solution because its new 68020-based 9800 workstation utilizes the faster VME bus instead of its slower Q-Bus predecessor. Upgrade pricing ranges from \$4,000 for a single board with 2 Mbytes of memory from Sun Microsystems up to \$13,500 for a high-performance board set with the Weitek 64-bit floating-point processor from Silicon Graphics.

As DATAQUEST expected, most of the 68020 workstations are priced at nearly the same level as their older 68010 predecessors even though the 68020 offers two to three times greater performance. Falling memoryprices and ferociously competitive market conditions are the root causes of this phenomenon.

An interesting skirmish that appears to be brewing is the issue of availability. Apollo says that it will begin volume shipments of the 12-MHz version of its 68020-based products in September, while Cadmus, Masscomp, Silicon Graphics, and Sun will not begin shipping until late in the fourth quarter of this year with their 16.67-MHz versions. While it is understandable that Apollo could offer a product sooner due to volume availability of the slower, 12-MHz 68020, Hewlett-Packard claims that it will be shipping 16.67-MHz 68020 units in volume beginning in September. It appears that Motorola is sticking with the tried and true practice of having the integrators line up in a row and then doling out parts based on the volume size of unit commitments.

The floating-point processor issue is another focal point that carries great importance due to the widespread use of engineering workstations in floating-point-intensive applications such as CAD/CAM and scientific computing. Motorola manufactures a companion floating-point processor chip for the 68020 called the 68881. Currently, the 68881 is only available in limited quantities, and runs at the slower, 12-MHz clock rate. DATAQUEST does not expect volume availability of the 68881 until close to the end of this year. An interesting alternative for the 68881 is the Weitek 1164/1165 64-bit floating-point processor chip set. Because of its highly pipelined architecture, the Weitek chip set operates from five to ten times faster than the 68881. Weitek, which is already a household name in the CAD business with its graphics processing chip sets, has recently received design wins at Silicon Graphics and Masscomp for handling 68020 floating point using the 1164/1165 combination. DATAQUEST expects that other 68020-based workstation vendors are likely to adopt the higher-performance Weitek floating-point implementation as well.

#### Apollo Computer

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Apollo announced its 68020-based systems during the Siggraph '85 show held recently in San Francisco, California. In addition to a \$7,500 upgrade to its 68010-based systems, Apollo announced two new products: the DN330 and the DN560. The DN330 and the DN560 are the new 68020-based versions of the DN320 and DN550 products, respectively, and are identical to their 68010 predecessors except that they now use the 68020 CPU. Apollo also announced price reductions on its higher-performance DN460/660 products, which DATAQUEST believes are now virtually obsoleted by the 68020. Apollo is attempting to differentiate the DN330/560 from the DN460/660 by limiting memory expandability to 3 Mbytes on the DN330/560 versus 16 Mbytes on the DN460/660. DATAQUEST believes that the memory expandability limitation imposed by Apollo is purely a temporary marketing manuever that will be lifted when Apollo unveils its higherperformance (2 mips and greater) products, which are expected later this year.

Apollo also announced some very strong networking products that position the company as the leader in network communications. These products include:

- DOMAIN/BRIDGE--A hardware/software product that connects multiple Apollo networks via a high-speed coaxial bridge or industry standard T-1 long-distance links
- DOMAIN/VACCESS--A hardware/software product based on Ethernet that allows Digital's VAX to be plugged into the Apollo network. Apollo users can execute Apollo directory and file-manipulation functions on VAX/VMS files as if they were local DOMAIN files
- DOMAIN/SNA--A hardware/software product that links the Apollo to IBM hardware via IBM's System Network Architecture (SNA).
   DOMAIN users can either log on to a remote IBM host through a 3270 emulator or submit batch jobs via Remote Job Entry (RJE)
- DOMAIN/PCI--A software package that allows the IBM PC to tie into the Apollo network as an ASCII terminal and also allows PC users to store DOS 3.1 text and binary files on the DOMAIN network

DATAQUEST believes that these announcements, coupled with Apollo's demand-paged, virtual network and highly integrated graphics environment, will continue to help Apollo differentiate itself in the face of the cutthroat market conditions that are likely to occur after IBM's forthcoming workstation announcements.

#### Cadmus

Like Apollo, Cadmus announced its 68020-based system at the Siggraph '85 show. In recent months, Cadmus has shifted its focus from being a general-purpose workstation supplier to being an Apple Macintosh high-performance lookalike. The new, 68020-based 9800 workstation has the capability to run the CadMac graphics environment. It also incorporates the VME-bus architecture instead of the older Q-bus, in order to take full advantage of the higher-bandwidth 68020.

DATAQUEST believes that Cadmus, for whatever its worth, will have to continue emphasizing its Macintosh connection in order to differentiate itself from the rest of the pack. We believe, however, that Apple may introduce a 68020 version of its own before long, which would place considerable pressure on Cadmus.

#### Hewlett-Packard

A relatively disappointing performer in the engineering workstation marketplace, the HP 9000 has been given a new lease on life with a facelift that includes the Motorola 68020. HP announced the 9000-310 and the 9000-320 machines, which utilize the Motorola 68010 and 68020, respectively. The HP 9000-500 series, which incorporates a proprietary microprocessor design, has been repriced and repositioned as a higherperformance, multiuser machine. DATAQUEST believes that the 300 series is much more in line with the mainstream workstation market and should help HP in its attempts to gain wider acceptance as a workstation supplier in the design and manufacturing automation markets. At a minimum, the 300 series will provide a sound computing platform when HP unveils future vertical software applications in the CAD/CAM and EDA areas.

#### Masscomp

Priced at the higher end of the 68020-based workstation market, Masscomp has announced two board-level upgrades for its 15-slot, 68010-based machines. One upgrade employs the Motorola 68881 floatingpoint processor, while the other offering uses the faster and more powerful Weitek floating-point chip set. Masscomp appears to be moving away from a workstation orientation toward more of a systems orientation. DATAQUEST also believes that Masscomp will continue to place major emphasis on squeezing more performance out of its 68000-based systems and differentiating itself by attempting to become the peak computing performance leader.

#### Silicon Graphics

Also unveiled at the Siggraph '85 show, Silicon Graphics' 68020 offering consists of a 16.67-MHz board with 2 Mbytes of memory, along with an optional, high-performance Weitek floating-point processor called the "turbo" option. Silicon Graphics is also migrating away from its terminal business and placing increasing emphasis on its workstation and computing environments. The company also announced an interesting new breed of workstation called the 2300 that contains a minimal disk configuration and a custom execution-only UNIX kernel for people who need to run, not develop, application programs. This kind of device appears

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to be an ideal vehicle for offering a lower-cost computing environment without sacrificing Silicon Graphics' high-performance graphics capability.

# Sun Microsystems

Sun, as usual, offers the most aggressive pricing of the 68020-based machines. While other vendors were cutting memory prices 20 to 30 percent, Sun recently slashed memory prices a staggering 63 percent-from \$4,100 per megabyte down to an incredible \$1,500 per megabyte. Sun also introduced a new VME-bus-based extension to its product line called the 2/130. The 2/130 is essentially a VME-bus version of the 2/120 and will eventually allow a \$4,000, 68020 upgrade option to be added when it becomes available by year end. DATAQUEST believes that Sun will continue its strategy of being the low-cost supplier, although margins are likely to get squeezed when IBM enters the workstation fray. We consider Sun's pioneering efforts in the area of standards such as the network file system (NFS), in addition to its having more than 7,000 workstations installed, to be strong factors driving the success of this company.

#### DATAQUEST ANALYSIS

It is clear that the MicroVAX II-68020 true 1-mip workstation market is out of the starting blocks and running full stride. What is not clear is who is going to finish the race-respecially after IBM's workstation announcement, which is expected during the first week of September. The slowdown that has hit the CAD/CAM industry in recent quarters, along with the fact that most of the major OEM workstation deals have already been completed, has rapidly changed the complexion of this market. Where once the operative word was thrive, we expect that the new credo will be to survive. In light of this, DATAQUEST believes that the following points are salient:

- The window of opportunity has snapped shut for competing 32-bit microprocessor vendors in the workstation market, with the possible exception of Intel with its forthcoming 80386 chip in an IBM PC product.
- Now that all the workstation vendors have true 1-mip workstation offerings, workstation purchasers are likely to scrutinize more heavily the issues of networking, graphics capabilities, and the breadth and depth of the third-party software that is available.
- The eye of the needle has closed with respect to new players getting into the workstation marketplace.

David B. Burdick

# Table 1

# 68020 UPGRADE PRICING

- Apollo
  - \$7,500 to upgrade 68010 (DN320, DN550)-based system. Includes:

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- . 68020 CPU at 12.5 MHz
- . 68881 floating point
- . 2 Mbytes memory
- \$11,000 for same as above with 3 Mbytes memory
- Cadmus
  - No upgrade available
- Hewlett-Packard
  - \$6,000 to upgrade 68010 (HP 9000-310)-based system.
    Includes:
    - . 68020 CPU at 16.67 MHz
    - . 68881 floating point

#### Masscomp

- \$7,900 to upgrade 68010 (MC500 15-slot)-based system. Includes:
  - . 68020 CPU at 16.67 MHz
  - . 2 Mbytes memory
  - . 68881 floating point
- \$12,900 for above with Weitek advanced floating-point processor

(Continued)

# Table 1 (Continued)

# 68020 UPGRADE PRICING

• Silicon Graphics

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- \$6,000 to upgrade 68010 (2400, 2500)-based system. Includes:
  - . 68020 CPU at 16.67 MHz
  - . 2 Mbytes memory
- \$7,500 for above with Weitek advanced floating-point processor
- Sun Microsystems
  - \$4,000 to upgrade VME-based products (2/130, 2/160).
    Includes:
    - . 68020 CPU at 16.67 MHz
    - . 2 Mbytes memory

Source: DATAQUEST

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# Table 2

# BASE 68020 CONFIGURATIONS

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Apollo Computer	DN 330\$26,800 12-MHz 58020, 17" screen, 1,024 x 400 resolution, 2 Mbytes memory, floating point, 70 Mbytes hard disk, 5-1/4" flexible disk , 2 RS-232 ports, ODMAIN LAN, AEGIS O/S, 20/3D GNR, DIALOGUE-user interface	DM 560\$46,400 12-MHz 68020, 19° screen, 1,824 x 800 resolution, 16 colors, 2 Mbytes memory, Éloating point, 86 Mbytes herd dist, 5-1/4° flexible disk, 2 RS-232 ports, DOMAIN LAN, AEGIS 0/8, 2D/3D GNR, DIALOGUE umer interface Not evailable		
Cadmus	9800-#21,500 16.67-MHz 68020, 17° acrean, 1,024 x 800 resolution, 1-Mbyte memory, 40 Mbytee bard disk, 5 1/4° flexible disk, 2 RS-232 portm, Ethernet LAW, UM1%, CadMac graphicm software			
Hewlett-Packard	HP 9000-320-331,470 16.67-MHx 60020, 17 <sup>4</sup> acreen, 1,024 x 768 resolution, 2 Mbytes memory, 68881 floating point, 55 Mbytes hard disk, 1/4 <sup>*</sup> tape, 1 RS-232 port, Sthernet	HP 9000-320454,175 16.67-HHx 68020, 19" wcreen, 1,024 <b>x 768 resolution</b> , 256 colors, grephics accelerator, 2 Mbytes Memory, 60801 floating point, 55 Mbytes hard disk, 1/4" taps, 1 RS-232 port, Ethernat LAN, UNIX (AM, UNIX		
Иазэсовр	MC500449,200 16.67-MHz 68020, 19° mGreen, 1,024 # 800 resolution, 2 Mbytes memory, 66881 floating point, 50 Mbytes, 5-1/4° flexible disk, 3 RS-232 ports, Ethernet 1AM, UNIX, Portran, C	MC500\$60,200 16.67-MH: 68020, 19° screen, B32 x <b>600 resolution</b> , 64 colors, 2 Mbytes memory, Meitek floating point, 50 Mbytes hard disk, 5-1/4° floppy, <b>3 RS-232 ports</b> , Ethernet LAN, UNIX, Portran, C		
Silicon Graphice	Not evailable	Iris 2400\$67,500 16.67-MHz 68020, 19° acreen, 1,024 x 768 remolution, 256 colors, 2Mbytes memory, Weitek floating point, 72 Mbytem hard disk, 1/4° tape, 3 R8-232 ports, Ethernet, UNIX, C, IRIS graphicm library		
Sun Microsystems	2/130420,000 16.67-MHz 60020, 19° screen, 1,152 ± 900 resolution, 2 Moytes memory, 71 Mbytes hard disk, 1/4° tape, 2 RS-423 ports, Ethernet LAH, UNIX, Sun Windows, Core,	2/160\$45,700 16.67-NHz 68020, 19" screen, 1,152 x 900 resolution, 256 colors, graphics processor, 2 Mbytes memory, 21-Nbyte disk, 1/4" tape, 2 RS-423 Ports, Ethernet LAN,		

256 colors, graphics processor, 2 Moytes memory, 21-Kbyte disk, 1/4" tapa, 2 RS-423 ports, Ethernet LAN, UNIX, Sua Mindows, Sum Core, C, Mortran, Peecal

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CCIS Code: Newsletter, No. 89

RESEARCH

NEWSLETTER

# THE 22ND DAC: THE INDUSTRY SHAKES, RATTLES, AND ROLLS IN LAS VEGAS

Dataquest

#### INTRODUCTION

Amid a backdrop of corporate shakeouts and a troubled economy, an anxious ECAD market rolled out its new product offerings at the 22nd Design Automation Conference (DAC) on June 23 through 26. Flashy Las Vegas seemed an almost contradictory location for a relatively serious-minded technical conference and tradeshow. Imagine hundreds of electrical engineers scurrying past roulette and blackjack tables, one-armed bandits, and fun seekers to attend technical sessions such as "Synthesis of Logic Structure from Behavioral Descriptions" and "Mixed-Mode and Switch Level Simulation." Yet, by conference end, it seemed only Las Vegas could match the energy and excitement of the ECAD market itself.

Several new product announcements, including significant entries from major corporate players, lent the tradeshow an electric atmosphere. As any gambler knows, when the stakes get high, as they are today in the \$789 million electronic CAD market, competition gets fierce and the number of new players begins to dwindle. Predictably, not as many start-ups were represented as at previous shows. And, at times, the dialogue resembled advertising hype more than high technology.

What is happening seems clear: With increasing degrees of design automation, the ECAD players have become more marketing-oriented and less engineering-driven. As the design functionality offered by vendors becomes more similar and more a function of software, spec sheets are being replaced by rhetoric.

This newsletter discusses some of the industry-wide issues raised at the DAC.

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#### SYSTEMS-LEVEL DESIGN

DATAQUEST believes that the theme of this year's DAC was systems-level design integration, as product introductions and demonstrations focused on the following phases of the design cycle:

- Functional description
- Logic and circuit design and analysis
- Physical layout
- Layout verification
- Test interface and analysis

Vendors' product lines have necessarily expanded or migrated beyond earlier product offerings to address full-design functionality. EDA or front-end design companies are adding physical layout technology to their product lines. Many traditional layout companies have announced front-end capability. Both types of companies are now offering test, simulation, and compilation.

DATAQUEST believes, however, that as part of seeking to provide total design solutions, these vendors need to address the major challenges posed by the installed user base: How to integrate within their own specific product line, as well as provide communication and integration with outside vendors' products or a user's own in-house developed software.

#### NICHEMANSHIP

Also present in number at the DAC were the so-called "niche" companies offering isolated or discrete functionality rather than full systems-level design functionality. These niche companies are able to play one of two roles: either identifying and trailblazing new niche markets, or addressing voids in current ECAD companies' products with their own offerings. Their specific application products include tools addressing the following areas:

- Application accelerators
- Test
- Analysis
- Simulation
- Project management
- Communications
- 🗢 💿 Data base management

DATAQUEST believes that, as the process of migration continues among the systems-level vendors, windows are increasingly opened for these niche companies. As these smaller players possess a high degree of flexibility, responsiveness, and specialized expertise, they are uniquely able to anticipate and respond to the market's direction. In certain cases, niche company products actually complement existing major ECAD company products. For example, as major ECAD companies begin to approach the analog market, these niche companies are already offering analog design, test, and compilation tools.

#### INTEGRATION

Besides the unique product offerings of the niche companies, DATAQUEST believes that other healthy trends evidenced at the DAC were:

- The inclusion of alternate, third-party supplied products and methodologies
- Alliances based on complementary technologies
- The relative "openness" of hardware and software to include or complement other systems and solutions

These trends all spell integration in the larger sense. By integration, we mean tying together applications within each of the design cycle phases to provide a cohesive design solution. Integrated test and simulation product announcements clearly demonstrate the level of sophistication of the current design tools.

DATAQUEST believes that the integration of microprocessor development systems, computer-aided software engineering, logic analyzers, and automatic test equipment represent new directions which the industry must now take. Vendors must begin presenting the buyer with a clearly comprehensible product line, one that makes sense rather than one that merely occupies shelf space. Only in this manner can vendors hope to truly integrate their products to meet users' total design needs.

#### FEATURES VERSUS BENEFITS

The focus of the vendors at the DAC seemed more on the competition than on design solutions, which is understandable when the competition is in an adjacent booth. However, the customer is not a marketer, but a relatively sophisticated engineer seeking solutions to design problems. The benefits of any particular design solution must be readily apparent, and ideally must integrate with systems already in-house, as well as provide significant cost advantage when compared with the cost of non-implementation. The design solution must also integrate with future products, as no customer wishes to commit to a closed-end technology. Engineers are well aware that technological leads are short-lived. Precisely because of this, we believe that they will choose systems that allow for add-ons, upgrades, or enhancements to take advantage of whatever the leading edge may be. Buyers also want to believe in the integrity of the vendors' product: Will the product perform as claimed and will support be there when needed? In short, buyers purchase a product's benefits, not its features. By contrast, the DAC seemed replete with "features" hype, and rumored performance replaced benchmarking.

Should this feature-marketing trend persist, customers will be hard-pressed to differentiate products. What will be left is confusion. For example, two companies announced "gridless" printed circuit board (PCB) layout systems at the DAC. Asked to distinguish their products, the company representatives replied something about "dynamic gridding" versus "truly gridless." A gridless system would seem to be an advantage, if you could be sure you bought the right system and not a buzzword. DATAQUEST believes that differentiating products on the basis of intangible features alone can be a very risky gamble indeed, and can confuse the issues. The question raised is: What is being sold--the products' features or its benefits?

#### DATAQUEST ANALYSIS

The 22nd Design Automation Conference once again outdid the previous . years' shows, with 6,200 people attending the exhibits and conferences (3,800 paid attendees versus 2,400 vendors and free passes). The interest level in developing and improving the electronic product design process underscored the end user's need for comprehensive and cohesive solutions.

Like any high-technology industry, product introduction rates, vendor learning curves, and product line mixes experience growth similar to the industry itself. Although electronic CAD/CAM as an industry is not so young, the vendor's current focus on general design automation tends to reposition the industry into the early growth stages of an industry life cycle. Illustrated by the products at the DAC and the growth of the ECAD market itself, the industry is maturing beyond a simple focus on product features to a focus on the benefits of new design automation solutions.

DATAQUEST identifies several issues relating to the long-term success of the ECAD market and the companies that comprise it, and to the advancement of the electronic product design process.

#### Integrity

With so much emphasis on features, benefits, intangibles, rumored performance, and hype-filled glossies, one has to wonder how a new company, or at least one with a good product, gets its message across without getting lost in the shuffle. There is no question in our minds that the marketing- versus engineering-orientation of the ECAD vendors is here to stay. We believe that is inevitable. However, we also believe that the marketing focus must concentrate on long-term customer relationships. To do this, DATAQUEST believes that it is critical for vendors to not only focus on what their message is, but also on living up to that message. As the industry matures to a marketing orientation, we believe that companies must concentrate on the following:

- Differentiate between announcements, introductions, and delivery
- Define product specifications and target market strategies from the beginning
- Recognize internal strengths and weaknesses as well as the competitors' strengths and weaknesses
- Sell internal strengths, not the competitors' weaknesses
- Be willing to perform comprehensive benchmarks
- Develop product solutions and benefits that match the user's problems and needs

We believe that integrity is critical to the long-term success of both companies and the industry. This is due to the high degree of competition and the speed with which the industry changes. Integrity refers to integration of internal product lines as well as to a company's public and corporate image. Without it, buyers are left to a random decision-making process. As competition and change continue to accelerate, we believe that the sophisticated engineer will seek out those vendors that demonstrate sound product strategies, benefits, and features.

#### <u>Marketing</u>

With the growth of the industry, responsibility for product definition and marketing strategy shifts from a solo engineering performance to one directed by marketing and perhaps shared with engineering. It is marketing's responsibility to differentiate the product from those offered by the competition and to separate facts from fantasy. It is clear that marketing's role is twofold:

- Perform classical marketing functions
- Ensure that technology does not have to sell itself, by itself

As the degree of automation and integration increases, companies must take a pro-active role in educating, marketing, selling, and supporting their products. We believe that those that do not take an active lead will not only succumb to competitive pressures, they will also confuse and clutter the industry.

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#### Flexibility

Where did all the traditional turnkey companies go? Although at the conference in force, the traditional turnkey companies (i.e., Applicon, Calma, and Computervision) are late in providing the front-end and full systems-level design capabilities offered by companies such as Daisy, Mentor, and Valid.

Perhaps established and high-technology are mutually exclusive terms, and that if a company maintains pace with ever-changing technology it cannot also be large and bureaucratic. We do not believe that this is entirely true, as one very large company (Tektronix) introduced its products at the DAC with all of the focus, integrity, and functionality of any of its younger competitors. Managing growth is the obvious challenge. However, the possibility exists that even the young stars of today's market will become entrenched in their own politics and miss moving-target market opportunities.

We believe that the focus must be on providing solutions to, rather than products for, the design automation problem. To achieve this focus, vendors must be flexible enough to react quickly to changing design methodologies, as well as to the changing technologies of the products themselves.

#### Barriers to Entry

Given that vendors must be flexible with a strong marketing orientation, they must also protect their market positions and installed bases. Developing or capitalizing on barriers to entry is a short-lived luxury with tremendous protection payoffs. Recognizing that barriers to entry can take many forms, DATAQUEST believes that these barriers are undergoing a transition.

The number of vendors at this year's DAC increased to 76 from 40 the previous year. Not only did the number of vendors increase, but the type and scope of these companies changed. Companies with a strong hold in a particular ECAD application segment are experiencing competitive pressures from what seemed to be outsiders. The barriers to entry are being broken down. One example is printed circuit board CAD applications and the ever-increasing types and numbers of companies offering them.

If a company's barriers to entry are short- rather than long-lived, it can expect steady and increasing competitive pressures. We believe that this situation is an excellent opportunity for the company to form strategic alliances with which to balance its features and barriers to entry. However, strategic alliances that offer advantages which competitors can easily obtain are, in our opinion, short-lived. They merely maintain status quo rather than gaining an edge. This distinction is important because it focuses on the barrier as a means to an end rather than as the end itself.

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# SUMMARY

The 22nd DAC proved to be a good show in terms of attendance, interest level, and new product announcements. This question remains, however: To what degree will the electronic CAD/CAM market be affected by the doom and gloom of the computer and semiconductor industries? We believe that the following applies, regardless of the financial status of the market:

- Companies must develop and manage barriers to entry
- Marketing must take a pro-active role in directing the company
- Companies must manage their public images, maintaining a balance between advertising strategies and deliverables
- Companies with measureable productivity tools in general will survive through a financially unstable period

DATAQUEST believes that Darwin's theory is in effect: only the strong will survive. It's in the cards.

Tony Spadarella Beth W. Tucker NESEN Dataquest

# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 88

# AE SYSTEMS 85 LOW-COST PC DRAFTING PENCILS VERSUS INTEGRATED SOLUTIONS

In Henny Youngman-like fashion, the AE Systems 85 show held recently in Anaheim, California, might best be characterized as "I went to a personal computer show and an AE conference broke out." With few exceptions, most of the vendor exhibitions consisted of offerings based on IBM's PC AT with two-dimensional drafting functionality. Understandably, the low cost of PC-based systems is generating a great deal of interest within the typically conservative architectural community. However, we fear that these low-cost systems are being unfairly compared with the more expensive, more fully integrated design systems. As dramatized in Figure 1, creating such unrealistically high expectation levels usually leads to disappointing results.

This newsletter will describe what we considered to be the highlights of the conference and discuss our overall impressions of this important annual event.



Figure 1



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#### COMPUTERVISION'S PERSONAL ARCHITECT

Computervision Corporation announced what appears to be a very promising architectural design system based on the IBM PC AT and software from a French-based company that has more than 50 systems installed in France. The new system, called the Personal Architect, combines a simple 3-D wireframe interface with AI-styled routines that guide the designer interactively through the design process. The system is driven by information extracted from a construction technology data base that helps to define the geometrical relationships between walls, floors, and ceilings, as well as aiding in the proper material selection. Plan and elevation drawings are created by passing the appropriate cross sections to the drafting module.

While the system seemed a little rough around the edges in the sense that some of the system prompts were in French and the units were in metric, it looks like it could evolve into a highly useful product. The design-based orientation of the system is a very strong feature that goes beyond the electronic drafting pencil mentality found on many other PC-based products.

#### AUTOTROL'S 32-BIT IBM PC-BASED SYSTEM

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Autotrol Technology Corporation announced a new hardware platform based on the IBM PC AT coupled with a 32-bit, UNIX co-processor board. Unlike many of the point-source PC offerings recently unveiled from the turnkey CAD/CAM suppliers, this product will run the full spectrum of Autotrol's software used on the Apollo-based workstations, including Series 5000 (AEC) and Series 7000 (mechanical CAD/CAM). In addition, this product platform will be fully upward and downward compatible with Autotrol's Apollo-based offerings. Detailed pricing information has not yet been released, but the company did reveal that a fully functional system running its AEC or mechanical software would be available for less than \$20,000.

#### ARTECON INCORPORATED ~- OBJECT-ORIENTED SYSTEMS

Artecon Incorporated is a new start-up founded by Jim Lambert, a former Calma Company engineer from Carlsbad, California. Artecon has developed an object-oriented AEC system based on the Sun Microsystem family of engineering workstations. In addition to the elegant, woodgrain, works-in-a-desk styling, the system features a visually appealing icon-user interface. This user interface is similar to Autotrol's Steel 3-D arrangement except that the ioons are color coded to specific functions, adding an even greater level of clarity.

Although Artecon's current application functionality is very limited, this system appears to have a strong foundation for future developments. Artecon plans to develop modules for site planning, road layout, bridge and building construction, drafting, solids modeling, and project scheduling.

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#### SKOK'S HANDS-ON TRAINING

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Although Skok did not announce any splashy new products, it was the talk of the show with its 4,000-square-foot main exhibit and a second 800-square-foot exhibit used as a hands-on training lab. DATAQUEST applauds Skok's innovative hands-on training booth, where users got a first-hand feel for the Artech personal workstations during the half-hour sessions. Instead of wading through the seemingly endless array of canned demonstrations, we found this personalized training approach to be very useful, informative, and refreshing.

We also thought that the park-like setting of the main exhibition booth was both unique and attractive. Although sometimes maligned by competing vendors, we believe that the main booth reflected Skok's keen eye for appealing architecture, and was closely aligned with the company's intended audience. After all, the AE Systems show caters to people whose very livelihood depends on designing cost-effective, appealing architecture.

#### CALCOMP'S CADVANCE PC-BASED SOFTWARE

From California Computer Products, Inc.'s recent acquisition of Personal CAD's AEC group comes a new program called CADVANCE. CADVANCE is a completely rewritten AEC-based software package designed for IBM personal computers. CADVANCE uses the same basic menu structure found in its earlier predecessor, CADPLAN, but has vastly improved speed and functionality. Some of the major functional improvements include the ability to do macros and nested display commands, and a much more powerful dimensioning capability. The system also uses a fully relational data base and allows data entry in user-defined units.

#### AUTODESK'S APOLLO AND SUN WORKSTATIONS

Autodesk, Inc. announced that it will begin to offer AutoCAD on the Apollo and Sun Microsystems engineering workstations. Product availability is expected sometime during the fourth quarter of this year. Information on pricing was not available. DATAQUEST believes that this product is significant because it signals Autodesk's intention to offer a UNIX-based system in an environment that has been dominated by vendors who provide software and hardware integration with direct sales and support. Autodesk does not currently provide hardware support and integration on its popular PC-based systems.

Another interesting note about Autodesk: although its booth at the AE Systems show was small, it was virtually swamped with people. It took nearly a superhuman effort to get close enough to look at the systems.

#### ENERCALC'S LOTUS-BASED STRUCTURAL ANALYSIS

Tucked away in a corner of the show was a little company called Enercalc, which has developed a powerful structural analysis program that runs under the Lotus 1-2-3 spreadsheet program. By using Lotus 1-2-3 as a menu template, a user can type in the appropriate input parameters and get nearly instantaneous answers in the areas of structural steel, concrete, and timber design. The system is well documented and comes with 26 user modifiable templates for \$795. Ľ

#### ROBO SYSTEMS' MACINTOSH-LIKE INTERFACE

Robo Systems, the second largest unit shipper of personal computer-based CAD systems, demonstrated its IBM PC version of RoboCAD. The user interface is nearly identical to the Apple Macintosh personal computer, complete with pull-down menus and icons for selecting fonts and line styles. The system looks very easy to use, although its CAD functionality appears to be somewhat limited.

#### IBM'S PC STORYBOARD

Although it is not a CAD product, IBM's PC Storyboard appears to be a very useful tool for preparation of professional, animated presentations for unattended operation. It works by creating and capturing screen images (such as CAD drawings) and organizing them via a story editor for continuous screen playback. The \$250 package, which runs on all the IBM PCs, contains four modules. These include a picture maker for creating screen images, a picture taker for capturing and storing screen images, a story editor for organizing the pictures, and a storyteller for picture playback.

#### SUMMARY

DATAQUEST believes that two camps are forming in the AEC market--the electronic drafting pencil market and the 3-D integrated solution market. While there are clearly a number of very good, low-cost, IBM PC-based products for generating architectural drawings, we are not convinced that the architectural community is best served by improving drawing productivity only. DATAQUEST thinks that addressing the entire design process in an integrated fashion, from concept through facility management, is a much better way to improve overall productivity. For example, instead of building an architectural mock-up, a 3-D system with dynamic viewing and shading capabilities could be used to build and display the model. A client could be invited to a working presentation, at which the model could be viewed and walked through directly on the workstation. The client could also suggest changes and see the results of the changes almost instantly. If the client could not attend the CAD site, a video tape could be made and sent, instead of sending a stack of drawings and blueprints.

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Once the basic form features were agreed to, further detail could be added to the model and the necessary plan and elevation drawings could be created for subsequent construction. The key point here is that the detail drawings would be a direct derivative of the original model data base, not just a redundant shortcut for producing paper drawings.

However, we do not want to belittle the low-cost electronic drafting products. For many companies, this is all the CAD they will ever need. We believe, however, that the major market opportunity will evolve from vendors' abilities to address applications from an integrated standpoint rather than using point-source drafting solutions.

> David B. Burdick Michael J. Seely

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CCIS Code: Newsletter No. 87

RESEARCH

NEWSLETTER

# THE ULTIMATE IC DESIGN TOOL RACE RAGES ON

Dataquest

#### INTRODUCTION

The IC CAD market is entering the prime of its life--from the adolescence of digitizing systems, to the teen stages of polygon pushers, to the roaring twenties of EDA systems, and currently to the maturity of automatic layout tools.

No longer are polygon pushers considered state-of-the-art. Yet, virtually no IC is designed without the aid of these tools. The growth of the IC CAD market brings yet another level of productivity tool to the market--silicon compilation. By definition, true productivity tools must not only decrease the amount of time required to do a particular job, but they must do it more efficiently. With market maturity and new productivity tools also comes the race to provide the best, the most functional, and, in short, the ultimate IC design tool.

This newsletter discusses an automatic IC layout product introduced by Silicon Design Labs, Inc., and the challenges of a dynamic market entering the prime of its life.

#### THE COMPANY

Founded in February 1983, Silicon Design Labs (SDL) is based in Liberty Corner, New Jersey, close to Bell Laboratories where four of the five founders previously worked.

SDL closed its second round of financing in May 1984 in the amount of \$4.5 million, bringing the company's total capital to \$6.3 million. Principal investors in the second round were Merrill Lynch Venture Capital; Battery Ventures of Boston; Technology Ventures Investors of Menlo Park; and Crown Advisors. All investors in the first round also participated in the second round. They are Menlo Ventures; Welsh, Carson, Anderson & Stowe; and Technology Funding.

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DATAQUEST views SDL's overall business as automating the design process of electronic products in general. The company's short-term product strategy is to automate integrated circuit design processes. However, we believe that the company's long-term strategies could be expanded to address systems-level design through the use of customized ICs. Our belief is based on the inherent benefits of highly automated IC development products and their applications in higher-level designs.

The SDL founders from Bell Labs, among other projects and with other people, were responsible for the development of PLEX. Briefly, PLEX was a research project that combined both systems and silicon design to create IC geometries based on a set of executable programs. DATAQUEST believes that the experience derived from having already developed a highly automated systems design tool combined with in-house systems design expertise is one of SDL's main strengths, and that it promises a leading position in the ultimate design tool race.

#### THE PRODUCT

SDL's Generator Development Tools (GDT) was introduced at the Custom Integrated Circuit Conference in May 1985 and is available as of May 1985. GDT is an IC design product that captures the IC designer's expertise, which is needed to develop a silicon compiler. Hence, it ultimately automates the IC design, from logic and analysis through mask geometries.

GDT is a software-based product written in C, which currently runs on Sun and Apollo workstations. The core of GDT is the proprietary "L". language, with a graphic view of the integrated, hierarchical design data base. L expresses all aspects of the IC design process, including circuitry, geometry, and computations. Additionally, ICs created using GDT's L can be edited at either the geometric or textual levels. Figure 1 illustrates four levels of L hierarchy, and Figure 2 represents the modules GDT comprises.

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# Figure 1

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Source: Silicon Design Labs

# Figure 2

# GENERATOR DEVELOPMENT TOOLS MODULES



Source: Silicon Design Labs

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GDT is intended to be used by what DATAQUEST calls hard-core IC design engineers-engineers who are experienced in designing in silicon. GDT includes the following functions:

- Leditor--Editing capabilities for generating design representations ranging from schematics through mask geometries
- Lsimulator--Interactive hierarchical logic simulator
- fmc--Functional module compiler for simulator
- Lrc--Design rule checker
- Gdstol--GDSII stream translator
- Lgen--Form-based interface to L Generators
- Lc--L translator to other formats
- Sample Generator library

With the exception of the Generator-related functions, GDT seems similar to any other manual or automated IC design tool. But it is not. GDT is the vehicle to capture the engineer's IC design knowledge so that the original design can be used to generate customized versions via a silicon compiler, or the Generator. With GDT, design and customization occur in two stages.

Initial circuit design is not unlike any other current methodology. The IC design engineer describes the logic to the system in a way fairly common to most EDA systems. GDT has a fully integrated hierarchical data base, whereby the circuit can be described and simulated at a variety of levels, each maintaining graphic and electrical associations. Mask geometries are created using GDSII-like editing capabilities and the same editor used to create schematics.

The similarities end here.

GDT maintains electrical connectivity between block-, gate-, or transistor-level schematics and layout. From this point on, the circuit can be redesigned by using Lgen, a user-definable form entry for describing the functionality and performance of a similar type of circuit. The Generator customizes the original design based on the relationships among performance, design rules, ratios, and connectivity of the original design.

Using the hierarchical capabilities of GDT, blocks of cells can be customized to create yet another IC. At this point, routing between cells or blocks becomes an issue. Routing is a functional module within GDT and occurs on a hierarchical level rather than flattening all of the interconnections.

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#### **Distribution**

SDL's original distribution strategy is to sell its product to silicon manufacturers with in-house IC design expertise. We believe that NCR, its first customer, will use GDT to develop parameterizable cell-based ICs. Once the original design has been completed, NCR, or possibly, one of NCR's customers, may tailor the original design to individual requirements. ŧ:

Although SDL's first customer is a standard cell IC manufacturer, DATAQUEST does not believe that SDL's customer base is limited to standard cell manufacturers, nor do we believe that the product is a cell compiler per se. However, it is the ASIC companies in general that possess the current products and distribution channels to reach the systems-level design engineer in need of custom or customizable ICs.

#### Product Assessment

Reading between the lines, DATAQUEST expects SDL's long-term product strategy to include the silicon manufacturers and their customers--the systems design engineers. We believe that SDL could sell the fully functional GDT product to the silicon company, and perhaps a scaled down version to the systems company. Only by implementing a strategy similar to this, do we believe that SDL will reach the large target market demanding custom ICs.

In the interim, SDL's current strategy of selling to silicon manufacturers offers the company the luxury of time. Time buys SDL IC design experience for its product as well as its R&D staff. It also buys the process technology expertise required to build any circuit. Moreover, time buys manufactured design successes, assuming the product performs as specified.

#### DATAQUEST ANALYSIS

Selling a highly automated, state-of-the-art product such as a silicon compiler may be rewarding in the long term; however, the short term is not without extreme and taxing challenges. DATAQUEST believes that the type of product offered by SDL is a prime example for the case that technology does not sell itself.

SDL has maintained a low profile since its inception fifteen months ago. We believe that the company has used this time to align its products, personnel, and strategies. Nevertheless, SDL is certainly not without competition, both direct and indirect. It will not only compete against other silicon compiler companies, some of which have flaunted their marketing savvy, but also against other design methodologies offered by CAD and IC vendors.

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DATAQUEST believes that eventually the majority of ICs will be designed using some form of automatic layout products. We have identified the following criteria that CAD vendors selling true productivity tools must achieve prior to widespread acceptance of their products:

- Marketing and sales savvy
- Financial and managerial strength
- Technical excellence
- Product functionality
- Proven design successes

Only time will tell if SDL has the strength to achieve its goals. For now, we believe that SDL came out of the gate at a full gallop. The questions are when will the pack cross the finish line with the ultimate design tool and is there a finish line at all in the ongoing race for technology.

Beth W. Tucker

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RESEARCH NEWSLETTER

CCIS Code: Newsletter No. 86

THE GENERATION GAP--AN UPDATE ON 32-BIT MICROPROCESSORS

Dataquest

#### SUMMARY

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The 32-bit generation of microprocessors is now emerging. Three devices are already on the market, and there are more to come. The decision to move to a new generation of semiconductor devices is complex, and timing can be critical to the company making that decision. This newsletter gives an update on the 32-bit microprocessor, its applications, and its current and future manufacturers.

#### INTRODUCTION

Users look to the 32-bit microprocessor to provide increased speed and functional enhancements. Engineering and CAD workstations represent the most visible market segment to adopt the 32-bit MPU. Other important design-ins are in robotics, computer-aided manufacturing, and telecommunications.

DATAQUEST anticipates three phases in the adoption of the 32-bit microprocessor:

1. The replacement of 16-bit devices by 32-bit devices will be the first phase as new versions of existing systems are designed. We see this occurring initially with engineering workstations as growing systems complexity demands greater performance from the microprocessor. The important issue in this phase will be upward compatibility. The Motorola 68020 and the National 32032 are expected to be important players here because many of the existing workstations have been designed with the 16-bit predecessors to these 32-bit MPUs. In both cases, the conversion to the new MPU can easily be accomplished. This phase is already beginning.

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- 2. In the second phase of the market development, we will see the use of 32-bit microprocessors in minicomputers and small business systems. Designers will use these products to improve the cost/performance ratio of their machines. A significant factor in this market will be the captive manufacturers of 32-bit devices, such as Data General, Digital Equipment Corporation, Hewlett-Packard, and NCR. The potential exists for any of these companies to offer its devices on the merchant market. NCR's entry into the merchant market marks the beginning of this phase.
- 3. The third phase of the development of the 32-bit market will occur when the devices are well understood and accepted and become the basic design elements of many microprocessor-based systems. Rapid growth in consumption of 8-bit and 16-bit microprocessors occurred about five years after they were first introduced. We expect 32-bit microprocessors to follow the same trend, with rapid growth beginning in 1989.

#### MICROPROCESSOR PRODUCT ACCEPTANCE

If 32-bit microprocessors follow the trends we have observed, they will exhibit slow to moderate growth in the first two or three years after introduction, followed by a period of extremely rapid growth in the fourth and fifth years. There are, however, arguments for either faster or slower growth than this experience suggests.

The arguments for slower acceptance revolve to some extent around the fact that the full capabilities of existing 16-bit devices have not yet been exploited. Another argument is that there are more design alternatives than ever before. Many systems designs are being done with multiple 8- or 16-bit microprocessors.

With the evolution of application-specific ICs, we are seeing the development of intelligent microperipherals. A number of coprocessors for 16-bit devices are also coming to the market. All these devices make the design of higher-performance systems possible without resorting to the use of a 32-bit microprocessor.

Faster acceptance of the 32-bit microprocessor could come about simply because the market is much larger than it was when the 8-bit and 16-bit devices were introduced. Some 32-bit microprocessors offer upward compatibility with existing 16-bit devices, making the transition from a 16- to 32-bit device much easier than previous generation switches.

The 32-bit device will appeal to manufacturers of minicomputers and superminicomputers as a means of reducing cost. These manufacturers will not have the same commitment to previous generations of microprocessors as microcomputer manufacturers, so they may accept the devices more readily, thus accelerating the rate of acceptance.

#### MANUFACTURERS--PRESENT

#### <u>Motorola</u>

The Motorola 68020 was introduced in the third quarter of 1984. The company is now ramping up to full production. The 12-MHz version will be in volume production by mid-1985 and the 16-MHz version in the Fall. Motorola has entered into a second-source agreement with Thomson-CSF, contingent upon certain technology exchange agreements. If these agreements are met, Thomson-CSF is expected to start production of the 68020 by the end of 1985. Hitachi, Rockwell International, and Signetics also second-source Motorola's 16-bit devices and may be regarded as potential second sources for the 32-bit family.

# National Semiconductor Corporation

National Semiconductor Corporation is currently the leading supplier of 32-bit MPUs with its 32032. The device has been in production for more than a year. Texas Instruments, which is second-sourcing the family, is expected to start sampling around mid-1985.

#### NCR Corporation

NCR is offering its 32-bit chip set, originally developed for internal use, on the merchant market. The device, which features external microcode, can emulate existing microcomputers. Honeywell, Inc., has signed an agreement with NCR to use the NCR/32 chip set for a future small- to medium-scale computer system.

#### MANUFACTURERS--FUTURE

This section of the newsletter will cover the announced plans of future participants in the 32-bit microprocessor market. Table 1 lists those companies believed to be currently involved in 32-bit microprocessor development.

#### Advanced Micro Devices

The Advanced Micro Devices (AMD) 29300 family of bipolar devices includes the Am29323 Multiprecision Multiplier, the Am29325 Floating Point Processor, the Am29332 16-bit Micro-Interruptible Sequencer, the Am29332 32-bit Arithmetic Logic Unit, and the Am29334 Four-Port Dual-Access Register File. Each device can function alone or act as a building block for a 32-bit system. The products are intended for use in high-performance applications, for intelligent peripherals control, and in digital-signal and array processors. The 29325 arithmetic unit will be sampling within two months, and all five devices will be sampled by the end of 1985.

#### AT&T Technologies

AT&T'S WE32100 is a CMOS microprocessor originally developed for in-house use. The company recently announced commercial availability of the family. The WE32100 is now in production, together with the WE32101 memory management unit and the WE32105 system interface unit. The 32106 math acceleration unit is now being sampled, and the 32103 DRAM access controller and the 32104 DMA controller will complete the chip-set early next year.

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#### <u>Hitachi Ltd.</u>

Hitachi Ltd. announced the development of a CMOS 32-bit microprocessor at the end of 1984. Sample quantities are expected at the end of 1986, with full production beginning in mid-1987. The device is expected to be upwardly compatible with Motorola's 68000 family. Hitachi had been regarded as a potential second source for the Motorola 68020 and it is not yet clear what effect the announcement of a proprietary 32-bit device will have on the situation.

#### Inmos

Inmos is in the final development stages of a family of devices based on its unique, high-performance architecture. The family includes both a 16-bit and a 32-bit transputer as well as some intelligent microperipherals. Inmos will begin sampling the first parts of this family by the end of 1985 or early 1986.

#### Intel

Intel announced early this month that it plans to ship samples of its 80386 32-bit microprocessor in about six months. The device will be offered in 12- and 16-MHz versions, and Intel will also offer a 32-MHz clock generator and a floating-point coprocessor chip.

#### NEC

NEC's V series family of microprocessors will include 32-bit devices. The V-60 is scheduled for introduction in 1986 and the V-70, described by NEC as a second-generation 32-bit device, is planned for 1987. NEC has licensed both Sony Corporation and Zilog, Inc., as second sources. NEC is also licensed as a second source for Zilog's 280,000.

#### <u>Ziloq</u>

The Zilog 280,000 is now expected to be sampled by the end of 1985. NEC is a licensed second source for the part.

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#### Other Manufacturers

Data General, Digital Equipment Corporation, and Hewlett-Packard have all introduced 32-bit microprocessors for internal use, but it is not yet known whether they will offer these devices on the merchant market. The other companies listed in Table 1 are believed to be developing 32-bit devices for the merchant market.

#### SELECTING A 32-BIT MICROPROCESSOR

As Table 1 shows, 17 companies already produce or are planning to produce 32-bit microprocessors. How do you pick a winner from such a range of alternatives? The market is still too young to predict who the big winners will be, but there are several points worth considering.

For the first time, the computing power of a minicomputer will be available in a microprocessor. This means that the 32-bit device can be approached from two directions: it can provide an upward migration path for current users of 16-bit devices, and it can offer a lower-cost option to manufacturers of mini- and superminicomputers. These two categories of users make different demands on 32-bit devices. Those taking the upward migration path are looking for upward compatibility from existing 16-bit devices so that they can continue to exploit the existing software base. Those taking the downward path from the minicomputer environment are more concerned with getting the architectural capabilities available with advanced technology. In the long term, this diversity could set the stage for a larger number of suppliers to enter the market.

There are two new factors in the 32-bit market that could change the market pattern. The first is the presence of the captive manufacturers. Captive manufacturers were ahead of the merchants in their development of the 32-bit device. There has been an increasing trend for captive semiconductor manufacturers to offer their products on the merchant market. NCR's device, the NCR/32, is the first of such products to be offered, but others could follow. Such a development could herald the growth of a 32-bit niche market for those users who are looking for minicomputer capability in a microprocessor. Captive manufacturers have the advantage of a protected internal market to help them weather the vicissitudes of market their products effectively will obviously be an important factor in the growth of this niche market.

The second factor to be considered in the 32-bit market is the development of proprietary devices by Japanese companies. In previous generations, Japanese manufacturers have second-sourced U.S. products.

The most important issue to consider in selecting a 32-bit microprocessor is whether you really need the added capabilities that the device can offer. Have you fully exploited the 16-bit options available? If your application requires 32-bit capability, then the next areas of consideration are similar to those for any microprocessor:

- Does the device match your application?
- Will it be available in sufficient quantities when you need it?
- Are the appropriate microperipherals and coprocessors also available?
- Are there adequate development tools?
- Is there a viable second source?

The point of divergence that you reach when selecting a 32-bit device is the decision about which category of 32-bit devices you should be considering. Is upward compatibility an issue? If so, you should be considering those devices that offer a migration path from earlier generations. Are you looking for minicomputer-like architecture? Devices developed initially for captive use will fit into this category. National Semiconductor's 32032 offers a VAX-like architecture, and Fairchild is promising to take a minicomputer-like approach to its 32-bit offering. Japanese companies will also be entering the market with devices that are not upwardly compatible with existing products. There is yet another segment, represented by AMD's 29300 family and also, perhaps, by the Inmos transputer. These devices offer alternatives for high-performance applications that do not fit into either of the other categories.

The ultimate success of 32-bit microprocessors may rest on the rate at which the market develops. If market acceptance of the 32-bit device is delayed, the winners could be those companies that gained an early share of the market, those companies with upward compatibility to a substantial installed base of 16-bit devices, or those companies with protected internal markets. Early acceptance of the 32-bit devices, on the other hand, may permit market growth adequate to support a wider range of successful products than we have seen in any previous generation.

Future newsletters on the 32-bit microprocessor will examine the growth of the market and the development of new devices. This information will help you to implement a selection strategy that will satisfy your product's requirements.

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Beth Tucker Mel Thomsen

# Table 1

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# COMPANIES INVOLVED IN 32-BIT MICROPROCESSOR DEVELOPMENT

Advanced Micro Devices (Bipolar) AT&T Technologies Data General Digital Equipment Corporation Fairchild Semiconductor Hewlett-Packard Hitachi Inmos Intel

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Matsushita Motorola National Semiconductor NCR NEC Texas Instruments Toshiba Zilog

> Source: DATAQUEST May 1985

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NEWSLETTER

RESEARCH

#### 16-BIT MICROPROCESSOR MARKET IN 1984

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Growth of approximately 40 percent in 1984 for an exciting product area does not appear substantial when compared with its strong growth rates of previous years--73 percent in 1983 from 1982 and 133 percent in 1982 from 1981. The 1984 growth rate of 38.8 percent for all 16-bit microprocessors is a misleading indicator of the growth experienced by key products in this market segment. Six 16-bit devices made up 87 percent of all 16-bit MPUs shipped in 1984 and grew 140 percent from 1983. This is typical of a market segment reaching the rapid growth phase of its life cycle. Older 16-bit product shipments (CP-1600, 9900, 9980, and PACE) declined very rapidly in 1984. The product market share and growth for 16-bit microprocessors is shown in Table 1.

#### Table 1

# PRODUCT MARKET SHARE AND GROWTH FOR 16-BIT MICROPROCESSORS (Thousands of Units)

	1983	Share	1984	Share	Growth
8086	2,150	30.1%	4,040	40.5%	87.98
68000	773	10.8	2,036	20.4	163.48
80186	130	1.8	1,570	15.9	1,107.78
Z8000	409	5.7	628	6.3	53.6%
80286	13	0.2	208	2.1	1,500.0%
32016	109	1.6	202	2.0	85.3%
Others	3,554	49.8	1,280	12.8	(64.0) %
Total	7,138	100.0%	9,964	100.0%	39.6%

Source: DATAQUEST May 1985

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#### TOP TEN SUPPLIERS

Table 2 shows the top ten leading suppliers of 16-bit microprocessors in 1984. Intel and Motorola, the number 1 and number 2 suppliers, accounted for almost half of the total unit shipments in this market segment. Both of these U.S. manufacturers enjoyed high growth rates, but anticipate intense Japanese competition in the next few years. AMD, Hitachi, NEC, and Siemens have all indicated strength in the 16-bit marketplace. Even though Texas Instruments showed a decrease in growth in the 16-bit market, it has second-sourced National's 32016 product line and is expected to get back in the race.

#### Table 2

# TOP TEN 1984 16-BIT MICROPROCESSOR MANUFACTURERS (Thousands of Units)

1983	1984		Units S	Shipped	
Rank	Rank	Company	1983	<u>1984</u>	Growth
2	1	Intel	1,448	3,663	153.0%
4	2	Motorola	465	1,266	172.3%
l	3	General Instrument	1,800	920	(48,9)%
6	4	NEC	255	660	158.8%
7	5	AMD	232	600	158.6%
9	6	Hitachi	220	445	102.3%
11	7	Siemens	135	430	218.5%
5	8	Fujitsu	305	340	11.5%
8	9	Zilog	221	319	44.3%
3	10	Texas Instruments	1,262	260	(79.4) %
		Others	<u> </u>	1,061	
		Total	7,138	9,964	39.6

Source: DATAQUEST May 1985

# Regional Suppliers

U.S. suppliers of 16-bit microprocessors lost market share to Japanese and European manufacturers during 1984, as shown in Table 3. Six of the top ten 16-bit microprocessor suppliers were American manufacturers, three were Japanese, and one was European. Table 3

# REGIONAL MARKET SHARE UNIT SHIPMENTS FOR 16-BIT MICROPROCESSORS

	<u>1983</u>	<u>1984</u>
United States	84.6%	77.1%
Japan	12.6	16.3
Europe	2.8	6.6
Total	100.0%	100.0%
	Source:	DATAQUEST May 1985

#### Growth Rates

AMD, Intel, Motorola, NEC, and SGS all had similar growth rates during the past year--slightly more than 150 percent. (See Table 4.) Considerably more growth was shown by Harris, Mostek, Siemens, Signetics, and Thomson. Harris, Siemens, and Signetics shipped less than 1 percent of the total 8-bit microprocessor market segment in 1984. U.S. companies remain strong and viable in this market; however, second-source agreements have increased competition from Japanese and European manufacturers.

#### Table 4

# TOP GROWTH RATES OF 1984 16-BIT MICROPROCESSOR SUPPLIERS (Thousands of Units)

	Units :	Shipped	
	1983	1984	Growth
Harris	15	135	800.0%
Mostek	35	143	308.6%
Thomson	11	42	281.8%
Signetics	32	110	243.8%
Siemens	135	430	218.5%
Motorola	465	1,266	172.0%
NEC	255	660	158.8%
AMD	232	600	158.6%
Intel	1,448	3,663	153.0%
SGS	54	136	151.9%
	Se	ource:	DATAQUEST

May 1985

#### ANALYSIS

The 16-bit microprocessor market segment is taking off, despite the slump in the semiconductor industry. DATAQUEST expects unit shipments of this market to grow approximately 34 percent in 1985, compared to an During 1984, 16-bit expected flat growth of total semiconductors. microprocessors grew approximately 38 percent, while 8-bit microprocessors grew only 13 percent. This is an indication that 16-bit microprocessors are replacing 8-bit microprocessors in computer-type applications. The high-integration chips provide cost-effective answers for cost-sensitive applications.

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Beth Tucker Janet Rey HB a company of The Dun & Bradstreet Corporation

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# RESEARCH NEWSLETTER

CCIS Code: Newsletter, No. 84

#### 1985 CAD/CAM USER SURVEY RESULTS

#### INTRODUCTION

DATAQUEST recently completed its second annual CAD/CAM end user survey. Our objective in doing this survey was to gain further insight into the current state of the CAD/CAM industry, with respect to several different issues. To accomplish this, we surveyed a sample frame of CAD/CAM end users that we feel best represents the industry as a whole.

The sample frame chosen included all of the worldwide end user installations of six major turnkey CAD/CAM companies--Applicon, Auto-trol, Cadam, Calma, Computervision, and McAuto. Approximately 3,260 questionnaires were mailed to the CAD/CAM system managers at these installations, and in the final tally, 20 percent of them had been returned for use in compiling the results.

The magnitude of this survey can be better understood by comparing the installed workstation population, as represented by the six end user bases surveyed, with the total worldwide workstation population. At the time this survey was conducted, none of these companies had shipped a personal computer-based CAD/CAM solution (hardware or software). Therefore, excluding the personal computer-based workstation population, DATAQUEST estimates that the six end-user bases we surveyed represent approximately 59 percent of the worldwide workstation population.

We were able to define exactly what the 20 percent return meant in terms of total workstations represented, and found that approximately 13,200 workstations were accounted for across the aggregate of respondents.

This newsletter discusses the focus of the survey and related survey findings.

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#### SURVEY FOCUS

DATAQUEST chose five issues as the focus of our survey, including:

- Distribution of CAD/CAM--by industry classification, by type of application(s), and by system usage
- Solids modeling in CAD/CAM
- Graphics workstations--including such factors as the use of standalone workstations, the use of color workstations, and penetration (users/workstation)
- Personal computer use in CAD/CAM
- Pricing expectations for workstations--relative to certain parameters including: memory, disk storage, screen resolution, and preference for either color or monochrome screen

Throughout the following sections, we will present findings on all of the factors pertaining to these five issues. We have also included findings on cross-tabulations of factors from different issues. An example of this is the findings shown for personal computer use relative to each industry.

#### DISTRIBUTION OF CAD/CAM

# Industry Classification

Those surveyed were asked to identify the industry classification that best described the type of business in which their company was engaged. They were asked to choose one classification from a list of ten, all of which adhere to the U.S. government's Standard Industrial Classification (SIC) system.

As shown in Figure 1, the Electronic and Electrical Machinery, Equipment and Supplies classification accounted for the greatest portion of respondents (CAD/CAM sites) relative to the other industries represented. Approximately a third of the respondents identified in the "Other" classification emanated from educational institutions, while another third were service bureaus. The remainder of the "Other" respondents represented a variety of industries, including chemical manufacturers, utility companies, and mapping-related concerns.

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# Figure 1

# INDUSTRY CLASSIFICATION (Percent of Respondents)



# Applications

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DATAQUEST identified eight major application categories for CAD/CAM systems, including:

- Architecture, engineering, and construction (AEC)
- Computer-aided manufacturing (CAM)
- Mechanical (ME)
- Printed circuit boards (PCB)
- Integrated circuits (IC)
- Electronic design automation (EDA)
- Technical publications (T-PUBS)
- Mapping

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Those surveyed were asked to check all applications that were being used at their CAD/CAM sites. Survey findings indicate that mechanical applications continue to dominate as the major CAD/CAM application, accounting for 63 percent of the sites represented. Most significant in this set of findings is the fact that 60 percent of the respondents are running multiple applications at their installations. It was most common to find two applications being done at a given site; the most frequent combinations were mechanical/CAM and mechanical/AEC.

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The distribution of respondents for each of the applications is shown in Figure 2. Table 1 shows the distribution of respondents within the different industries for each of the applications.

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# Figure 2

APPLICATIONS (Percent of Respondents)



# Table 1

# CAD/CAM APPLICATIONS (Percent of Respondents)

	Applications									
Industry	AEC		MECH	EDA	<u>1C</u>	Mapping	PCB	Tech. Pubs.		
Electrical/Electronic Machinery, Equipment,										
and Supplies	18%	298	52%	458	378	08	43%	10%		
Transportation	28%	448	70%	278	12%	38	25%	178		
Other	52%	378	63%	178	88	11%	16%	10%		
Non-Electrical Machinery,										
Equipment, and Supplies	20%	46%	81%	278	15%	80	38%	20%		
Fabricated/Structural										
Metal Parts	35₹	428	78%	08	08	08	0%	98		
Architecture/Building	93%	78	27%	0%	0%	5%	16%	10%		

Note: Percentages may total more than 100 percent due to multiple responses.

Source: DATAQUEST

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#### System Usage

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DATAQUEST identified four major functions for CAD/CAM system usage. These are:

- Drafting--capturing design data on the CAD system
- Design/modeling-designing products and creating models with design parameters for analysis
- Analysis--analyzing design data in models
- Manufacturing--utilizing design data for manufacturing applications in CAM or CIM

Survey findings indicate that drafting functions continue to dominate CAD/CAM system usage. Across the aggregate of respondents, drafting represented an average of 53 percent of a system's use. Figure 3 breaks out the system usage categories across the aggregate of respondents.

**Figure 3** 

SYSTEM USAGE

(Averages)



Source: DATAQUEST

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#### SOLIDS MODELING USE--FIRMLY ENTRENCHED AND COMING ON STRONG

We found that solids modeling is indeed here to stay. Of those responding to our survey, 25 percent are currently using solids modeling at their sites, and an even greater portion plan to use this technology in the future for their CAD/CAM applications. Figure 4 shows the distribution of responses for the solids modeling issue.

Those currently using solids modeling were asked to indicate what they are using it for on their systems. We found that 80 percent of the respondents are using solids modeling for design applications, while the remaining 20 percent use it for manufacturing purposes.

The current use of, or future plans for, solids modeling is more prevalent in some industries than in others according to our surveyed users. Table 2 breaks out the responses for solids modeling by each industry.

# Figure 4

SOLIDS MODELING (Percent of Respondents)



#### Table 2

# SOLIDS MODELING USE BY INDUSTRY (Percent of Respondents)

	Now	Planning	
Industry	Using	to Use	<u>Total</u>
Electrical/Electronic Machinery,			
Equipment, and Supplies	20%	33%	53%
Transportation	36%	35%	71%
Other	25%	378	62%
Non-Electrical Machinery, Equipment,			
and Supplies	26%	468	728
Fabricated/Structural Metal Parts	18%	40%	58%
Architecture/Building	12%	44%	56%

Source: DATAQUEST

#### GRAPHICS WORKSTATIONS

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This section of the survey focused on several important variables relative to the use of graphics workstations, including the penetration factor (users/workstation), the use of color workstations, and the use of standalone workstations. We began by questionning users about the number of graphics workstations they had installed at their sites.

# Number of Workstations Installed

A majority of the respondents indicated that ten or fewer workstations were installed at their sites. As shown in Figure 5, approximately 50 percent of the respondents have six or fewer workstations installed.

"A small minority will account for the greatest . . .", is an old adage that applies in this case to volume purchases (sales) of workstations. Of the more than 13,200 workstations represented by the aggregate of respondents, approximately 6,600 workstations are accounted for by the 4 percent of the respondents that have 100 or more workstations installed. More than three-quarters of the respondents in this group represent aerospace, computer, and semiconductor manufacturers.

Other implications arise when considering volume purchases (sales) of workstations on an industry-by-industry basis. The survey findings indicate that companies manufacturing non-electrical machinery, equipment, or supplies, will on the average have the most workstations installed at their CAD/CAM sites. Table 3 shows the findings by industry for the average number of workstations installed at a CAD/CAM site.

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# Figure 5

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# GRAPHICS WORKSTATIONS INSTALLED (Distribution of Respondents)



Source: DATAQUEST

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# Table 3

# NUMBER OF WORKSTATIONS INSTALLED AT A SITE--BY INDUSTRY (Average)

Industry	Workstations <u>Installed</u>
Electrical/Electronic Machinery,	
Equipment, and Supplies	25
Transportation	27
Other	12
Non-Electrical Machinery, Equipment,	
and Supplies	34
Fabricated/Structural Metal Parts	7
Architecture/Building	9

Source: DATAQUEST

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# Users/Workstation

This set of findings indicated how many people share one workstation. The results show that 77 percent of the responses fell in the range of one to three users per workstation. Regardless of the number of workstations installed at a particular CAD/CAM site, the average number of users per workstation was three.

#### Use of Color Workstations

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The use of color workstations has unquestionably become a mainstay for many CAD/CAM users. We found that 40 percent of all workstations installed across the total base of respondents are color. Survey findings presented in another section of this newsletter indicate that the color workstation population will most likely increase as a percent of the total workstation population, particularly as costs to end users continue to fall, and consequently, users' perceptions change.

#### Type of Workstations Used--Standalone Workstations Make a Strong Showing

Rounding out the focus on graphics workstation installations are the following findings regarding the types of workstations being used:

- Installations with only host-dependent workstations were represented by 61 percent of the respondents.
- Installations with only standalone workstations were represented by 13 percent of the respondents; three-quarters of these installations have only two workstations installed.
- Installations with a combination of host-dependent workstations and standalone workstations were represented by 26 percent of the respondents. On an average, an installation with this combination has full standalone capabilities in one-third of its workstations.

#### PERSONAL COMPUTERS -- HOW MUCH PENETRATION IN CAD/CAM TODAY?

Use of personal computers for CAD/CAM has definitely taken hold among this base of traditional mini/mainframe-based users. The findings indicate that 23 percent of the respondents are currently using personal computers for CAD/CAM applications. We carried the personal computer issue one step further by asking those who do not use them currently to indicate whether or not they had plans to use them in the future. Figure 6 illustrates the overall distribution of responses for the personal computer issue.

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Two questions were posed to those already using personal computers for CAD/CAM: "Who uses them?" and "Are they being networked?". More than half of the respondents indicated that they were networking their personal computers.

As shown in Figure 7, more than 50 percent of the respondents indicated that engineers, rather than designers/draftsmen, are using personal computers.

We also viewed the personal computer issue as it relates to each industry. Our findings are presented in Table 4. In most cases, we found that within each industry, more than half the respondents (in a combined total) are already using, or planning to use, personal computers for CAD/CAM applications.

Figure 6

PERSONAL COMPUTER USE IN CAD/CAM (Percent of Respondents)







# RESPONDENTS USING PERSONAL COMPUTERS

Table 4

# PERSONAL COMPUTER USE BY INDUSTRY (Percent of Respondents)

	Are Using or
Industry	Planning to Use
Electrical/Electronic Machinery,	
Equipment, and Supplies	61%
Transportation	428
Other	59%
Non-Electrical Machinery Equipment and	
Supplies	52%
Fabricated/Structural Metal Parts	38%
Architecture/Building	60%

Source: DATAQUEST

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#### PRICING EXPECTATIONS FOR WORKSTATIONS

DATAQUEST believes that the use of personal computers correlates closely with CAD/CAM users' expectations about price. We asked these users to name a price that would compel them to put workstations on all of their engineers' desks. The findings showed that 58 percent of those who responded wish to pay \$10,000 or less to do so.

A large percentage of the respondents (25 percent) fell at exactly the \$10,000 price level, with the remaining respondents above and below this level. Because of the heavier weighting of responses above the \$10,000 price mark, the average price occurred at \$14,000. Figure 8 illustrates the distribution.

What actually occurred above and below the \$10,000 price level were three distinct clusters of responses. Figure 9 shows these distinct price clusters, including the cluster of responses at the \$10,000 level.

DATAQUEST believes that these pricing expectations will not remain unmet for long by the CAD/CAM vendors. As indicated in the recent DATAQUEST CCIS newsletter (No. 80), "Personal Computer-Based CAD/CAM---Miracle or Mirage?", the rapid decline in workstation component prices and increasingly competitive nature of the market will cause a drop in workstation prices by an average of 26 percent per year from 1985 through 1988.

Of course, price alone is not an issue. We also asked the users what an acceptable workstation configuration would be at the price level they indicated. The configuration features we asked these users to address included screen resolution, minimum memory requirements, minimum storage requirements, and the need for color graphics terminals.



Figure 8

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# Figure 9

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# PRICE FOR EVERY ENGINEER'S DESK--FURTHER BREAKDOWN (Percent of Respondents)

Because such a large percentage of the respondents indicated \$10,000 as their ideal price, we chose to present the survey findings for the ideal configuration at this price level. Tables 5, 6, and 7 show the most frequent responses for screen resolution, minimum memory, and minimum storage requirements, respectively. As for whether or not color is necessary at this price level, the survey findings showed that for 60 percent of the respondents, it was preferred over monochrome.

As one would predict, user expectations for configuration requirements became greater at the higher price levels. For example, 77 percent of the respondents who indicated \$20,000 as their ideal price preferred color rather than monochrome workstations.

# Table 5

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# MOST FREQUENT RESPONSES FOR SCREEN RESOLUTION AT \$10,000 PRICE LEVEL (Percent of Respondents)

Resolution Requirement	Percent of <u>Respondents</u>
512 x 512	18%
640 x 480	11%
1,024 x 1,024	38%

# Table 6

# MOST FREQUENT RESPONSES FOR MINIMUM MEMORY REQUIREMENTS AT \$10,000 (Percent of Respondents)

Minimum Memory <u>Requirement</u>	Percent of <u>Respondents</u>
0. SMb	30%
1.0Mb	28%
2.0Mb	18%

Source: DATAQUEST

# Table 7

# MOST FREQUENT RESPONSES FOR MINIMUM STORAGE REQUIREMENTS AT \$10,000 (Percent of Respondents)

Minimum Storage <u>Requirement</u>	Percent of Respondents
10Mb	20%
20Mb	21%
50Mb	78
300Mb	10%

Source: DATAQUEST

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#### SUMMARY

The survey results unquestionably support the fact that mechanical applications still dominate as the major use of CAD/CAM systems. However, according to the survey findings, CAD/CAM users are not limiting their scope to just one application. Findings show that more than 60 percent of the CAD/CAM sites are employing multiple applications on their systems.

We now have greater insight into the untapped market potential for workstation sales. The survey findings show that on an average, three persons typically share one workstation. Assuming that CAD/CAM buyers eventually plan to furnish every user's desk (engineer or designer) with a workstation, this constitutes an extremely healthy market potential for future sales.

Recognizing the enormous potential for future workstation sales, we attempted to gain further insight into CAD/CAM buyers' price/performance criteria. Not surprisingly, most CAD/CAM buyers definitely have their thinking set below the \$20,000 price level when considering the possibility of providing all of their engineers with workstations.

The influx of personal computer-based CAD/CAM solutions into the market has naturally played a role in the price perception shift of many of these users. According to the survey findings, such solutions will be used (if they are not already) in more than half of these traditional mini/mainframe-based CAD/CAM sites. We now have an idea of where the personal computer issue stands with these users, but more interesting, perhaps, are the views on performance criteria at price levels below \$20,000. Ideally, most users want color workstations, with 1K x 1K screen resolution, no less than 1Mb of memory, and no less than 50Mb disk storage capacity. (1Mb and 50Mb are averages.)

Eileen Barth

Telegram Dataquest

CCIS Code: Newsletter, No. 83

NEWSLETTER

RESEARCH

# CAE SYSTEMS' PC STRIKES AT STANDALONE MARKET

#### INTRODUCTION

Tektronix Incorporated's CAE Systems Division announced on May 28 the Tekstation AT, an IBM PC AT workstation contender. The Tekstation AT (Tektronix 6030) combines the power of a standalone workstation with the general-purpose flexibility of the IBM PC. DATAQUEST anticipated future PC product offerings would include concurrent operation of UNIX and PC DOS, and CAE Systems has met our expectations. (See CCIS Newsletter No. 80, "Personal Computer-Based CAD/CAM--Miracle or Mirage?", April 18, 1985.)

The Tekstation AT also addresses what we perceive are other PC shortcomings:

PC Shortcoming

CAE Systems' Response

Lack of virtual memory

Insufficient mass storage Poor graphics Limited communications National 32016, UTek (Tektronix version of UNIX 4.2) Up to 280 Mbytes on enclosed fixed disk Tektronix graphics capability option Capabilities of UTek (UNIX 4.2) distributed processing

#### THE TEKSTATION AT

The Tektronix AT offers these significant features:

- Concurrent applications running under both PC DOS and UTek
- Distributed processing, where a file can be edited on one workstation while residing on another
- IBM platform entry for Tektronix CAE Systems

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The base configuration of a CAE Systems' Tekstation AT (priced at \$25,000) is described below:

IBM PC AT 80286 with 512-Kbytes memory

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- PC DOS
- Coprocessor based on National 32016 with 2-Mbytes memory
  - Floating point
  - 16-Mbytes virtual addressable memory
  - UTek (Tektronix's version of Berkeley UNIX 4.2)
- IBM monochrome display
- 85-Mbyte fixed disk
- 1.2-Mbyte flexible disk
- Three-button mouse
- CAE 2000 software, including:
  - Hierarchical data base
  - Schematic entry
  - Logic simulation
  - Library of standard design parts
  - Standard interfaces

Hardware options for the Tekstation AT include:

- 2-Mbyte memory for coprocessor
- 280-Mbyte fixed disk, in 140-Mbyte disk drive increments
- Ethernet board
- IBM professional graphics color monitor and controller
- Tektronix 4109 (special 19-inch version for the Tekstation)
- Magnetic tape drive

#### DATAQUEST ANALYSIS

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We believe that the low-end standalone market has not yet realized the full impact of personal computers with add-on coprocessor boards. However, two issues are apparent:

- The market potential for add-on or retrofit PC boards is sure to explode.
- It's a solid move on Tektronix's part not to enter the personal computer market with yet another PC.

With the introduction of this product, Tektronix's CAE Systems offers a viable entry-level tool for design automation. Now participating in the largest product type segment in electronic CAD/CAM, CAE Systems joins the ranks of Daisy, Futurenet, P-CAD, Racal-Redac, Telesis, and other CAD companies with IBM PC-based product offerings.

Who said IBM is not in the electronic CAD/CAM business?

Tony Spadarella Kelly Leininger

CCIS Code: Newsletters, No. 82

RESEARCH BULLETIN

#### THE WAIT IS OVER--DIGITAL UNVEILS THE MICROVAX II

Esen∰∖ Dataquest

Complete with flashing lights and symphonic overtures, Digital Equipment Corporation has at long last announced the MicroVAX II. The MicroVAX II signals Digital's long-awaited entry into the fast-paced and high-growth engineering workstation market. The MicroVAX I, introduced by Digital more than a year ago, was the company's first effort to enter the engineering workstation marketplace. However, because of the poor relative performance of the MicroVAX I and the aggressive competition from Apollo and Sun, Digital failed miserably in its attempt to penetrate this market and has fallen from favor with many of its large OEMs. By combining a full 32-bit "Vax-on-a-chip" architecture (yielding true VAX 11/780 performance) with unbelievably aggressive pricing, DATAQUEST believes that Digital has positioned itself to once again become the darling of the engineering computing world.

In addition to the VAXstation II configuration listed in Table 1, the MicroVAX II product line extends from single-user systems starting as low as \$18,840 up to a 16-user system that lists for \$43,780. Memory is expandable to 9 Mbytes at a cost of \$3,500 per Mbyte; disk sizes range from 31 to 456 Mbytes.

The MicroVAX II includes a prorietary 40-MHZ, 32-bit microprocessor and floating-point chip developed by Digital. These two components sit on a single board that also contains 1 Mbyte of memory. Digital claims that this new chip set performs at 70 to 90 percent of its popular VAX 11/780, depending on the application. DATAQUEST has learned from a number of OEMs testing the MicroVAX II that floating-point performance in some cases exceeds that of the VAX 11/780.

The MicroVAX II has three different operating system options--MicroVMS, ULTRIX-32 (Digital's optimized version of Berkeley 4.2 UNIX), and VAXELN, which is a layered VMS product designed for real-time applications. In a surprise move, Digital announced that it will charge MicroVAX operating system license fees by the number of logged-in users. Prices are \$2,000 for 2 users, \$4,000 for 8 users, \$6,000 for 16 users, and \$8,000 for an unlimited license.

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# Table 1

# WORKSTATION PRICE/CONFIGURATION COMPARISON

	<u>Digital</u>	<u>Apollo</u>	Apollo	<u>Sun</u>		
Model	VAXstation II	DN460	DN320	2/120		
Memory	2 Mbytes	2 Mbytes	2 Mbytes	2 Mbytes		
Disk	31 Mbytes	80 Mbytes	34 Mbytes	42 Mbytes		
Таре	N/A	N/A	N/A	1/4" Streamer		
Floppy	800 Kbytes	1.2 Mbytes	1.2 Mbytes	N/A		
LAN	Ethernet	Domain	Domain	Ethernet		
Monitor Type	19" Mono	19" Mono	17" Mono	19" Mono		
Resolution	1,024 x 864	1,024 x 800	1,024 x 800	1,152 x 900		
Floating Point	Yes	Yes	Yes	Yes		
Whetstones (SP)	925,000	812,000	375,000	240,000		
Virtual Address	-					
Space	4,000 Mbytes	256 Mbytes	16 Mbytes	16 Mbytes		
Price	\$26,500	\$59,900	\$33,050	\$33,400		

N/A = Not Available

Source: DATAQUEST

#### DATAQUEST CONCLUSIONS

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Given the tremendous price/performance characteristics of the MicroVAX II, DATAQUEST expects the following:

- Industry price cuts on the order of 20 to 30 percent are likely.
- The MicroVAX I, VAX 11/725, VAX 11/730, and VAX 11/750 are dead products for all practical purposes.
- While some OEMs will undoubtedly defect to Digital, we believe that most non-Digital OEMs will probably use the MicroVAX II as a bargaining chip to lower the prices of their current OEM arrangements with other manufacturers.

David B. Burdick Yu Uemura

CCIS Code: Newsletters, No. 81

RESEARCH

NEWSLETTER

#### WHITECHAPEL COMPUTER WORKS' MG-1--A PERSONAL WORKSTATION

Dataquest

#### OVERVIEW

Whitechapel Computer Works Ltd. is a relatively new British start-up that shipped its first product in September 1984. This product, the MG-1, is a computer aimed at the science, engineering, and CAD/CAM markets, that combines workstation performance with personal computer pricing. It has already generated interest in the U.K. market. Pafec, the largest independent British mechanical CAD/CAM vendor, has given the product high marks and has rushed out a version of its DOGS drafting package at less than £30,000 (\$37,500) for a complete system including plotter. In May 1985, Whitechapel was awarded the British Electronic Industries Federation's TOBIE Award for 1985 New Product of the Year.

DATAQUEST estimates that the standalone workstation segment of the CAD/CAM market will continue to grow to more than \$9,352 million in sales by 1989 from the 1984 level of \$625 million. DATAQUEST believes that the key elements fueling this growth are:

- Level performance
- Lower incremental cost
- Increased systems up-time
- Lower cost per user

Since the early 1980s, Apollo, with a specialized networking protocol and proprietary operating system, has been one of the dominant companies in the standalone workstation segment. Sun Microsystems has taken a significant share with an approach based on industry standards. Whitechapel has taken a marketing approach similar to these companies, and has already built up an impressive number of respected software packages in its catalog as well as selling direct to a number of influential sites.

The MG-1's price/performance sets a new benchmark for competitors to match with a 32-bit personal workstation for under \$10,000.

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#### THE COMPANY

Whitechapel was formed in April 1983 to develop a high-performance, 32-bit personal workstation with the graphics, networking, and processing capabilities of computers such as the Apollo and Sun, but available at a personal computer price. The result is the MG-1. The company is located in Whitechapel, a short walk from the City of London. It now employs 63 people and has sales offices in London; Paris; and Mountain View, California. It has received two rounds of venture capital. The first was in May 1983 from the Greater London Enterprise Board, the second in May 1984 added Newmarket and Baillie Gifford. The staff retained more than 50 percent of the equity, and the company is now looking for funding to allow expansion into international markets.

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The principals formerly worked at Logica, a respected British software house, and have links with London University's Queen Mary College. However, the ideas in the MG-1 can be traced back to the Xerox Palo Alto Research Center and to William Newman, a consultant to the company.

Tim Eccles, the Managing Director, is a co-founder. Previously, he was Telecommunications Manager at Rank Xerox, where he was responsible for the Xerox voice and data networks throughout Europe. He studied at Oxford, Sussex, and Stanford, and has worked for Bell-Northern in the United States as well as for Logica and British Airways in the United Kingdom.

Bob Newman, the Technical Director, is the other co-founder. He is a lecturer at Queen Mary College and has worked for Logica on the design of advanced office automation equipment.

Mike Cole is the Marketing Director. He was formerly the Major Accounts Sales and Marketing Manager at Logica. He lectured at Queen Mary College and studied at London and Cambridge.

Chris Christofis is the Manufacturing Manager. He was formerly responsible for a computer communication by satellite project at Logica. Before that he worked at BOC and Crosfields.

DATAQUEST believes that a key factor in Whitechapel's success is that the management team, having the advantage of previously working together in a successful company, shares common visions and working methods. By taking advantage of the United Kingdom's lower labor costs for high-quality hardware and software engineers, we believe that Whitechapel should be able to compete aggressively with U.S.-based companies.

#### THE MG-1

Six months after company formation, Whitechapel successfully completed the MG-1 prototype. The first product was shipped in September 1984 and volume production began in December 1984. The company is now shipping 60 units a month. It has been profitable on a month-by-month basis since January 1985. The company has firm plans to expand production to 100 units a month by mid-1985 and expects to reach 200 per month by the end of 1985. This implies an expected turnover of more than \$10 million. Mr. Cole is cautious about further predictions, but believes that the company can continue initial success. Regarding the United States, it is too early to make projections until U.S. operations are established. The company is, however, committed to market share and growth.

#### PRODUCT DESCRIPTION

The heart of the MG-1 is a single 16-inch x 18-inch printed circuit board. It uses a virtual memory NS32016, along with the NS32082 memory management unit and the NS32081 floating point unit. The display memory is integrated into the main memory, and 60Hz display refresh rate is maintained by using a 200Hz memory bandwidth. The memory can be expanded up to 8Mb within the cabinet using a proprietary memory expansion bus. The graphics screen is a 17-inch landscape bit-mapped display with a resolution of 80 pixels per inch. This 1,024 x 800 resolution is the minimum that Mr. Newman regards as acceptable for CAD applications.

A high-performance, single VLSI chip, disk controller is tightly integrated into the centralized DMA controller. This DMA service is available to IBM PC expansion cards fitted to the expansion bus.

The IEEE 802.3 variant of the Ethernet system is included in the MG-1. Mr. Newman feels that the lack of performance that many UNIX and Ethernet users complain of is rooted in the software rather than in the hardware. Future developments will address this issue.

The performance of the MG-1 running many classic benchmarks, including Whetstone and Sieve Fast Fourier Transform, matches or exceeds a DEC VAX 11/750 with the same memory running UNIX. In the Whetstone benchmarks, the MG-1 is about 20 percent faster than the UNIX-based VAX 750. The instruction set is comparable. Further performance enhancements are expected as faster versions of the processor are used.

Whitechapel is using a version of Berkeley Unix 4.2 with the kernel extended to support a proprietary window manager. This kernel provides an ordered list of rectangles associated with each input, output, and process. Users are able to tailor the window manager to their applications. A full set of icon and cursor editing tools are provided to assist users who wish to write tailored user interfaces. This release will also provide for distributed files and GKS libraries. All the usual development tools such as EMACS, Pascal, and FORTRAN are available.

DATAQUEST believes that the industrial design of the MG-1 has a large number of small but elegant features that make the MG-1 more attractive the more it is used. There is the design itself, a clean black box about the same size as an IBM PC but with an elegant Scandinavian design. Starting up with a battery-operated date and time clock is simple. There is software power off to guarantee an orderly file shutdown that can be a problem with UNIX. To prevent cursor dragging operations being disrupted, a separate microprocessor handles the mouse, keyboard, and cursor. There is serial number protection for software vendors to use. The whole machine is small and quiet.

The MG-1 will evolve over the next few months to provide options that add color and a laser printer while maintaining the price/performance equation. There is a three-year development plan to continue to provide products taking advantage of the latest technology, but to avoid management problems, Whitechapel does not expect to expand the development team significantly beyond the current 20 people. The company believes that small is beautiful.

#### MANUFACTURING

DATAQUEST believes that a key factor in Whitechapel's ability to gain a significant share is whether or not it can successfully expand manufacturing from the present small-batch operation to a full, high-volume, production line basis. At present, manufacturing vends out about five separate processes and only performs functional testing, inspection, and assembly in-house. In the near future, subcontractors will integrate some of these steps so that the number of processes that are vended out can be reduced. When visiting the shop, it was clear to DATAQUEST that the production, documentation, and manufacturing instructions were of high quality. From its conception, the product was designed with manufacturability in mind. Established components with second sources were carefully chosen. With about 200 units in the field, it is too soon to obtain figures for reliability, but DATAQUEST has a high level of confidence based on the four currently in repair. A large British multinational company is about to take on responsibility for the Whitechapel's field service operation.

#### MARKETING STRATEGY

The current MG-1 sales have gone in approximately equal shares to OEMs, educational institutions such as the University of Glasgow, and public sector research laboratories. In Europe, Whitechapel is setting up national distributors in each of the main markets. The U.S. office should be fully operational by mid-May 1985. Direct sales are mostly to users who write their own programs with the more basic models being shipped. The OEMs are using bigger configurations.

OEMs have been quick to buy machines for evaluation. Genrad's Hilo, Radan's Radraft, Lattice Logic's Chipsmith Silicon Compiler, and Perspective's MicroSolid have all been converted to Whitechapel, in addition to Pafec's DOGS. There will be a delay before these OEMs are shipping MG-1 based products, but when they are onstream, Whitechapel expects half of its business to come from this source.

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The key tactical issue is price. A basic model with 22Mb disk and 1 Mb memory costs £7500 (\$9,300); a typical configuration for CAD/CAM with 45Mb and 2Mb memory costs £10,000 (\$12,500).

#### DATAQUEST ANALYSIS

DATAQUEST believes that at half the price of comparable products, the price of the Whitechapel MG-1 is what immediately excites interest. When examined more closely, the product has stood up to the cynical British OEMs who need a step down in their input hardware costs to increase their volume of shipments. Prospective buyers are enthusiastic about the We believe that the smaller and more MG-1's ease and consistency. aggressive European CAD/CAM vendors will use the MG-1 as a vehicle to exploit the large market that exists in smaller firms. At this time, Whitechapel's small size means that it will not yet disrupt the bigger vendors such as Apollo, but the CAD/CAM vendors that use those products This could be a problem for the may find their margins eroded. industry. The workstation market is already very competitive. Companies need a margin, and must give their OEMs a margin sufficient to cover the R&D expenditure to design the next product.

DATAQUEST believes that Whitechapel could prosper from small-scale profitable business in the European market with little trouble. It is entering the U.S. market, and here, the costs are high. OEMs such as Calma and Applicon are part of large corporations that will not be able to react quickly to convert their products. While they may buy initial quantities of evaluation machines, Whitechapel will face difficulties in closing volume sales through these accounts in the face of entrenched suppliers. Margins may need to be higher to accommodate these costs and delays; however, the difference between U.S. and U.K. labor rates gives considerable scope for maneuver. Also, newer markets such as technical publishing and artificial intelligence may prove easier to penetrate.

The remaining question is whether or not Whitechapel can manufacture enough reliable units to satisfy customers if demand takes off. We believe that the subcontracting procedures used, if tightly controlled, can allow Whitechapel to respond without investing vast quantities of capital and management time.

Mike Evans

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 80

PERSONAL COMPUTER-BASED CAD/CAM--MIRACLE OR MIRAGE?

Dataquest

As the CAD/CAM war for the minds and dollars of the world's engineers rages on, personal computer (PC)-based CAD/CAM systems threaten to breach the traditional battle line boundaries. A key question in the minds of vendors, buyers, and market forecasters alike, is whether or not the personal computer is a short-lived phenomenon that will eventually give way to the more powerful engineering workstations. Although DATAQUEST believes that standalone workstations will continue to gain market share as costs fall, we also predict that personal computers (specifically the TBM PC AT) will be a major force within the CAD/CAM industry. (See Figure 1.) This newsletter discusses the interesting dilemma that these lower-cost PC-based CAD/CAM systems present to the market, as well as some intriguing implementation alternatives.

#### Figure 1

#### CAD/CAM WORKSTATION SHIPMENTS



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#### LOW COST--THE REAL ISSUE

While many PC CAD system purchase justifications contain the over-used and abused item for access to other business applications (e.g., spreadsheets and word processing), DATAQUEST believes that the real issue is cost. Given a choice however, we believe that most engineers and technicians would opt for a 32-bit, virtual computing architecture with high-performance (1K x 1K resolution with pan and zoom) graphics. This fact is further validated by our most recent end-user survey in which we asked users at more than 3,000 CAD/CAM installations what their cost and feature requirements would be in order to place one workstation on every engineer's desk. The most frequent responses are listed in Table 1.

While there currently are no systems in the marketplace that meet these parameters at the \$10,000 price level, we expect that this type of architecture will be quite common by the end of 1986. Given the rapid decline in workstation component prices (listed in Table 2) along with the increasingly competitive nature of the market, DATAQUEST believes that the average price of a 32-bit workstation will drop an average of 26 percent per year from its current level of \$20,000 to approximately \$6,000 by 1988, as illustrated in Figure 2.

#### Table 1

# END-USER SURVEY RESPONSE FOR IDEAL WORKSTATION CONFIGURATION (Most Frequent Responses)

Cost: \$10,000 Minimum Disk Requirement: 50 MB Screen Resolution: 1,024 x 1,024 Color Required: 60% yes, 40% no Minimum Memory Requirement: 1 MB

Source: DATAQUEST

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# Table 2

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# WORKSTATION COMPONENT AVERAGE PRICES (Estimated Prices in \$US in OEM Quantities)

Component	<u>1</u> :	<u>983</u>	19	84	ļ	1 <u>985</u>	1	.986	1	<u>1987</u>	<u>1</u>	.988	1983-88 <u>CAGR</u>
Memory													
64K	\$	3.75	\$ 3	3.16	\$	1.71	\$	1.57	\$	1.48	\$	1.52	(16.5%)
256K	\$5	0.00	\$19	9.55	\$	8.69	\$	4.93	\$	2.96	\$	2.47	(45.2%)
1M		N/A		N/A	\$:	175.00	\$4	18.89	\$2	26.75	\$1	6.13	(54.8%)
32-bit MPU	\$	400	\$	40	\$	36	\$	30	\$	25	\$	20	(45.1%)
1MB Main Memory	\$	480	\$	404	\$	218	\$	158	\$	95	\$	79	(30.3%)
128K Image Memory	\$	60	\$	51	\$	27	\$	20	\$	12	\$	10	(30.3%)
Monochrome Display	\$	388	\$	366	\$	346	\$	326	\$	308	\$	290	( 5.6%)
Color Display	\$1	,157	\$1,	,099	\$	1,044	\$	992	\$	952	\$	923	(4.4%)
50-MB Winchester	\$1	,300	\$1	,000	\$	850	\$	800	\$	700	\$	650	(13.0%)
LAN Connection	\$1	,160	\$1,	,225	\$	1,070	\$	935	\$	840	\$	760	( 8.1%)
Avg. Monochrome Cost	\$3	,788	\$3,	,086	\$	2,547	\$2	2,269	\$	1,980	\$1	,809	(13.7%)
Avg. Color Cost (256 colors)	\$4	,977	\$4,	,172	\$	3,436	\$3	8,073	\$:	2,707	\$2	2,511	(12.8%)

# Figure 2

# AVERAGE ENGINEERING WORKSTATION SELLING PRICE FOR A FIXED CONFIGURATION



\*Configuration includes tMp main memory 50Mb disk 1K  $\times$  1K monochrome display 16Mb virtual address space, LAN connection

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Source, DATAQUEST

#### WHERE IS THE CAD/CAM MARKET?

#### Small vs. Large Companies

When one begins to contemplate the penetration potential of low-cost systems, it is important to consider not only the total market size, but where the market exists as well. A common misconception about the market for low-cost systems is that smaller companies (lo0 employees or less) form the vast majority of possible unit sales. In the United States, this is not the case. As Table 3 illustrates, 48 percent of the 2.8 million engineers and draftsmen work in large establishments with 1,000 employees or more, and only 17 percent work in establishments with 100 or less employees. Although DATAQUEST acknowledges that larger establishments have a higher incidence of installed CAD/CAM capability than smaller establishments, the number of workstations per engineer is still very low (approximately 1 workstation for every 20 engineers).

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Given this understanding of where the market exists underscores the following key points:

- The fact that larger establishments already possess some CAD/CAM capability obviates the need for data base compatibility when selling low-cost or PC-based systems.
- Due to the relative amount of risk, the smaller establishments view cost as the number one buying criteria, whereas larger establishments tend to place greater importance on system functionality.
- Because of their cost sensitivity, smaller establishments view CAD/CAM expenditures as a choice between either buying or not buying a system, while larger establishments view CAD/CAM expenditures from a standpoint of how much CAD/CAM they can buy with a given amount of money.

#### Table 3

U.S. ENGINEERS AND DRAFTSMEN BY ESTABLISHMENT SIZE

Company Size (No. of Employees) <100	Number of Engineers <u>and Draftsmen</u> 482,361	Percent <u>of Total</u> 17% ,
>1,000	1,361,962	48%
Total	2,837,420	100%

Source: U.S. Dept. of Labor, Bureau of Labor Statistics DATAQUEST

#### The Educational Market

By virtue of their lower cost and lower productivity requirements, low-cost CAD/CAM systems are a natural fit for the educational market. Sales of CAD/CAM systems to the educational and other low-productivity markets could represent a significant portion of the future CAD/CAM market, especially when considering the following facts compiled by the DATAQUEST Software Industry Service:

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- By the end of 1984, approximately 1 million personal computers had been shipped to the U.S. school environment. This is expected to increase to 7.8 million by 1989.
- In 1984, 44 percent of all worldwide shipments of personal computers went to the school environment.
- In 1984, the school environment purchased \$209 million worth of PC software. Nearly half of the PC software revenue went for scientific and technical applications including CAD/CAM.

#### The Players

Currently, the low-cost CAD/CAM market is dominated by a number of young start-up companies that specialize in offering PC-based CAD/CAM systems. Figure 3 reflects our 1984 market share ranking of these companies in terms of units. DATAQUEST estimates that there are now well over 100 companies who offer some type of PC-based CAD/CAM software. We expect that number to double by the end of this year.

Another interesting development is that the large turnkey CAD/CAM companies have begun to throw their hats into the low-cost CAD/CAM arena. Computervision, Daisy, Applicon, and Racal-Redac all started shipping PC-based CAD/CAM systems during the last few months. DATAQUEST expects the rest of the traditional turnkeys to announce some type of low-cost CAD/CAM system later this year.

Surprisingly, Computervision shipped nearly 200 units of its IBM PC-based Personal Designer systems during the last eight weeks of 1984 without any formal announcement of the product. This clearly demonstrates the tremendous need for this type of product, even within the installed base of companies that also use larger, mainframe-based CAD/CAM systems.

Another-vendor related issue is the question of who is likely to dominate in the low-cost marketplace. From a hardware point of view, the IBM PC is clearly today's leader. IBM's market leadership position does not appear to be waning; most of the CAD/CAM vendors we talked to acknowledged that they will offer at least one IBM PC AT-based solution. DATAQUEST expects that low-cost engineering workstations such as the DN 300 from Apollo Computer and the Sun 2/50 will also be very competitive hardware solutions as their prices continue to fall.







Source: DATAQUEST

From a software standpoint, there are two battlegrounds forming, based on types of distribution channels. The dealer channel is currently dominated by the new start-ups such as AutoDesk, Chessel-Robocom, and PCAD, while the direct sales channel appears to be the territory of the larger turnkey vendors. DATAQUEST believes that these two sales channels require completely different types of sales and marketing strategies; and therefore we think the likelihood of one vendor dominating the total market is rather remote. However, it is reasonable to assume that the turnkey companies, with their large and relatively well-trained sales forces, will continue to dominate the direct distribution channel, while the newer start-ups will continue to capitalize on their early lead via the dealer channel.

#### CURRENT PROBLEMS

Despite the tremendous promise the low-cost CAD/CAM market holds, there currently are a number of technical hurdles that need to be overcome in order to realize the total market potential. These problems include:

- Poor graphics performance
- Non-virtual computing
- Limited storage
- Limited communications

#### Poor Graphics Performance

The absence of high-resolution (1K x 1K) graphics, coupled with the inability to effectively pan and zoom across a drawing, seriously limits the productivity of PC-based systems. Ironically enough, the type of users most frequently associated with PC-based CAD (e.g., architects and small engineering firms) usually create the densest drawings and therefore have the greatest difficulty achieving acceptable levels of productivity. The pan and zoom problem is especially troubling to many engineers because their eyes can scan a manually created drawing in microseconds whereas the PC renderings often take minutes to generate new views of a drawing. This artificial constraint usually causes a great deal of frustration and can result in total abandonment of CAD/CAM by the engineer. DATAQUEST believes, however, that an acceptable fix in the form of a board-level, add-on solution is on the way, and should be publicly available by June of this year.

#### Non-Virtual Computing

Even though the Intel 80286 used within the IBM PC AT supports virtual addressing in a protected mode, neither DOS nor Xenix utilize this facility. As a result of this non-virtual environment, CAD/CAM application programmers continually have to make compromises between functionality and performance. The PC environment is not unlike the 16-bit older-generation CAD/CAM systems (e.g., Digital Equipment's PDP-11, Data General's Eclipse), to which the CAD/CAM industry has so fervently bid farewell over the last few years. Ironically, now that the CAD/CAM vendors have sweated and slaved to move their systems into the 32-bit, virtual world, the PC beckons them to return to the days of yore when 16-bit systems were fashionable and response time was measured in the length of coffee breaks taken between keystrokes. In any event, it doesn't appear to be very likely that the turnkey CAD/CAM vendors will try to shoehorn their systems down to the PC. Rather, we believe that they will either purchase companies or packages that already run on the PC or develop new programs from scratch.

#### Limited Storage

The current PC configurations do not fully address the size limitations of storing CAD/CAM drawings and programs. Ten megabytes of hard disk is woefully inadequate when one considers that an average drawing consumes around 1 MB of storage. Forty megabytes of hard disk, the maximum allowable on the IBM PC AT, is closer to the amount required in most production applications, but that, too, could quickly be used up when one starts adding Xenix operating systems and the necessary application programs. In any case, access to larger amounts of hard disk storage is needed, either locally within the workstation or via a communication network.

#### Limited Communications

The lack of an effective means of sharing peripherals and data within a network of PCs is still a limiting factor. Although there are now a number of networks available for PCs (IBM's included), most of them pale in comparison with Apollo's Domain LAN. The Apollo LAN allows a virtually effortless ability to share peripherals, programs, and data, and contains numerous options for communicating with other manufacturers' machines such as Digital Equipment's and IBM's. Although a similar end can be achieved with a PC, the user is usually left with the tasks of doing the integration himself by patching together the necessary hardware and software pieces. This is difficult, and therefore not done very often. We believe that the CAD/CAM vendors will probably have to get into the PC communications act in a big way in order to solve these integration problems and avoid the messy user alternative.

#### IMPLEMENTATION ALTERNATIVES

While DATAQUEST believes that the PC will unquestionably play a major role within the CAD/CAM market, there are a number of implementation alternatives available other than the generic IBM PC approach. These alternatives include:

- Waiting until prices fall on 32-bit workstations
- Building a low-cost workstation
- Converting the PC to a virtual workstation

#### The Waiting Game

The waiting game is certainly the least expensive alternative from a development standpoint, but it could become very costly in terms of market share. Even when the more powerful 32-bit workstations arrive at the lower price points, DATAQUEST expects that users will demand some type of PC interface that will allow the casual user (e.g., an engineering manager) to view drawings created on the CAD/CAM system.
#### "Build-It-Yourself"

Building its own low-cost workstation is the strategy that Intergraph has adopted for addressing this marketplace (see the DATAQUEST CCIS newsletter #67, entitled Intergraph--Four New Significant Products" dated October 31, 1984). The Interpro 32 combines 32-bit virtual computing under a UNIX environment with the ability to run PC programs under MS-DOS. Coupled with its unbelievable \$20,000 price tag, we expect this product to be a big winner in the low-cost arena. The only missing piece in the Interpro 32 is that it currently does not run any of Intergraph's CAD/CAM software locally. DATAQUEST expects, however, that Intergraph will eventually support its software on the Interpro 32.

#### PC Conversion

Another rather interesting alternative for solving the low-cost puzzle is to transform the PC into a 32-bit, virtual computer. OPUS Systems, a start-up in Los Altos, California, has developed a board set that plugs into the IBM PC and allows users to run full 32-bit, virtual UNIX applications. The process of porting large CAD/CAM programs to the PC environment is greatly enhanced with this product. In addition to Futurenet Corporation, which has already implemented a PC-based CAD/CAM system using the OPUS board set, DATAQUEST expects that a number of other CAD/CAM vendors are likely to take advantage of this low-cost alternative.

## DATAQUEST ANALYSIS

DATAQUEST believes that the PC will have the following effects on the different types of companies within the CAD/CAM market:

## Traditional Turnkey Companies

Since the turnkeys have evolved from the era of \$100,000 workstations, they are not overly elated about the prospects of selling \$10,000 CAD/CAM systems. Nevertheless, the aggressively priced IBM PC AT, coupled with the smaller start-ups such as AutoDesk, T&W, and PCAD moving into the turnkey's hallowed installed bases, signals that the low-cost race has officially begun. When considering that the larger engineering and manufacturing establishments contain the greatest unit potential, the turnkeys are likely to be the major benifactors since their large, direct sales forces are the most expeditious way of reaching this group.

The major challenges for the turnkeys in the PC marketplace as we see them will be:

- Training their existing sales forces to sell low-cost systems effectively
- Differentiating low-cost, PC-based products from their other more expensive solutions

#### PC-based CAD Vendors

Although the smaller PC-based CAD vendors were first out of the starting block, staying ahead of the pack will be difficult. Provided that the larger turnkey companies supply good interfaces in and out of their larger systems, it will be very difficult for the PC-based vendors to penetrate the turnkeys' installed bases and new sites that require an end-to-end CAD/CAM solution. The PC-based vendors do have a significant lead, however, in establishing a dealer network. This dealer network should increase the effectiveness of the PC-based vendors to reach the smaller, and more geographically dispersed establishments in comparison with the direct sales methods of the turnkey vendors.

We believe that the major challenges facing the PC-based vendors will be:

- Holding off the charge of the turnkey vendors
- Retaining and expanding their dealer networks
- Providing interfaces to and from other CAD/CAM systems

#### Workstation Suppliers

The major market for the workstation companies exists as OEM suppliers to the CAD/CAM vendors. Consequently, the PC AT and other forthcoming products will have a profound effect on their financial well being. We expect that the major challenges the PC will present to the workstation vendors will be:

- Addressing the low-cost market with some type of PC-compatible solution
- Retaining the loyalty of their existing OEMs

The PC CAD/CAM issue adds a whole new level of complexity to a marketplace that already suffers from an overabundance of confusion. With hundreds of CAD/CAM companies and products all vying for the engineers' desks, one wonders how sellers and buyers can break through the noise and install useful CAD/CAM solutions. One thing that seems certain however, is that the days of the \$100,000 CAD/CAM workstation are numbered.

David Burdick

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RESEARCH

NEWSLETTER

# COMMUNICATIONS/NETWORKING IN DESIGN AUTOMATION: A VITAL LINK

#### INTRODUCTION

Communications and networking have received a great deal of attention since the 1982 release of John Naisbitt's enlightening book <u>Megatrends</u>, <u>Ten New Directions Transforming Our Lives</u>. In his book, Mr. Naisbitt states that "networks are people talking to each other, sharing ideas, information, and resources. What occurs in a network is that members treat one another as peers--because what is important is the information, the great equalizer."

CAD/CAM typifies what Mr. Naisbitt points out. To satisfy the goals of information and resource sharing in CAD/CAM, more sophisticated networking technologies have become increasingly important. For these reasons, CAD/CAM, computer, and communications companies alike are focusing heavily on the role of networking in the design automation process. In this newsletter, DATAQUEST:

- Discusses the challenges faced by turnkey CAD/CAM companies when integrating communications products into a total product offering
- Examines the communications/network product offerings of five major turnkey CAD/CAM companies: Applicon, Auto-trol, Computervision, Intergraph, and McAuto (CIMTECH)

#### DIMENSIONS AND RELATED CHALLENGES OF COMMUNICATIONS

A turnkey CAD/CAM company must choose from numerous communications strategies. Figure 1 illustrates the dimensions of communication that dictate a turnkey company's decision path when integrating communications products into total CAD/CAM product offerings. We believe that the areas shown in the figure are those that must be addressed by a turnkey company that wishes to offer as much of an integrated approach as possible to CAD/CAM users.

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DIMENSIONS OF DATA COMMUNICATIONS



Source: DATAQUEST

The first dimension deals with networking in terms of local and remote communications:

- Local communications
  - Communications that use hard wiring between computing devices (e.g., device-to-device RS-232-C connections) in a local setting
  - Local area networks (LANs)
- Remote communications
  - Require the use of modems, which facilitate communications by way of dial-up or leased telephone lines, public data networks, or satellite links

Within the broader context of local or remote networking falls the second dimension--the need for communications between CAD/CAM computing devices. Before the advent of the intelligent, standalone workstation, using a host computer with a basic graphics terminal or semi-intelligent workstation was the only way to implement CAD/CAM applications. DATAQUEST believes that the standalone workstation will become the computing device of choice for many CAD/CAM users. We forecast a 73 percent CAGR in revenues between 1984 and 1989 for standalone workstations used in CAD/CAM applications and a 36 percent CAGR in the host-dependent segment for the same time period. These growth rates apply only to the revenues of turnkey companies.

Complicating the process of communication between computing devices are factors that relate to the third dimension of communications. The factors that warrant the most attention by the major CAD/CAM companies are as follows:

- A turnkey's total product offering might consist of several CAD/CAM systems, each possibly using a different CPU and/or operating system.
- The omnipresence of IBM in data processing centers and now CAD/CAM settings means that another set of communications rules is needed to provide compatibility with IBM's proprietary systems network architecture (SNA).

In Figure 1, these two factors are shown as communications "across product lines" and "IBM" respectively. The multivendor category shown in the model rounds out the third dimension and refers to communications between two different turnkeys' systems, or between one turnkey's system and an unrelated computer system (not including IBM).

## Meeting the Challenges through Standards

The challenges presented by the different dimensions of communications can usually be minimized by adhering to standard approaches. Many of the standardized approaches that are suitable for CAD/CAM have evolved from the Open Systems Interconnection (OSI) model for communications. Figure 2 illustrates some of the more frequently implemented standard approaches for communications in CAD/CAM.

As shown in Figure 2, standards activity has focused mainly on specifications for physical and data link connections of computer devices (layers 1 and 2 of the OSI model), and more recently, for layers 3 through 5. Consequently, the Transport Control Protocol/Internet Protocol (TCP/IP), Xerox Network Systems (XNS) protocol, and National Bureau of Standards (NBS) protocol, will likely become de facto standards for local communications (most notably for Ethernet-based networks).

Lately, the lack of standardization for network services (layers 6 and 7 of the OSI model) has been the focus of attention in communications circles, and for good reason. It is in these higher levels that most communication incompatibilities exist. Several standards-setting organizations, with the participation of CAD/CAM, computer- and communications-related companies, are working vigorously at standardizing higher-level services.

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## Figure 2

MULTIVENDOR PROTOCOLS UNDER OSI

# **OSI Layer** • File Transfer Terminal Emulation 6--7 Program-Program Electronic Mail (Layer 4 Only) Xerox XNS TCP/IP NBS 3-5 X.25 802.5 Token Ring Public Data | Network (PDN) Broadband) Ethernet) 802.3 eased 802.4 Lines C al 1-2 LOCAL REMOTE

Source: DATAQUEST

DATAQUEST recently interviewed ACC, a communications company based in Santa Barbara, California, with a LAN research center in Soquel, California. The work being done at ACC is a good example of the efforts being made in the area of solutions for network services.

The company's sole purpose is to develop interconnections for heterogeneous computing equipment, with special emphasis on interconnections for CAD/CAM equipment. ACC keeps close tabs on development of the higher-level layers (6 and 7) of the OSI model, so its products follow on the heels of any new developments. At ACC's LAN center, computers are disassembled, Ethernets and intelligent communication controllers are inserted in them, and the computers are then reassembled and made to talk with each other.

ACC has developed a family of products (ACCES) that consists of modular hardware and software packages designed for multivendor, multioperating system environments. Most of the ACCES products encompass the TCP/IP and XNS bit-oriented protocols for solutions relating to layers 3 through 5 of the OSI framework. To address layers 6 and 7, ACC is now offering the ACCES Network File Management System (FMS), which provides complete file management devices for VMS (VAX) and UNIX operating systems--file management being a key service that can be performed via networks. With FMS, complete files, individual blocks, and even individual records can be manipulated across a network regardless of the file management structures of the different operating systems. Every complete file transferred is accompanied by a file header that provides critical information to the receiving computer regarding the incoming file format. Thus, the network file header ensures that information is not lost as the file is moved, even though each computer may maintain different file management attributes.

ACC has only begun to break ground in providing solutions for distributed processing systems. The company's progress is significant, however, because its products cater to users of VMS and UNIX-based systems, two of the most popular systems used in CAD/CAM applications. Nonetheless, development of a universal communications interface for the higher-level network services layers, regardless of differences in computing devices or operating systems and independent of a particular network architecture (e.g., Ethernet), is still in its infancy.

# THE VENDORS: COMMUNICATIONS OFFERINGS

Tables 1 through 5 at the end of this newsletter correspond to each of the five selected companies and their specific communications offerings. Table 6 combines all the products that are unique to the individual companies.

DATAQUEST found while researching the companies selected for this newsletter, that each has embraced specific industry-standard approaches where possible as a basis for certain communications offerings. This phenomenon is reflected in each of the tables corresponding to the selected companies.

#### Applicon, Inc. (Table 1)

Applicon's communications offering provide a simple, straightforward method for configuring a network of its Digital Equipment-based systems. The company continues to hold true to its Digital Equipment commitment and, as one might expect, a DECnet-oriented communications scheme. The recent announcement of a standalone workstation product (ARIA) based on Digital Equipment's 11/730 processor, further indicated Applicon's commitment.

DATAQUEST believes that the ARIA announcement signals an important move toward taking advantage of the current demand for lower-cost standalone solutions, but that it will by no means be Applicon's final answer to satisfy this market demand. Furthermore, DATAQUEST does not anticipate any major departure from Applicon's current orientation toward Digital Equipment-based CAD/CAM offerings. However, should Applicon decide to bring a different CPU/operating system into its fold, the communications platform would incur new challenges. Applicon would need to consider a broader-based approach to communications. Decisions relating to additional networking software and/or hardware offerings, and a choice of whether to develop its own or source from a third-party communications vendor (or a combination of both), would be inevitable. Additional cost considerations would naturally follow from any such decisions.

#### Auto-trol Technology Corporation (Table 2)

Early on, Auto-trol recognized a major advantage inherent in the Apollo-based line of products: equal distribution of computing power of high-performance, across а network standalone engineering workstations. Auto-trol combined its strengths in graphics software offerings with Apollo's DN series standalone workstations and proprietary DOMAIN network scheme, which brought the announcement in 1981 of Auto-trol's Advanced Graphics Workstation (AGW) line of standalone systems. This made Auto-trol the first major turnkey CAD/CAM vendor to offer such a system.

The Apollo-based DOMAIN networking scheme provides transparent network-wide access to all resources connected to the ring. DOMAIN also supports network-wide demand paging, thereby allowing users to share programs and data without having to maintain multiple copies.

Although the DOMAIN LAN networking scheme is proprietary, both Apollo and Auto-trol have recognized the importance of providing interconnection with other network architectures. As shown in Table 2, both the Apollo-developed Ethernet gateway and Auto-trol's ATCOMM product satisfy the need for communication between Auto-trol's AGW and Digital Equipment-based systems. Both products allow Auto-trol's customers to fully exploit the capabilities of a DOMAIN network while also being able to access files or resources associated with Auto-trol's Digital Equipment-based systems.

DATAQUEST believes that future announcements from Auto-trol will include expanded capabilities for communication between AGW systems and IBM machines. Furthermore, we believe that Apollo will announce an SNA gateway some time this year, which could be the expansion Auto-trol is looking for to supplement its IBMCOMM product offering.

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# Computervision Corporation (Table 3)

During a news conference in August 1983, Computervision (CV) made public its intention to move in a direction of more horizontal integration in certain areas of its product offerings for CAD/CAM. At that conference, CV announced agreements with Sun Microsystems, of Sunnyvale, California, and IBM Corporation. These agreements later became the basis for the lower-cost CDS 3000 and high-end CDS 5000 systems, both of which were announced during May 1984. During 1984, CV also announced its decision to market the MEDUSA product, which runs on a Digital Equipment VAX 11-750. In line with this integration shift, CV is now obtaining more communications products through third-party sources.

An Ethernet-based networking approach, used in CV's proprietary CDS/M product, provides the backbone for most CV-based local communications implementations. However, that backbone only extends so far. What may not be immediately obvious is that the CDS/M product does not extend full resource and information sharing capabilities to a CDS 3000 system, across a LAN containing other CV systems. Although a CDS 3000 system is able to share the same Ethernet LAN cable with other CV systems, only the DESIGNER V-X, CDS 4000, and CDS 5000 are able to fully utilize a CDS/M implementation. The inability of CADDS 4X to support the UNIX operating system (UNIX being standard on all CDS 3000 systems) imposes many of the restrictions on CDS 3000 systems in terms of communicating with other CV systems running CADDS 4X. DATAQUEST believes CV will eventually offer CADDS 4X on its CDS 3000 systems, which should resolve the communications shortfall.

The high-end solution provided through the use of CV's CDS 5000 system poses additional communications challenges. DATAQUEST believes that CV now has in place the communications products necessary to achieve its initial goal, which was stated during the announcement of its IBM VAR (value-added remarketer) agreement in August 1983: to provide a greater magnitude of data management capability for product engineering and manufacturing data bases. CV combined the interactive graphics capabilities of its CGP process line (found in the CDS 4000 series) with the data base management capabilities of IBM's 43XX Series processors as the basis for its CDS 5000 offering. This combination requires several key communications elements in order to achieve integration. These elements include a channel connector device that allows the IBM processing unit to share an Ethernet-based CDS/M network and, more importantly, the CDS-R ACCESS software package for the CDS 4000 or DESIGNER V-X interface to CV's data base management program (Product Data Manager) on the IBM unit.

DATAQUEST views the CDS 5000 offering as a sure bet where the CDS 4000 and/or DESIGNER series are already installed and customers need additional data base management capabilities (the incorporation of an IBM 43XX series processor would be the only major addition). However, in light of the activity related to IBM VAR agreements in the CAD/CAM industry (see the CCIS newsletter number 73) over the past few months, DATAQUEST believes that CV will have to provide a broader range of functionality on the CDS 5000 system beyond the current data base management functionality offered on the 43XX series processors. A

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customer's willingness and ability to justify the time and dollar investments that would accompany the purchase of a CDS 5000 (particularly in products for communications) will, to a great extent, determine the success of the CDS 5000 platform.

CV is the first of the major turnkey CAD/CAM vendors to bring the IBM PC AT system into its product line as another low-cost solution. At this writing, communication product plans had not yet been completed for CV's IBM PC-based (PERSONAL DESIGNER) product. DATAQUEST believes that CV will announce within the next 60 to 90 days new offerings for PERSONAL DESIGNER networking capabilities with other CV systems. DATAQUEST will at that time, issue a Research Bulletin with details of the -communications offerings.

## Intergraph Corporation (Table 4)

Intergraph recently announced support for Ethernet LAN capabilities, incorporating XNS protocols for internetworking and transport services. The company will also offer support for DECnet software and the DECnet SNA gateway for communications with IBM equipment. Intergraph also stated that Ethernet capabilities will be standard in all Intergraph hardware products shipped after second guarter 1985.

DATAQUEST views the Intergraph communications product announcements as being natural extensions of its already strong Digital Equipment-based product platform and particularly the new INTERPRO 32.

Previously, Intergraph's communications platform was limited to a key offering that included a proprietary high-speed concentrator unit incorporating Intergraph's INTERNET software. Intergraph's lack of communications offerings prior to the Ethernet announcement obviously did not hamper its ability to maintain a phenomenal year-to-year growth rate. DATAQUEST estimates that Intergraph's average annual growth rate during each year from 1980 through 1984 was approximately 78 percent.

As is the case for most companies offering VMS and UNIX-based CAD/CAM systems, Intergraph should be able to capitalize on a range of commercially available communications products using industry-standard protocols, which allow for higher-level (network services) compatibility across networks containing these operating system types. DATAQUEST believes that Intergraph's announcement of its plans to incorporate the bit-oriented XNS and TCP/IP protocols into its overall communications platform is further indication of the company's plans to embrace industry standards as an approach to communications implementations in the future.

#### McAuto (Cimtech) (Table 5)

McAuto's approach to communications appears to be tightly integrated, and at the same time, highly flexible.

Standard DECnet software from Digital Equipment and XODIAC software from Data General (DG), using Ethernet as a backbone, have been optimized on the higher levels (for network services) with the addition of McAuto's TC2 software interface. This communications interface allows a McAuto workstation user to access UNIGRAPHICS files from any point on a network (local on remote) without having to learn special DECnet or XODIAC commands. In effect, the interface provides for extension of the UNIGRAPHICS File Manager, (UGFM), which is already familiar to McAuto users. The same directory structure is extended throughout the network, while DECnet or XODIAC perform functions in unison with, or independent of the TC2 interface (as indicated in Table 5).

McAuto's asynchronous communications software (TC2/ASYNC) is the common thread that not only provides a lower cost advantage over using DECnet and XODIAC software but also links heterogeneous end points together in a combined Digital Equipment/DG installation running McAuto's UNIGRAPHICS software. As with the TC2/DEC and TC2/DG interface, McAuto's TC2/ASYNC package uses the same UGFM procedures. Because of this, a network of Digital Equipment and Data General computing devices incorporating all three communications packages would be extremely transparent to the user.

The extent to which McAuto's CIMTECH group can implement a sound and timely strategy for a Digital Equipment/Data General/IBM communications environment will be a critical factor during 1985 and beyond, particularly because of the recent IBM VAR agreement.

DATAQUEST believes that at least one or two McAuto customers are currently beta testing McAuto's recently announced cross-vendor interface (TC2/XNET) for Digital Equipment/Data General/IBM communications requirements. High-speed file transfers will be available using Ethernet with only one major addition to the hardware and software combination used in other TC2 offerings. At this point, DATAQUEST believes that the addition will be in the form of an Ethernet-compatible channel connector device to provide the front-end processing capabilities necessary for the IBM connection.

According to McAuto, release of the XNET product is scheduled for third quarter 1985. The addition of XNET to its communications offerings positions McAuto as a major leader in providing transparent and integrated networking capabilities for a heterogeneous CAD/CAM computing environment.

## DATAQUEST ANALYSIS

As demonstrated by the numerous communications offerings of the five companies we examined, it is obvious that each has acknowledged the need for information and resource sharing in a CAD/CAM environment. DATAQUEST believes that these companies will continue to devote considerably more attention to communications in the future. Our belief is influenced by one important event already occurring in the CAD/CAM arena--the increased demand from users for highly responsive CAD/CAM workstations, in many cases meaning fully independent (standalone) capabilities.

Although mainframe and high-powered minicomputers will continue to play a role in CAD/CAM, we believe that the most dominant turnkey configuration within the next five years will be networks of powerful independent workstations. DATAQUEST believes that this trend has several important implications for turnkey companies previously offering only host-dependent systems but planning to include standalone systems as part of a total collection of CAD/CAM offerings. The companies must offer communications products that support capabilities for:

- Workstation-to-workstation communications (via LANs)
- Reliable file transfer capabilities (workstation to workstation, workstation to a host-based system)
- Terminal emulation procedures (workstation to an unrelated computing system)
- Gateways allowing LAN-to-LAN communications

Most of the major turnkey companies have announced products addressing the standalone workstation trend. DATAQUEST found in most cases that each of the five companies we evaluated now supports, or is planning to support, all the capabilities listed above. We view none of these capabilities as mutually exclusive, in that the absence of any of them would limit a user's ability to achieve effective information and resource sharing, and could also be detrimental to a turnkey company's successful transition from exclusively host-dependent product offerings to a combination of standalone/host-dependent (and even to exclusively standalone) offerings.

Eileen Barth

# APPLICON, INC.

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Communications <u>Environment</u>	Local	Wide Area/ <u>Remote</u>
WITHIN PRODUCT LINE:		
Digital Equipment-based to Digital Equipment-based (including ARIA workstation)*	DBCnet/Ethernet	DECnet .
	High-Speed Serial Interface Link(SIL)/DECnet	High-Speed Serial Interface Link(SIL)/DECnet
	Multipurpose Communications Controller (MCC) for asynchronous/synchronous connections	MCC for asynchronous/ synchronous communications
ACROSS PRODUCT LINES:		
Digital Equipment-based to 4000 series workstations	SIL/DECnet	SIL/DECnet
IBM:		
Digital Equipment-based to IBM	DEC/SNA Gateway	DEC/SNA Gateway
	2780/3780; HASP RJE; 3270	2780/3760; HASP RJE; 3270
OTHER PRODUCTS/SERVICES:		
On all Applicon's Ethernet-based networks	NetServer	NetServer
PUTURE STRATEGIES:		
	Broadband networking via Ethernet MAPS- like** architecture	Satellite link/ DECnet
*Standalone system offering **MAPS is General Motors' broadban environments.	d network implementation suppo	rting multi-vendor

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Source: Applicon, Inc. DATAQUEST ÷

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# AUTO-TROL TECHNOLOGY CORPORATION

Communications <u>Environment</u>	Local	Wide Area/ <u>Remote</u>
WITHIN PRODUCT LINE:		
Apollo-based to Apollo- based*	DOMAIN	ATCOMM via RS-232-C; X.25 (DOMAIN supported)
Digital Equipment-based	DECnet (point-to-point)	DECnet
to Digital <i>B</i> quifment-Dased	DECnet/Ethernet	
ACROSS PRODUCT LINES:		
Apollo-based to Digital Equipment-based	DOMAIN-Ethernet/TCP-IP Gateway	ATCOMM vía RS-232-C
	ATCOMM via RS-232-C or IEEE-488 bus	
IBM:		
Apollo-based to IBM	IBMCOM-RJE	IBMCOM-RJE
	3270 Interactive	3270 Interactive
Digital Equipment-based	DEC/SNA Gateway	DEC/SNA Gateway
-	DEC AJE Products	DEC RJE Products
	HYPERCHANNEL	
OTHER PRODUCTS/SERVICES		
Apollo-based networks	AGW Network Switch	
Apollo-based to other vendors products	ASCII procedures through AEGIS operating system to facilitate file transfer to other vendors' systems	ASCII procedures through AEGIS operating system to facilitate file transfer to other vendors' systems
FUTURE STRATEGIES:		
	IBMCOM/SNA	IBMCOM/SNA
	3770/SDLC for file transfer	3770/SDLC for file transfer
*Standalone system offering		
	Source: Auto-t	ol Technology Corporation

Source: Auto-trol Technology Corporation DATAQUEST

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# COMPUTERVISION CORPORATION

Communications Environment	Local	Wide Area/ <u>Remote</u>	
WITHIN PRODUCT LINE:			
CDS 3000 to CDS 3000*	Ethernet with TCP/IP	2780/3780	
CDS 4000 to CDS 4000	CDS/M Distributed Network Software (DNS)	FASTLINK	
	CDS/M Centralized Network Server (CNS)		
	FASTLINK		
CDS 5000 to CDS 5000	CDS/M-DNS; CNS	VM Pass-Thru Facility;	
	VM/Pass-thru Facility	Terminal Emulation Facility	
DECTONED IN to	Terminal Emulation Facility		
DESIGNER VX to DESIGNER VX	CDS/M DNS	FASTLINK	
	CDS/M CNS		
	FASTLINK		
ACROSS PRODUCT LINES:			
3000 (Medusa) to VAX	Digital Equipment/ Ethernet, MEDUSA ACCESS, MEDUSA Network Software	2780/3760	
3000 to 4000	CADDS ACCESS via RS-232-C	CADDS ACCESS via Modem	
3000 to DESIGNER VX	CADDS ACCESS via RS-232-C	CADDS ACCESS via Modem	
3000 to 5000	CADDS ACCESS via RS-232-C	CADDS ACCESS via Modem	
	2780/3780; HASP RJE	2780/3780; HASP RJE	
4000 to DESIGNER VX	FASTLINK	FASTLINK	
	CDS/M (DNS)		

(Continued)

# Table 3 (Continued)

# COMPUTERVISION CORPORATION

Communications <u>Environment</u>	Local	Wide Area/ <u>Remote</u>	
ACROSS PRODUCT LINES: (Continue	ed)		
4000 to 5000	CDS/M-DNS; CNS, CDS-R ACCESS	2780/3780; HASP RJE; 3270	
	2780/3780; HASP RJE; 3270		
DESIGNER VX to 5000	CDS/M-DNS; CNS, CDS-R ACCESS	2780/3780; HASP RJE; 3270	
	2780/3780; HASP RJE; 3270		
IBM:			
3000 to IBM	2780/3870; HASP RJE	2780/3780; HASP RJE	
4000 to IBM	CVSNA/RITS**	CVSNA/RITS	
	CVSNA/CVDMS	CVSNA/CVDMS	
	2780/3780; HASP RJE; 3270	2780/3780; HASP RJE; 3270	
DESIGNER VX to IBM	CVSNA/RITS	CVSNA/RITS	
	CVSNA/CVDMS	CVSNA/CVDMS	
	2780/3780; HASP RJE	2780/3780; HASP RJE;	
OTHER PRODUCTS/SERVICES;			
4000/DESIGNER Series to:			
Univac 1100	On-line synchronous UNIVAC 1004	On-line UNIVAC 1004	
Honeywell 6000	On-line synchronous GRTS	On-line GRTS	
CDC 6000 or CYBER	On-line synchronous UT-200	On-line UT-200	
FUTURE STRATEGIES:	÷		
		Satellite link via X.21 protocol	

\*Standalone system offering

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\*\*Remote Interactive Terminal Subsystem; may run in standalone mode or in CDS/M network mode.

 $^{\sharp}\mathrm{CV}$  Data Management Subsystem; may run concurrently with RITS in standalone or CDS/M network mode

Source: Computervision Corporation DATAQUEST 2

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#### INTERGRAPH CORPORATION

#### Communications Environment

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Local

Wide Area/ <u>Remote</u>

INTERNET/High-speed

(RS-232-C or V.35)

high-speed concentrator

Ethernet/XNS using gateways (RS-232-C or V.35)

concentrator to

DECnet

WITHIN PRODUCT LINE:

Digital Equipment-based to Digital Equipment-based INTERNET/High-speed concentrator to high-speed concentrator via coaxial cable

Ethernet/XNS

DECnet/Ethernet

Interpro-32 to Interpro-32\* Ethernet/XNS

Ethernet/XNS using gateways (RS-232-C or V.35)

#### ACROSS PRODUCT LINES:

DEC-based systems to Interpro-32

DEC-based to all Intergraph highperformance workstations Ethernet/XNS

INTERNET/High-speed concentrator to

via coaxial cable

high-speed concentrator

(RS-232-C or V.35)

Ethernet/XNS gateway

INTERNET-High-speed concentrator to high-speed concentrator via coaxial cable

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Ethernet/XNS

IBM:

DEC-based systems

DEC/SNA gateway

XNS/SNA gateway 3270 Interactive

2780/3780: HASP RJE

DEC/SNA gateway

XNS/SNA gateway

3270 Interactive 2780/3780; HASP RJE

**FUTURE STRATEGIES:** 

Support of DOD TCP/IP	Support of X.21 and
protocols in Ethernet network	X.25 in gateways

\*Standalone system offering

Source: Intergraph Corporation DATAQUEST

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# MCAUTO (CIMTECH GROUP)

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COMMUNICATIONS ENVIRONMENT	LOCAL	WIDE AREA/ <u>REMOTE</u>
WITHIN PRODUCT LINE:		
Data General-based to Data General-based	TC2/ASYNC via RS-232-C/ Gandalf limited-	TC2/ASYNC
	distance modems	XODIAC/X+20
	TC2/DGXODIAC/Ethernet	
	XODIAC/Ethernet via DG's AOS operating system	
Digital Equipment-based to Digital Equipment-based	TC2/ASYNC	TC2/ASYNC
	TC2/DECDECnet/Ethernet	DECnet
	DECnet/Ethernet via DEC's VMS operating system	X.25 supported
ACROSS PRODUCT LINES:		
Data General-based to Digital Equipment-based	TC2/ASYNC	TC2/ASYNC
IBM:		
Data General~based to IBM	2780/3780; HASP RJE	2780/3780; HASP RJE
Digital Equipment~based to IBM	2780/3780; HASP RJE	2780/3780; HASP RJE
OTHER PRODUCT/SERVICES		
All systems	File server for both DG- and Digital Equipment-based networked systems	File server for both DG- and Digital Equipment-based networked systems
FUTURE STRATEGIES:		
Digital Equipment/DG/IBM	Cross-vendor network (XNET)	
		Source: McAuto DATAQUEST

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# ALL VENDORS COMMUNICATIONS PRODUCTS UNIQUE TO OVERALL OFFERINGS

Company/Product	Type of Offering	<pre>Description/Application(s)</pre>
Applicon, Inc.		
Multipurpose Communications Controller (MCC)	HW	Facilitates peripheral connections to host system
NetServer	НМ	Comprises a VAX 11/370 processor and permits auxiliary storage of data and attachment of shared resources
Serial Interface Link (SIL)	HM	Provides 1-2 Mbps transmission for workstation- to-host and/or host-to-host communications
Auto-Trol Technology Corporation		
AGW Switch	HM	Manual switch for partitioning an AGW (DOMAIN) network into multiple subnetworks; one switch recommended for every 3-5 AGW workstations
atcomm	SW	Asynchronous communications for data file transfer from AGW ring to DEC systems at 9,600 baud
IBMCOMM	SW	2780/3780 and HASP RJE, providing capabilities for graphics file transfers
Computervision Corporation		
CADDS ACCESS	ंहोंग	Enables CDS 3000 users to log on a CDS 4000, 5000, or DESIGNER-VX system and access, display, or manipulate commands, files, and data bases; processing, retrieval, and storage take place on the 4000, 5000, or DESIGNER VX system; requires separate packages: one for CDS 4000/ 5000; one for DESIGNER series
CDS/M-DNS	Hw/Sw	Ethernet-based network package that facilitates inter- connection of CDS 4000 and/or DESIGNER VX systems for data file transfer among all network nodes concurrently

(Continued)

# Table 6 (Continued)

# ALL VENDORS COMMUNICATIONS PRODUCTS UNIQUE TO OVERALL OFFERINGS

Company/Product	Type of Offering	Description/Application(s)
Computervision Corporation (Continued)		
CDS/M-CNS	HW/SW	Ethernet-based network package that facilitates management of centralized storage and peripherals; excludes use of the DESIGNER VX (Series M), CDS 4101, or CDS 4201 as network servers
CDS-R ACCESS	SW	Allows a DESIGNER VX and/or CDS 4000 series system configured with a CDS 5000 system (via CDS/M) to access the Product Data Manager (PDM) resident on the CDS-R (IBM host unit)
CVSNA/CVDMS	SW	Allows users on a CDS 4000 and/or DESIGNER VX series system to store and access a graphics data base on an IBM host computer
CVSNA/RITS	SW	Allows for interactive access (via SNA/3767 emulation) to programs resident on IBM main- frames, including TSO, CICS, IMS, VTAM, and VTAME
FASTLINK	SW	Synchronous data communications via direct connection or modem for disk file and message communications
MEDUSA ACCESS .	SW	Interconnection over the Ethernet network of MEDUSA (3000) workstations to VAX processing unit; enables MEDUSA user to log on to VAX and access, display, and manipulate MEDUSA commands, files, and data bases
MEDUSA NETWORK SOFTWARE	SW	Facilitates the configuration of up to six MEDUSA (3000) workstations to the VAX processing unit
Terminal Emulation Pacility	SW	3270 terminal emulation; requires presence of CDS-R ACCESS software

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# Table 6 (Continued)

# ALL VENDORS COMMUNICATIONS PRODUCTS UNIQUE TO OVERALL OFFERINGS

Company/Product	Type of Offering	Description/Application(s)
Intergraph Corporation		
INTERNET	SW	Uses high-speed concentrator units to conduct file transfers, printing, copying, and renaming at rates of 2 Mbps locally over coaxial cable, or up to 4,800 baud over phone lines
McAuto (CIMTECH GROUP)		
TC2/ASYNC	SW	Asynchronous connections
TC 2/DG	SW	An interface to Data General's XODIAC package, allowing UNIGRAPHICS users to access the resources of XODIAC transparently from UNIGRAPHICS
TC2/DEC	SW	An interface to DEC's DECnet package, allowing UNIGRAPHICS users to access the resources of DECnet transparently from UNIGRAPHICS
TC2/XNET	SW	Ethernet-based LAN incorpo- rating XNS protocol and third- party hardware/software for interconnection; combined with the UNIGRAPHICS File Manager (UGFM) to facilitate communications between DEC, Data General, and IBM machines
HW = Hardware		

SW = Software

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Source: Applicon, Inc. Auto-trol Technology Corporation ComputerVision Corporation Intergraph Corporation MCAuto (CIMTECH) DATAQUEST i.

# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 78

#### CALMA ANNOUNCES LOW-COST GDSII

Dataquest

## INTRODUCTION

Calma Company introduced its first standalone IC CAD workstation. The GDSII/32 answers Calma's competition with a low-cost, standalone, 32-bit workstation, and supports Calma's IC and PCB applications software.

This newsletter discusses the new GDSII/32 and analyzes Calma's position in the marketplace.

## BACKGROUND

For many years Calma has dominated the full-custom IC CAD market segment with its GDSI and subsequent GDSII products. It is not without competition, however. Applicon and Computervision products have gnawed away at Calma's market share. Via Systems, Metheus, and Avera (now out of business) entered the IC CAD market with low-cost products in hopes of luring business from Calma's Cadillac-priced, host-dependent systems. Recently, Daisy, Mentor, and Valid, perhaps Calma's archrivals, have all introduced and shipped full-custom IC CAD systems.

Nonetheless, Calma continues to lead the IC CAD market and maintain its position. Table 1 indicates IC workstation installed base market share through 1983. (Data for 1984 are still being compiled; however, we believe that Calma still dominates the 1984 revenues and installed base, despite a concerted effort from the EDA companies.)

DATAQUEST believes that Calma's biggest concern was not the functionality of GDSII itself, but the expensive host-dependent system on which it ran. Calma has alleviated this concern with the introduction of GDSII/32.

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#### THE PRODUCT

The new GDSII/32 workstation is based on an OEM version of Data General's MV/4000 computer. With a base price of \$95,000, the standard GDS11/32 configuration includes the following:

- Data General DS/4000
- 2-MBytes memory, expandable to 4 MBytes
- Hardware floating point accelerator
- 737-KByte flexible disk drive
- Two 5-1/4 Winchester disk drives
- 15-MByte cartridge tape drive
- Lexidata C90 graphics display
- 1,280 x 1,024 resolution, 60Hz non-interlaced
- Four bit planes providing 4,096 colors
- Alphanumeric keyboard and terminal
- Graphics tablet and pen
- Eclipse Ethernet hardware interface
- GDSII, GPLII, and CHIPS

The Company will sell the GDSII/32 as a workstation that can operate in an office environment, communicating with a host system for what Calma calls background tasks--design rules check and pattern-generation output CAM.

By late 1985, Calma plans to have the workstation support full GDSII background tasks. In this way, it can operate independently of a host computer. To maximize system throughput, Calma will offer its DRC Engine, output devices, and a file server as part of its IC CAD design environment.

## Compatibility

Upward compatibility is a major issue when broadening a product line from 16- to 32-bit hardware. Calma has addressed this issue with Data General's Agent, which allows the 32-bit DS/4200 operating system to emulate the 16-bit Eclipse operating system. The Agent allows use of existing design libraries without converting the data base.

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# Applications Software

GDSII is the core software from which CHIPS, CARDS II, and CUSTOMplus (a repackaged and renamed version of STICKS) run. The new GDSII/32 supports all three application packages and comes standard with the VLSI layout editing capabilities of CHIPS. CARDSII and CUSTOMplus are priced at \$3,000 and \$5,000, respectively. The spacer program for CUSTOMplus is priced at \$11,000.

Calma offers two printed circuit board CAD products from its electronic marketing group. Both the PCB products are quite different in terms of software and hardware. Table 2 compares the two PCB products.

While the differences between the two PCB CAD products are not overtly obvious, we believe that Calma will sell either one or the other based on the user's need for close coupling with front-end design capabilities, preference for hardware, and design requirements.

## DATAQUEST ANALYSIS

Because the EDA vendors are infringing on Calma's stature in the Electronic CAD/CAM arena, we believe that a product of the GDSII/32's class is critical to Calma's long-term success, at least in the IC CAD segment. Users' demands for relatively low-cost standalone systems created a gaping hole in Calma's IC CAD product line, which previously consisted of host-dependent products with a comparatively high cost per seat.

By the end of 1985, when Calma plans to have its background verification products running on the GDSII/32 workstation, we believe that Calma will have a competitive response to the EDA vendor's full-custom IC CAD workstations. Table 3 compares the products offered by Calma, Daisy, Mentor, and Valid.

For the GDSII/32 product to be a long-term viable solution, we believe that Calma must ensure that the following occurs:

- Data base compatibility--Compatibility must go beyond Data General's Agent, thus ensuring Calma's installed GDSII base a smooth and workable migration path from its 16-bit processors and operating systems to the new 32-bit processor and operating system.
- Closely coupled design solutions--Through the software OEMed from ECAD Inc., Calma must provide a clean integration with front-end logic design and analysis in order to remain competitive. To provide leading-edge electronic product design solutions, Calma must view its EDA, IC, PCB, and electromechanical products from a user perspective--as a single entity.

Calma needs to address the dynamic structure of the semiconductor industry and the ever-changing IC and systems design methodologies. With application-specific ICs (ASICs) and semicustom design methodologies increasing usage, we believe that Calma's IC CAD products, including GDSII, T-ARRAYS, the pre-announced standard and macro cell products, and the silicon compiler in development, will give Calma the tools with which to protect its leading position in the IC CAD/CAM segment, and perhaps even allow it to gain market share.

Beth W. Tucker

## Table 1

# 1983 IC CAD/CAM WORKSTATION INSTALLED BASE MARKET SHARE (Workstation Units)

Company	<u>Units</u>	<u>Share</u>	
Applicon	1,037	29%	
Calma	1,518	42	
Computervision	548	15	
Other	524	4	
Total	3,627	100%	

# Table 2

#### PCB CAD PRODUCTS

Component	T-Boards	GDSII/32 CARDS II
Processor	Apollo	Data General
Software Source	Omnicad	Calma proprietary
EDA Interface	Net List Extraction	STREAM and ECAD
Major Application	PCBs	PCBs, hybrids, surface-mount designs
List Price	\$100,000	\$98,000

Source: DATAQUEST

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# IC CAD SYSTEM COMPARISON

Component	Calma .	Daisy	Mentor	Valid
Product:	GDSII/32	CHIPMASTER	CHIPSTATION	SCALDSTAR
Processor :	MV/4000	80286	Apollo 660	68010
Graphics Processer:	Lexidata C90	AMD 29116	Apollo	66010
Configuration:				
Мелогу	2 MBytes	2 MBytes	2 MBytes	2 MBytes
Hard Disk	210 MBytes	80 MBytes	68 MBytes	70 MBytes
Floating Point	Yes	Yes	Yes	Not included
Resolution	1,280 x 1,024	1,024 x 826	1,024 x 1,024	1,024 x 800
Displayable Colors	16	128	256	256
Software:			۰.	
Logic Design/Analysis	N/A	Included	Not included	Not included
DRC	Host option	Yes, option	Interactive only	Yes, option
ERC	Host option	Yes, option	N/A <sup>1</sup>	In development
Pattern Generation	Host option	Stream format <sup>2</sup>	Stream format	Stream format
Net List Compare	Host option	Yes, option	N/A <sup>1</sup>	Yes, option
Symbolic Layout	Yes, option	N/A <sup>2</sup>	N/A	N/A
Communication:	Included	Yes, option	Included	Yes, option
Base List Price:	\$95,000	\$124,000 <sup>3</sup>	\$127,000	\$75,000
Option Prices:				
DRC	N/A	\$35,0004	See Note 1	\$10,000 <sup>5</sup>
ERC	N/A	See Note 4	See Note 1	N/A
PG	\$33,000 <sup>6</sup>	N/A	N/A	N/A
Symbolic Layout	\$16,0007	N/A	N/A	N/A
Communications	Included	\$5,000	Included	\$5,000
Other	\$60,000			\$25,000
	(DRC Engine)			(compiler)

## Notes:

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1. Dracula II software from BCAD, Inc., is available on the Apollo, not sold through Mentor 2. In development

3. Price includes all Logician EDA software

Price includes DRC, ERC, layout versus schematic, and layout parameter extraction
Price includes DRC, layout net list extraction, and net list compare

6. Price includes pattern generation post processor and one device-specific formatter 7. Price includes CUSTOMplus and the spacer

N/A = Not Applicable

Source: DATAQUEST

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CCIS Code: Newsletter, No. 77

RESEARCH

NEWSLETTER

3-D GRAPHICS TERMINALS--PERCEPTIONS CHANGE AS COSTS FALL

Dataquest

As the level of technical ingenuity increases, and reduces the cost and scale of a product that once was perceived as a luxury, that product soon becomes a necessity. This well-known axiom has long been the cornerstone of the high-tech industry in general, and appears ready to be applied to the 3-D graphics terminal market as well. During the past few months, a number of new or enhanced 3-D graphics products have been introduced that, by virtue of their price/performance characteristics, are too compelling for systems integrators to ignore any longer. This newsletter discusses these 3-D devices and technologies and the promising future of this market.

In the worldwide mechanical and AEC CAD/CAM market (which represents the largest market opportunity), DATAQUEST believes that these high-performance, 3-D display devices will account for 1,500 of the potential 25,000 units shipped during 1985. By 1988, we believe that 3-D unit shipments will account for nearly 50 percent of the market potential, which translates to a total of 35,000 units, as illustrated in Figure 1.

#### Figure 1

## WORLDWIDE CAD/CAM 3-D DISPLAY MARKET FORECAST



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# DEFINITION

To the casual observer, the differences between a 3-D terminal and a 2-D terminal are rather subtle. In fact, a 2-D terminal can produce the same visual effects as a 3-D terminal. The major difference between these two types of devices is that the 3-D terminal can produce and manipulate 3-D images much faster. In the not-so-distant past, 3-D applications relied heavily on the use of slower, general-purpose host computers and extensive software algorithms to simulate three dimensions. By moving these algorithms into custom-designed, high-speed VLSI chips, 3-D image generation and manipulation is fast approaching real-time performance. Table 1 illustrates the evolution of these interactive graphics functions.

DATAQUEST classifies 3-D terminals as those devices that contain the following attributes:

- 3-D geometry creation--This feature allows the local creation and rapid display of 3-D geometries that can include points, lines, circles, cubic curves, surfaces, polygons, and text.
- 3-D rotations with perspective--This function allows a model to be instantaneously or nearly instantaneously viewed from any angle by locally applying a 4 x 4 matrix transformation to the 3-D entities held in a display list.
- Local smooth shading--This capability allows a model to be processed to create a 3-D smooth-shaded, visual rendering. Methods used to perform this task can include Gouraud Shading, Phong Shading, and Ray Tracing.

While these three tests are difficult to quantify, it is clear that there is a group of graphics devices that have these characteristics. DATAQUEST considers the graphics terminals listed in Table 2 to be current members of this elite class.

#### Table 1

	Past		Present		
	Host/ Software	Local/VLSI	Host/ Software	Local/VLSI	
Applications	x		x		
Geometry Creation	X			х	
View Transformation	X			x	
Shading/Rendering	х			х	
Clipping/Scaling		X		х	
Display		<b>X</b> .		x	

#### THE GRAPHICS PROCESS PAST AND PRESENT

Source: DATAQUEST

# 3-D GRAPHICS TERMINALS--FUNCTIONAL COMPARISON

<u>Adage</u>	<u>Megatek</u>	Ramtek	Raster <u>Technologiés</u>	Silicon Graphics	<u>Tektnonin</u>
3000	9200	7119	One/380	2200	4129
1,024 x 1,024	768 x 576	1,280 x 1,024	1,280 × 1,024	1,024 <b>x 1,024</b>	1,280 x 1,024
X	X	X	X	x	X
		X	X	x	X
X		X		X,	
X		X		x	
X	x	X	x	x	X
x	x	x	x	x	x
16-bit Int.	16-bit Int.	16-bit Int. 32-bit Float.	16-bit Int. 32-bit Float.	24-bit Int. 32-bit Float.	16-bit Int.
4 x 4	4 x 4	4 x 4	4 * 4	4 ± 4	4 x 4
N/A	N/A	6.7	10	8.5	N/A
Yes	Yes	Yes	Yes	Yes	Tes
x	x	x	X	x	X
X	х	x	X	x	X
x	x				
Yes	Yes	Yes	Yes	Yes v	Yes
\$50,000	\$48,300	\$57,000	\$55,000	\$50,250	\$40,000 '
	Adage 3000 1,024 x 1,024 X X X X X 16-bit Int. 4 x 4 N/A Yes X X X X X X	Adage     Megatek       3000     9200       1,024 ± 1,024     768 ± 576       X     X       X     X       X     X       X     X       X     X       X     X       X     X       X     X       X     X       X     X       X     X       A ± 4     4 ± 4       N/A     N/A       Yes     Yes       X     X       X     X       Yes     Yes       Yes     Yes       Yes     Yes	Adage     Megatek     Ramtek       3000     9200     7119       1,024 x 1,024     768 x 576     1,280 x 1,024       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       X     X     X       Yes     Yes     Yes       Yes     Yes     Yes       Yes     Yes     Yes	Adage     Megatek     Ramtek     Technologiás       3000     9200     7119     One/380       1,024 x 1,024     768 x 576     1,280 x 1,024     1,280 x 1,024       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       X     X     X     X       Yes     Yes     Yes     Yes       Yes     Yes	Adage     Megatek     Ramtek     Technologist     Silicon Graphics       3000     9200     7119     One/380     2200       1,024 x 1,024     768 x 576     1,280 x 1,024     1,280 x 1,024     1,024 x 1,024       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X       X     X     X     X     X     X

\*Prices are quantity-one prices for the following configuration:

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- 256 colors (0 bit planes)
- All shading and transformation hardware

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• 16-bit 2 buffer

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Monitor

• Keyboard

I Mbyte of display list memory

Source: DATAQUEST

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## THE BOTTLENECKS

Since the major difference between 2-D and 3-D terminals is speed, it is appropriate to discuss where the major bottlenecks occur and how each of the vendors listed in Table 2 satisfies these conditions. Figure 2 illustrates the three major bottlenecks and a series of subfunctions commonly used in 3-D display devices to increase graphic throughput.

## Figure 2

## 3-D GRAPHICS BOTTLENECKS



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#### Geometry Creation

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This bottleneck deals with how well a graphics device matches the incoming application. The closer the graphics device matches the application program in terms of creating and manipulating geometries, the less overhead and time are required to convert application geometries to a form suitable for the display device. The major difficulty faced by graphics terminal manufacturers in this step is the wide variety of geometries employed by the CAD/CAM application builders. It currently is too costly, for example, to build VLSI support mechanisms for the dozen or so different surface types used by CAD/CAM vendors. However, there are a number of general-purpose functions that have been implemented in the various 3-D display devices to improve the throughput performance of geometry creation and manipulation. These functions include converting application coordinates to display device coordinates, tessellating or breaking up geometries into a form suitable for the display device, and providing local support for general forms of higher-order geometries, including compound curves and surfaces.

One of the more advanced devices for manipulating higher-order geometries is the Silicon Graphics 2200 Geometry Engine. This device allows nearly real-time creation and manipulation of cubic curves and bicubic surfaces (two commonly found geometries used in CAD/CAM applications). By changing any of the coefficients used to describe these geometries, the 2200 Geometry Engine can dynamically alter the shape and screen image of the model without having to reconstruct an entirely new display list.

The Ramtek 7119 offers similar higher-order geometry manipulation functionality and features a powerful geometry data base management scheme whereby groups of graphic entities can be "grafted" together and manipulated as a single entity. This feature is especially useful when creating assemblies of individual piece parts.

An interesting piece of technology on the horizon is the Insight Solids Engine from Phoenix Data Systems. This device allows the local storage and manipulation of a CSG (constructive solid geometry) description by a method called "octree subdivision." This method tessellates the CSG description into a series of cubes called "voxels," which are then manipulated by the geometry pipeline. DATAQUEST believes that this technology looks very promising for advancing the acceptance of solids modeling and is likely to be incorporated by other graphics vendors as well.

Another interesting device that addresses the geometry creation bottleneck is the Tiling Engine from Weitek (see the DATAQUEST CCIS newsletter no. 38, "Real-Time Displays and CAD/CAM: The Weitek Approach"). The Tiling Engine derives its name from the fact that it can tessellate a bicubic surface into a series of polygon "tiles" for subsequent shading and display. It is interesting to note that the Weitek Tiling Engine is being used by graphics terminal vendors and CAD/CAM application vendors alike, in addition to the Weitek floating-point chip set used by an even larger number of vendors to assist in the display coordinate transformation process.

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While there are a number of interesting approaches to reducing or eliminating the geometry creation bottleneck, this area still lags technologically behind viewing transformation and shading. DATAQUEST believes that new VLSI implementations employing a richer set of geometric primitives such as solid entities and concave polygons have yet to be developed. However, we feel that the technology and market awareness are far enough along to justify the efforts of CAD/CAM vendors to modify applications to incorporate a smoother handshake with these 3-D devices.

## Viewing Transformation

The most dramatic throughput improvement that the 3-D devices have over their 2-D counterparts is in the area of viewing transformation. By incorporating high-speed VLSI multipliers, these devices can move and rotate a moderately complex model (e.g., 10,000 vertices) in near real time. This increased level of interactivity frees the CAD/CAM user to play "what if" during the design process by providing dynamic visual feedback on how a model or an assembly will appear during motion or articulation.

One of the nice features of the solution to the view transformation problem is its relative simplicity. By using a matrix of 16 numbers (4 by 4), any coordinate can be rotated, scaled, and transformed, with perspective. This general-purpose formulation lends itself naturally to high-speed VLSI implementations, as is the case with all of the machines listed in Table 1.

The only major difference between the various vendor implementations of the solution to the view transformation problem is whether or not a floating-point internal representation is supported. Since most CAD/CAM programs use a 32-bit floating-point internal representation, an intermediate conversion step is necessary on machines that support an integer-only format. This acts as a bottleneck in terms of total system throughput. DATAQUEST expects all of the 3-D manufacturers will eventually succumb to market application demands and provide a full 32-bit pipeline for view transformation.

#### Shading/Rendering

The shading and rendering pipeline is the most computationally expensive of the 3-D graphics processes. Smooth shaded images first require a mechanism for determining color intensities by evaluating the amount of light hitting each pixel. This intensity calculation can be performed by an averaging technique known as Gouraud Shading (which linearly interpolates pixel intensity values across the face of a polygon) or by a technique called Phong Shading (which computes individual pixel intensities based on a vector normal calculation at each pixel). As one would expect, Phong-shaded images are a bit more realistic but take considerably more computation time that do Gouraudshaded images. Following the intensity calculation, each pixel must be depth tested to determine if it is in front or in back of any pixels currently residing at the particular screen location. This test is usually accomplished by employing a series of memory banks called 2 buffers, which hold the depth information of each displayed pixel for comparison against incoming pixels. The pixels that are in front are included in the picture while those that are behind other pixels in the 2 buffer are discarded.

One of today's fastest machines for generating Gouraud-shaded images is Raster Technologies' Model One/380. By using a high-speed math processor (10 megaflops per second), the Model One/380 can fully rotate, scale, transform, and shade a moderately complex model (10,000 3-D vertices) in less than one second.

As illustrated in Table 2, all of the vendors support the Gouraud method of shading and use a 2 buffer. DATAQUEST believes that the Gouraud shading method is more than adequate for meeting the needs of the mechanical and AEC CAD/CAM marketplace. However, we also believe that graphics terminal vendors need to stay close to the work being done in the ray tracing area (which has produced the most realistic computer images known today), as technical breakthroughs in price/performance will most likely create another perception shift in the marketplace.

In the near term, we expect the major technical breakthroughs in shading and rendering to focus on increasing the speed of the intensity calculations and lowering the costs. The 35 percent price decline per year of memory alone will fuel healthy cost reductions for the Z buffer component.

#### DATAQUEST ANALYSIS

With the typical graphics terminal selling for between \$15,000 and \$30,000 in the CAD/CAM market today, one could question whether the \$40,000 to \$60,000 price tags of the 3-D systems are higher than the market will accept. We believe that today's price levels are still in the luxury category for most CAD/CAM buyers, thereby limiting the current market to those who are technically courageous and have deep pockets. However, DATAQUEST expects the prices of the 3-D systems to be half of what they are today by the end of 1986. This should have a dramatic effect on the penetration of these systems in the CAD/CAM marketplace, despite the fact that the 2-D systems will also be getting cheaper.

In the interim, DATAQUEST believes that the CAD/CAM application builders need to recognize that these 3-D devices will soon become a main staple in the diets of many CAD/CAM purchasers. This emphasizes the need for the CAD/CAM vendors to begin or complete efforts to revamp existing applications to take advantage of these devices or else face the dire consequences of a starving sales force.

David Burdick

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CCIS Code: Newsletters, No. 76

RESEARCH

NEWSLETTER

## TEKTRONIX PREPARES TO TEST EDA VENDORS

Dataquest

#### SUMMARY

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Tektronix has demonstrated that it is serious about becoming a full-fledged EDA CAD/CAM vendor, as shown by its recent acquisition of CAE Systems, Inc. By pooling the resources of its CAD, workstation, test and instrumentation, and microprocessor development groups, Tektronix now has an ace that no other EDA vendor can currently claim--a large installed base of microprocessor development system and test equipment users that are more likely than not in need of front-end design automation and integration.

Assuming that the acquisition is finalized, DATAQUEST believes that Tektronix will bring the following strengths to the market:

- Test and measurement closely coupled with front-end design
- Mircroprocessor and perhaps software development integration within the design process
- Graphics and hardware expertise
- Gate array and printed circuit board layout
- Design data base and interface

#### INTRODUCTION

Tektronix Incorporated and CAE Systems Incorporated announced an agreement in principle to a corporate acquisition on January 18, 1985. Under the terms of the agreement, Tektronix will issue \$75 million of common stock to the CAE Systems shareholders and CAE will become a wholly owned Tektronix subsidiary. The acquisition is contingent upon approval from both companies' boards of directors, which are expected to reach a decision by early February.

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This newsletter will discuss the acquisition and its added dimensions to the EDA market.

#### THE ACQUISITION

Tektronix acquired CAE Systems for \$75 million, or nearly 10 times CAE's 1984 revenues of approximately \$8 million. Although CAE Systems is a privately held company and DATAQUEST is not privy to its net income and earnings per share data, we believe that the purchase price is on the high side.

Therefore, in our opinion, Tektronix has bought the potential for future opportunities. For example, if one assumes that CAE's growth will maintain the same growth curve as the EDA CAD/CAM segment for the next four years, CAE's combined revenues would be approximately \$126 million for the years 1984 through 1988. The chart below shows DATAQUEST's estimates for the EDA segment's growth rate through 1988.

		<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Percent	Increase	84%	54%	47%	43%

Thus, Tektronix has purchased a company with hypothetical five-year revenues of \$126 million for \$75 million. Tektronix obviously has the capital to make a purchase of this size, and it obviously has intentions of becoming a serious competitor in the EDA segment.

With the acquisition, Tektronix has reorganized its EDA and CAD efforts within its Information Display Group, as outlined below.

- Information Display Group, Jon Reed (Oregon)
  - CAE Systems, Phil Smith (California)
    - . Logic Design Systems, Jerry Sullivan (Oregon)

VR Information Systems, Tom Ota (Texas)

The sheer physical distance between the above organizations will make it a unique, and perhaps difficult one to manage. However, with all of Tektronix's EDA and CAD efforts reporting to Phil Smith, DATAQUEST believes that Tektronix has an opportunity to present a consolidated front on the CAD side, and integrate the resulting products with its test and instrument and microprocessor development products from the Design Automation Group in Oregon headed by Tom Long.

## WHAT CAE SYSTEMS BRINGS TO THE PARTY

CAE Systems, founded in June 1981 (refer to DATAQUEST'S CCIS Newsletter No. 32, dated 3 August 1983), shipped its first product in the fourth quarter of 1983 and had revenues of less than \$1 million. Since that time, the company's revenue has increased to an estimated \$8 million in 1984. CAE holds fifth place in the EDA CAD/CAM market segment, as indicated in Table 1.

CAE's most apparent marketing strategy is exploiting two key features of its product--the hierarchical data base and its interface capability. The hierarchical data base, which in theory is not unique solely to CAE Systems, allows engineers to design circuits at different conceptual levels and associate different process technology variables with the design. The interface capability, again not unique solely to CAE Systems, allows users to complete logical designs on a CAE system, then interface to assorted commercially or in-house developed analysis and layout tools. What is unique to CAE is the structure of its proprietary data base, and the fact that the company puts a large portion of the interface capability in the user's hands.

CAE Systems is mostly a software company, and supports its software running on hardware from Apollo, Digital Equipment, and Sun Microsystems. It is not a software-only company because it OEMs Apollo workstations and delivered an estimated 150 workstations during 1984. Because CAE supports multiple processors, it has the ability to align the application and computional requirements of its users and prospective customers with the choice of hardware that it can support.

#### Table 1

## ESTIMATED 1984 EDA REVENUE (Millions of Dollars)

Company	<u>Revenue</u>
Mentor Graphics	\$87
Daisy Systems	\$82
Valid Logic	\$48
Silvar-Lisco	\$12
CAE Systems	\$8

Source: DATAQUEST
DATAQUEST believes that Tektronix benefits from the choice of CAE Systems for the acquisition for the following reasons:

- Flexibility--CAE Systems' portable software can run on three system products currently accepted by the end-user market, and can be fairly easily transported to run on Tektronix's 6000 family of products.
- Open Architecture--CAE's software provides easy interface capabilities to users' preferences of analysis and layout tools, in-house developed software, and Tektronix's other hardware products.
- Management Finesse--CAE Systems has strong, aggressive, and strategic management, most notably, Phil Smith, CAE's President and CEO.

## The CAE Fit

While all the logistic and organizational details were not disclosed at the time of the announcement, it was stated that CAE Systems will continue to be the primary focal point of all EDA and CAD software sales. The CAE sales force will continue to sell software for the three currently supported hardware lines and presumably for the Tektronix 6000 workstation line.

DATAQUEST foresees a possible conflict between the Tektronix hardware and the others that CAE currently supports, since we believe that Tektronix would prefer to sell its own hardware for revenue, gross profit, market share, and compatibility reasons. Other than straightforward user preference, both companies must clearly differentiate the systems products from one another in terms of price and performance so as to not confuse end users.

#### DATAQUEST ANALYSIS

DATAQUEST believes that the single most significant factor in this acquisition is Tektronix's presence in the test and instrumentation markets. Table 2 indicates Tektronix's revenues by major product line, with instrument revenues constituting approximately 43 percent of 1983 and 1984 revenues.

CAE Systems, and ultimately Tektronix, benefits from the installed base because it has a ready-made prospect list. And through Tektronix, CAE now has large resources for research and development, service and support, and other EDA and CAD products and projects already underway.

## Table 2

# TEKTRONIX REVENUES BY PRODUCT LINE (Millions of Dollars)

	<u>1983</u>	<u>1984</u>
Instruments	\$ 527	\$ 564
Design and Display	455	527
Communications	209	240
Total	\$1,191	\$1,331

Source: Tektronix 1983 Annual Report

Tektronix benefits from the acquisition because it has purchased a company with proven, working software. What remains to be seen is transporting the CAE software onto the Tektronix workstation. Through CAE systems, we believe that Tektronix will strive for a new level of systems level design automation including front-end design, layout, test, and integration with microprocessor and software development systems.

Although the CAE sales force will be responsible for the sale of EDA software, we believe that the Tektronix parent will do all in its power to open doors to its current customers. To be sure, the leading EDA companies are currently calling on many of Tektronix's customers and trying to sell an integrated design solution, and none are likely to give up a sale without an exerted sales effort.

However, we believe that CAE's major sales strategies will focus on:

The Tektronix name

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- Design automation integration, from logic and analysis through layout and test
- A united front, combining the strength and integration of Tektronix's graphics and workstation, front-end logic design and analysis, instrumentation, and physical layout products
- Service and support, on the hardware side from Tektronix, and, we believe, from the soon-to-be-enhanced software side from CAE and another Tektronix subsidiary, VR Information Systems
- Open architectures, with hardware ranging from the Tektronix 6000 to Apollo, Sun, and Digital, and software interfacing to proprietary tools and in-house developed or commercially available ones

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## The Challenges

There have been rumblings that Tektronix would enter the electronic design automation segment for at least two and one-half years. Its newly acquired EDA vehicle and organization is not without major challenges, which DATAQUEST believes to be:

- Presence: Tektronix, through its subsidiaries, must quickly provide the solutions that the end-user market expects, and then some. With a 1984 worldwide installed base of nearly 5,400 EDA workstations from all EDA vendors, Tektronix can no longer afford the luxury of time as the current EDA leaders continue their strong revenue and installation growth.
- Product: The collective efforts of all concerned Tektronix organizations must provide a demonstrable, deliverable, and functional systems solution, certainly by the Design Automation Conference in June 1985.
- Personality: The small company, entrepreneurial, and agile atmospheres of the young CAE Systems and VR (a wholly owned Tektronix subsidiary since June 1983) must dovetail with the established and often bureaucratic ways of their parent.
- Positioning: Tektronix surely would prefer its 6000 family of workstations to be sold with CAE's software. Both companies must establish strategic policies concerning the sale of Tektronix hardware versus hardware that CAE currently supports.

### Impact on 1985

Due to the major efforts required of Tektronix's research and development, sales and support, and marketing staffs, DATAQUEST believes that the impact of the CAE Systems acquisition will not be felt until at least mid to late 1985. We do not expect to see Mentor, Daisy, or Valid's market shares displaced significantly during 1985.

However, in the long term, we believe that Tektronix will challenge the positions of the top four EDA companies, and all those contemplating entering the market. The industry's eyes now turn to Hewlett-Packard to observe its next move.

Beth W. Tucker

RESEARCH NEWSLETTER

CCIS Code: Newsletter, No. 75

# A SILICON VALLEY START-UP TAKES ON THE CAD MARKET GOLIATHS

#### OVERVIEW

Dataquest

Silicon Valley has spawned literally hundreds of companies with dreams of faster, better, cheaper ways of solving problems. DATAQUEST believes that the computer-aided design and drafting market is ready for some new ideas that use current technology to solve today's complex design challenges.

TASVIR, a Silicon Valley start-up, has positioned its recently introduced SUPERCADS design and drafting product to appeal to a wide variety of CAD buyers. The first-time buyer will find a low-cost, low-risk entry system based on the IBM PC AT, with most of the CAD functionality of larger systems. The CAD veteran will find a system that addresses his expectations in key areas such as ease-of-use, data base access, and hardware configuration flexibility--all at less than \$50,000 per seat. A unique product feature gives buyers familiar with Computervision's CADDS4 an easy transition path to SUPERCADS.

TASVIR is focusing on the price/performance curve in providing a basic three-dimensional design and drafting function on a full range of system types. Assuming that TASVIR can also meet the growing expectations of its customers in other CAD/CAM applications, such as numerical control and finite element modeling, as well as balance business operations for sales, support and development, we believe that it can be a contributor toward helping industry solve its design requirements.

TASVIR'S SUPERCADS product is targeted for mechanical and architectural engineering construction (AEC) industry applications. By focusing its product into these markets, TASVIR has positioned itself to go after the largest segment of the worldwide CAD/CAM market. Nearly 70 percent of 1984 worldwide CAD/CAM revenues were spent on mechanical and AEC applications. In 1984 this represented more than \$2 billion, which DATAQUEST believes will grow to nearly \$7 billion in 1988. (See Figure 1.)

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## Figure 1

# ESTIMATED WORLDWIDE CAD/CAM MARKET REVENUE



(Billions of Dollars)

## Source: DATAQUEST

#### PRODUCT OVERVIEW

SUPERCADS is a 3-dimensional wire frame, surface modeling, and drafting software package. It is designed to be used both for mechanical component and assembly design, for AEC design and the resulting documentation such as detail drawings, layouts, assemblies, illustrations, and plan or elevation layouts. Written entirely in "C" language, SUPERCADS follows the SIGGRAPH CORE standard for graphics.

TASVIR's product philosophy is based on eight major features that DATAQUEST believes are important to the CAD/CAM and AEC marketplace:

- Processor and graphics display device independence is possible via an open system architecture that allows easy installation on a variety of processors and display devices.
- The unbundled software offering provides marketing flexibility for direct sales to end-users and joint marketing arrangements with hardware vendors.

- System performance is designed to be similar for drafting and design independent of the processor, with the larger systems supporting more users. Hardware selection is based on other application requirements or preference.
- A dynamic, menu-driven user interface is easy to use and learn for either full-time or casual users.
- The design process is enhanced by a 3-D modeling operation that is integrated with a drafting function for efficient drawing construction.
- An interface to commercial relational data base managers is provided for effective design, drawing, and data base control. Note: the ELXSI 6400 installation has a fast data base manager built into the hardware.
- The data base structure has been designed for efficient direct interface to other systems. A Computervision (CV) CADDS3, 4, and 4X interface to SUPERCADS has been demonstrated, and additional interfaces to CADAM and Calma are under consideration.
- Command syntax in SUPERCADS is similar to the CV CADDS4 system. This creates an opportunity for TASVIR to address the existing add-on market.

## COMPANY BACKGROUND

## Strategic Philosophy

SUPERCADS is intended to be a full-function mechanical CAD system priced within reach of most mechanical design engineers, draftsmen, and architects. According to TASVIR President Shyamal Roy, "The ambition of TASVIR is to be a value-conscious company that can provide straightforward solutions to the CAD/CAM/CAE marketplace." This philosophy and product goal have been the primary guides in product development since May 1982 when Mr. Roy started TASVIR.

## The Seed

Starting with \$2.5 million for research and development, TASVIR has remained an independently owned company. The seed money came from a multibillion dollar Scandinavian telecommunications company. This equity investment has been negotiated into a long-term note, leaving company ownership to the principals and personal backers. The pride of ownership and resulting sense of control is evident in discussions with the management team. Apparently this view is shared by several end users and equipment suppliers, who have expressed interest in extending additional financial support.

#### The Executive Team

- Shyamal Roy, President
  - 19 years experience in information processing, product development, and marketing support
  - Manager of Technical Operations (Europe), Itel Corporation
  - Participated in IBM System/370 development of IBM World Trade Corporation
- Hash Patel, Executive Vice President
  - 18 years experience in high-technology industries
  - Served in variety of engineering and management positions at National Semiconductor, Motorola, Intersil, and GTE Sylvania
  - Well-known figure in Silicon Valley financial circles
- Ben Chaudhuri, Vice President of Software Engineering
  - 14 years experience in CAD development
  - Managed software development at Computervision
  - Founder and vice president of ISO Graphics, Inc.

Using a circular management concept, this team is directly involved in day-to-day operations of the company. Mr. Roy, Mr. Patel, and Mr. Chaudhuri all have areas of expertise that complement each other. In DATAQUEST's opinion, their combined 51 years of experience provides a sound basis for future growth and development.

#### MARKETING STRATEGY

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TASVIR has built a two-tiered marketing strategy. The first tier involves a general CAD package that has an open system architecture which allows implementation on a variety of processors and display hardware, and is structured to cost less than \$50,000 per seat. DATAQUEST believes that this is a sound strategic move now, and will grow in importance as newer, higher-performance computers and display devices become available.

The second tier of the company's product development strategy addresses the Computervision add-on business opportunity. With minimal training expense, existing Computervision CADDS4 users can operate SUPERCADS. In addition, CADDS4 drawing files can be transferred directly to the SUPERCADS data base for revision. We believe that this will encourage potential add-on customers to take a close look at SUPERCADS' functionality, performance, and cost.

# Pricing

The list price of a system based on SUPERCADS is relatively easy to estimate--it is the number of seats required multiplied by \$45,000. This will vary slightly up or down depending on the processor or display required, but provides a ballpark number.

Below are typical hardware/software configurations using TASVIR's product, including pricing information.

- An IBM PC AT with a Tektronix 4107 and SUPERCADS lists at \$29,000 to \$33,000 depending on software options. It provides a good evaluation, low-risk entry into CAD and is also effective for large-volume configurations.
- All node types from Apollo can operate SUPERCADS; cost is \$18,000 per node for software. This system is effective in a network environment or for those with Apollo preference.
- Silicon Graphics Inc. supports SUPERCADS on its new 2000 series workstations. Package price is about \$58,000. The higher cost per seat is justified by the dynamic display performance that increases user productivity.
- SUPERCADS also supports the Digital Equipment Corp. VAX family of processors. The Digital catalog of engineering software complements SUPERCADS, making this configuration effective for multifunction applications. Software cost is \$25,000 for the first user, going to \$80,000 for SUPERCADS on an 11/780 that supports eight users.
- ELXSI 6400 is a high-performance processor that supports up to 16 users. With \$100,000 for SUPERCADS and about \$550,000 for the processor and peripherals, this represents a cost per seat of about \$41,000. The built-in relational data base and computation power for analysis makes this a strong engineering tool.

## Distribution

- The first distribution channel is direct sales to end users by the TASVIR sales staff. End users such as Martin-Marietta and Varian have embraced the TASVIR approach. Martin has recently added 50 workstations running SUPERCADS on ELXSI and Tektronix hardware.
- TASVIR is setting up joint marketing arrangements with some leading hardware manufacturers. Working agreements of this type have already been reached with Apollo and ELSXI and more are pending. DATAQUEST thinks that the CAD/CAM market is ready for well-integrated PC-based systems, and that developing a joint marketing agreement with a major PC supplier would be a good strategic move by TASVIR.

DATAQUEST believes that the distribution channels are typical and appropriate for TASVIR at this time. However, we see the low-cost, PC-based product creating a demand for a new distribution process in the future.

## DATAQUEST ANALYSIS

Although the mechanical CAD/CAM arena has more than 50 vendors, DATAQUEST believes that the 36 percent compound annual growth rate in revenue will continue to make room for new companies.

Using the collective experience of its founders, TASVIR has effectively positioned its first product and has come up with some ideas that have unique or strategic impact.

- We expect that the less than \$50,000 per seat price will attract the next tier of potential CAD users. It will also be attractive to current users with significant expansion plans, particularly if they own CV CADDS4 systems. The user interface and data base are directly compatible according to TASVIR.
- The open system architecture allows SUPERCADS to be installed on a variety of processors. This applies to several of the most popular processors available now and will allow TASVIR to implement SUPERCADS on newer, faster, lower-cost systems as they become available.

TASVIR's approach represents an emerging trend in the CAD/CAM industry, in which a start-up will use the latest programming techniques on current hardware to package a low-cost, well-performing system compatible with a leading system. Historically, brand loyalty has existed in the user environment at near evangelic levels. However, we believe that low-cost alternatives with good performance, direct access to the archival data base, and minimal training impact will definitely cause some soul searching.

TASVIR is a Sanskrit word meaning "image." The image of a successful CAD vendor is growing in Mountain View, California. If TASVIR can maintain its current momentum in providing product enhancements, support, training, reliability, and new development in numerical control, finite element modeling, and solid modeling, we believe that it will continue to grow.

Michael J. Seely

CCIS Code: Newsletters, No. 74

**RESEARCH BULLETIN** 

## DAISY SYSTEMS ACQUIRES VULCAN SOFTWARE PLATFORM FOR ELECTROMECHANICAL STRATEGY

Dataquest

Daisy Systems' acquisition of Vulcan Software (Campbell, California) from Object Recognition Systems (Princeton, New Jersey) flags the initial movement of one of the major electronic design automation (EDA) vendors into the electromechanical CAE market.

Daisy purchased all outstanding shares of Vulcan Software for \$2.3 million in stock and cash.

As a result of this purchase, Vulcan becomes a wholly owned subsidiary of Daisy and will operate as Daisy's Electro/Mechanical Division. The newly formed division will be under the direction of David Albert, founder and president of Vulcan Software.

DATAQUEST views Daisy's acquisition of Vulcan as a significant move in establishing a solid foundation for the new product division. The new division's products, although not yet announced, will address electromechanical packaging and design.

The Vulcan product, an integrated software package based upon solids modeling technology, will provide Daisy and its customers with an integrated solids modeling data base. DATAQUEST sees these tools as being essential in taking system design through packaging and fabrication. The integration of the Daisy and Vulcan products should provide electromechanical engineers with tools that address design and fabrication problems concerning heat, power, noise, and size constraints.

DATAQUEST believes that the strategic direction of this integration will close the traditional gap between the systems designer and the electromechanical engineer.

In a separate announcement, Daisy revealed that it will release a printed circuit board CAD product in early 1985. This product has been developed by Daisy's Israeli Development Center and represents the initial offering from this group, which was formed in 1983. Daisy's PCB package will be released from the Physical Layout Division, headed by Harvey Jones.

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With the new products from the Electro/Mechanical and Physical Layout Divisions, Daisy will be able to provide a set of design and analysis tools to meet the needs of engineering services departments within electronic systems houses.

#### ANALYSIS

DATAQUEST views the following items as significant to the Daisy-Vulcan product integration:

- The acquisition reinforces Daisy's commitment to provide a full complement of solutions for the design of electronic systems. Daisy appears to be destined to deliver a very broad product offering which, in some cases, incorporates third-party software or third-party hardware.
- The acquisition of Vulcan underlines Daisy's consistent strategy of announcing products that are not only cost effective and timely, but also market driven.
- When announced, the products of the Electro/Mechanical Division will most likely run on Daisy's high-end LOGICIAN product line.

Based on DATAQUEST's perspective of the marketplace, we note that:

- Daisy will fulfill 100 percent of the obligations that Vulcan currently has in place, such as Vulcan's agreement with Gould Computer.
- Although Daisy is not recognized as a major player outside the EDA environment, these new announcements will certainly position it against the traditional turnkey companies that have sold successfully in the electromechanical market.
- In addition, it is well known to DATAQUEST that the Vulcan software offering provides drafting, design, and numerical control modules based upon solids modeling methodologies. Hence, this platform could be reused at a later time to participate in the mechanical market, competing against companies that have been traditionally successful.

DATAQUEST predicts that this new venture will be a very positive move for both Daisy and Vulcan in that the parties may now leverage both the excellent engineering at Vulcan and the market and sales savvy of Daisy.

James Newcomb

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CCIS Code: Newsletter, No. 73 Rev. 1/18/85

RESEARCH

NEWSLETTER

## MCDONNELL DOUGLAS' CIMTECH AND IBM . . . NOT JUST ANOTHER VAR

### OVERVIEW

The McDonnell Douglas CIMTECH (Computer Integrated Manufacturing Technology) group, formerly named McAuto, has announced support of its UNIGRAPHICS II Mechanical CAD/CAM software on the IBM 4361 family of processors. In addition, CIMTECH stated that it will use the IBM 5080 graphics terminals as the front end for its IBM-based UNIGRAPHICS II offering. DATAQUEST believes that this announcement is significant because this is the first full-function mechanical CAD/CAM system to be offered on IBM hardware by a turnkey vendor.

Recognizing the emergence of IBM in the host-based CAD/CAM systems market (as illustrated in Figure 1), and the customers' increasing desires to interface their CAD/CAM systems to the IBM-dominated data centers, CIMTECH is capitalizing on an opportunity that it feels will generate an additional \$100 million in revenue over the next two years.



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## THE ANNOUNCEMENT

Delivery of the new IBM-based product will begin during the second quarter of 1985 and will include the full functionality of UNIGRAPHICS II running on the IBM 4361 under VM/CMS. Initially, CIMTECH expects to deliver a high-level interface module in the fourth quarter of 1985 that will fully support advanced 5080 display list hardware features such as panning, zooming, and 3D rotation.

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The 5080 workstation will also be configured with only one viewing screen. Thus, the text menus and graphics appear on the same screen, unlike the traditional two-screen CIMTECH offerings. The user, however, will have full control over the screen orientation, which includes the ability to position the menus anywhere on the screen and choose if the menus are to be opaque or translucent with respect to the model graphics. Allowing a user to customize the screen orientation is a very powerful feature that is rapidly becoming commonplace among the newer generation CAD/CAM systems.

While the base UNIGRAPHICS II software will be CIMTECH's initial offering, other CIMTECH application packages such as UNIPCB and UNISOLIDS will follow soon after the initial delivery period. In addition, DATAQUEST believes that support for other IBM processors, including the large 308X, would be a natural follow-on provided that CIMTECH chooses to support UNIGRAPHICS II on IBM's MVS operating system. DATAQUEST also believes that other revenue-producing alternatives could be realized if CIMTECH were to unbundle its software, especially when selling into the large IBM data center-type accounts.

## PRICING

The price range for the new McDonnell Douglas offering was announced to be between \$400,000 and \$800,000, depending upon configuration. A four-workstation system priced at \$600,000 includes the following components:

- IBM 4361 Model 5 processor
  1-5088 graphics controller
- 8MB memory
- 4-5080 color graphics workstations
- 730MB disk with controller
  VM/CMS operating system
- 1,600/6,250-bpi tape
  Fortran compiler
- Line printer
  UNIGRAPHICS II

A comparable CADAM configuration with CADAM's new 3D interactive software lists for approximately \$510,000.

# ANALYSIS

DATAQUEST believes that CIMTECH's offering represents much more than the typical IBM VAR arrangement. The basis for our thinking here is found in Table 1. When examining the current IBM-based product offerings, CIMTECH offers much greater end-to-end functionality for mechanical CAD than the predominantly niche-oriented, data base solutions of the other IBM VARs. DATAQUEST believes that this is significant in IBM-based end-use sales situations because CIMTECH can leverage its broader-based functionality against competitive offerings requiring additional satellite processors. By not requiring the use of other processors, CIMTECH avoids all the associated communications bottlenecks and pricing disadvantages.

## Table 1

## IBM-BASED CAD/CAM PRODUCT MATRIX

Vendor	IBM <u>Relationship</u>	IBM Hardware <u>Products</u>	Vendor Products
Computervision	VAR	43XX	Data Base Management, Group Technology, FEA
Calma .	VAR	4361	Data Base Management
CIMTECH	VAR	4361, 5080	Mechanical CAD/CAM, Solids, FEA, PCB
CADAM, Inc.	IBM-supported software	43XX, 308X, 5080, 3250	Mechanical CAD/CAM, Piping, FEA, PCB
Matra Datavision	VAR 👻	43XX, 5080	Mechanical CAD/CAM, Solids,Data Base Management, FEA, Kinematics
SDRC	IBM-supported software	43XX, 308X, 5080, 3250	FEA, Solids
Dassault Systems	IBM-supported software	43XX, 308X, 5080, 3250	Solids, Kinematics, Drafting
IBM (CBDS)	IBM product	43XX, 308X, 5080, 3250	PCB
IBM (Fastdraft)	IBM product	7361, 3250	Drafting

Source: DATAQUEST

With regard to future CAD/CAM offerings, DATAQUEST believes that CIMTECH's system is the beginning of a new wave of IBM-based solutions. We expect the following IBM-based CAD/CAM related events to occur during 1985:

- More announcements of IBM-based mainframe compatibility by the turnkey vendors
- Increased levels of start-up activity to provide IBM-mainframe based CAD/CAM solutions
- IBM's announcement of a distributed, 32-bit, virtual computer system with integrated bit map graphics.

In light of what we expect to occur next year, McDonnell Douglas' CIMTECH appears to be well positioned.

David B. Burdick

CCIS Code: Newsletter, No. 70

BULLETIN

RESEARCH

# DIGITAL ANNOUNCES ITS MOST POWERFUL PERFORMER--THE VAX 8600

On October 31, 1984, Digital Equipment Corporation announced a 32-bit processor called the VAX 8600 (known as Venus while in development). The 8600 is a high-end supermini that has 4.2 times the performance of a VAX-11/780 at only twice the price. The CPU technology is ECL (emittercoupled logic) using macrocell arrays that are designed and manufactured by Digital. The system is priced at between \$450,000 and \$970,000 depending on the configuration. A single CPU is priced at \$351,000 without peripherals or memory. Digital Equipment is expecting to start volume shipments in April.

This is the eighth and most powerful computer to be announced in the VAX product line and the first system designed for large-scale computing. The VAX 8600 provides fast throughput in scientific and technical applications. DATAQUEST believes that this is a significant product introduction because it now allows the company to offer a single product line with a single operating system to span application requirements from the desk to the data center.

#### PRODUCT CHARACTERISTICS

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The VAX 8600 has the following product characteristics:

- Supports the full VMS operating system
- Supports 32 Mbytes of memory using 256K RAM chips (upgradable in 4-Mbyte increments)
- Supports up to 160 Gbytes of storage
- Utilizes a 16Kb associative high-speed write-back cache
- Provides four-state pipeline architecture that allows overlapped execution and decoding for address and instructions
- Provides two separate SBI (synchronous backplane interconnect) buses and a separate bus for memory

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- Uses the same packaging and requires the same floor space and approximately the same power as the VAX-11/780
- Supports up to 512 communication lines

## CONFIGURATION

The typical system configuration is as follows:

- CPU
- 12 Mbytes of memory
- 456 Mbytes of disk drive using RA81 disks
- HSC50 mass storage server
- Floating-point accelerator
- Magnetic tape drive--TA78
- The system is priced at \$450,000 for the above configuration.

#### DATAQUEST ANALYSIS

Digital Equipment is focusing its marketing efforts for the VAX 8600 on technical applications, the office, and commercial markets. This system expands the VAX computer line, which runs the VMS operating system on all models from the MicroVAX to the VAX 8600.

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A configuration of eight VAX 8600s using the VAXcluster has the approximate performance of the IBM 3084. This VAX 8600 configuration would cost \$6.7 million; the IBM 3084 is priced at approximately \$10 million. A VAXcluster makes it possible to balance I/O and processing loads among as many as 16 VAX systems and intelligent mass storage controllers.

DATAQUEST believes that this is a significant announcement for Digital and represents a turning point for the company in servicing the commercial mainframe needs of its customers. The use of the VAX 8600 with the VAXcluster provides the performance Digital needs to compete in the mainframe arena. The introduction of the VAX 8600 will force Digital's traditional competitors (Data General, Gould SEL, Perkin-Elmer, and Prime) to respond with similar product offerings.

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David Burdick Brad Smith

- 104 communication lines
- Printer port
- STAR coupler
- VMS operating system
- DECnet (proprietary network)
- Console
- VMS operating
- DECnet (proprie

CCIS Code: Newsletter No. 69

RESEARCH

BULLETIN

SOLIDS MODELING: MARKET POTENTIAL STILL UNTAPPED

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Despite increasing awareness of the benefits derived from using solids modeling techniques, the CAD/CAM buying community has largely ignored this technology. Based on a recent survey of the world's top 20 companies selling solids modeling applications, DATAQUEST believes that one workstation in five is being sold with solids modeling capabilities. In terms of revenue, DATAQUEST estimates that \$330 million in systems, workstations, and solids modeling software was sold in 1983. This represents only 24 percent of the total available market, which is estimated at \$1.4 billion. (Total available market is estimated to be the sum of the mechanical CAD/CAM market and 80 percent of the AEC (Architectural, Engineering, and Construction) market.)



Source: DATAQUEST

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DATAQUEST believes that there are four key underlying reasons why solids modeling has not fulfilled its marketing potential. First, there is the mistaken notion on the part of many CAD/CAM vendors that solids modeling should be treated as an application rather than as an integrated data structure. This rather perplexing dichotomy causes undue heartache when a user must bounce back and forth between the CAD system and the solids modeling package to perform various applications such as drawing creation and NC tape generation. DATAQUEST believes that solids modeling geometries need to be integrated with the base CAD/CAM systems, and that core applications such as drafting and numerical control (NC) need to be enhanced in order to take advantage of the solid geometries.

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Second, there is the abused and overlooked ease-of-use issue. While most CAD/CAM vendors claim that their systems are already "easy to use," DATAQUEST research within the CAD/CAM user base reveals that the contrary is true. One of the more common complaints is the lack of uniformity between CAD/CAM systems and solids modeling applications packages. DATAQUEST believes that the CAD/CAM vendors need to listen to the users (who vote for system improvements with their dollars), and strive to improve the ease of learning and using solids modeling systems.

Application-specific hardware is the third area that holds great promise for promoting widespread use of solids modeling systems. Equipment incorporating new hardware advances that improve the interactive performance of solids modelers are just beginning to enter the market. Examples of these devices are the Phoenix Data Systems Solids Engine, the Silicon Graphics Geometry Engine, and the Weitek Tiling Engine, all of which serve to enhance the computational and display speed of geometric data. DATAQUEST believes that the evolution and acceptance of these devices will be a key component fueling the growth of solids modeling systems.

Last, but certainly not least, is the cost issue. A typical solids modeling software package can cost from \$30,000 to \$130,000. The high price of solids modelers is often viewed as a tradeoff to purchasing one or two more workstations in many CAD/CAM purchasing decisions. DATAQUEST believes that the cost of solids-based CAD/CAM systems needs to come down appreciably in order to be removed from the "luxury" category of most purchase lists.

Dave Burdick

# RESEARCH BULLETIN

CCIS Code: Newsletter, No. 68

#### SUN MICROSYSTEMS EXPANDS PRODUCT LINE

**Dataquest** 

#### OVERVIEW

In an effort to fill a product gap at the upper end and to bump the price/performance curve at the lower end, Sun Microsystems has added two new workstations to its product line. The Sun-2/160 is a color version of the popular Sun-2/120, with an integrated high-performance color raster display and controller. The Sun-2/50 is an aggressively priced 68010-based desktop workstation priced for less than \$10,000.

In another major competitive development, Sun has announced the Network File System (NFS), a software extension to its operating system. The NFS allows transparent network-wide read and write access to files and directories. Sun and Apollo are the only two vendors offering true network-wide demand paging systems.

#### THE NEW PRODUCTS

#### Sun-2/160

The Sun-2/160 is Sun's long-awaited high-resolution color product. Although Sun offers a medium-resolution color system as an option to its 2/120 and 2/170 products, the 2/160 is a fully integrated system product unlike the "slave-like" architecture of the medium-resolution system. Like its monochromatic counterparts, the 2/160 features a 1152 x 900 display resolution running at 66 Hz non-interlaced. The system also uses 8 bit planes of color image memory, which allows 256 colors to be displayed simultaneously from a palette of 16 million. Although the 2/160 does not offer any high-speed local display list processing, DATAQUEST believes that this capability is forthcoming.

The Sun-2/160 is priced aggressively at \$32,900, which includes: a 10-MHZ MC68010 processor; 1-Mbyte memory; Ethernet connection; 19-inch, 1152 x 900 screen; 8 bit planes, 256 colors; 12-slot VME card cage; C, Fortran, and Pascal languages; SunWindows and Display Manager; UNIX 4.2; and SunCore graphics library.

#### Sun-2/50

A new low-priced desktop model with a lot of power, the Sun-2/50 is a diskless workstation priced at \$9,900. The base configuration includes:

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10-MHz MC68010 processor; 1-Mbyte memory; Ethernet connection; 19-inch, 1152 x 900 mono screen; C, Fortran, and Pascal languages; SunWindows and Display Managers; UNIX 4.2; and SunCore graphics library.

Although this configuration requires the use of another workstation containing a disk, its low price coupled with the network-wide demand paging capability makes this new model an attractive system option for expanding the number of users per system.

#### Sun Network Filesystem

The Sun Network Filesystem (NFS) now supports network-wide read and write access to files and directories along with network-wide demand paging. This feature is extremely useful from a user's point of view because it allows programs and files to be shared among all network users without having to make duplicate copies. In addition, demand paging across the network allows diskless workstations to be used.

#### ANALYSIS

DATAQUEST believes that these products will significantly bolster Sun's product line. Sun's installed base and OEMs should welcome the addition of both a higher-performance color unit and a low-cost diskless model. DATAQUEST believes, however, that Sun will need to add a higherperformance product (greater than 1 mip) to its family to fully round out its product offering. The Motorola 68020 processor should be a natural product extension for filling this void when the processor becomes commercially available.

With nearly \$40 million in sales last year, and well on its way to more than \$100 million in sales this year, Sun has established itself as a clear number two behind Apollo in the workstation industry. Sun has, and is continuing to secure, major OEM agreements that will further entrench its position in this young and fast-paced industry.

While many observers remain skeptical as to Sun's long-term chances when IBM and Digital Equipment start flexing their muscles in this marketplace, DATAQUEST believes that Sun will be a strong and viable competitor in the workstation market for the following reasons:

- Sun has established a strong foothold in many key application segments through some very large OEM agreements (e.g., Computervision, Compugraphic, Ericsson, etc.). It is unlikely that IBM or Digital Equipment will unseat Sun in these accounts.
- Sun has established itself as the low-cost producer in this market and continues to emphasize providing more performance, using accepted industry standards, and passing the cost savings on to the user. Although some observers may argue that this is not a niche market, DATAQUEST believes that technological windows are short and that long-term viability will depend on the manufacturer's ability to cost effectively produce and supply products to the market.

David B. Burdick

RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 67

## INTERGRAPH--FOUR NEW SIGNIFICANT PRODUCTS

Dataquest

### OVERVIEW

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Intergraph Incorporated, the third largest CAD/CAM vendor behind IBM and Computervision, has ended speculation about its future workstation direction and announced four new products. The announced products include a new Intergraph developed workstation based on the NS32032, support of Digital Equipment Corporation's MicroVAX, support for Ethernet XNS, and an agreement with Tangent Systems for standard cell semiconductor design software.

Intergraph is one of the fastest growing turnkey CAD/CAM companies in the industry, and these new products should bolster its already strong product line. Table 1 illustrates Intergraph's phenomenal year-to-year growth percentage measured against the rest of the turnkey CAD/CAM industry. One of Intergraph's key success factors has been its ability to recognize industry trends and deliver leading-edge solutions in a timely fashion. While these new products are certainly in the leading-edge category, the six- to nine-month product delivery targets are not in line with Intergraph's standard modus operandi.

## Table 1

INTERGRAPH VS. THE TURNKEY INDUSTRY YEAR-TO-YEAR GROWTH PERCENTAGES

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	1984 (est.)
Turnkey Industry	73	46	35	41	47
Intergraph	96	57	87	94	60

Source: DATAQUEST

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#### THE NEW PRODUCTS

The new product announcements are based on Intergraph's future workstation and communication offerings. The four major pieces announced in Huntsville include:

- Interpro 32--A UNIX and MS-DOS workstation based on the NS32032 and the Intel 80186
- Micro II--A new Digital Equipment minicomputer brought into the fold that will support up to four Interpro 32 workstations
- Networking--Intergraph has chosen the Ethernet XNS protocol as its LAN strategy
- Tangent Systems--A startup in Sunnyvale, California, developing software for standard cell IC design (Intergraph owns about 50 percent of Tangent Systems.)

## INTERPRO 32

The Interpro 32 uses a dyadic architecture employing both an NS32032 and the Intel 80186. This type of architecture allows execution of both UNIX and MS-DOS programs. DATAQUEST believes that Intergraph's move to support UNIX and MS-DOS programs is strategically sound in light of the many third-party UNIX and MS-DOS programs available. The ability to run large CAD/CAM applications and the popular spreadsheet programs on a desktop workstation is an industry first. DATAQUEST believes that this type of design is far more suitable than trying to "cram" a large CAD/CAM application onto a personal computer. We also expect that this type of dyadic processing architecture will soon be adopted by other turnkey CAD/CAM vendors as well.

The Interpro 32 uses a 15-inch, 60-Hz, noninterlaced color monitor, and is capable of displaying up to 64 colors at a resolution of 1,184 x 884. There is no monochromatic configuration available. A large percentage of the monitor components were designed, developed, and manufactured by Intergraph. This is one reason for the low cost of the system.

There are four separate modes under which the Interpro 32 can operate:

- Intelligent Graphic Workstation Mode--In this mode, the Interpro 32 acts as a host-dependent display terminal. This is the mode of operation required to run the Intergraph IGDS software. Although the Interpro 32 still requires the use of a host such as a VAX to run the base graphic software, DATAQUEST will treat this unit as a standalone workstation for counting purposes in the future.
- UNIX Mode--This mode allows users to run user-developed or third-party software under UNIX.

- Terminal Emulation Mode--While in terminal emulation mode, the Digital Equipment VT-200, Tektronix 4014, or an IBM 3270 Series terminal can be emulated.
- PC Mode--This mode allows users to run programs running under MS-DOS.

The Interpro's ability to operate in these modes concurrently allows maximum flexibility for the user to perform several given tasks from the same workstation. It also opens the door to an almost endless array of possible configurations.

The Interpro 32 does not yet contain a high-speed display list processor or any advanced display list manipulation capabilities. DATAQUEST believes, however, that these capabilities will be offered as a future option.

The \$20,000 Interpro 32 includes 26 Mbytes of hard disk, 1-3/4 Mbytes of memory, a 64-bit floating processor, UNIX, and the 15-inch 64-color display mentioned above. We consider the \$20,000 price tag truly remarkable; it places the Interpro 32 as one of the lowest-cost 32-bit color workstations available on the market today.

Availability for the Interpro 32 is said to be second quarter 1985. DATAQUEST believes that this time frame may be optimistic, given the delays of the 10-MHz NS32032. However, Col Rada, National's Marketing Director for the NS32032, recently stated that volume shipments of the 10-MHz 32032 will be ready by the end of January 1985.

In addition to the product availability issue, there is the question of software. Intergraph has stated that its IGDS CAD/CAM software will not run locally on the workstation. This could be a troubling issue for Intergraph when assessing the competitive potential of the system against Autotrol, Calma, and Computervision standalone systems that run applications locally on the workstation.

## MICRO II

Intergraph also announced support for the Digital Equipment MicroVAX II with a product called the Micro II. It will support up to four workstations including the Interpro 32. Depending on memory and disk capacity, the Micro II will be priced from \$40,000 to \$60,000. Availability is believed to be late in the second quarter of 1985.

## NETWORKING

The Ethernet XNS (Xerox, Network Standard) LAN will be used as the high-speed communication medium for Intergraph's VAX and MicroVAX-based products, as well as for the Interpro 32 and M68000-based terminals. They will also offer support for DECnet and IBM's SNA.

#### TANGENT SYSTEMS

Intergraph also recently invested a 50 percent stake in Tangent Systems Corporation of Sunnyvale, California. Tangent is a start-up that is focusing on development of software for designing standard-cell integrated circuits. This investment launches Intergraph into the fastpaced, highly competitive world of EDA (Electronic Design Automation).

Tangent was formed by a group of professionals from Chancellor Computer, Hewlett-Packard, and Trilogy. Its product will run locally on the new Interpro 32 under the UNIX operating system. First product introduction is expected to be during the first quarter of 1985.

## DATAQUEST ANALYSIS

DATAQUEST believes that the Interpro 32 will be a big winner in the CAD/CAM marketplace, and expects it to receive an enormous reception from companies using the more than 1,500 installed Intergraph systems worldwide. We also believe that having the dual UNIX and MS-DOS processing capabilities, along with being the lowest-cost 32-bit color workstation in the industry, have the potential of fueling healthy orders for Interpro 32 as a standalone engineering workstation, even though Intergraph has publicly stated that it does not intend to get involved in the workstation commodity business. While Apollo, Sun Microsystems, and the other engineering workstation manufacturers are not directly affected by the Interpro 32, Intergraph will certainly expand its sphere of influence within the workstation market, which could result in some industry price-cutting measures and earlier-than-planned product announcements.

The Micro II and Ethernet announcements are viewed as being natural extensions to an already strong product line. The only real question here is how the Micro II will affect the future of the VAX 11/730 and the VAX 11/751. With raw processing power greater than the VAX 11/751, we question the need for keeping Digital's slower and more expensive iron in the product line.

The value of the Tangent Systems agreement is difficult to assess at this early stage. DATAQUEST believes that breaking into the highly competitive and fast-paced EDA market will not be a cakewalk. In addition to the blistering pace being set by Daisy, Mentor, and Valid, we expect that Intergraph will have to add to or retrain its sales force to successfully sell this type of product into the electrical CAD marketplace.

David B. Burdick

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# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 66

AUTOFACT 1984

#### OVERVIEW

The 1984 Autofact show held recently in Anaheim, California, has clearly evolved into a full-fledged CAD/CAM show, departing from its earlier roots as a robotics showplace. However, there were a number of significant announcements and first-time vendor showings that will be discussed in this newsletter. Heading up the list in the mostsignificant category were Intergraph with its first public showing of the Interpro 32, and Computervision with its long-awaited PC AT personal designer product. DATAQUEST believes that these products will be major revenue producers for Intergraph and Computervision. These announcements and others are discussed below; companies are grouped according to types of products.

#### TURNKEY COMPANIES

Applicon introduced the new ARIA line of workstations based on the VAX 11/730. Introductory price will be \$65,000 through the remainder of 1984; the price will increase to \$80,000 beginning in January 1985. Included with the standard configuration is 3 Mbytes of memory, 160 Mbytes of disk, a 13-inch 765 x 504 color monitor, and the BRAVO software.

Autotrol introduced several new NC enhancements including the ability to machine concave surfaces without gouging. In addition, software light source shading and hidden line removal capabilities have been added. Autotrol also announced a library of more than 300 NC post processors. An agreement with Brigham Young University for the joint marketing of the DCLASS group technology program was also announced.

CADLINC showed off its line of CIM Station products in an impressive booth that dramatically illustrated CADLINC's focus on integrating engineering with the factory floor. Included in the exhibition was the new CIM Factory Manager, which is a NEMA-12 enclosed factory floor workstation.

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Computervision introduced CADDShade based on the Weitek Tiling Engine for CDS 4000, and Designer V-X under CADDS 4X. Priced at \$40,000 per CPU, CADDShade will be available during the fourth quarter of this year with delivery of CADDS 4X Revision 3. CV also announced and demonstrated three new plastics packages including MOLDESIGN, MOLDCOOL, and Total Molding Concept Molding and Cost Optimization (TMC-MCO). All three packages work in conjunction with CADDS 4X and are priced at \$25,000, \$50,000, and \$15,000 respectively. The biggest news, however, was CV's announcement made at the analysts' conference concerning the personal An IBM PC XT- and PC AT-compatible system, the personal designer. designer emulates CV's CADDS 4X system with a nearly identical user interface. The 2D and 3D module is priced at \$5,800; surfaces cost an \$2,800. Α finite element module developed additional by MacNeal-Schwendler is also available for \$995.

Intergraph showed off its new Interpro 32 and Micro II products. A future DATAQUEST newsletter will contain descriptions of these products.

Matra Datavision announced software performance improvements of two to four times with its new software release. Matra also announced a new VAX-based color workstation that includes 2 Mbytes of memory and is priced at \$95,000.

McAuto unveiled a prototype of the D-2300 graphics workstation based on the Megatek Merlin 9200. The D-2300 includes high-speed local display list operations such as view transformation and smooth rendering functions. A new ergonomic packaging design has also been used with this product, greatly enhancing ease of use. DATAQUEST believes that this workstation, along with McAuto's Unigraphics II implementation, represents one of the first demonstrable real-time 3D CAD/CAM systems with full rendering capabilities.

MDSI announced a new networking system called EQUINOX. Based on a three-tiered approach, the system uses an ISO model link for the factory floor, Ethernet for the engineering environment, and an X.25-based system for long distance links. MDSI also announced a Motorola VME bus-based workstation. Pricing and configuration will be announced during the fourth quarter of 1984.

## COMPUTER COMPANIES

IBM announced enhancements to the "three C's": CADAM, CATIA, and CAEDS. The CADAM enhancements included the long-awaited 3-D version called CADAM 3-D Interactive. CATIA enhancements that were announced included 5080 support, enhanced drafting capabilities, and enhancements to NC and robotics modules. Major new CAEDS features include 5080 support, color-shaded images, and new interface capabilities. DATAQUEST believes that these new features and enhancements look very strong but have increased the amount of functional overlap between the three systems. Sperry unveiled a completely new look with its CIM/ME CAD/CAM system. The system is much more than a repackaged version of UNIS-CAD. Complete with Apollo workstations, DATAQUEST believes that Sperry's new effort is geared toward establishing a new factory-based CAD image.

ELXSI announced an agreement with Tasvir to jointly market SUPERCADS mechanical CAD software. The company also announced a communications link with Apollo.

## TERMINALS AND WORKSTATIONS

Apollo announced an interface with ELXSI's System 6400 superminicomputer using TCP/IP network communication software developed by Danford Corp. Tasvir's new SUPERCADS 3-D mechanical CAD package was also announced as a third-party vendor.

Celerity showed off its new Cl200 high-performance engineering workstation. DATAQUEST believes that the Cl200 and the Ridge RISC machines are carving out a new niche in the high-performance workstation market. Coupled with graphics from Raster Technology, the Cl200 is wellsuited for computer-intensive tasks that require high-performance graphics such as solids modeling, kinematics, and finite element analysis.

Megatek showed off its Merlin 9200 graphics terminal.

Ridge Computers announced an agreement with Silicon Graphics to bolster graphics capability. (See Silicon Graphics (below) for further discussion.)

Silicon Graphics announced a joint marketing agreement with Ridge Computers that will combine the Geometry Engine with the Ridge line of high-performance RISC computers. DATAQUEST sees this agreement as being very beneficial for both sides, since it fills a product void for both companies.

Spectragraphics announced IBM 5080 emulation capability for the 1500.

Tektronix showed off its new 6000 line of standalone engineering workstations. There will be an upcoming DATAQUEST newsletter about this product line.

Vectron Graphic Systems ushered in its new family of workstations, the DAWN family. Based on Digital Equipment's MicroVAX processor, the system also incorporates the lightning-fast graphics capability of the Parallax graphics controller.

## SOFTWARE COMPANIES

Automation Technology Products (ATP), a new player on the scene, announced CIMPLEX and FAIM (Factory Automation Information Management). ATP's developmental philosophy is to address automation of the engineering and manufacturing processes as a whole rather than trying to automate individual components of the processes. The software packages run on IBM mainframe computers using the Silicon Graphics geometry engine workstations. Price for the FAIM package is \$100,000, while the CIMPLEX software is offered at a minimum of \$40,000 depending on configuration.

MCS unveiled Anvil 1000 MD, a new IBM PC AT drafting product for less than \$16,000.

MSC introduced MSC/pal, a three-dimensional finite element program for the IBM PC market. The package is priced at \$995.

Tasvir introduced its SUPERCADS 3D Mechanical CAD package. A syntax-level CADDS4-compatible system, SUPERCADS runs on the IBM PC, Apollo, VAX, and ELXSI computers.

UNICAD now has its own booth instead of exhibiting as a third-party figure in another booth. UNICAD showed off its Universal CAD system.

## SUMMARY

Overall, DATAQUEST believes that while show attendance appeared to be less than at last year's Autofact, the level and significance of new product announcement activity was noticeably greater. Lower-cost engineering workstations and personal computer-based systems seemed to predominate the hardware area, while software emphasis was focused on data base integration and expanding applications. DATAQUEST believes that future CAD/CAM hardware innovations will generally be directed toward lowering the costs of existing technologies. The 3D graphics display list-handling devices should prove to be a major target for future cost reductions.

We also see more applications being developed with on-screen menus and menu-driven systems versus command-driven or syntax-based systems. This trend appears to be driven by the explosion of low-cost systems on the market in an effort to make the systems easier to use.

Perhaps the most significant trend that has emerged over the last few shows is the increasing degree to which the turnkey vendors are arming themselves with third-party software and hardware offerings. It used to be easy to identify what any particular vendor had in the way of application functionality. Now, however, the software and hardware combinations that vendors are offering are so diverse and intertwined with third-party relationships that it will soon take a magnifying glass to differentiate between vendors. This trend highlights the need for CAD/CAM companies to emphasize raising the level of support services and expanding the areas of sales coverage in order to be successful in the future.

David B. Burdick

CCIS Code: Newsletters, No. 65

<u>Research</u>

NEWSLETTER

ADAGE: THE NEW CAD/CAM TURNKEY VENDOR WITH THE CADSTATION 2/50

#### INTRODUCTION

Esen ()) Dataquest

Adage Incorporated and Adra Systems Incorporated recently announced a CADAM-like CAD system called the CADstation 2/50. Targeted as a low-cost alternative to the IBM/CADAM solution, the CADstation includes a standalone, full-function workstation and the associated 2D drafting software. System operation is nearly identical in functionality and presentation to Lockheed's CADAM CAD-only system, but costs nearly one-third less per workstation.

#### BACKGROUND

Adage Incorporated is a \$50 million company that supplies display terminals for use in the IBM plug-compatible terminal market. Along with Spectragraphics, CGX, and Vector General, Adage has traditionally enjoyed a comfortable position in the IBM plug-compatible terminal market, bolstered by its lower cost and its raster display offering.

IBM's introduction of its 5080 raster graphics terminal late last year, however, sent Adage and the other plug-compatible manufacturers scurrying into a price war, with cuts ranging from 25 to 50 percent across many product lines. To combat the effects of reduced market share and lower profit margins, Adage has teamed up with technical partner Adra Systems to develop a complete turnkey CAD/CAM solution. The culmination of this venture was unveiled during SIGGRAPH '84 at Adage's headquarters in Billerica, Massachusetts.

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#### THE CADSTATION 2/50

The CADstation hardware consists of a 19-inch monochromatic raster monitor and a neatly packaged desktop tower that houses the following components:

- M68010 processor for general-purpose computing functions
- AMD 29116 bit-slice processor for graphics and math functions
- 1 Mbyte of RAM
- 5-1/4 inch, 1-Mbyte flexible disk drive
- Four serial ports
- 1K x 1K x 4 of image display memory
- Communications interface
- Data tablet and/or light pen

Figure 1 shows a system block diagram of the CADstation hardware architecture.

#### System Operation

Although the CADstation 2/50 system is not an IBM-compatible computer, it does provide the ability to locally create, edit, and modify a CADAM drawing without requiring the intervention of the IBM host computer via the CADRA software. The only host intervention required is for passing drawings back and forth to the CADAM data base that is resident on the IBM computer.

To create a drawing, the operator interacts with the CADstation 2/50 almost as if he or she were interacting with the CADAM system. The CADRA software was designed to allow CADAM users to readily adapt themselves to the system without extensive retraining. To accomplish this, the system's command input structure and user interface closely parallel the CADAM structure. Geometry creation, editing, transformations, and detailing tasks are performed locally on the system. The user can either save the drawing locally on the flexible disk or transmit it to the CADAM data base resident on the IBM mainframe.

The CADAM interface mechanism is illustrated in Figure 2. Through the IBM 3270 controller, the drawings are sent or received using a software package that talks to the CADAM data base via the geometry interface utility available within CADAM. When sending a drawing from the CADstation 2/50 to CADAM, the program converts the CADRA data structure to a format that can be read-in subsequently through CADAM's geometry interface module. To receive a drawing from the CADAM data base to the CADstation for viewing or editing, a reverse translator converts the CADAM drawing to a format suitable to the CADRA software. In addition to the file sending and receiving mechanism, the CADstation can operate in 3278 emulation mode in order to view and access programs on the host. The system operates simultaneously in local and 3278 mode, allowing the user to operate the CADRA software while accessing host programs such as data base managers and finite element programs.

The CADstation 2/50 is priced at \$21,900, which includes all the hardware and software described above. DATAQUEST believes that the low price will attract the attention of CADAM users in installations that emphasize electronic drafting board applications.

#### ANALYSIS

DATAQUEST believes that the CADstation 2/50 should be a winner when measured in terms of the IBM CAD marketplace. The system's low price coupled with the similar CADAM functional and interface capabilities, make this product an ideal add-on solution.

The CADstation 2/50 has some relative weaknesses that may limit its move into the CAD market outside of the IBM world. First, the system has no operating system or hard disk storage. In its current configuration, the user must rely on the mainframe for drawing archival, or must use the flexible disk, which can hold only 6 to 10 drawings and is not an optimal solution for archival and data integrity. Furthermore, until an operating system becomes available, the user cannot run any other third-party or user-developed programs on the system without the use of a host computer.

Second, the system has no networking capability in an age where local area networks are extremely popular among purchasers of engineering workstations. Even IBM has acknowledged the importance of LANs as a key component for distributed computing.

Third, the system virtually requires an IBM host and a CADAM license to operate effectively. This clearly limits the low-cost advantage of the workstation in new system installations where the user must amortize the cost of the host and CADAM license over the number of low-cost CADstations. However, a strong case can be made that the CADstation 2/50 would allow many more workstations to be connected to the host versus a terminal requiring a greater degree of host intervention.

Fourth, what will IBM do in this market? In the last few months, IBM has started to assert itself in the distributed computing engineering workstation market with the 3270 PC/GX and the more recent PC AT. DATAQUEST believes that IBM is far from through with this marketplace, and we expect the announcement of an Apollo-like, higher-performance engineering workstation soon.

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Despite these relative weaknesses, DATAQUEST believes that the CADstation 2/50 represents a very cost-effective alternative for add-on CADAM workstation purchases. The \$21,900 price tag should allow ADAGE to expand the IBM CAD market to the desks of draftsmen who are either sharing or doing without CAD tools. The CADstation will also allow these installations to add workstations without the usual performance degradation trade-offs.

We also believe that while the current CADstation 2/50 is ideally configured and priced for the IBM/CADAM marketplace, the addition of a hard disk operating system and a local area network would greatly improve Adage's ability to compete in the non-IBM world. With the outstanding job that Adra Systems has done with its CADRA software, CAD sales outside of the IBM world could certainly be realized, provided the necessary hardware is in place.

David B. Burdick

Figure	1
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System Block Diagra	68010	
AMD 29116		4K BYTES 2 PORT MEMORY
DUAL 24-BIT MULTIPLY	1K x 52-BIT WCS	1 MB RAM
PIXEL R/M/W LOGIC		5¼″ 1 MB DISK DRIVE
4 PIXEL PLANES 1K x 1K	KEYBOARD DATA TABLET FUNCTION KEYBOARD BS.232C	FOUR SERIAL PORTS
VIDEO DRIVE	LIGHT PEN	
MONITOR		

ADAGE CADSTATION 2/50 HARDWARE ARCHITECTURE



CADSTATION 2/50 INTERACTION WITH CADAM DATA BASE



Source: Adage

CCIS Code: Newsletters, No. 64

RESEARCH

BULLETIN

# IBM ANNOUNCES NEW GRAPHICS PRODUCTS; OPENS DOOR FOR GRAPHICS STANDARDS

Ridsen () Dataquest

On September 10, IBM announced several graphics products that extend the graphics capabilities of its personal computer family and reinforce its intention to be a major vendor in the scientific and engineering environment. The product announcements included IBM's endorsement of a graphics standard developed by a third-party software vendor, Graphic Software Systems (GSS). DATAQUEST believes that IBM's endorsement will create a de facto industry graphics standard for the PC industry.

The IBM Personal Computer Engineering/Scientific Series includes:

- The IBM PC Professional Graphics Display, Professional Graphics Controller, the IBM PC Enhanced Color Display, and Enhanced Graphics adapter, which help generate and display advanced color graphics
- The IBM PC Graphics Toolkit, which includes a Virtual Device Interface and other programs to assist in design graphics applications that are independent of devices such as displays, printers, and plotters
- The IBM Personal Computer Graphical File System, Graphical Kernel System, Plotting System, and Graphics Terminal Emulator, which assist programmers in developing high-performance graphics applications
- The IBM PC Data Acquisition and Control Adapter, Data Acquisition and Control Adapter Distribution Panel, and Data Acquisition and Control Adapter Programming Support, which are used to gather, control, and analyze data
- The IBM PC General Purpose Interface Bus Adapter and General Purpose Interface Adapter Programming Support, which allows professionals to access and control more than 2,000 instruments or devices
- The IBM PC Professional FORTRAN, offering ANSI-77 functions
- IBM also is publishing a new Engineering and Scientific Programs Directory listing more than 340 compatible applications
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#### DATAQUEST ANALYSIS

DATAQUEST believes that the medium resolution and other graphics capabilities offered by the Professional Graphics Display and Controller and the Enhanced Graphics Display and Adapter will result in higher-quality graphics on personal computers, and will promote regular use of graphics by professional and technical personnel.

Although plug-in graphics cards with similar capabilities are offered by several independent manufacturers for IBM PCs, DATAQUEST believes that IBM's offering will encourage a new round of software that emphasizes and features much more sophisticated graphics than is currently available on personal computers, especially in the CAD/CAM area.

The Graphics Terminal Emulator, which brings Tektronix 4010 and 4100 protocol compatibility to the PCs, is necessary to allow the PCs to be integrated into the current graphics software world. The combination of the Graphics Terminal Emulator mode and applications software created with the Graphics Development Toolkit, which take advantage of the Graphical File System and the Graphical Kernel System, allows IBM PCs to replace graphics terminals in situations where both host interaction and local programmability is needed.

The Data Acquisition and Control Adapter and General Purpose Interface Bus Adapter will open new applications environments for the PC both in the laboratory and on the factory floor. These applications areas often demand a graphics format to summarize and present data.

The GSS software package offered will establish the GSS versions of the Graphical Kernel System and Virtual Device Metafile as the primary source of graphics software tools for the personal computer. IBM's selection of GSS will significantly impact the ability of the other vendors of similar software--i.e., Digital Research, Microsoft, and Xerox--to market their VDI products to software and hardware vendors. The GSS products support graphics standards developed by the ISO and ANSI.

IBM's endorsement of GSS is good news for manufacturers of IBM-compatible hardware. Hardware manufacturers can license the software from GSS in the same way they now license MS-DOS from Microsoft. The design function allows hardware manufacturers to maintain product differentiation, yet not lose compatibility by their choice of graphic hardware devices. It provides an easier way of following the lead as IBM announces new-generation personal computer products.

More third-party software vendors will develop or incorporate graphics products into their applications. Using IBM's defined set of graphics utilities, programmers will be able to write code faster and easily port their products, leading to increased profits.

> Wendy Ledamun Kathleen Lane Ed Washington
# RESEARCH NEWSLETTER

CCIS Code: Newsletter No. 63

# DAISY SYSTEMS CORPORATION: THE GROWTH OF A COMPANY

Dataquest

#### INTRODUCTION

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The electronic design automation (EDA) market segment of the CAD/CAM industry is currently dominated by three companies, Daisy Systems, Mentor Graphics, and Valid Logic, with 32, 29, and 18 percent share of 1983 revenues, respectively. This segment is still very much in its infant stages; the first turnkey system was shipped by Daisy Systems Corporation in November 1981.

This newsletter will take a look at the background of Daisy Systems Corporation, its new products, and what makes this company so successful.

#### BACKGROUND

Daisy was incorporated in August 1980 and was founded by two people:

- Arych Finegold is President, and was previously with Intel Corporation and Elbit Computers, Ltd.
- David Stamm is Executive Vice President of Operations; he was previously employed by Intel Corporation.

Three other executives were then brought in to develop the specific product strategies and implement corporate operations:

- Dr. Ram Banin, Vice President, Research and Development, was previously with ADAC Laboratories and worked as an independent consultant.
- Rafael Chatav, Vice President of Engineering, was formerly with Dataproducts Corporation and was also an independent consultant.
- Harvey Jones is Senior Vice President and General Manager, and was formerly with Calma Company.
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In November 1981, Daisy shipped its first Logician system. Since that time, Daisy's revenues have skyrocketed to \$18.54 million for the second calendar quarter of 1984. Table 1 and Figure 1 indicate the company's quarterly revenues and growth, adjusted to reflect the calendar year. **.** .

Also indicated in Figure 1 are Daisy's major products and their introduction dates. The company has pursued an aggressive and ambitious product introduction schedule, with six major new products announced in 11 quarters of operation.

# Table 1

# Daisy Systems Corporation QUARTERLY SALES HISTORY (Millions of Dollars)

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Quarter l		\$1.00	\$ 2.82	\$15.70
Quarter 2		1.77	5.12	18.54
Quarter 3		1.60	7.32	N/A
Quarter 4	<b>\$0.19</b>	2.21	13.10	<u>N/A</u>
Total	\$0.19	\$6.58	\$28.36	\$34.24

N/A = Not Available

NOTE: Quarterly revenues are adjusted to reflect a calendar year.

Source: Daisy Systems Corporation



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Source DATAQUEST

#### Organization

Daisy's research and development staff has increased to approximately 225 people (200 software engineers, 25 hardware engineers) as of May 1984, from approximately 70 people in April 1983.

The field sales organization has been increasing even more quickly than R&D. From an estimated 60 sales and application engineers in October 1983, it has increased by approximately 158 percent to 155 people as of May 1984. During this period, Daisy has maintained close to a one-to-one ratio of sales engineers to application engineers, showing the need for intense applications support during the sales cycle.

#### EDA PRODUCTS

Daisy started out in the computer-aided engineering portion of the electronic design automation segment, as indicated in Figure 2. Since May 1982, when this illustration was issued, Daisy has become a full-fledged electronic design automation vendor, with products addressing the entire product design cycle, not just logic and circuit design and analysis. It is also significant to note that most of the other companies listed in Daisy's early description of the market have also changed their product lines.

DESIGN CYCLE BUYING UNITS	FUNCTIONAL DESIGN	DESIGN	CIACUIT	SIMULATION	AUTOMATIC PHYSICAL DESIGN	HNTERACTIVE LAVOUT	DESIGN ANALYSIS	5NUTOO1
SEMICONDUCTOR MERCHANT CAPTIVE	OPMENT EARCH	*	ĸ	NCA PDS COMSAT	SILVAR. LISCO COMPEDA	CAL APP AVERA	MA LICON NCA-	
SEMI-CUSTOM	E DEVEL And MIC RES	Davey S	Systems.					
SYSTEMS	N-HOUS ACADE		1.		Se		<u></u>	
DIGITAL	-	7	5					
ANALOG					<b>→</b> R			

#### Figure 2

# DAISY'S ORIGINAL PRODUCT STRATEGIES

Source: Daisy Systems May 1982 Corporate Background

Design and analysis remain the core of Daisy's product line, since all other products are directly integrated with the hierarchical data base and analysis software of the Logician. Daisy's primary hardware product lines include:

- Logician
- Gatemaster
- MegaLogician
- MegaLogician Physical Moduling Extension (PMX)
- Personal Logician

Two new products were demonstrated at the 21st Design Automation Conference. They are the Personal Logician and the Chipmaster, each of which will be described in this newsletter.

#### Personal Logician

During the Design Automation Conference, Daisy introduced the Personal Logician (PL), based on the IBM PC/XT. Daisy is an IBM value-added dealer (VAD) for the PC. The company's value-added is its proprietary graphics controller and graphics display, boosting the graphics interface and performance of the PC to that of the Logician. Daisy packages the PL in three basic configurations, described below:

- Monochrome (\$17,000 list price)
  - IBM PC/XT
    - . 640 Kbytes of memory
    - . 10-Mbyte Winchester disk drive
    - . 360-Rbyte flexible diskette drive
    - . Two RS-232 ports
  - 1,022 by 826 monochrome display
  - Maestro "shell" (Daisy's UNIX-like operating system)
  - PC DOS 2.0
  - Three-function mouse
  - Schematic entry capability
  - Netlist extraction (for interface to analysis or CAD tools)

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- Standard Device Libraries
- Computer-Aided Instruction software
- Color (additional \$8,000)
  - All of above, but substitute a 1,100 x 900 color display for the monochrome display
- Add-on to a properly configured IBM PC/XT (\$11,000 list price)
  - Includes all listed under the monochrome configuration except for the PC/XT

The Personal Logician is able to communicate with other Daisy products in one of two ways: by asynchronous RS-232 point-to-point communications; or by an optional Ethernet interface board available for \$2,500 list price.

The PL is intended to be used for schematic entry, using Daisy's graphics editor. It will not directly support analysis or simulation software, and relies on its netlist extraction capabilities and communications interfaces to either a Logician or MegaLogician to complete this compute-intensive task.

To accommodate the new product, Daisy also announced that is has formed the Personal Systems Division, headed by Harvey Jones, who is now senior vice president and general manager with profit and loss responsibility. The new division has its own research and development, engineering, and marketing departments but will rely on corporate manufacturing, sales, and applications software groups.

#### DATAQUEST Analysis

Until the Personal Logician introduction, Daisy maintained vertical integration strategies for hardware development and, for the most part, for software development. Vertical integration strategies for turnkey CAD/CAM companies have many pros and cons, especially for very young companies such as Daisy. However, DATAQUEST believes that by becoming an IBM VAD, Daisy has demonstrated that it will implement whatever tactics are necessary to achieve its overall corporate objective--remaining a dominant force in supplying electronic design automation products.

We believe that the choice of general-purpose hardware instead of dedicated proprietary hardware has further significance. IBM had approximately 30 percent of the worldwide 1983 personal computer market, and all signs indicate that it will remain strong throughout the next few years, with new introductions such as the 3270 PC/GX. Not only will a Personal Logician user be able to run highly specialized EDA functions, but there are more than 10,000 software packages that will run on the IBM PC/XT. Thus, the engineering community has an option--electronic design automation integrated with office/personal automation. Further, price barriers are diminishing with the availability of functional systems in the \$20,000 price range. Daisy has the opportunity to more deeply penetrate the design engineering end-user market. This opportunity is not without unique challenges. DATAQUEST believes that Daisy will be faced with the conditions described below.

There will be a need for unique sales strategies. The sales cycle of a \$20,000 system is not that different from that of a \$65,000 system. It is still many months long, requiring sales and applications engineers' involvement. We believe that Daisy will first penetrate its existing customer base with the PL because these companies have already been sold on the Daisy concept. We do not foresee Daisy going into a new account selling only the PL for several reasons: Daisy wants to address the entire product design cycle, not just front-end schematic capture; the PL is just one piece of Daisy's design automation solution and is not a standalone product; and the cost of selling only the PL is not cost-justifiable.

Daisy will require unique training and support strategies. The low selling price and lower per-unit margins will neither justify nor support traditional training and support programs. Daisy has taken the approach of on-line computer-aided instruction as an integral part of the PL. DATAQUEST believes that for Daisy to realize a long-term profit from the PL, it will implement support for the PL on the basis that the PL is part of a networked design solution, not a standalone front-end product. For example, assuming that the on-line training is adequate, the support required for the schematic-only product would be from a design problem as a whole, not the PL as a single piece.

DATAQUEST believes that the introduction of the Personal Logician will play a key role in Daisy's future product mix. With the availability of low-cost graphics systems for schematic capture, and dedicated hardware for compute-intensive tasks (i.e., the Personal Logician and the MegaLogician), the Logician could theoretically be stuck in the middle without a home. However, we do not believe that the PL will replace the Logician, since it really is a dedicated, single function extension of the Logician. More likely, the Logician will be used for block level design and interactive simulation, and for reviewing simulation results from the MegaLogician and modifying the design accordingly.

# Chipmaster

Daisy also demonstrated its Chipmaster at the DAC. The Chipmaster is Daisy's full-custom integrated circuit layout product, and competes with two classes of products--dedicated and discrete host-dependent, fullcustom IC CAD systems as sold by Applicon, Calma, and Computervision, and integrated, full-custom IC layout systems as sold by Mentor, Metheus, and Valid.



The Chipmaster, based on an advanced version of the Logician with all of its base software, has an Intel 80286 microprocessor. Daisy has also added a graphics accelerator to meet the higher peformance requirements for physical layout. The graphics accelerator includes an AMD 29116 which boosts the display time up to 80 million pixels per second. With multiwindowing capabilities, the Chipmaster allows layout designers much versatility in viewing both schematics and layout simultaneously.

Daisy provides optional design rules check and electrical rules check programs through a licensing agreement with ECAD Corporation. Under the terms of the agreement, Daisy directly supplies ECAD's Dracula I software package.

The Chipmaster is a significant addition to Daisy's product line. It allows the company to directly compete with and match the products sold by Mentor and Valid, its two largest competitors. The product also allows the company to more closely integrate front-end and back-end design functions and not rely so heavily on CAD tools supplied by physical layout vendors.

Daisy's product strategies involve bundling all software with the hardware, yielding a turnkey solution. DATAQUEST believes that in the future, the company may move more toward unbundling some of its products, especially the Chipmaster. We believe this because of the logistics involved between design engineering and full-custom physical layout. Layout designers, not design engineers, currently do the actual physical layout, and do not require front-end analysis functionality to complete their jobs. Therefore, the end-user market may force Daisy to unbundle analysis capabilities from the Chipmaster.

#### APPLICATION-SPECIFIC IC APPROACH

The company has put into place its "Daisy Vendor Program," in which Daisy and an application-specific IC (ASIC) manufacturer jointly develop data sheets for ASIC libraries supported by Daisy's products. Daisy currently has agreements with 27 silicon foundry vendors. With this program, a Daisy user can design an electronic circuit or product with process technology variables directly associated with schematic graphics.

There are two winners in this case. The silicon foundry wins because of increased distribution for its parts libraries, hence increased production opportunities. Daisy wins because it can take advantage of a buyer's preference for a particular foundry and can offer its users a choice between foundries.

At this point, it is relevant to note that the end-user market both for EDA vendors and for silicon foundries prefers to buy a more general purpose EDA workstation, i.e., one not dedicated solely to one particular foundry and its unique process. This results in the following: the

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silicon foundries themselves, although some do offer dedicated EDA workstations, are shifting more toward supporting the EDA turnkey vendors by supplying parts libraries with the process parameters required to simulate a circuit; and the turnkey EDA vendors are supplying a multitude of libraries from different foundries, thus negating or washing out any competitive advantage from having one library or another.

Daisy currently supports parts libraries from the following foundries or semiconductor manufacturers:

AMCC	<ul> <li>Monolithic Memories</li> </ul>
American Microsystems, Inc.	Mostek
California Devices	Motorola ·
Diplomat Electronics	NCR
Dumont/Alphatron	NEC
Exar	National Semiconductor
Fairchild	Oki
Fujitsu	RCA
Harris Semiconductor	Semi Processes
IMI	Siliconix
IMP	Synertek
Intersil	Texas Instruments
LSI Logic	Zymos
Microlinear	_

Gate array design, including logic completion and analysis, and placement and routing, is accomplished by Daisy's Gatemaster. The core of the Gatemaster is the Logician, with the following additions:

- Intel 8087 floating point processor
- 750-Kbyte memory
- Automatic placement and routing functionality
- Library utilities

Standard cell designs are placed and routed at the manufacturer, as Daisy currently addresses only gate array layout. However, front-end logic design and analysis for standard cells can be accomplished on a Daisy system.

# DATAQUEST ASSESSMENT

Daisy is successful for many reasons. Some of the key corporate characteristics that DATAQUEST believes have contributed to Daisy's explosive growth include:

 Solid Nucleus--From the beginning, Daisy has exhibited a commitment to electronic design automation, building upon a core group of people and technology.

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- Strategic Policies--Daisy's product introductions fit within both short- and long-term plans. Although Daisy may not always be first to the market with a new product, it is an active participant in setting a fast competitive pace.
- Engineering Focus--Nearly one-half of the company's employees work in software or hardware engineering. Sheer size of staff alone does not guarantee success; however, the R&D staff turns a product out in months, where a less aggressive company can take years.
- Marketing Emphasis--Advertising statements like "Daisy is Engineering" illustrate the company's creative and aggressive posture.
- Sales, Sales, Sales--Second in size to R&D, the staff of sales and application engineers duly executes the strategies and objectives of the company. Being a young company emerging from its start-up phase, strength in the sales organization is critical to long-term success.

DATAQUEST believes that implementation and combination of the above attributes contribute to Daisy's success. We do not believe that these characteristics are unique solely to Daisy, since the EDA market segment currently comprises very young or start-up companies that also demonstrate the skill and desire to be long-term winners.

The EDA segment is being pioneered by young companies, and DATAQUEST believes that the above attributes are significant because the competitive pace has been set for all others to follow. DATAQUEST estimates that by 1988, the EDA segment's revenues will be more than \$1 billion, and companies deciding to enter this large and lucrative segment must know and understand the rules of the game and be willing to play by them. We do not expect any of the current market leaders to take a passive role and give up the market share unwittingly.

Beth W. Tucker

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# RESEARCH BULLETIN

CCIS Code: Newsletters, No. 62

# IBM ANNOUNCES AWESOME NEW PRODUCTS

Dataquest

IBM Corporation today introduced 55 new products. The most significant product announcement was the IBM PC-AT, the first of a new generation of IBM personal computers. The PC-AT, deemed IBM's most powerful personal computer, uses the advanced high-speed Intel 80286 microprocessor and can be used as a standalone system or as a multiuser system. IBM also introduced the IBM PC network, which provides the capability to link up to 72 IBM PCs or PC-XTs for sharing information programs and peripheral devices.

#### IBM PC-AT

12321

The IBM PC-AT's physical appearance is very similar to the other members of the PC family. Its initial configuration includes 256 Kbytes of RAM memory expandable to 3 Mbytes, and one 1.2-Mbyte floppy diskette drive, all priced at \$3,995. The PC-AT can be expanded to a total of 41.2 Mbytes of disk storage. It has eight expansion slots with both 8and 16-bit data paths. The unit is physically and logically compatible with the add-on boards for the PC and PC-XT.

# **Operating System**

IBM also announced DOS 3.0, which provides a single-user multitasking capability. It is priced at \$65. An upgrade to DOS 3.1 will be required in order to add networking capability to the PC; it will be available in first quarter of 1985. IBM also announced a multiuser/multitasking PC operating system--the IBM PC XENIX. PC XENIX will provide multiuser capabilities, but at this time it appears that it will only support two user terminals plus a console. PC XENIX will be available in first quarter of 1985 for \$395.

#### PC NETWORK

The IBM PC Network for linking personal computers includes products that customers can tailor to their own application and install themselves.

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The PC Network is cable TV-based using CSMA/CM. The Network uses a tree topology and runs at 2 million bits per second. This network is independent of, and incompatible with, IBM's announced cabling scheme. The Network's heritage is based on Sytek's Local/Net 20 broadband network; however, IBM's implementation is unique in network speed and location of hardware components inside the PC system units. Components include:

- IBM PC Network adaptor card. Priced at \$695 and available October 1, 1984, the Network adaptor card will fit into any of the PC product family except the PCjr. It is based on an Intel 80186 microprocessor and an Intel advanced function communications chip. A radio frequency modem is also included. Software termed "NetBios" will be used for Layer 5 of the OSI Model and will follow future standards developed by ISO.
- The IBM PC Network Translator. Priced at \$595, the Network translator will be available October 1, 1984. One translator is required per network. The translator performs frequency shifts and amplification for broadband networks.
- Cables for the network will be preconfigured in 25-, 50-, 100-, and 200-foot lengths, and are available at a price of \$29, \$39, \$59, and \$99, respectively.

IBM also announced it intends for the PC Network to interconnect with its token ring LAN at some point after the token ring has been announced.

# ANALYSIS

DATAQUEST has come to the following conclusions about the impact of IBM's product announcements on the market for PC-based CAD/CAM systems:

- The PC-AT's advanced high-speed microprocessor provides a higher level of price/performance within the CAD environment, thus expanding the potential market for PC-based CAD/CAM systems.
- The PC XENIX operating system, which is similar to UNIX 3.0, expands the potential for PC-based CAD in heavily UNIX-based environments.
- The PC Network provides communications capability that will augment overall productivity in the design and manufacturing automation environment.

DATAQUEST believes that these new IBM products will generate increased market penetration of PC-based CAD/CAM systems into design, engineering, and manufacturing operations. This leads us to conclude that IBM will continue to sell more personal computers, install more office networks, and increase its overall market penetration by providing a practical array of personal computer systems and an independent, workable network to link them together.

> Wendy A. Ledamun James R. Carreker

# RESEARCH NEWSLETTER

CCIS Code: Newsletters, No. 61 Rev: 08/17/84

# SABER TECHNOLOGY COMBINES DESIGN INNOVATION AND SYSTEMS INTEGRATION

# OVERVIEW

Saber Technology, San Jose, California, delivers advanced state-of-the-art raster graphics products to the design and manufacturing automation marketplace. The products fit in three distinct categories:

- Ultra high-resolution displays
- Interactive graphics computer system workstations

Dataquest

Pattern generators

Although these products provide solutions to a wide range of applications within the engineering environment, the majority of these systems will be employed within the CAD/CAM marketplace. DATAQUEST forecasts the CAD/CAM market to exceed \$10 billion by 1988, reflecting a compound annual growth rate of 40 percent from 1983 through 1988.

DATAQUEST segments CAD/CAM workstations into two categories:

- <u>Standalone Graphics Workstations</u>--The operating system and host CPU reside internal to the local physical device
- <u>Host-Dependent Workstations</u>--The operating system and host CPU are not resident within the local physical device

Saber Technology provides display and computational tools to each of these segments.

DATAQUEST predicts that in 1988 the total population of standalone architecture will account for 50 percent of all CAD/CAM systems shipped.

Table 1 shows DATAQUEST's market forecasts for the CAD/CAM workstation market.

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#### Table 1

# DATAQUEST MARKET FORECASTS STANDALONE AND HOST-DEPENDENT WORKSTATIONS

		<u>19</u>	983	<u>19</u>	88	CAGR
<u>Host-Der</u>	endent					
Revenue	(\$M)	\$ 1	L <b>,</b> 778	\$ <del>(</del>	5,095	28%
Units		13	3,699	62	2,871	368
<u>Standalc</u>	one					
Revenue	(\$M)	\$	267	<b>\$</b> 4	,716	78%
Units		3,	601	57	,975	748

Source: DATAQUEST

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This newsletter addresses Saber's workstation product--The SaberStation.

# COMPANY BACKGROUND

Saber, in positioning itself as a developer and manufacturer of next-generation technologies, has faced the task of integrating company-developed proprietary designs with a commercially available, high-performance central processing unit. The Saber displays and workstations incorporate high-performance raster technologies and optimum processing power, to provide a harmonious solution set. This combination addresses a multitude of applications within the CAD/CAM marketplace.

# The Roots

Saber was founded in 1982 by Paul Magnuson, who also founded Magnuson Computer Systems Incorporated. In February 1984, Dennis Peck took over the corporate controls after his selection to succeed Mr. Magnuson. The management nucleus is a combination of large corporation savoir faire, engineering constitution, operations expertise, and entrepreneurial perception. The executive team consists of:

- Dennis Peck--Chief Executive Officer, Chairman, and President
  - 17 years experience at NCR Corporation

- General Manager of Engineering and Manufacturing at NCR
- Managed development and design of NCR's 32 microprocessor family
- Assistant Vice President of Product Marketing at NCR
- Lawrence Dorie--Vice President of Marketing
  - High degree of technical knowledge and marketing skills
  - Past experience includes Avera Corporation, DMC Systems and Calma
  - Extensive background in graphics systems design and marketing
- James Richardson--Vice President of Operations
  - Formerly Vice President of Engineering and Operations at Forward Technology
  - Helped found Plexus Computers in capacity of Vice President of Engineering
  - Prior technical background at Fairchild and NCR Corporation
- Frank A. Valdez--Vice President, Display Systems
  - 20 years experience in display design engineering
  - Raster Products Manager/Principal Engineer at Kratos Displays
  - Prior background includes Kaiser Aerospace, Litton, and Singer
- Kevin E. Anderson--Vice President, Software Development
  - 12 years experience in software development
  - 5 years as Vice President of Software R&D at Magnuson Computer
  - Previous experience at Itel, MCRB, and Transamerica Information
- Edward Petrin-Chief Financial Officer
  - Industry experience at Arthur Anderson
  - Chief Financial Officer at Magnuson Land Development Corporation

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- Bruce Schaefer-Vice President Hardware Design
  - Fifteen years computer industry experience
  - Experience includes Corvus/Mountain Computer Inc./National Semiconductor, Amdahl, and Singer

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#### The Seed

Starting with \$2 million in private seed funding, Saber successfully raised an additional \$4 million in its initial round of financing and is looking to attain an additional \$6 million in second-round financing. The initial investors included; Asset Management, GE Ventures, Churchill International, Bryan and Edwards, and Glenwood Management. The initial financing was used for product development while the second-round financing will be directed toward manufacturing production and marketing.

#### PROJECTED REVENUE

Saber estimates that its 1984 revenues will reach \$4 million, with workstation revenue reaching an estimated 55 percent of the bottom line. In addition Saber estimates that its 1985 revenues will increase tenfold, with workstation revenues representing approximately 85 percent of the bottom line.

#### PRODUCT OVERVIEW

Saber's product development philosophy addresses four major areas of concern within the CAD/CAM and graphics display marketplace:

- Ultra-high resolution raster graphics displays
- High-performance graphics subsystems
- Provision of optimum compute power in coordination with extensive raster graphics capabilities
- Ergonomics, human factors, and systems size

# SaberStation

In developing leading-edge display technologies, Saber confronted three very pertinent factors that are key within the CAD/CAM marketplace today. The first challenge was to improve the visible resolution of the graphics display. To meet this challenge Saber expanded the number of addressable pixels, increasing the resolution to 1,664 x 1,248.

The SaberStation is a unique "composite" of proprietary and standard architectures. The SaberStation is one of the industry's fastest and highest resolution workstations, utilizing the National Semiconductor NS32032 microprocessor as its Central Processing Unit (CPU), the UNIX operating system, a proprietary Tri-Bus architecture, and a proprietary circuit technology called Quasi-Saturated Emitter Logic (Q-SEL). The workstation consists of three major subsystems: the NS32032 microprocessor, the graphics subsystem, and the image subsystem, of all utilize a proprietary TriBus Data Transfer Architecture. (See Figure 1.)

# Figure 1 SABER TRIBUS ARCHITECTURE

HARDWARE

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• PERIPHERALS

# NS32032 Microprocessor

The NS32032, an actual 32-bit processor, is the "applications" processor. It is composed of four chips in addition to the central processing unit:

- High-performance floating point coprocessor
- Memory management unit (supporting demand page virtual memory)
- Timing control unit
- Interrupt control unit

Although the workstation was designed using an 8 MHz NS16032, the upward migration to the NS32032 is very easy. The present architecture will be upgraded to a 6 MHz NS32032 sometime in 1984, depending on its availability. The incorporation of the NS32032 version is expected to be available in production quantities in 1985. The 8 MHz processor running at 10 MHz can process approximately 1.2 million instructions per second; in addition, the system can use two processors. Saber has designed its own proprietary Direct Memory Access (DMA) system, which supports 8 DMA channels at a 20-Mbytes transfer rate, which accesses all peripherals without interruption of the central processing unit.

DATAQUEST believes that in addition to its 32-bit architecture and full virtual memory addressability, the NS32032 incorporates two very substantial features: its efficient ability to run programs written in high-level languages, and its "orthogonality" or the symmetry of its instruction set. The orthogonality of its instruction set is highly significant because it allows all instruction types to operate on all addressing modes and data types. The applications processor supports a minimum of 1 megabyte of main memory and a maximum of 4 megabytes (with 64K RAMS).

All information is processed via a first in first out (FIFO) buffer. In addition the SaberStation has two independent disk controllers, each on a separate DMA channel with its own disk subsystem. One is allocated to the UNIX operating subsystem--presently UNIX 4.1 BSD; version 4.2 BSD will be available in September 1984--while the other controller is used for applications. Each disk can support four drives.

# Graphics Subsystem

The graphics subsystem supports an 1,664 x 1,248 resolution display resulting in a 2 million pixel image. The screen's brightness, resolution, and speed are fully exploited in the graphics subsystem. The graphics subsystem architecture is based on a proprietary high-bandwidth bus structure, supporting a data transfer rate of 20 Mbytes. The graphics subsystem accepts accelerators and application-specific devices to address the following:

- Matrix transformation
- Array processing
- Tesselation (tile generation)
- Mesh generation

The subsystem supports application-dependent algorithms for clipping, scaling, perspectivization, and scalable hardware font processing. The graphics subsystem can take data directly from mass storage by by-passing the CPU, and can bring it to the video display very quickly under DMA control. By utilizing this high level of systems integration, the full screen can be filled in less than 1 second. The subsystem also provides the capability to read any pixel information back from the image memory in high-speed block mode. This facility is required in image processing systems and allows the SaberStation to address the high-end imaging marketplace.

DATAQUEST believes that the flexibility of the graphics subsystem will allow Saber and its end users to incorporate custom, semi-custom, or off-the-shelf silicon engines, into maximizing the performance and price ratio. This offering should help position the SaberStation into specific market niches requiring customized solutions.

# Image Subsystem

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The image subsystem supports a unique high-speed display interface providing 180-MHz video with 24-bit color resolution. The subsystem contains 2 to 24 image planes with the capability of displaying 16 million colors. The image memory unit is composed of image planes that are designed to the 2-million pixel density of the display. The system contains true bit-mapped graphics and provides the ability to control the placement and movement of any pixel. The high-speed memory allows memory update simultaneous with screen update, hence 2 megapixels are displayed 60 times per second. Since each primary color has an effective 8-bit conversion at the 180-MHz video rate, pixel time is less than 6 nanoseconds. Furthermore, memory can be configured as continuous, layered, or in blocks for double buffering.

In addition to the subsystems mentioned above, the SaberStation architecture utilizes a proprietary circuit and a proprietary Tri-Bus topology.

# Q-SEL

In order to continuously provide sharp and bright pixels, Saber developed a proprietary circuit topology called Q-SEL, meaning Quasi Saturated Emitter Logic.

The Q-SEL's topology is a video amplifier design that greatly reduces the capacitance that ordinarily limits the speed of the amplifier. This improves the image quality of the video display and delivers a pixel time of 5.5 nanoseconds. This factor is most significant in displaying a brilliant and bright pixel on the display. In depicting the rise and fall time of the pixel brilliance it is pertinent to note that the steepness of the rise and fall curve is relevant to the time the pixel retains its brightness. In Figure 2, a normal capacitance cycle, shows that the total pixel time is 5.5 nanoseconds. Without the implementation of the Q-SEL topography, the rise and fall curves are very gradual, representing a very short time period of full brightness. Figure 3 represents the SaberStation capacitance cycle, which incorporates Q-SEL topography. In comparing the areas between the fall line, F, and the rise line, R, one can clearly observe the significant difference in areas and length of time of maximum gun energy. The difference is due to the steepness of the the rise and fall curves, which is a direct function of the video amplifier design.

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# System Buses

Saber's ICGS product uses the following three bus structures to deliver optimum video and computing performance:

- Application bus
- Image bus
- Graphics bus

The applications bus and the graphics bus transfer data at 20-Mbytes per second while the image bus executes at 48-Mbytes per second. Each bus is asynchronous and bidirectional. The Tri-Bus architecture provides very high throughput capability in addition to providing a method of integrating application-specific hardware to replace functionality now being handled in software.

# Software

In addition supporting UNIX as its operating system, the SaberStation supports SIGGRAPH Core 2D and 3D with extensions. The system also supports Graphic Kernal Systems (GKS) 2D. The extensions include a window manager that allows a user to create 'n' number of windows of any size. The graphics package allows access to the 2-megapixel display level.

Both core programs interface to the virtual device interface (VDI), which frees the application from device dependency. The subsystem supports C, Pascal, Fortran, and other high-level language compilation.

#### <u>Communications</u>

Saber provides a multibus adapter board that provides both Ethernet and TCP/IP communications protocols. The company's newest product is an IBM cluster SaberLink, controller. This product provides а communications link between IBM mainframes and SaberStations via direct attachment to the mainframe channel. The communications link supports up to 8 workstations in both interactive and file transfer modes. It operates at up to 2-Mbytes per second on the channel; in addition, each workstation has a 3.5-megabit-per-second coax link to the cluster controller. Available in first quarter 1985, the link will be priced at \$29,950 for a 4-port system, and \$32,500 for an 8-port system.

# Marketing/Distribution

#### Domestic Operations

Saber is implementing a vertical sales/marketing organization segmented into two major vertical markets:

- Workstations
- Displays

Each segment will have its own dedicated sales manager and support team. The workstation personnel will focus on sophisticated end users who have in-house CAD capability, end users, and systems houses.

#### International Operations

At present, Saber is formulating marketing and sales plans for a European entry while simultaneously building distribution channels for the Asia/Far East basin.

# DATAQUEST ANALYSIS

Although new workstation developers and manufacturers are entering the marketplace every day, Saber has developed a leading-edge product. By addressing many of the conventional pitfalls of today's graphics systems--brightness, resolution, flicker, and system "footprint"--Saber has successfully developed a new level of computer-power/video-display ratios. DATAQUEST believes that with the successful integration of custom graphics engines and 32-bit microprocessor technology, Saber is continuing its drive toward photo quality graphics capability.

The proprietary SaberStation provides the highest resolution within the workstation marketplace today. Utilizing its subsystem architecture, Tri-Bus data transfer technology, and proprietary silicon designs, Saber is delivering approximately 60 percent additional viewing density over existing workstation designs.

The product positioning of the Saber workstation provides the end user with a high-performance engineering workstation complimented with an open systems architecture. DATAQUEST believes that these factors will be important in Saber developing its end user base and third party software offerings. With the incorporation of designs from strategic partner complemented with "internal" designs, the Saber product will provide a very flexible solution set to specific CAD/CAM market segments.

Targeted at the upper end of the graphics market segment, the SaberStation, positions itself as a formidable candidate for both solids imaging and model rendering.

Although Saber has incorporated the NS16032 in its present architecture, the requirement for the NS32032 remains. In that the availability of the 32-bit chip has slipped numerous times, specific dates of its availability are in question. DATAQUEST believes that the NS32032 will play an important role in the performance of the SaberStation, although the 16032 SaberStation looks extremely efficient.

DATAQUEST sees the creation of a third party software library for Saber to be a requisite for success, in the workstation marketplace. DATAQUEST predicts the average cost of workstation hardware to be decreasing at 15 percent per year over the next five years. With this in mind it will be important for Saber to deliver a low-cost/ high-performance product within the next 24 months.

Also a significant point is the rising availability of personal workstations, (personal computer based) in the price range of \$15K to \$25K, utilizing applications specific hardware and custom/semi-custom graphics engines. Thus, moving the average cost per workstation to a new level as well as end-user expectation levels.

DATAQUEST observes that it will be critical to Saber's success to continue to provide a high level of product differentiation among the rapidly growing base of workstation manufacturers. DATAQUEST agrees that display capability combined with overall performance are key in the engineering environment but also are price, flexibility and distribution channels.

James Newcomb

CCIS Code: Newsletters No. 58

RESEARCH BULLETIN

CV ACKNOWLEDGES THE VAX AND USHERS IN MEDUSA

#### OVERVIEW

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Computervision (CV), amidst the recent flurry of new product announcements, has added yet another new offering to its fold. The new system, called MEDUSA, will run on Digital Equipment Corporation's VAX computers, coupled with CV's 3400 Sun-based workstations. MEDUSA is a series of software solutions for two-dimensional design, detail drafting, and three-dimensional solids modeling. It was developed by Cambridge Interactive Systems Limited (CIS), which has been a CV company since 1983. In an accord reached in March 1984, CV and Prime agreed to share MEDUSA product beginning marketing rights for the worldwide However, Prime would be responsible for its own June 7, 1984. maintenance and development of MEDUSA, while CV would retain CIS for continuing support and development of the product.

#### CONFIGURATIONS

The configuration of a basic CV MEDUSA system requires a VAX to run the software and maintain the data base. The VAX 11/730, 11/750, 11/780, or 11/782 are supported under this offering, running under an unmodified version of VMS. CV will either sell the VAX or support existing installations in which the service is handled by Digital.

Three possible workstation configurations are possible with this system. The MWS 3410 is a Sun Model 120-based diskless system, with a base configuration of 1 Mbyte of memory, an Ethernet interface, and a 19-inch monochromatic screen with 1,152 x 900 resolution. The 3410 diskless configuration requires the use of either a 3901 or 3911 Sun Model 170 to act as a file server for the diskless nodes. A second workstation solution is the MWS 3411, which is the same as the 3410 except that it comes with a disk. Because the 3411 has its own disk, it does not require the use of a 3901 or a 3911 file server. The third possible workstation configuration involves the use of the 3911 configured with a graphics display. To better illustrate the possible configurations, a sample six-workstation configuration is listed below. This system is reported to be priced at \$496,000.

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# Quantity

#### Description

- VAX 11/750 with 4 Mbytes of memory, floating point processor, 456-Mbyte disk drive, 1,600-bpi tape drive, operator console, Ethernet interface, VMS, and basic MEDUSA software
- 5 MWS 3410 with 1 Mbyte of memory, 19-inch monochromatic display, and Ethernet interface
- MWS 3911 Shared Resource Manager with 2 Mbytes of memory, 19-inch monochromatic display, 300-Mbyte disk, and tape drive

The 3400 series workstations serve as graphics displays with local intelligence for storing and manipulating the display list. This functionality offloads the host VAX, thereby increasing the level of interactivity or allowing more workstations to be added to the system.

The communication link between the workstations and the VAX is an Ethernet link that runs at 10 million bits per second. CV also supplies software support on both ends of the Ethernet connection.

# DATAQUEST ANALYSIS

The VAX/MEDUSA offering is clearly another step that affirms CV's new product direction toward providing a wider range of hardware solution possibilities. While MEDUSA and CV's own CADDS 4 have a wide overlap in software capabilities, it appears that CV has recognized that many CAD/CAM purchasing decisions are based on a hardware brand preference (e.g., Digital, IBM). Although some may argue as to whether or not these brand preferences are well-founded, there is much more third-party software available for the VAX than there is for CV's own CDS 4000. In sales situations where preference for a VAX or for third-party software is an issue, CV no longer has to "sell around" the objection.

On the flip side of the coin, CV now has another data base and hardware offering to support, requiring additional training of its sales force and field support staff. When assessing the penetration potential of this product into CV's installed base, one has to question the viability of a customer learning two different systems and maintaining two separate data bases. However, DATAQUEST believes that the vast majority of these systems will be sold to first-time CV users or to installed accounts where the groups using the systems are virtually autonomous.

In the final analysis, DATAQUEST believes that the MEDUSA/VAX offering was an excellent move on the part of CV. Given the broad acceptance of MEDUSA in Europe and the popularity of the VAX, we expect that CV will both increase its market penetration overseas and boost its domestic sales volume as well.

David B. Burdick

CCIS Code: Newsletter No. 59

RESEARCH

NEWSLETTER

# THE DESIGN AUTOMATION CONFERENCE IS THE PREMIER EDA SHOW

Dataquest

#### INTRODUCTION

The 21st Design Automation Conference (DAC), held in Albuquerque, New Mexico, June 25 through June 27, outdid even the one held last year in Florida. It proved to be the best attended and most spectacular DAC yet. With more than 4,000 people attending the technical sessions and visiting the vendors' exhibits, this year's DAC clinched the status of being the premier conference and trade show for the electronic design automation (EDA) CAD/CAM market segment.

The conference was marked by 45 technical presentations in the form of papers, panel discussions, and workshops. Forty vendors demonstrated their EDA, CAE, IC, and PCB CAD/CAM products at the exhibition hall, while numerous private, invitation-only demonstrations took place in hotel suites located throughout Albuquerque.

The interest in, and the demand for, design automation products have spurred the DAC into joining the fast pace of the EDA CAD/CAM market segment. With attendance increasing 33 percent and the number of exhibitors increasing 67 percent from 1983 to 1984, the DAC reflects the need for products that increase productivity of electrical engineers.

Many new and significant products were announced or shown at the DAC. This newsletter will discuss the products that DATAQUEST believes will positively impact the growth and applications of the electronic CAD/CAM products and market.

#### DESIGN AUTOMATION PRODUCTS

These companies showed significant new products at the DAC.

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#### Cadnetix Corporation, Boulder, Colorado

Cadnetix made its debut into the EDA market with the introduction of its Logic Design and Verification System (LDVS) based on a hierarchical schematic editor, document processor with word processing capabilities, HHB Inc.'s CADAT logic and optional fault simulators, and the SCALD-based timing verifier. The software packages run on the CDX-5000 and on the newly introduced desktop CDX-9000 Motorola 68010-based workstations.

Users of the Cadnetix CDX-5000 printed circuit board system can now incorporate comprehensive logic design capabilities with physical board layout in either one system or standalone and desktop units. DATAQUEST believes that Cadnetix's expanded product line enables the company to fulfill the end-to-end design needs of its customers and, possibly, to grow into other electronic CAD applications such as integrated circuit design.

#### CAE Systems Incorporated, Sunnyvale, California

CAE Systems demonstrated its front-end logic design and analysis functionality running on either an Apollo or a VAX computer. The company has developed interfaces for a variety of independently supplied software tools, including HiLo, Spice, and Zycad simulators; SCALD timing verifier; and SCI-MEDS, SCI-CARDS, GARDS, and CAL-MP physical layout products.

CAE announced that its products will run on Sun Microsystems' line of standalone workstations. CAE will not OEM the Sun system unless the sales volume is high enough to warrant such an arrangement.

CAE is pursuing its original software product strategy by interfacing its front-end design capabilities to already existing design automation tools. DATAQUEST believes that in this manner, the company can differentiate itself and its products, and offer users a choice of cost-effective integration solutions.

# Calma Company, Santa Clara, California

Calma introduced T-ARRAYS and announced an agreement with ECAD. T-ARRAYS is a technology-independent gate array router that currently runs on the VAX, with plans to move it to an Apollo-based system in 1985. The ECAD agreement calls for Calma to modify ECAD's Dracula II software to provide a direct interface between the TEGAStation and GDSII for logic-to-layout (electrical rules) checking.

The company also demonstrated several of its other newly introduced or enhanced products, including: T-Boards, PCB software from Omnicad that runs on the Apollo and interfaces to Tegate's data base; FAST-MASK, a hardware accelerator for design rules checking manufactured by Silicon Solutions Corporation in Menlo Park; and testing communications options as an enhancement to TEGAStation. A lot of activity, especially in the form of third-party agreements, is going on at Calma as they concentrated on becoming a major factor in the entire electronic CAD/CAM marketplace. With approximately 700 installed IC and PCB systems, DATAQUEST believes that Calma must continue this high level of activity to protect its installed base. We believe that the key to Calma's success lies in its ability to provide effective interfaces between its physical layout systems and its newly introduced front-end design automation tools.

#### Daisy Systems Corporation, Sunnyvale, California

Daisy announced that it is an IBM value-added remarketer (VAR) and introduced its Personal Logician, a schematic entry system based on the IBM PC/XT and Daisy's graphics display and controller. Through the proprietary graphics hardware and Daisy's operating system "shell," the Personal Logician provides the same user interface as Daisy's full product line. It is fully compatible with all Daisy products via an Ethernet communications interface. Daisy demonstrated Chipmaster, its recently introduced full-custom physical layout system, and the company's entire line of EDA products.

DATAQUEST believes that the Personal Logician is very significant because it provides a new level of price/performance on general-purpose hardware optimized for interactive, graphics applications. We believe that because of the Personal Logician, Daisy will be able to further penetrate the end-user market and protect its installed base.

# Control Data Corporation, Minneapolis, Minnesota

CDC demonstrated its end-to-end electronic CAD solutions, which range from personal computers, workstations, minicomputers, mainframes, and supercomputers, to time-sharing and design center services. CDC incorporates both third-party and internally developed software into its products, which cover IC, PC, and systems level design.

CDC is one of the few computer vendors selling turnkey electronic CAD solutions. DATAQUEST believes that CDC offers unique design automation solutions through its design center and time-share network strategies matched with its turnkey products. The company provides not only the hardware and software tools, but also engineering services.

# Data General Corporation, Westboro, Massachusetts

During the second show day, Data General announced its new DS/4000 distributed system standalone workstation. It is a single-user system, based on the MV/4000, that can operate in an office environment running office automation software. The DS/4000 supports all of the third-party software that is currently available from Data General.

DATAQUEST believes that the DS/4000 is significant, not only because it is Data General's initial entry into the engineering workstation market, but because it meets the diverse needs of engineers--namely, it is capable of running engineering and office automation software on one piece of hardware using one operating system.

# Genrad Incorporated, Santa Clara, California

Genrad demonstrated its HiLo-2 logic design simulator, which it procured through the acquisition of Cirrus Computer, Ltd. Genrad is approaching design from a different perspective than that of the turnkey EDA vendors. It views design from the test world, and wants circuits to be built for testability. DATAQUEST believes that Genrad is in an excellent position to solve testing issues in the design phase, which is currently the largest gap in electronic design automation products.

The HiLo-2 logic design simulator includes functionality for functional modeling, logic simulation, timing analysis, fault simulation, and test pattern generation. Genrad is pursuing a third-party software strategy, and has formed several agreements for its HiLo-2 product with companies such as CAE Systems and Metheus-CV. DATAQUEST believes that by following this strategy, Genrad will be able to maximize sales of its simulators, while protecting the installed base of its testers by increasing integration with design products.

# HHB Softron, Mahwah, New Jersey

HHB is the software company that developed the CADAT logic and fault simulator. The company has several major third-party software agreements with EDA vendors, most notably Mentor Graphics and Racal-Redac. DATAQUEST believes that because HHB offers one highly focused product, the company is in an excellent niche position to provide software to a wide range of EDA vendors.

#### Mentor Graphics Corporation, Beaverton, Oregon

Mentor announced its Hardware Verification System (HVS), which is used for both data acquisition and test pattern generation to stimulate electrical nodes for testing prototype circuits. The company also demonstrated the products it announced during February 1984 (refer to DATAQUEST Research Bulletin No. 49). Mentor also announced that it has repackaged its systems into the Idea Series, previously the Idea 1000 line. The newly packaged systems are bundled with the appropriate software to accomplish most electronic design tasks. They include the Capture, Design, Idea, Spice, Chip, Gate, Cell, Test, and DOC Stations.

Mentor also demonstrated its products on the Apollo DN550, Apollo's newly announced lower-cost color graphics product. Although Mentor has a schematics capture product priced in the high \$20,000 range at large . quantities (Apollo DN300-based), DATAQUEST believes that Mentor must

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aggressively pursue other low-cost hardware options so that it can provide systems with price/performance ratios competitive with new product introductions from Daisy and Valid.

# Metheus-CV Incorporated, Hillsboro, Oregon

Because Metheus signed up for booth space as Metheus Corporation prior to the announcement of the joint venture with Computervision, the DAC committee would not allow the company to use the new name of Metheus-CV on its booth. Metheus demonstrated its 700-series workstations, which have a full range of logic design and analysis and physical layout functionality, as well as direct interfacing capabilities to Computervision's CADDS-2 VLSI design systems. (Refer to DATAQUEST Newsletter No. 55 for further details on the newly formed joint venture.)

# NCA Corporation, Sunnyvale, California

NCA traditionally has been a software company specializing in the post-physical layout phases of the design cycle, with products for design and electrical rules checking and pattern generation. At the show, NCA demonstrated its newly announced Viewport and Graphic Logic Editor (GRALE) stations. The Viewport is an edit-only station intended to allow the layout designer to quickly correct layout errors found by NCA's design rules check programs. GRALE is a graphics station that allows the logic diagrams to be input directly to NCA's data base for use with its electrical rules checking program.

DATAQUEST believes that NCA has identified a specialized market niche for itself by developing programs that meet very specific needs within the design process.

#### Omnicad Corporation, Fishers, New York

Omnicad was at the DAC with its Omniboards and Omnigates PCB and gate array CAD/CAM products. Omnicad is the first CAD/CAM company to support AT&T's new microprocessor-based personal workstation. DATAQUEST believes that this is significant, because it takes AT&T into the CAD/CAM industry, competing with all the other computer and workstation companies. Companies now have a choice between a PC/DOS-based IBM personal computer and an AT&T UNIX-based personal computer.

Omnicad is a spinoff from nearby Scientific Calculations and has signed a major third-party agreement with Calma Company for Calma's newly announced T-Boards.

# Phoenix Data Systems, Albany, New York

Phoenix Data Systems (PDS) is expanding its traditional line of logic simulation and layout verification products (LOGCAP and MASKCAP, respectively) into more comprehensive EDA products. At DAC, the company

demonstrated its schematics capture, simulation, layout, verification, and pattern-generation products. PDS is largely dependent on Digital's host-dependent products, ranging from the VAX 11/725 to the VAX 11/780.

PDS is one of several software companies selling products for electronic design automation. DATAQUEST believes that for PDS to be successful in this market segment, it must differentiate its products from those offered by its competitors. In this way, it will be able to expand its end-user sales, as well as be able to interface its more well-established MASKCAP and LOGCAP products to other EDA systems.

# Racal-Redac Incorporated, Westford, Massachusetts

DATAQUEST calls it EDA, and Racal calls it CIEE (Computer Integrated Electronic Engineering). Racal has long been one of the leaders in the PCB CAD/CAM market segment, and recently it has shown its intentions of becoming a dominant force in the entire electronic CAD/CAM market segment. Aside from its traditional PCB router, the company now offers logic design and analysis and full-custom VLSI design capabilities. In addition to Digital's PDP and VAX series, Racal's hardware lines have been expanded to include IBM PC/XT and Apollo processors.

Racal has signed agreements with HHB/Softron for its CADAT logic and test simulator, and with Inmos for its internally developed full-custom stick-like layout editor. Racal spokepersons say it has plans to announce a router for standard cell design methodology in the near future. DATAQUEST believes that Racal's new strategy will be especially successful in Europe, where the company dominates the PCB CAD/CAM market. We believe that the company will have to continue its corporate awareness campaign in the United States in order to effectively compete with the existing EDA vendors.

# Silvar-Lisco, Menlo Park, California

Silvar-Lisco's booth stressed its software marketing strategies by demonstrating its full line of products on the newly announced Apollo DN550 and VAX computers. (The company's products are discussed in our Research Newsletter No. 56.) The company stressed that its software is compatible and integrated with a wide range of processors, including the two mentioned here and the IBM and Prime computers.

#### Teradyne Incorporated, Boston, Massachusetts

Teradyne, like Genrad, is approaching product design from a test perspective. Teradyne demonstrated Lasar, its logic and test simulator, at the show. The company is formulating a new strategy to market its software not only directly to end users, but also to turnkey CAD/CAM vendors. Teradyne already has formed several third-party agreements with major CAD/CAM vendors. DATAQUEST believes that by pursuing two distribution channels, Teradyne will be able to enter the CAD/CAM market quickly, and integrate testing with design via its Lasar products.

# Valid Logic Systems Incorporated, Mountain View, California

Valid introduced its low-cost desktop workstation at the show. Unlike Daisy, Valid's product is proprietary, based on the Motorola 68010 and UNIX operating system. Called the SCALDsystem IV, the new system can perform schematic capture, timing verification, logic simulation, and documentation. It interfaces to Valid's entire product line via Ethernet. The company also announced that it has added color capability to its SCALDsystem I and II. Valid was showing its entire line of EDA products at the show.

# Via Systems Incorporated, North Billerica, Massachusetts

Via, until recently, has sold products solely for IC physical layout. At the DAC, the company was demonstrating its recently announced logic design system, which performs schematics capture and logic simulation. Via has chosen Sun Microsystems' product for its processor, and also sells systems based on Digital's PDP 11/23. DATAQUEST believes that Via's decision to expand its product lines to include front-end capabilities was wise, since logic design and simulation are more critical needs than products for physical layout only.

#### SUMMARY

The 22nd Design Automation Conference, to be held in Las Vegas during June 1985, promises to be just as spectacular as the 21st DAC. Although many of the vendors have mixed feelings about the structure of the conference (i.e., entry fee, floor selling, competing after-hour functions), most of the vendors agree that it attracts highly qualified sales prospects and is an extremely productive trade show.

Of all the products shown at the DAC, all illustrated one or more of several trends that are spurring the growth of the EDA market segment. These trends are described below.

#### Deliverable, Functional Personal Workstation

DATAQUEST believes that three major factors are restricting an even faster and more widespread acceptance of EDA systems: change from current design methodology, a relatively steep learning curve to become proficient with a system and realize real productivity increases, and cost. With the availability of both general-purpose and dedicated low-cost systems, the average system selling price is no longer such a large obstacle. We also believe that prices will continue to decrease, and conversely, that price/performance ratios will continue to increase. Because the majority of EDA systems will be used mostly for applications with low computational requirements and mid-range graphics requirements (such as logic design or schematics capture), the availability of systems priced in ranges less than \$20,000 will open the market to all levels of engineers, not just to those working on key, high-priority projects.

#### Broadened Functionality

EDA systems have expanded from the originally introduced logic design and analysis products to include products that address the entire design cycle. Most notable is the inclusion of physical layout tools that can operate with or from the same data base used for logic design. The EDA companies are directly attacking turnkey companies with physical layout-only products. DATAQUEST believes that they will gain market share because users want integrated solutions.

#### Increased Analysis Emphasis

Second to schematics capture, EDA systems are used mostly for analysis. Schematic capture is a relatively rudimentary 2-D graphics application. Intractive, usable analysis of the design is the key to the successful logic design. Products range from logic and circuit simulation, to behavioral-level simulation, timing verification, physical modeling, fault simulation, and physical layout verification. DATAQUEST believes that as users become more confident with the functionality of the currently available analysis tools, the vendors will seek not only to add more analysis products to their lines, but to increase the performance of their existing ones.

# Application-Specific Hardware

Specialized engines are being incorporated into product lines to implement software functionality onto hardware. Striving for ever-shortening product design throughput, not only does the applicationspecific hardware offered by EDA vendors decrease computational time, but the products offered also are distributed in nature, and can be accessed by many workstations within a network.

# Niche Applications

Not all vendors participating in the EDA segment will be, or are, full-range turnkey vendors. Due to the high degree of sophistication and complexity of design automation products, many vendors can be successful with specialized, niche products, even though they may not reach hundreds of millions in sales. The high growth of the EDA segment and its infant stage create an umbrella for companies to participate with niche products and complement the turnkey vendors' product lines rather than compete directly with them.

The level of competition (i.e., the costly and glamorous booths, number of sales personnel and systems on the exhibit floor, new product introductions, and the sheer number of vendors) exemplifies the pressure to succeed and be one of the big winners in the still very young EDA market segment.

Beth W. Tucker

RESEARCH NEWSLETTER

EPIS Code: Newsletters

# THE RASTER IMAGE PROCESSING COMPANIES PART II--OFFICE AUTOMATION SYSTEMS

Dataquest

#### SUMMARY

This is the second in a series of DATAQUEST newsletters that will address the dynamic field of raster image processing. This newsletter covers the products and technologies of Office Automation Systems, Inc. (OASYS), a San Diego, California, company. At the 1984 NCC show, OASYS will be demonstrating and introducing its controllers, which work with a wide range of raster non-impact printers.

# INDUSTRY OVERVIEW

During the last year, several non-impact printing technologies have matured, and are increasingly and aggressively being introduced to the market in product forms that meet specialized printing needs. There is growing usage of page printers to meet the sophisticated printing demands resulting from application of personal computers, small business systems, telecommunications advancements and de facto standardization of local networks (LANs), and their support from industry stronghold area companies. Recently, the price of these printers has eroded significantly. Less than six years ago, these printers were expensive (more than \$400,000) and were used primarily as line printer emulators in data processing applications. The flexibility of these devices was not truly realized until several software packages were developed, and though the software was difficult to use, programmers in EDP shops created applications programs that opened new areas for non-impact printers to serve. Two years ago, when Xerox announced the 2700 product line, priced at approximately \$20,000, these devices still were barely competitive with the daisywheel printers in the office. Graphics were done on slow and expensive pen plotters, and this tedium coupled with the nonintegrated printing method kept most applications confined to the data processing environment. Today, the old standbys, the Xerox 9700 and IBM 3800, have managed to build a modest user base of approximately 3,700 machines in the United States, which is a clear indication of the effects of a very high price/performance of more than \$3,500 per page minute.

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A remarkable pricing trend has been displayed recently by several vendors who are value-added resellers of the Canon LBP-CX marking engine. Last April, Imagen Corporation announced a fully featured printer with a controller providing full text (multifont) and good resolution graphics for \$9,995. At the last Comdex show, Quality Micro Systems announced a similar product for the same price. The price aggressiveness of the manufacturers did not stop here. In the same Comdex show, Hewlett-Packard announced a Canon LBP-CX-based product at less than \$3,500. The performance of Hewlett-Packard's product, the Laserjet, is rather limited in graphics and in its current offering of fonts and graphic software. Nonetheless, in the last four months, the price has dropped from \$1,250 per page minute to less than \$450 page per minute. DATAQUEST expects this pricing to accelerate the move of laser page printers into the office and corporate printing environments.

As the printer market grows, so will the demand to exploit the full potential of these devices with flexible printing applications. Additionally, the prices of both monochrome and color display stations have become more affordable, and this has placed a burden on raster output devices (printers and film recorders) to produce hard copy of what one can create on the screen. New products that add value to the original marking engines have increasingly been in the limelight in the industry. These are the intelligent front-end controllers (raster image processors -- RIPs) that work with the CPU where the document description Intelligent controllers (RIPs) provide raster resides. (dot-based) information to print engines, determining the placement of dots to construct images. While a simple bit map scheme is straightforward, it has some severe limitations. It uses a great deal of memory, which is further compounded exponentially if gray scale and color intensities are included. The cost of memory, limited functionality, and tying up the CPU during page printing are not likely to be widely accepted.

Value-added resellers are designing, developing, and marketing controllers (raster image processors) to work with commonly available printers. Their strategy is to provide intelligent printing systems compatible to large OEM systems sellers, who have captive markets for their products, have large established customer bases, and have national/international sales and service networks. The value-added resellers, as well as the original equipment manufacturers, are prime sales opportunities for the controller manufacturers. The growth of the controller market is further fortified by DATAQUEST's forecast that more than 500,000 page printers will be placed during the year 1988. The rush to gain a share of this market has already begun. Xerox has already announced and released Interpress to the public (see DATAQUEST's newsletter entitled "Xerox Releases Interpress to Public Domain," dated May 1, 1984). It is an application-level architecture for the 9700 and 8700 line of printers. Imagen, based on a proprietary technology as licensed by Stanford, is forging ahead with its planned family of product introductions during the next several months. QMS, Interleaf, and HP have taken steps to announce their products. Several other announcements are in progress. We expect to see a wide spectrum of products in the intelligent controller raster image processing area, if not in the NCC show, definitely by end of third quarter 1984.

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#### COMPANY BACKGROUND

Office Automation Systems, Inc. (OASYS) was incorporated in June 1983. The work to develop an intelligent controller for the non-impact printer was started as a research and development project two years prior to the forming of the company. The two key personnel in the company are Anthony Stramondo, who is the President, and Robert Freeman, Vice President of Marketing, who also serves as vice president for product development. Currently, the company has more than 47 years of electronic experience among various personnel. It intends to share and build on this expertise in various aspects of product design including non-impact printers, LSI, VLSI design, fonts, lasers, software, and high-precision defense work. The company is planning to gear up its staff to perform further work in the controller area.

In developing and introducing its first product, OASYS claims that its philosophy has been to develop a high-performance printer controller based on integrated hardware and software. The key emphasis is on providing high-performance printing without mainframe (CPU) performance degradation.

#### THE OASYS-I

# Product Strategy

The OASYS-I product is a simple mother/daughterboard controller. It contains a main logic board controller and a printer personality board controller. By designing in this manner, the company claims that a true level of modularity can be retained that will result in the ability to build interfaces for both commonly available printers and customized printers. The only board that needs to be altered is the printer personality board (also known as the daughterboard), which can be modified for different vendors/printers within 30 days. The company has stated its strategy to be a simple and pragmatic one:

- To design and manufacture custom controllers for non-impact printers (raster device only)
- To provide low-cost printer controllers for speeds up to 60 ppm (with higher speeds feasible). Raster image processing by design is not limited to 60 ppm; the company claims faster speed is equally implementable
- To have a short turnaround in controller design and delivery;
   30 days for prototype, 90 days for production
- To provide low-cost, device-independent, controllers

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### Marketing Strategy

Initially, the company plans to market the product to three primary targets:

- Printer manufacturers
- OEM distributors
- System integrators

The company's philosophy in selecting its initial targets is based on market share expansion and satisfying the needs of a large supplier base.

#### Features

The company will introduce the OASYS-I at the NCC show in Las Vegas. OASYS has indicated that some additional features will be available soon in OASYS-II. Table 1 highlights the OASYS-I product features along with DATAQUEST's comments describing their attributes. Figure 1 is a functional diagram of OASYS-I and its interaction with the host CPU and the printer.

# **Product Specifications**

Table 2 gives detailed product specifications of the two controller boards.

# Table l 🔅

# OASYS-I PRODUCT FEATURES

#### Features

#### Comments

1. Inexpensive Typically, controllers have three to five boards. OASYS claims that it has only the main logic board and the personality board. The controller uses real-time rasterization, which results in reduced memory requirements.

The small number of boards also reduces the controller's complexity and enhances its reliability.

- 2. Higher speed Currently, OASYS-I controllers can support 20 ppm at 300 dpi and 30 ppm at 240 dpi. The plan is to go to 60 ppm with OASYS-II.
- 3. Size A small size enables the controller to be attractively fitted inside a small printer, e.g., the Canon LBP-CX. This eliminates the need for an extra housing unit next to the printer.
- 4. Express Command Language This is a language that provides access to all system features such as operating parameters, the Pyramid font system, downloadable fonts, and images and graphic primitives.
- 5. Accurate positioning Documents printed using OASYS-I controllers will match a preprinted line within 1/300" tolerance.
- 6. Modular design DASYS-I has two board configurations. By replacing the smaller of the two, the printer personality board, true device independency is obtained.

(Continued)

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# Table 1 (Continued)

### OASYS-I PRODUCT FEATURES

#### <u>Features</u>

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#### Comments

7. Font cartridges OASYS-I provides single font cartridges that will be expanded to two or more font cartridges in OASYS II. By using bit map fonts directly from the cartridge, valuable RAM space is saved.

8. Graphics The controller has a full set of graphic primitives including:

• Vectors

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- Boxes
- Circles
- Pie charts
- Halftones

9. Font system

OASYS uses a company-proprietary font system called Pyramid. The fonts are scalable over a continuous range of 2 points to 50 points. The software in the controller can scale a typeface to the user's specifications. Additionally, a set of shear, rotational, bolding, image polarity, and spacing factors are available to control the character to be printed. This feature automatically extends to landscape printing without any loss of portrait mode characteristics. Currently, the resolution of up to 500 dpi does not create any font distortion.

10. Number of font styles

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One Pyramid font style is standard with a controller. Additional fonts and bit map fonts are also available as options.

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(Continued)

# Table 1 (Continued)

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# OASYS-I PRODUCT FEATURES

Features	S <u>Comments</u>
11. Font capacity	• Pyramid fonts: 20
	<ul> <li>Bit-map fonts: up to 14 10-point fonts</li> </ul>
	<ul> <li>RAM for downloading up to 14 bit- map fonts</li> </ul>
	<ul> <li>One Pyramid font style comes with the standard controller</li> </ul>
12. Control panel	A unique feature is the alphanumeric control panel with an eight-key membrane switch pad. This provides

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control panel with an eight-key membrane switch pad. This provides status monitoring and inquiry privileges to understand the printer functions, control state and values, command to select paper trays, and form feed the last page. Additionally, it is an aid in diagnostic troubleshooting.

Source: DATAQUEST

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# Table 2

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# OASYS PRODUCT SPECIFICATIONS (Print speeds are rated for an 8-1/2" x 11" page)

# Print Speed\*

OASYS-I: 30 ppm at 240 dpi; 20 ppm at 300 dpi OASYS-II: 60 ppm at 300 dpi

# Board Size

Main logic controller board: 11.5" x 11" Printer Personality Board (variable for product): 5" x 4"

Printer Interfaces (for introduction at NCC)

- Canon LBC-CX
- Ricoh 4120
- Fujitsu M3071A, M3072

# Computer Interfaces

- Centronics
- Dataproducts
- RS-232-C
- ANSI x 3.64
- Printer Emulation
  - Diablo 630
  - Xerox XD1630
  - NEC Spinwriter
  - Qume Sprint II
  - Epson MX80
  - Dataproduct BP-1500
  - IBM Printer Emulations (under development) are 3287, 3289, 3262, 5225, and 5256

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\*Portrait or landscape printing

Source: OASYS, Inc.

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# PRODUCT INTEGRATION INTO SYSTEM

A typical product implementation is shown in Figure 2. Information to be printed, along with the control information, resides in the host system. Image and control data are transferred to the OASYS raster image processor through the host interface logic. The raster image processor, responding to the Express Command Language, will merge the text (using the selected Pyramid fonts) and the graphics, do the final page construction, and pass raster data to the OASYS printer interface. The custom printer interface logic controls the flow of the final raster data to the print engine in conjunction with printer control signal interchange.

Functionally, the main logic board (MLB) takes source data and combines it with Express Language and Pyramid font systems to yield a raster image format suitable for driving the raster printer. The printer personality board (PPB), on the other hand, handles the protocol between the controller (MLB) and the raster marking engine (printer).

# Figure 2



#### CONTROLLER INTEGRATION

Source DATAQUEST

## OASYS MARKETING AND PRICING

# Marketing

Office Automation System, Inc.'s primary marketing strategy is to sell its products through avenues where market share can be increased. With this in mind, the company will initially be working with:

- Printer manufacturers
- OEMs and value-added resellers
- System integrators

The company plans to work full time to develop and enrich products for OEMs. Its primary strategy is to support the OEMs since the OEMs' growth will help its growth.

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# Pricing

The standard OASYS-I product that will be introduced at the NCC in Las Vegas is scheduled to be announced as an OEM model at \$1,500. The company states that other pricing, based on quantities and complexity of printers, is negotiable.

#### ANALYSIS

As the prices of non-impact printers (NIPs) drop, many more vendors will be offering controllers or raster image processors in the not-toodistant future. To be successful (other than the industry giants like Xerox, who still have considerable captive markets), these controller manufacturers will be seeking fairly large volume sales agreements with OEMs, distributors, and value adders. The real plum, of course, would be a long-term, large-volume agreement with a major OEM. OASYS's strategy of offering flexible products and working closely with its customers is certainly indicative of the company's marketing experience.

During the last several months, many new and creative methods have been employed to develop and sell raster image processors to printer suppliers and users. Imagen's primary focus is on delivering complete printing systems. Adobe intends to provide its Postscript interpreter with each printer to make it a de facto standard in the industry. OASYS has designed and packaged a rather unique way to claim a share of this young but growing market. It is the stated goal of each controller manufacturer to provide printer device independence of some sort, but with the absence of any major industry-wide software standards, the end user will still find it somewhat difficult to switch his printing system. However, with the products being offered by controller manufacturers such as OASYS, the printer suppliers should find it much less difficult and, indeed, much quicker to add new printing systems to their product lines.

DATAQUEST believes that OASYS's philosophy and design uniqueness will certainly open the door to the NIP market, providing the company with an opportunity to supply products for office applications, demand publishing, and complex data processing applications. Full utilization of non-impact printers will continue to be restrained by the lack of standards. But companies like OASYS should find a rather lucrative market supplying a much-needed flexible bridge. When standards do become a reality, the RIP/controller manufacturers should find themselves in a position to offer some very interesting advanced functions.

The RIP/controllers will act as a positive boost in exploiting the functional capabilities of non-impact printers, in turn accelerating the growth of this latent market. DATAQUEST believes that the winners and losers in the RIP/controller market will not be determined by pure technology demonstrations. While technology is important, it must be complemented with good marketing and the establishment of a reputation for quality products and service. OASYS, along with several others, has an early entry into this young market. The company certainly has the opportunity to establish itself as a key participant.

(Pyramid and Express Command Language are trademarks of Office Automation Systems, Inc.)

Ajit Kapoor

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Dataquest

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RESEARCH

NEWSLETTER

#### PERSONAL COMPUTER-BASED CAD/CAM SYSTEMS: MARKET TRENDS

#### INTRODUCTION

This newsletter is the first of a series of DATAQUEST Research Newsletters discussing the market for personal computer (PC)-based CAD systems. In April 1983, DATAQUEST reported on the emerging market for PC-based CAD systems. Since that time, more than 25 vendors have opened their doors and begun shipments of software or hardware for performing CAD on PCs. With the exception of the major computer manufacturers themselves, most of the companies involved in the PC-based CAD market have been in operation less than two years. Future newsletters in this series will include company profiles and product performance evaluations.

#### OVERVIEW

Penetration of the personal computer into the design engineering environment continues to gain momentum. There are now approximately 15 companies devoted solely to developing software programs or software programs with integrated enhanced hardware for CAD/CAM applications on PCs.

A majority of these applications are running on the IBM PC and PC/XT and the Apple IIe and II+. DATAQUEST believes that the number of PC-based CAD vendors will increase as the expectations of the end-user community and the vendors' abilities to meet these expectations align. DATAQUEST estimates that approximately 8.9 million personal computers were shipped in 1983. Of these, we estimate that approximately 3,000 units were sold with software for CAD/CAM applications. By 1988, we expect shipments for CAD/CAM applications to increase to 34,200, reflecting a compound annual growth rate of 63 percent. Table 1 presents DATAQUEST's forecast for PC-based CAD/CAM system shipments through 1988. Following is our analysis of why we believe personal computers are rapidly penetrating the CAD/CAM engineering environment.

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# Table 1

# ESTIMATED MARKET FOR PERSONAL COMPUTERS WITH CAD/CAM SOFTWARE (Actual Units)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR
Shipments	3,000	8,000	12,000	17,400	24,400	34,200	62.7%
Cumulative Shipments	6,000	14,000	26,000	43,400	67,800	102,000	

Source: DATAQUEST

#### BENEFITS

The principle reasons for the penetration of PC-based CAD systems into the engineering environment are their price/performance ratio, their versatility, and their availability.

The overriding need that PCs are fulfilling in the engineering environment is one of increasing design engineers' personal productivity. Approximately one-third of a design engineer's workweek is spent in actual design activities. The balance of the time is spent performing other nontechnical functions such as budgeting, planning and scheduling, attending or conducting meetings, report writing, and a variety of other tasks. Figure 1 presents a graphical representation of an engineer's work load.

A principle advantage of PC-based CAD systems is that, in addition to CAD/CAM functions, they provide office automation features, such as word processing, spreadsheet analysis, electronic mail, and data base management functions.

Another significant advantage of PC-based CAD systems is their shorter learning curve and a higher level of user interactivity. Engineers are not software designers. To perform their work efficiently and effectively they require tools that provide practical user interfaces. PC-based CAD vendors have recognized this fact and are providing higher levels of user interactivity through software developed specifically for PC CAD applications.

# **Figure 1**





Source: Future Net Corporation

#### PC-BASED CAD SYSTEM VENDORS

DATAQUEST has segmented PC-based CAD system vendors and their products into three types:

- <u>Software-only Vendors</u>--software application packages that run on personal computers from various manufacturers
- Software and Value-Added Hardware Vendors--software application packages that require additional hardware for the PC in order to execute the programs. The additional hardware is generally available off-the-shelf from the PC manufacturer
- <u>PC-based Turnkey Vendors</u>--add proprietary graphics boards, monitors, co-processors, and other hardware features to improve the performance of the PC

Table 2 lists the primary vendors of PC-based CAD systems by type and product application category.

Prices for the systems vary considerably. Software-only programs range from \$500 to \$1,500. Software programs that require additional peripherals range in price from \$1,500 to \$4,500. PC-based turnkey systems range in price from \$13,000 to \$28,000.

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	APPLICATIONS							
Company	Туре	Facilities Management	General Drafting	3-D Draiting Design	Schematic Capture	Electronic Design	Net-List Extraction	Simulation
Auto Desk, Inc.	1	x	x					
BG Graphics System, Inc.	1		x					
Cad Cal Products	2		x					
Cascade Graphics Development	1,2,3		x	×	•			4
Case Technology, Inc.	2				×	×	x	x
Chancellor Computer Corp.	3			1	×	×	x	x
Chessel-Robocom Corp.	2		x					
Cubicomp	1			ͺ X				
Design Data Logic Systems	1		x					
Engineering Systems Corp.	1,3			×		×		
FutureNet Corp.	1,3			l		x	x	
Personal Cad Systems, Inc.	1,2		х		x	×	x	x
Summit CAD Corp.	2		x			x		
T&W Systems, Inc.	1,2		x					

# PC-CAD SYSTEM VENDORS

1 = Software-only Vendor

2 = Software and Value-added Hardware Vendor

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3 = Turnkey Vendor

Source: DATAQUEST

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# Marketing Strategies

Each of the three types of vendors address a different market niche, and their sales and marketing strategies reflect this. Software-only vendors generally sell their products through distributors, thus keeping the cost of sales relatively low. Training manuals or disk tutorials are usually provided for the application packages. Advertising and promotion is conducted primarily through trade shows and trade magazines and periodicals. Their predominant market is small businesses that require 2-D drafting and drawing capabilities. Currently, the markets that these firms' application packages address and reach are architects, facilities planners, and interior designers.

Software and value-added hardware vendors generally use manufacturer's representatives who sell various instrumentation products to engineering departments. Depending on the sophistication of the software package, these vendors may also use retailers. For example, a very low-end drafting package might be sold through PC retailers. Their market niche consists primarily of small businesses (generally under 10 employees) in the electronics and architectural industries. This group also participates in the educational market. Formal training classes are provided by these vendors in addition to training manuals. In some cases, audio cassettes are also available.

The PC-based turnkey group generally employs a direct sales force to . market its systems. These systems are typically higher-priced and more sophisticated than the other vendors' systems and, therefore, require interaction between sales engineers, applications engineers, and customers to effectively market the systems. Service, customer support, and training are all provided. DATAQUEST believes that this group's target market consists of firms involved in printed circuit board (PCB) and integrated circuit (IC) design.

#### ANALYSIS

DATAQUEST has come to the following conclusions on the future market for PC-based CAD/CAM systems.

- With the transfer of technology from standalone engineering workstations to personal computer-based workstations, yet another generation of design and manufacturing automation tools is available.
- PC-based CAD systems are increasingly taking over non-CPUintensive tasks traditionally performed by minicomputers, such as drafting, schematic entry, layout, and analysis.
- With the combination of lower-cost hardware and improved price/ performance ratios, the end-user community is establishing new expectation levels.

- With the availability of PC-based CAD products, the sell cycle of systems and the marketing of these systems will force traditional CAD/CAM vendors to adapt to another type of selling strategy.
- In addition to use of PC-based CAD systems in a standalone environment, PC-based CAD systems will also be networked with standalone "supermicro" workstations, as well as minicomputers and mainframes.
- DATAQUEST believes that through PC-based CAD systems, the possibility of achieving an integrated office automation and manufacturing automation network from both a physical and logical aspect can become a reality.

Within the next 8 to 12 months, DATAQUEST believes that a new generation of 32-bit computers or "Personal Workstations" (PWs) will emerge that will approach the performance of the higher-end standalone. workstations available today. Figure 2 presents DATAQUEST's perspective on the developing trends in workstation price/performance.





TRENDS IN PRICE/PERFORMANCE

Performance

Source: DATAQUEST

In the future, DATAQUEST believes that PWs will fulfill the personal productivity needs of engineers, while also providing complete communications capability to augment large, networked engineering environments.

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Wendy A. Ledamun

# RESEARCH NEWSLETTER

CCIS CODE: Newsletter No. 56

# SILVAR-LISCO: A SOFTWARE COMPANY OR A TURNKEY COMPANY?

Dataquest

#### BACKGROUND

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Silvar-Lisco participates in the electronic design automation (EDA) segment of the CAD/CAM industry. It offers designers and manufacturers of electronic circuits and products a wide array of software-based design automation tools to address the complex electronic design cycle.

The Company was formed in 1981 when Silicon Valley Research, Inc. and Leuven Industrial Software Company, Inc. merged. Silvar-Lisco's corporate headquarters are in Menlo Park, California; its European headquarters are in Leuven, Belgium; and its Far East distributor, C. Itoh Data Systems, is located in Tokyo, Japan.

Silvar-Lisco released its prospectus in April 1984, with its initial public offering culminating May 9, 1984. Selected income statement data are presented in Table 1. DATAQUEST estimates that approximately \$1 million of the company's 1984 revenue was derived from the sale of turnkey systems based on the Apollo workstation.

Silvar-Lisco has a large, well-established customer base of more than 75 companies, of which approximately 60 percent are located in the United States. The company's European revenue was 17, 40, and 41 percent of 1982, 1983, and the nine months ended January 31, 1984 revenue, respectively. DATAQUEST believes that Silvar-Lisco has the largest European revenue of all the current EDA vendors.

In late 1983, Silvar-Lisco relocated its corporate headquarters from Palo Alto, California, to a 35,000-square-foot building in Menlo Park. At that time, the company employed approximately 105 people, of which 45 people were in R&D, 20 in sales, and 6 in marketing. The remaining 34 people were support and administrative personnel.

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#### CORPORATE STRATEGIES

From its inception through June 1983, Silvar-Lisco developed and marketed software products for the electronic engineering community. The company sold software to run on customer-supplied computers from Apollo, Digital, IBM, or Prime. However, at the Design Automation Conference in June 1983, Silvar-Lisco announced that it, too, was in the turnkey EDA business. The company began shipping fully integrated workstations based on Apollo's DN300 system in November 1983. At the Design Automation conference in June 1984, the company will demonstrate its products on Apollo's new low-cost DN550 color workstation.

Although Silvar-Lisco changed the tactical implementation of its corporate strategies, DATAQUEST believes that the company's overall corporate strategies have not changed--that is, to supply EDA software products to a large, broad customer base. Instead, Silvar-Lisco changed the product packaging. We believe that Silvar-Lisco's decision to market a turnkey product was a direct response the the market's demand for one-stop shopping.

Software companies may have several advantages over turnkey companies that sell both hardware and software:

- Lower cost of goods sold--and, conversely, higher relative gross profit margins
- Device-independence--in Silvar-Lisco's case, its software will run on four different companies' processors and therefore, the company is not locked into any single one
- Concentrated R&D efforts

DATAQUEST believes that Silvar-Lisco will continue to concentrate on the software-only portion of its business, and that software revenues will equal approximately 80 percent of the company's 1984 calender year revenues. We believe that the company will benefit from turnkey sales by:

- Increased revenues from hardware sales, although, dollar-fordollar, hardware revenue is not as profitable as software revenue
- Direct competition with major EDA turnkey companies
- Meeting the needs of a larger number of potential customers

#### EDA PRODUCTS

During February 1984, Silvar-Lisco announced a repackaging of its software products, so that individual products are now bundled together based on specific applications. Consistent with the company's previous product offerings, the following new packages are available for Apollo, Digital, IBM, or Prime Computer:

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- STAR DESIGNER--Design and Analysis
  - SL-2000
  - SDS
  - BIMOS
  - Logan
- STARGATE--Gate Array Design
  - STAR DESIGNER, plus
  - GARDS
- STARCELL--Standard Cell Design
  - STAR DESIGNER, plus
  - CAL-MP
- STARBOARD--Printed Circuit Board Design
  - SL-2000
  - SDS
  - Helix
  - Interfaces to other PCB Software CAD/CAM
- STARCAP--Switched Capacitor Design
  - SL-2000
  - SDS
  - SWAP
  - Logan

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Figure 1 illustrates Silvar-Lisco's products and their relationship to the electronic product design cycle. The following is a brief description of each of the company's major products:

 Design Entry-Structured Design System (SDS) allows logic designs to be created interactively on a graphics terminal, entered in a netlist form via the keyboard, or digitized.  Data Base Manipulation and Control--SDS is based on a hierarchical data base.

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 Hierarchical Interactive Partitioning (HIPAR) allows the design data base to be partitioned into selected physical packages such as ICs or PCBs. dine:

- Hierarchical Design Expander (HIDEX) allows the user to remove design hierarchy for single-level netlist extraction to be used by simulators and layout systems.
- Interfaces--permit interaction with other commercially available products or internally developed design tools.
  - SDS provides optional interfaces to LOGCAP, SALOGS, TEGAS, ILOGS, SCICARDS, NCC and SPICE.
  - Engineering Access Routines (EARS) provide the capability to interface the SDS data base to in-house developed design tools. It is a set of Pascal-callable procedures.
- Simulation/Verification--Silvar-Lisco offers three proprietary simulators.
  - HELIX is a system-level behavorial simulator operating at the functional-block, register, or gate levels.
  - BIMOS is a logic simulator for MOS and bipolar circuits with 15 values, 3 states, and 5 strengths.
  - SWAP is a simulator for analyzing switched capacitor networks.
  - LOGAN is the multiwindow environment in which waveforms resulting from a simulation are displayed.
- Layout--two programs are available.
  - GARDS is a set of interactive, menu-driven placement and routing programs for CMOS, ECL 12L, and TTL gate arrays.
  - CAL-MP is a set of standard-cell placement and routing programs for MOS and bipolar circuits.
- Artwork--Silvar-Lisco provides interfaces to Applicon, Calma, Computervision, and Scientific Calculations physical layout systems for either gate array or standard cell mask generation or printed circuit boards.

# SUMMARY

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DATAQUEST classifies Silvar-Lisco as a turnkey EDA company. Although the company's revenues for 1981 and 1982 were for the most part derived from direct end-user software sales, we believe that Silvar-Lisco has made a significant contribution to growth of the young and dynamic EDA market. Therefore, we have included Silvar-Lisco's revenue in our EDA segment forecasts and estimates. Table 2 represents DATAQUEST's market share estimates for 1982 and 1983.

Silvar-Lisco is still in the software business. The company's primary strategy is to sell software that runs on a multitude of processors. However, if selling an Apollo workstation is the vehicle by which it sells software, then, it is indeed a turnkey company.

Beth W. Tucker

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# Table 1

# SILVAR-LISCO FISCAL DATA (Millions of Dollars)

	<u>1982</u>	<u>1983</u>	<u>1984</u> *
Revenue	\$1.82	\$4.32	\$6.98
Gross Income	\$0.39	\$0.46	\$0.54
Net Income	\$0.24	\$0.23	\$0.34

Note: Piscal year ends April 30

\*Data for nine months ending January 31

Source: Silvar-Lisco Prospectus

# Figure 1



# SILVAR-LISCO'S MAJOR PRODUCTS



# Table 2

MARKET SHARE ESTIMATES (Millions of Dollars)

	1982		1983		
	Revenue	Share	Revenue	<u>Share</u>	
Daisy Systems	\$6.7	32%	\$28.4	318	
Mentor Graphics	\$1.7	88	\$26.0	29%	
Silvar-Lisco	\$4.0	19%	\$ 9.0	10%	
Valid Logic	\$2.6	13%	\$16.1	18%	
Other	\$6.0	28%	\$10.5	12%	

Source: DATAQUEST

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# RESEARCH NEWSLETTER

CCIS Code: Newsletter No. 55

#### THE SECOND BIG GUN EXPLODES

Dataquest

#### INTRODUCTION

Computervision Corporation announced on June 4, 1984, that it has entered the electronic design automation (EDA) market by forming a joint-venture company with Metheus Corporation. Computervision is the second of the big, more well-established companies to enter the EDA CAD/CAM segment. (Calma was the first big turnkey company to enter, with General Electric's acquisition of Tegas Systems, Inc.)

The newly formed joint venture is called Metheus-CV Incorporated and is headquartered in Hillsboro, Oregon. Metheus-CV will market EDA and other electronic CAD systems and products on a worldwide basis. Metheus-CV's EDA products will be the Lambda and CDS3000 Sun Microsystems based systems, previously sold by their two respective parents, Metheus and Computervision.

#### THE NEW COMPANY

At first glance, it seems that Metheus-CV (MCV) will operate as a separate company, independent from its two parent companies. However, MCV possesses the omnipotent letters--CV, instantly gaining a relationship with Computervision's installed base; product lines; sales, support, and R&D staffs; and financial strengths.

MCV's purpose is to provide EDA products on a worldwide basis, including CAE, CAD, CAT, and CAM. The products will bear the name logo of Metheus-CV, Inc. The company's specific products and product strategies have not yet been publicly disclosed; the company will make announcements at the Design Automation Conference in New Mexico this month. This newsletter will discuss products only on a general basis.

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MCV is 70 percent owned by Metheus Corporation, 20 percent owned by Computervision Corporation, and 10 percent owned by its employees. The company will receive \$10 million in funding from Computervision; the details of this arrangement were not disclosed. Computervision also has an option to acquire a majority interest over a period of time.

MCV will initially employ approximately 80 people, including Mr. Jim Towne as its president and CEO, Dr. Chong Lee as its vice president of integrated circuit design systems, and Dr. Robert Hunter as the logic design systems manager. All three men were previously with Metheus Corporation, which retains Dr. Gene Chao as its CEO. MCV expects to have approximately 27 salespeople employed by July 1, 1984, increasing to approximately 60 by year-end. Other employees may include those from its two parent companies.

The R&D staff at MCV will concentrate on development and support of its software product lines. Additionally, MCV will jointly sell Computervision's electronic CAD product lines for IC and PC physical design. The new company's product lines will address the design of custom, standard cell, and gate array integrated circuits, hybrid circuits, and printed circuit boards.

Manufacturing will be done either at Metheus, at Computervision, or at one of Computervision's OEMs. MCV will strictly do systems integration, working mainly with the Lambda and Sun workstations and the Omega graphics controllers and devices.

On an international scope, MCV will market its products through Computervision's international sales forces or distributorships. Service and support will also be handled through Computervision's international staffs.

#### BENEFITS TO COMPUTERVISION

Growth in the electronics CAD/CAM segments is in products that address the front end of the design cycle and products that integrate the front end with the back end. Computervision, until this announcement, has addressed solely the back end of the design phase with its CADD2X VLSI software and its printed circuit board software. Computervision has been losing market share in the PCB CAD segment, while its market share has been unstable in the IC segment. Table 1 presents DATAQUEST's estimates of the company's market share for 1981 through 1983.

The joint venture allows Computervision to quickly enter the EDA market segment with an already established product and company. Through the joint venture, Computervision will be able to offer its installed base not only front-end capabilities, but also integration with the physical layout software.

# Table 1

#### ESTIMATED COMPUTERVISION MARKET SHARES

	<u>1981</u>	<u>1982</u>	<u>1983</u>	
IC CAD	15%	17%	7%	
PC CAD	44%	39%	17%	

Source: DATAQUEST

DATAQUEST believes that the integration of front and back end is significant because many users with discrete software functionality (physical layout only) are not providing the necessary repeat business. Instead, they are choosing to install an EDA vendor's system. Thus, via MCV, Computervision can now hope to recapture its position in both the IC and PC market segments and to enter the EDA segment.

DATAQUEST believes that any company participating in the EDA segment must be able to react quickly and accurately. Because MCV will, for the moment, remain an independent company, it provides Computervision with the entrepreneurial characteristics necessary to be competitive.

#### BENEFITS TO METHEUS

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Metheus Corporation already has an impressive list of customers and OEM agreements for its Omega family of graphics controllers. Computervision will only enhance this list and broaden the distribution for the Omega through the interface with Sun Microsystems. Metheus also has a golden opportunity now to increase its corporate recognition and the distribution of the Lambda EDA product. The benefits are obviously financial.

Since its establishment in 1981, Metheus's sales have grown to approximately \$6 million in 1983 for both product lines. Not only should the bottom line increase because of the joint venture, but through MCV, Metheus will have an infusion of cash from Computervision for the joint development, sale, and support of the Lambda and Omega product lines.

#### DATAQUEST ASSESSMENT

There is a potential for confusion concerning the distribution and differentiation of Computervision's and Metheus-CV's products, especially for the sales forces and end users. The differences are explained by the two parent companies on the basis of the physical size of the Sun versus the Lambda, on price, and on the actual end user. In theory, the two product lines and companies mesh together very well. However, there is overlap.

For example, both the Lambda and Sun are 68000 and Unix based. Both systems currently have the same printed circuit board layout capabilities. MCV will be porting all of its Lambda software to run on the Sun. Both systems can use the Omega graphics controller. Both systems can be sold by two separate sales forces. There will be two different IC graphics editors, the Lambda running on two architectures and CADDS2X running only on the Sun.

With respect to customers, the strategy is to sell Lambda to electronic firms not requiring Computervision's full line of CAD/CAM applications and to sell the CDS3000 electronic CAD line to the remaining firms that fit in with Computervision's strategy to provide multifunctional CAD/CAM solutions.

In theory, it seems like a sound strategy. The potential problem area lies in the ability to manage and direct the two sales forces so that they do not often compete with each other and confuse the marketplace. Computervision is implementing a different set of compensation and sales management plans to address this specific issue. It will now have co-commission structures for both sales forces, finder's fees, and a complex national account program divvying up its installed base and any new prospects.

Metheus and MCV could now have Big Brother watching over them. As stated earlier, one of the keys to success in the EDA marketplace is to maintain entrepreneurship and react quickly to market and technological developments.

DATAQUEST believes that for the time being, Metheus and MCV will greatly benefit from the sheer size and force of Computervision, along with its financial and personnel strengths. Computervision's presence in the CAD/CAM arena will be enhanced with the addition of an already developed EDA product.

The joint venture's success depends on all three companies' abilities to manage their individual and joint sales, marketing, and product development efforts.

Beth W. Tucker

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CCIS Code: Newsletters No. 54

RESEARCH

NEWSLETTER

# CALCOMP'S NEW 32-BIT STANDALONE SYSTEM 25 FOR THE AEC MARKET

Dataquest

#### INTRODUCTION

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Calcomp has unveiled a new 32-bit standalone system known as the System 25 that will run its AEC (Architectural-Engineering-Construction) software products. The System 25, which had its first public showing at this year's NCGA show, was named to coincide with Calcomp's 25th anniversary which is this year. Although Calcomp is primarily recognized as a leading plotter manufacturer, it is placing increased emphasis, in both its marketing and product development areas, on becoming a leading supplier of AEC-based CAD systems. DATAQUEST estimates that the AEC segment of the CAD/CAM marketplace will grow to more than \$1.3 billion in sales by 1988 from its 1983 level of \$262 million. The majority of the \$1.3 billion will come from vendors offering standalone system solutions.

#### SYSTEMS ARCHITECTURE

The System 25 is based on Masscomp's M68000 implementation. Although purists may argue as to whether or not the M68000 is truly a 32-bit microprocessor, the Masscomp implementation employs a proprietary high-speed bus structure that, when coupled with the 64-bit floating point processor, exceeds the performance of a VAX 11/750. The System 25 uses dual 10-MHz M68000 processors. The memory management unit provides support for up to 16 megabytes of virtual address space in a demand-paged environment, while the second M68000 handles page swapping and address translation buffer misses. Up to 6 megabytes of ECC memory can be installed in the System 25. The system also uses an enhanced version of Bell's System III-based UNIX that offers a fixed priority scheduler, memory locked processes, contiguous disk files, and high performance pipes. These enhancements offer the added performance improvements required for high-level CAD systems.

Each System 25 station can be equipped with an optional Ethernet network interface unit that can provide high-speed communications between workstations or can be used as a high-speed interface to the VAX line of computers. The network interface unit allows common access to

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peripherals by all workstations, and offers a total link range of more than 3 kilometers using coax cable. Mass storage requirements are fulfilled by using either a 20-, 65-, or 143-megabyte Winchester disk. In addition, flexible disk and magnetic tape units are available for drawing storage and system backup. Figure 1 illustrates the system components' packaging.

The System 25's most unique feature is Calcomp's own picture processor. The picture processor is a Calcomp-designed, high-speed graphics controller that uses a proprietary pipelined architecture for all display functions. Figure 2 illustrates the picture processor's internal architecture. The picture processor eliminates the need to store a segmented display list, by allowing the geometry to be held locally in real-world coordinates. This drastically reduces the development overhead that is common in most CAD/CAM systems. Real-time panning and zooming is accomplished via the matrix multiplier engine so that models can be viewed dynamically at any scale and view position. Many of the CAD systems on the market today require the host CPU to perform the matrix operations that can typically take anywhere from a few seconds to a few minutes to regenerate the picture. By removing the burden of view manipulation from the CPU, the user is not artificially constrained by having to wait for the display to regenerate. In addition to real-time panning and zooming, the picture processor also supports rubber banding, hit detection, attention indication, cursor tracking, and electrostatic plotter rasterizing. By incorporating these functions locally, display manipulation runs much faster and the CPU is freed to perform other tasks. The net result of the picture processor is a much higher level of interactivity for the user, which in turn increases productivity.

#### SOFTWARE

Calcomp's software offering is geared exclusively to the AEC marketplace. The company offers the following software packages:

- Facilities Planning and Management
- Stacking and Blocking Analysis (SABA)
- Heating, Ventilation, and Air Conditioning (HVAC)
- Electrical
- Architectural
- Solid Modeling
- Report Writer
- Piping and Instrumentation Diagramming (P&ID)

- Piping Isometric Application (ISO)
- Accounting
- Mapping

All the software packages are functionally identical with Calcomp's previous 16-bit IGS 500 system. The packages have since been optimized and transported to run on the newer System 25.

The facilities management package is particularly significant. It is an extremely powerful and versatile tool that uses a preprocessing, solution set, and postprocessing methodology for creating facilities layouts. The preprocessing stage contains capabilities for the user to interactively define company activities, interrelationships, and the surrounding architecture via a series of prompts. The information can then be fed into the solution set package called SABA (Stacking and Blocking Application) to optimize the space locations to achieve the most desirable layout according to the desired parameters (e.g., where the cost of communication between employees is optimized). The output is then fed back into the postprocessor where it is converted into a graphic representation.

Another rather unique software package is the CALRITE report writer that allows access to all textual data within the Calcomp data base. What is truly revolutionary about the product is that the report generator works in a graphics mode whereby the user defines how the report should look by drawing it on the screen. The CALRITE program then automatically converts the graphic representation of the report format into the proper command sequence necessary for extracting and formatting the report. The user never has to worry about his own programming expertise in extracting and formatting the information. This greatly reduces the amount of time and training needed to create useful reports.

#### ANALYSIS

The System 25 is part of a rapidly emerging trend toward moving CAD solutions from shared logic minicomputers and mainframes to standalone dedicated workstations. Although the System 25 offers leading-edge solutions for AEC applications, DATAQUEST believes that Calcomp's main challenge will be to shed its image as a plotter manufacturer and emerge as a leading-edge supplier of AEC solutions. While the market presence task is a formidable one, Calcomp certainly does not lack the technical ingenuity needed (as evidenced by the System 25) to become a dominant player in the highly competitive CAD/CAM marketplace.

Dave Burdick







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Figure 2





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CCIS Code: Newsletters No. 53

RESEARCH NEWSLETTER

#### SST SYSTEMS--NEW LEVELS OF PRICE/PERFORMANCE FOR PLANT ANALYSIS

Dataquest

#### INTRODUCTION

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SST Systems is a start-up company that has developed a series of innovative, cost-effective, plant analysis programs that run on the IBM PC-XT. At first glance, one may question the level of performance that could possibly be achieved in such a compute-intensive task as piping analysis on a personal computer. However, through unique SST-developed algorithms, total performance is very comparable to that found on much larger minicomputer and mainframe systems at a price that is up to 10 times lower. This newsletter will describe the SST system and the company.

#### THE COMPANY

SST was formed in July 1982, in Sunnyvale, California. Its charter is to develop cost-effective solutions for engineering problems, primarily in the process plant and piping area. Since SST's beginning, it has assembled a technical staff with more than 50 years of experience in plant design applications and more than 30 years of experience in computer science and software development. All the technical staff has substantial experience dealing with the common analysis programs used today such as Nastran, Ansys, Marc, Stardyne, Sap IV, Nupipe, Adlpipe, and Tpipe. The president of the company is Dr. G. V. Ranjan, who has many years of experience in the power and process plant design area. By using industry experts as authors of the software, Dr. Ranjan has put together a very powerful and cost-effective series of analysis solutions that will be shown publicly for the first time at the Pressure Vessels and Piping Show in San Antonio later this month.

#### THE PHILOSOPHY

The basic premise behind SST's product development philosophy is to use the optimal mathematical approach to solve a specific set of problems. While the finite element method (which is the most widely used

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method for handling analysis problems) may be a powerful method for solving many analysis problems, it is often very time-consuming and too generalized to be used productively. Dr. Ranjan contends that each analysis solution should use the most optimal approach for solving a problem in the most cost-effective manner. To this end, SST has developed a series of programs that not only use the finite element method, but use proprietary closed-form solutions as well. Closed-form solutions greatly reduce the amount of time required to obtain analysis results because they do not require extensive model building. Building finite element models can typically take up to 60 percent of the total time required to obtain analysis results.

#### THE PRODUCTS

The analysis solution series offered by SST is called CADvantage. CADvantage runs on an IBM PC-XT that is configured with an additional color monitor, 640Kb of RAM, and the Intel 8087 math co-processor chip. CADvantage currently contains three application programs for process and power plant design analysis:

- CAEPIPE (finite element)
- CAEFRAME (finite element)
- CAENOZLS (closed-form)

All three modules contain a preprocessor, a main processor, and a postprocessor for performing the analysis.

The preprocessor is used for creating geometry, identifying material properties, assigning loads and constraints, and verifying input. CADvantage uses screen-driven menus for all program input, which is performed on the monochromatic text screen. The user is guided through the entire input sequence by the screen-driven menus, which also check the input for any discrepancies prior to evaluation. The screen-driven menu approach allows a user to learn the system much faster and is much easier to use, compared to the predominantly command-driven systems available today. In addition to the screen-driven menus, an on-line help facility is available that recalls useful information pertaining to the operation via a single keystroke. This facility also adds to the user friendliness of the system. Geometry is displayed on the eight-color screen, which also allows software view manipulation, so that the model can be viewed from any angle.

Following the preprocessor stage, the geometry and other input information is fed into the main processing routine, which uses either a finite element or a closed-form solution technique to analyze the problem. SST programs that use the finite element technique are limited to 300 members, due to the performance of the IBM PC. However, many problems in process and power piping applications are well under this size limitation. While the main processor is running, elapsed execution times are printed to the screen, informing the operator of the time required for each computational step.

After the main solution processor has finished, the results can be viewed graphically and in the more common text file form. The graphics postprocessor allows deformed geometry to be exaggerated and plotted against the base model. In addition, stress output can also be displayed and checked against industry codes to see if the model is within specification.

#### CAEPIPE .

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The CAEPIPE program performs linear, static analysis of three-dimensional piping systems with checks against the ANSI B31.3 code specification. The user first defines the piping geometry by using the preprocessor, which interactively prompts the user for various ways to assemble the piping runs. Pipe sizes and material types can either be selected from an on-line catalog or entered manually under user control. Rigid members such as tees and valves are also included during this phase. After the geometry has been entered, boundary conditions such as loads and constraints are added in the same interactive fashion. The user can check the model at any time to highlight any piece of the geometry based on any type of search parameter to aid in model accuracy.

The model is then run through the main processor, from which the results can be evaluated via the postprocessor. Results can be checked for compliance against ASME Class 2 and ANSI B31.1 codes. If a compliance problem exists, the member is highlighted in red to alert the operator. The geometry can then be modified and rerun in seconds to achieve the desired results.

# CAEFRAME

The CAEFRAME program is identical in operation to the CAEFIPE program. Like the CAEFIPE program, it uses the finite element technique for solving problems. The CAEFRAME program is used to analyze three-dimensional frame structures that are often used to support piping structures in a power or process plant. It contains a standard library of AISC sections and materials for easy data retrieval when building models. Model building, main processing, and postprocessing are accomplished in the same highly interactive and user friendly manner as described in the CAEFIPE section. Additionally, the postprocessor can check the results against the AISC design rules specification for conformity.

# CAENOZLS

CAENOZLS is a closed-form solution package that is designed to compute stresses for radial nozzles or pipe penetrations in spherical vessels or cylindrical vessel heads. Because it uses a closed-form solution technique, it does not require creation of a finite element mesh. The system prompts the user via the on-screen menus for the various geometry and loading conditions from which a model is parametrically built and readied for input to the main processor. The main processor then quickly analyzes the model and produces an output file suitable for postprocessing. The results can then be viewed to isolate the regions of maximum stress.

# ANALYSIS

DATAQUEST considers the SST products technological marvels that open up a whole new era of price/performance in an area that was previously limited to machines that run in "glass houses." They can truly be ít" classified as "see it to believe products. Market niche, price/performance, and diversified distribution channels are terms that aptly apply to these products. The only major questions that remain are how effectively SST will market the products and how they will manage their growth. While the growth issue is a great problem to have, the technological windows in the CAD/CAM business are such that mistakes can be very costly and even fatal to a company's survival. Although SST has not yet established a marketing and sales organization, the product definitely lends itself to use by both end users and the CAD/CAM turnkey companies. DATAQUEST believes that if SST can assemble a marketing and sales organization that is anywhere near as successful as its development team, it may well become one of the fastest growing and most successful companies in the CAD/CAM business today.

Dave Burdick

Dataquest

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RESEARCH

NEWSLETTER

# COMPUTER GRAPHICS TOKYO '84

Computer Graphics Tokyo '84, an international conference and exhibition organized by the Japan Management Association, was held April 24 through April 27 at the Ryutsu Center in Tokyo, Japan. The exhibition included products from 46 companies who market their software, hardware, systems, and peripherals in the Far East basin.

Included in the 46 exhibits was a mixed bag of U.S. and Japanese-manufactured goods. Although the exhibition was small in scale compared to many held in the United States, marketing of the various products was highly professional.

Some of the more interesting exhibits are described below. Addresses and telephone numbers of the exhibitors are included for convenience.

Mutoh Industries Ltd. 3-1-3 Ikejiri Setagaya-ku Tokyo 154 Phone: 03-413-8111

Mutch is one of Japan's leading suppliers of graphics equipment that includes digitizers, plotters, and drafting systems. Mutch exhibited the SAPIENS model MG-300 (3-D) and model MG-100 (2-D) graphics displays. The model MG-300 uses local hardware processors for graphic transformations, in addition to a graphics core library named "SCORE," based upon the GKS standard. The Japan domestic price is ¥4.5 billion.

Hitachi Ltd. 4-6 Kanda-Surugadai, Chiyoda-ku Tokyo, Japan 101 Phone: 03-258-1111

Hitachi, a Japanese super conglomerate, exhibited its mini-based GRAPHMASTER product line. The product is a 16-bit desktop system that is available in four configurations, priced from ¥3,400,000 to ¥4,260,000. All systems include an integrated graphics input tablet, disk storage device, pen plotter, CPU, monitor, and keyboard.

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Tool Corporation 1-1-71 Nakameguro, Meguro-ku, Tokyo, Japan 153 Phone: 03-715-2655

This exhibit contained two distinctly different products. The first product, "SENSUM," is a high-performance image processing system that is used in medical and industrial applications. The SENSUM system utilizes the Apollo DN400 workstation as its processing unit. The second product, named "SILICON," is an LSI software package that runs on the Apollo DN600 workstation.

Astro Design Inc. 2-4-17 Denenchofu, Ohta-ku, Tokyo, Japan 145 Phone: 03-722-0911

Astro Design manufactures a variety of graphic systems components. These include the GP-1000 Image processor system, IP4000 graphics display board, and various MULTIBUS single-board computers used for generating graphic images.

Sun Engineering Inc. 3-1-30 Roppongi, Minato-ku Tokyo, Japan 106 Phone: 03-722-0911

Sun, the Far East distributor for Megatek, exhibited various products from its WHIZZARD product family. These included the model 3355, which utilizes a dual bus architecture and surface processor module that fills 40,000 polygons per second. The 19-inch, 1024 x 1024, 60-Hz non-interlaced monitor can display 400,000 2-D absolute vectors per second. Sun also displayed the WHIZZARD 7210, 7250, and 1650 products.

Sony/Tektronix Corporation 5-9-31 Kitashinagawa, Shinagawa-ku Tokyo, Japan 141 Phone: 03-448-4611

This large exhibit contained numerous TEK products, including graphic workstations, terminals, hard copy units, and plotters. Included were the 4105 and 4107 color terminals, the 4114B and 4115B workstations, and the 4691 color graphics copier.

Ikelgami Tsushinki Co. Ltd. Sumitomo-Higashishimbashi Bldg. 1-1-11, Hamamatsu-Cho Minato-ku, Tokyo, Japan 105 Phone: 03-433-5251

This exhibit contained many products that are being sold in the Far East under the Ikegami-Ramtek label. The products included the "MARQUIS" family of colorgraphic displays. Available in four configurations, the model 1 and model 2 are based upon the Z-80A processor, while models 3 and 4 are based upon the Motorola 68000 microprocessor. In addition, the desktop 6211 terminal, the model 2020 graphics workstation, and the model 6221 color desktop terminal were shown. A new series, the RM-9465, was also introduced. It is available in two models, the high-resolution RM-9465/04 60-Hz non-interlaced system, and the RM-9465/02L/03L low-resolution system. Two new options were also offered: an RS-232-C serial port and a RM-9465-V6 video generator. The RM series is based on the Motorola 68000 microprocessor.

Nippon Univac Information Systems Kaisha Ltd. Akasaka Twin Tower Main Building 2-17-22 Akasaka, Minato-ku, Tokyo, Japan 107 Phone: 03-585-4111

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This joint venture was one of the largest and most impressive It included an integrated system containing software from exhibits. Univac and hardware from Nippon and Seikosha. The AGS 3000 turnkey svstem hardware microprocessors for includes integrated graphic transformation, hidden surface removal, and z-buffering. The display memory is expandable to 8 Mbytes, and supports a palette of 16.7 million colors with a 1024 x 1024 resolution monitor. Pricing for the AGS 3000 starts at ¥7,000,000. One of the most impressive demonstrations was that of BDAS, Bottle Design Arts System, which utilizes numerous algorithms for the optimization of liquid containers. Moldflow software, designed by Dentsu, was also demonstrated. It is used for design and analysis of mold cavities. Also shown was UNI-CATIS, a low-cost drafting system.

NEC Corporation Tokuei Bldg., 5-33-7, Shiba, Minato-ku, Tokyo, Japan 108 Phone: 03-453-5511

NEC, which had one of the largest exhibits, displayed five systems that were personal computer-based. The PC-100 is the low-end product, and supports 3-D geometry, multiple windowing, surfaces, and full screen In addition, the PC9801E and PC9801F personal computers manipulation. support a wide breadth of applications software. The CAE-EL software package is used for PCB design, logic simulation, and electronic circuit simulation and analysis. The MS-SCEMATIC package supports a parametric program for schematic design. This is a menu-driven program that includes full editing and manipulation capabilities. At this time, NEC offers applications software for mechanical, electrical, and architectural disciplines. DATAQUEST believes that the interest generated by the NEC exhibit was indicative of the high demand by end users for personal computer-based CAD systems.

Yokogawa-Hewlett-Packard Ltd. 3-29-21, Takaido-hihashi, Suginami-ku, Tokyo 168 Phone: 03-331-6111

This joint venture exhibit included various HP-based CAD/CAM systems. The two major systems were the CADVANCE 500 and the EGS/200. Both are based upon the HP 9000 processor, and support a wide variety of input and output devices. The CADVANCE 500 is priced at ¥25 million and supports full 3-D geometry, while the 2-dimensional system, EGS/200, is priced at ¥5 million.

Graphica Computer Corporation 505 Kaitori, Tama-city, Tokyo, Japan 105 Phone: 0423-73-6111

Graphica is leading manufacturer of graphics and imaging processing equipment. The SERIES I graphics displays are supported by a wide range of processors including VAX, FACOM, HP, Hitachi, Harris, TOSBAC, Data General, Prime, and IBM. SERIES I systems also support two very extensive software programs, IPSP (Image Processing Subroutine Package), and GLSP (Graphics Language Subroutine Package). The M SERIES display systems were used to execute a very impressive demonstration of solids modeling, molecular modeling and finite element modeling, and analysis. In addition, the M SERIES supports an extensive library of core graphic subroutines known as GDSP-1, GDSP-2, and GDSP-3 Graphics Display Software Programs. Most impressive were demonstrations of LUMINOUS, IMAGER-H, GRASP (graphics analysis software package), GEM (graphics enhanced molecular display software package), GINO, IMAGER-T, and DESIGN-T. These demonstrations were a high point of the entire exhibition. In addition to displays, Graphica manufactures various graphics input and output devices and video generation equipment.

Burroughs Co. Ltd. 13-1 Shimomiyabi-cho, Shinjuku-ku, Tokyo, Japan 162 Phone: 03-258-3211

Burroughs displayed the B-CAD graphics system that supports dual graphics displays. The numerous Burroughs systems were supported by both personal computer systems and minicomputer-based microprocessors.

Mitsubishi Electric Corporation 2-2-3 Marunouchi, Chiyoda-ku, Tokyo, Japan 100 Phone: 03-413-8111

DATAQUEST considered the presentation and marketeering of products in this booth the best in the exhibition. The MELCAD CAD/CAM/CAE system supports a wide range of application software addressing electronic, architectural, mechanical, and numerical control disciplines.

Sumitomo Electric Industries Limited 1-1-3, Shimaya, Konohana-ku, Osaka 554 Phone: 06-461-1031

Sumitomo's "USTATION" supports a UNIX operating system and uses a Motorola 68000 microprocessor and a 32-bit bus. The USTATION represents a standalone architecture and supports X.25 and HDLC protocols. The standard configuration supports a VT101 CRT display, but offers an optional color bit-mapped display terminal. The USTATION packaging was most impressive, providing a high level of user friendliness. The second product, U-GAL, is an engineering workstation that is used for LSI and PCB design. The product supports logic circuit designing, logic anđ simulation, circuit simulation, automatic layout wiring functionality, and mask design and verify function and artwork.

C. Itoh Data Systems Co. Ltd.
C. Itoh Bldg. 2-5-1, Kita-Aoyama, Minato-ku, Tokyo 107
Phone: 03-497-8098

This booth included three SUN-based microprocessor products: the new SUN 2/170 Rackmountable Sunstation, the SUN Model 2 Workstation, and the SUN 2/120 Deskside Sunstation. The systems are based upon the Motorola 68010 and support UNIX 4.2 BSD.

TOYO/Lexidata Toyo Corporation 1-2 Hongoku-cho, Nihonbashi, Chuo-ku, Tokyo 103 Phone: 03-279-0771

Lexidata Japan Sugahara Bldg. 2-10-16, Shibuya, Shibuya-ku, Tokyo 150 Phone: 03-486-0670

Included in this exhibit were the Lexidata Solidview Graphics/Image processor and the Lexidata 3700 Image Processor.

Japan Radio Co. Ltd. Akasaka-Twin Tower Main Bldg. 2-17-22, Akasaka, Minato-ku Tokyo 107 Phone: 03-584-2411

The JRC Super Graphics Display, NWX 237, supports a 60-Hz, 19-inch, 1280 x 1280 resolution monitor, and is available in both interlaced and non-interlaced configurations. The basic configuration price is ¥5.7 million.

Prime Computer Japan Inc. 2-7-1, Nishi-Shinjuku, Shinjuku-ku, Tokyo 100 Phone: 03-345-1171

Prime Computer exhibited various CPUs such as the 2250 Workstation. Prime also demonstrated the software capabilities of Medusa, PDMS, and GNC (graphic numerical control), and Scicards.

Daikin Industries Ltd. Shinjuku-Sumitomo Bldg. 2-6-1, Nishi-Shinjuku-ku, Tokyo 160-91 Phone: 03-347-8103

The Daikin Comtec (communication technologies) product line was displayed in full force. Included was a wide range of graphics products such as graphic tablets, hard copy units, color terminals, and the DS300 Workstation. The DS300 Raster Scan Graphic Display was designed for high speed and local 3-D graphic processing. The 60-Hz, 1280 x 1024 monitor supports a maximum of 4,046 colors; from a palette of 16.7 million. Hardware includes a hidden surface processor and a shading processor, providing real-time zoom, drag, panning, perspectivization, and transformation. The system supports 4x4 matrix transformations, has a DDA of 60 nsec/pixel, and draws 110,000 short vectors/second, 15,000 long

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vectors/second, and has a pick speed of 80,000/second. The segment buffer is expandable from 512 Kbytes to 4.5 Mbytes. In addition, the system supports KANJI symbols through JIS level 2. This product demonstrates the performance that can be attained by integrating application-specific processors with graphics devices. The DS300 demonstrated the fastest display speed at the exhibition; DATAQUEST considers it a very effective and efficient product. ۳.....

Fuji Xerox Co. Ltd. 3-3-5, Akasaka, Minato-ku, Tokyo 107 Phone 03-585-3211

Versatec, a Xerox company, displayed a variety of products that included a new large roll size electrostatic plotter, remote plotting controllers, video interface hardware, and vector-to-raster converters.

Nihon Binary Co. Ltd. MKC Shinsen Bldg., 20-22 Shinsen-cho, Shibuya-ku, Tokyo 150 Phone 03-463-9921

Jupiter Systems Inc. 2126 Sixth Street Berkeley, CA 94710 USA Phone (415) 644-1024

This Berkeley, California, manufacturer of high-performance color raster graphics systems had a most impressive showing of its Jupiter 7 and Jupiter 12 products. The Jupiter 12 supports a 60-Hz, 1280 x 1024, non-interlaced monitor that includes 4 memory plans, expandable to 32. The unit is based upon the Motorola 68000 microprocessor, and has multiple bipolar processors for hardware vector generation, manipulation, and graphic image transformations.

Fujitsu Ltd. 2-6-1, Marunouchi, Chiyoda-ku, Tokyo 100 Phone: 03-216-3211

This Japanese giant exhibited its FACOM product line that included various displays, plotters, input devices, and output devices. Their turnkey systems were initially delivered to market in July 1983, and since then 40 systems have been sold.

Toyo Denki Seizo K.K Mita 43 Mori Bldg., 2-13-16, Mita, Minato-ku, Tokyo 108 Phone: 03-457-0741

This manufacturer of computer graphics equipment displayed many products including the TGS-80, a PC-based CAD system. The majority of this exhibit included a very large variety of electrostatic and pen plotters, varying in size from A to roll size.

## DATAQUEST ANALYSIS

In compiling a post-exhibition analysis, DATAQUEST believes that these major assessments could be made:

- The majority of the systems level products exhibited at the conference were U.S.-designed.
- The presence of personal computer-based CAD systems was most evident. DATAQUEST believes the long-term market opportunities in this segment are second to none.
- Although personal CAD systems are very visible in the Far East market, the lack of extensive software required to support the multiple niches of design and manufacturing automation remains a problem.
- The integration of application-specific hardware is a must, not only at the high end of graphics imaging, but also for the low-end systems based on personal computers.
- The presence of high-performance low cost CAD/CAM systems has captured the interest and the public eye as one of the top areas of interest in Far East high technology.
- The distribution channels established by many of the U.S. manufacturers remain the major contributors to the Far East installed base, implying that U.S. products are still the main source of CAD/CAM technology in the Far East today.
- Japan's market potential regarding both the installed base and future systems shipped represents an opportunity which is second only to that of the United States.
- The Japanese are continuing to develop and deliver leading-edge peripheral devices that are aggressively priced, pressuring the Western-based manufacturers to incorporate lower-cost technologies at a much faster pace.

James R. Newcomb

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RESEARCH BULLETIN

PARALLAX TO UNVEIL HIGH-SPEED GRAPHICS CONTROLLERS AT NCGA

#### THE PRODUCT

RESER CONTRACTOR

Parallax Systems Incorporated will present its high-speed graphics controller family at this year's NCGA show in Anaheim, California. Parallax's graphics controller family features two of types configurations. The 600 Series is a 640 x 480-resolution system that is software switchable to 512 x 480 to allow double buffering. The 1000 Series, which will debut at the NCGA show this year, is a 1,024 x 1,024, 60-Hz system. Both products feature a proprietary pipelined architecture to produce extremely fast drawing and bit plane transfer speeds. Bit block transfer speed, a measure of how fast data can be transferred from addressable memory to display memory, is 6 million 8-bit pixels per Drawing is done at the rate of 12 million unclipped, second. untransformed pixels per second. These extremely high pixel speeds allow applications such as solids modeling and image animation to be performed in real time. Both products also feature hardware antialiasing to help eliminate the perceived "jaggies" of vectors and polygons. Hardware clip is also standard on both products. While Parallax does not currently offer any hardware 3-D operations such as viewpoint matrix manipulation, DATAQUEST believes that this system can complement many of the 3-D workstations available today, especially with its board-level implementation strategy.

Parallax will also announce Multi-Bus support at the NCGA show. Parallax's system was previously available only with the DEC Q-Bus. The support of Multi-Bus will allow the Parallax system to be marketed to a wide variety of CPU and workstation configurations.

#### THE COMPANY

Parallax Systems Incorporated was founded in November 1982 by Bob Goodwin and Bill Mears. Both men have B.S.E.E. degrees from Cornell University, which is regarded as one of the top schools in the computer graphics field. Prior to forming Parallax, Mr. Goodwin was a disk

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controller consultant at Digital Equipment Corporation and Mr. Mears served as a video consultant at Atari. Currently, Mr. Goodwin is Vice President of Engineering at Parallax and Mr. Mears is Vice President of New Product Development.

Parallax is headed up by Jim Summers, who is Chairman of the Board, Chief Executive Officer, and President. Mr. Summers served as Vice President/General Manager at Harris Video Systems before joining Parallax and was President of Consolidated Video Systems before joining Harris Video.

Mike Strozza, the newest member of the executive team, serves as Vice President of Marketing. Before joining Parallax, Mr. Strozza was Director of Sales/Marketing for International Imaging Systems.

# DATAQUEST ANALYSIS

Parallax's strategy is to provide very high speed, aggressively priced display controllers at the board level, versus the standard practice of offering a packaged workstation. DATAQUEST believes that Parallax's board-level strategy is very assertive in that it allows the company to market its products to a wider range of OEM customers, including the graphics terminal manufacturers. DATAQUEST believes that there are three key prerequisites to being successful in the CAD/CAM marketplace:

- Product differentiation
- Identifying a market niche
- Effective distribution

Parallax's product differentiation and market niche are clearly defined by the company's board-level marketing strategy. The company's channels of distribution still remain somewhat undefined due to the relatively early stage of Parallax's development. However, the company can leverage the selection of distribution channels with the fact that its product can be sold to both CAD/CAM manufacturers and graphics workstation companies. Parallax's closely knit management team and its high-performance product offering should allow the company to compete successfully in the highly competitive and revolutionary computer graphics market.

David Burdick

# RESEARCH BULLETIN

CCIS Code: Newsletter No. 50

# PRIME COMPUTER ACQUIRES JOINT CO-OWNERSHIP OF MEDUSA SOFTWARE

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Computervision Corporation of Bedford, Massachusetts, has agreed to share ownership of Medusa, a modular drafting, design and modeling software package, with Prime Computer of Natick, Massachusetts. Medusa was developed by Cambridge Interactive Systems Ltd. (CIS), of Cambridge, England, a Computervision subsidiary. According to a Prime spokesman, the financial terms of the purchase were not disclosed, although the payment plan to Computervision has been agreed upon.

## THE PAST

Computervision acquired CIS in 1983, thereby gaining control of all marketing and sales rights of Medusa. At that time, the agreement was that until June 1, 1984, Medusa would be marketed in Europe on an exclusive basis by Computervision/CIS, and in the United States and outside of Europe on an exclusive basis by Prime. Prime's rights were to expire in June. Although CV solely owned the Medusa product, it was marketed on Prime and Vax computers only.

#### THE PRESENT

Under the new shared-ownership agreement, effective June 1, 1984, both Prime and Computervision/CIS will have worldwide marketing rights of Medusa, with no restrictions regarding geographic areas or specific computer makes.

## WHAT DOES THIS MEAN?

DATAQUEST understands that both Prime and Computervision/CIS plan to develop, market, and support their own Medusa software offerings. Effective June 1, Prime will market a product known as Prime/Medusa while

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CV will market CIS/Medusa. This agreement will allow Prime to enhance and develop a "new" Medusa product without contract limitations, while CIS will continue to enhance and develop the CIS/Medusa product for CV. DATAQUEST believes this agreement will provide both Prime and CIS/Medusa users with a migration to the next generation of software offerings evolving from the Medusa product.

## Prime and Medusa

According to a Prime spokesman, Medusa has played a significant role in Prime's CAD/CAM revenue attainment. In addition, Prime reports for the time period of 1982-1983:

- 117 percent increase in revenue involving Medusa-based products
- 137 percent increase in license agreements involving Medusabased products
- 236 percent increase in workstation shipments involving Medusabased products

## CV/CIS and Medusa

DATAQUEST understands that CV will be announcing a new software offering in the near future, which is a derivative of Medusa, designed for 2-D drafting applications. This product would be offered on the Sun workstation.

## ANALYSIS

DATAQUEST believes the agreement:

- Reinforces Prime's commitment to Medusa and CAD/CAM
- Provides a major component in the development of a Prime integrated solution
- Ensures a migration path for both Prime and CV/CIS Medusa users
- Reinforces CV's commitment towards Sun workstation architecture

DATAQUEST expects that this agreement will play a very important role in the future of Prime's product development and product strategy, both short term and long term. In addition, DATAQUEST believes the agreement will improve the general perception of Prime's commitment to CAD/CAM. This agreement should spur the momentum of Prime to start putting the applications pieces together by developing and delivering an integrated CAD/CAM solution.

James R. Newcomb

Rider min Dataquest

# RESEARCH BULLETIN

CCIS Code: Newsletter No. 49 Rev. 4/10/84

# MAJOR PRODUCT ANNOUNCEMENTS FROM MENTOR GRAPHICS

Mentor Graphics Corporation, a leading electronic design automation (EDA) vendor, announced five major new products in mid-February during a two-week road show. The new announcements include:

- IDEA 1001, 1003, 1002C, and 1004--Standalone workstations based on Apollo's new DN460, DN660, and DSP160 nodes. Apollo's DN460 and DN660 offer a 300 percent increase in performance over the All of Mentor's applications software is DN420 and DN600. compatible with the new line of processors. Prices range from \$65,000 to \$99,000, depending on configuration.
- XSIM--A hardware simulator engine based on a customized version of the Logic Evaluator from Zycad, Inc. XSIM evaluates 500,000 equivalent gates per second, a substantial increase over conventional software simulation methods. XSIM operates with the IDEA 1000 design data base in a networked, shared-resource environment. Mentor also announced RSIM, a software interface that allows the design data base to interface to Zycad's entire line of Logic Evaluators, which can operate up to 25 million equivalent gates per second. XSIM's list price is \$180,000 and it will be available during the second guarter of 1984.
- FSIM--Fault simulation software based on HHB/Softron's CADAT product. FSIM provides concurrent analysis of test patterns and runs on the IDEA 1000 line of EDA Systems. The FSIM list price is \$29,900. It is scheduled for second-quarter 1984 delivery.
- Cadicell--Interactive and automatic placement and routing programs for standard-cell design methodologies. In addition to Mentor's product lines, Cadicell also runs on Digital's VAX, IBM processors, and Apollo. It is fully integrated with the IDEA 1000 software products. Priced at \$60,000, Cadicell is slotted for third-quarter 1984 delivery.

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Chipgraph--Full custom integrated circuit layout editor. Chipgraph can create physical geometrics at either the mask or symbolic level. It interfaces to Mentor's logic design data base for simulation and analysis. Interactive and batch design and electrical rules checking programs work with the physical chip layout. Priced at \$50,000, Chipgraph is planned for thirdquarter 1984 delivery.

DATAQUEST believes that successful EDA vendors will offer truly integrated design solutions. Integration, or the ability to link all of the critical design phases with a common data base and/or friendly interfaces to existing design tools, is what separates EDA vendors from companies that provide standalone design tools. Mentor's Chipgraph will compete directly with products like Calma's GDSII IC layout system. The key difference between Chipgraph and a standalone IC layout editor is Chipgraph's ability to maintain electrical continuity throughout the different design phases. Chipgraph is an example of how one of Mentor's product announcements is bringing the company one step closer toward an integrated design solution.

DATAQUEST believes that Mentor's announcements exemplify the intense competition and drive within the EDA market. Like Daisy Systems and Valid Logic, Mentor Graphics is also providing electronic product manufacturers with comprehensive and integrated design solutions.

Beth W. Tucker

CCIS Code: Newsletter, No. 48

RESEARCH

NEWSLETTER

# THE BOOM IN SEMICONDUCTOR START-UPS

# SUMMARY

Tesen Dataquest

Contrary to popular myth, the semiconductor industry has not settled into middle age. It is a young, vibrant industry undergoing dynamic Since 1977, DATAQUEST has recorded 51 semiconductor. growth. There have been 16 start-ups in 1983 alone, manufacturing start-ups. which tops the old 14 start-up record set in 1968. And the pace is picking up! In the past two years, we have observed 25 start-ups, which surpasses the 18 start-ups of the previous two years. The infusion of recovery, the increased use of venture capital, the economic customization, and the growing use of semiconductors in all aspects of daily life are the driving forces behind this upsurge in activity. As shown in Figure 1, these 51 new companies offer a variety of products.

#### Figure 1

# PRODUCT LINE OF SEMICONDUCTOR START-UPS (1977 to 1983)



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# HISTORIC TRENDS

The current upswing in start-up activity marks a new phase in the semiconductor industry. As shown in Figure 2, the industry has gone through five distinct periods:

- Establishment of the industry under Bell Labs and Shockley Transistor (1947-1957)
- Domination by Fairchild, which spun off National Semiconductor, Raytheon, Signetics, and other start-ups (1957-1967)
- The boom in start-up companies offering standard products, such as AMD, Intel, MMI (1968-1974), and Mostek
- Consolidation of the industry through mergers and acquisitions (1975-1979)
- The shift toward customization and new technologies, such as gate arrays, wafer scale integration, and gallium arsenide (1980-1983)

DATAQUEST believes that the shift toward customization is driven by the strong demand for unique, cost-effective products and the lack of standardized VLSI circuits. In our December 1982 newsletter on application-specific integrated circuits (ASICs), a category that includes custom circuits, customer-owned tooling, wafer foundries, standard cell circuits, gate arrays, and field-programmable devices, we estimated that the market share of ASICs would increase significantly. We have observed that 21 of the companies that have started since 1977 specialize in these devices, indicating that the move toward ASICs has gained momentum.

# Figure 2



المتقطاة بالثلاث متعاقد المعمل نصاد بمرجع فماد المحمد المحمد المتعادة

Source: DATAQUEST

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# THE BOOM IN VENTURE CAPITAL

A major reason for the upswing in start-up activity is the rapid growth of venture capital financing. As shown in Figure 3, the total flow of venture capital funds increased from \$450 million in 1969 to \$1.6 billion in 1982. Until 1977, however, most of these funds were invested in existing businesses. Venture capital for start-up companies did not appear in large amounts until the 1978 revision of the capital gains tax law, which lowered the corporate rate from 30 percent to 20 percent and the individual rate from 50 percent to 20 percent. Since 1978, we have observed an explosion of public offerings, private placements, R&D partnerships, and limited partnerships. In the first three months of 1983 alone, more than \$800 million in venture capital was invested in Silicon Valley start-up companies.

# Figure 3

## FLOW OF VENTURE CAPITAL



Source: Venture Economics

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## THE DRIVE FOR ORIGINALITY

The availability of venture capital, however, does not totally explain the upswing in start-up activity, since many new companies are internally financed. DATAQUEST believes that technological innovation continues to be the driving force. Several factors contribute to this trend:

- The proliferation of specialized market niches
- Developments in new technologies, such as E<sup>2</sup>PROMs, wafer scale integration, gallium arsenide, and specialized chips
- New process technologies and advanced computer-aided design (CAD)
- The availability of silicon foundries
- The entry into the marketplace of Korean and Taiwanese companies with sizable financing

Most of the memory start-ups offer advanced CMOS processes and fine-line geometries in the 1.5- to 3.0-micron range. Larger wafers are also popular. Modern Electrosystems and Tristar Semiconductor use 5-inch wafers, while Exel Microelectronics and Lattice Semiconductor are experimenting with 6-inch wafers. Advances in wafer etching and stepper equipment make these approaches technically feasible.

# SILICON VALLEY IS STILL THE START-UP CAPITAL

Despite the emergence of high-tech centers throughout the United States and the world, Silicon Valley still leads in the number of semiconductor start-ups. As shown in Table 1, 37 of the 51 start-ups since 1977, or 73 percent, were located in Silicon Valley. Recently, there has been growing activity in Southern California and Oregon. A complete list of start-ups established since 1977 is shown in Table 2.

Table	1

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	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>Total</u>
Silicon Valley		5	1	5	10	5	11	37
Southern California Oregon/Idaho		1		1	1	2	2	3
Texas Utah Plorida	1				.1		*	1
Nichigan New York	•					1	ı	1
Overseas	<del></del>		—			1		<u> </u>
	1	6	1	6	12	9	16	51

# LOCATION OF SEMICONDUCTOR START-UPS

Source: DATAQUEST

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# Table 2

# SEMICONDUCTOR MANUFACTURING START-UPS (1977 to 1983)

<u>Year</u>	Company	Capital <u>(Million)</u>	Product Line	Location
1977	Micro-Circuit Engineering	<b>H/</b> A	Custom, semicustom	West Palm Beach, FL
1978	Acrian	W/A	RF power discretes	Cupertino, CA
	California Devices	H/A	Senicuston	Sen Jose, CA
	Nicron Technology	M/A	64K DRAM	Boise, ID
	Universal Semiconductor	H/X	Foundary, semicustom	San Jose, CA
	Ricor	10.0-20.0	Monvolatile RAM memory	Milpitas, CA
	Synos	15.0	Custom, foundary	Sunnyvale, CA
1979	Condial Semiconductor	H/A	Poundry	Bunnyvale, Ch
1980	Applied Micro Circuits	M/A	Custom, semicustom	Cupertino, CA
	Earris Microwave	<b>E/X</b>	GaAs microwave	Sunnyvale, CA
	LSI Logic	26.0	Semicuston	Milpitas, CA
	Trilogy Systems	190.0	Wafer scale integration	Cupertino, CA
	VISI Technology	35.0	Foundry, custom	San Jose, CA
	Silicon Systems	H/A	Custom	Tustin, CA

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(Continued)

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# Table 2 (Continued)

# SEMICONDUCTOR MANUFACTURING START-UPS (1977 to 1983)

<u> 168 r</u>	COMPANY	Capital (Million)	Product Line	<u>Location</u>
1961	Gigabit Logic	8.0(2nd)	Gale ICs	West Los Angeles, Ch
	Integrated Device Technology	7.5	CNOS RANS	Santa Clara, CA
	International Microcircuits	M/A	Semicuston	Santa Clare, CA
	International Microelectronics	21.0(1st)	Custom, foundry	Mountain View, CA
	Products	13.5(2nd)		
	Linear Technology	13.6(1-3)	Linear devices	Wilpitas, CA
	SEBQ Technology	15.0(1-2)	Nonvolatile RAM memory	San Jose, Ch
	Signal Process Circuits	18/A	Linear	Salt Lake City, UT
	Silicon Compiler#*	5.5(2nd)	Custom chipe	Los Gatos, CA
	STC Computer Research	50.0	Computers	Santa Clara, CA
	Telmos*	18.9 (1-4)	CMOS gate arrays, analog	Sunnyvele, CA
	Weitek*	4.5 (1-2)	Arithmetic processors, graphics ICs	Santa Clars, CA
	Sytrex*	6.0	CHOS memory & logic	Sunnyvale, CA
1982	Array Devices*	K/A	E-CHOS gate arrays	San Diego, CA
	Array Technology*	H/A	Custom, semicustom CHOS	San Jose, Ch
	Custom MDE Arrays*	4.0	CHOS gate arrays, full costom, standard cell	Milpites, CA
	· Cypress Seliconductor*	20.0	CHOS PALA	San Jose, CA
	IC Sensors*	H/A	Pressure-sensing chips	Sunnyvale, CA
	Lattice Logic*	#/A	Gate arrays, CAD software	Edinburgh, Scotland
	Microwave Monolithics*	N/A	GaAs Monolithic micro- wave ICs (MMICs)	Simi Valley, CA
	Mogaic Systems*	11/X	Wafer scale integration	Troy, NI
	Mational Microelectronics*	30.0	NOS memories, NODS	Santa Clara, Ch
1943	Alters Semiconductor*	11/A	Electrically programmable logic	San Jose, Ch
	Sipolar Integrated Technology*	M/A	Digital Bipolar ICs	Beaverton, OR
	Elante;*	2.7	Bigh-performance analog circuits	Milpites, CA
•.	Exel Microelectronics*	6.5	Ultra-high-speed H <sup>2</sup> PMCMs	San Jose, CA
	HTPRES*	2.2	Josephson junctions, Quiterons	Elestord, MY
	International CHOS Sechnology*	5.0	Nonvolatile memories	Cupertino, CA
	Iridian Microwave*	2.35	GeAs FET devices	Chateworth, CA
	Lattice Semiconductor*	#/A	MHOS/CHOS memory & logic	Portland, OR
	LeserPath*	1.0	CNOS Logic	San Jose, CA
	Naxim Integrated Products*	4.9	CMOS linear ICs	Sunnyvale, Ch
	Microlinear*	4.0	IC filters, D/A and A/D	Saratoga, CA
	Nodern Electrosystems*	40.0	HECE/CNCS memories, logic	Sunnyvale, CA
	S NOS Systems*	<b>H/</b> A	VLSI CHOS ICs	San Jose, CA
	Texet Corp.*	12.0-14.0	Power ICs, MIS FETS	Richardson, TX
	Tristar Semiconductor*	13.0	Here / CHOS memory & logic	Sente Clara, Ch
	Wafer Scale Integration*	25.0	Wafer scale integration	Sents Clars, Ch

H/A = Not Available
 \*Covered in this newsletter
 (Nound of financing)

Hote: Excludes five start-ups not publicly announced yet

Source: DATAQUEST

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# DEFINITION OF START-UPS

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DATAQUEST defines start-ups as semiconductor manufacturers that design and ship finished products under their own label, whether or not they have in-house wafer fabrication facilities. In the past, we defined start-ups as semiconductor manufacturers with fabrication facilities. With the trend toward customization and the rapidly rising cost of processing equipment, however, we have observed that many recent start-ups use foundries to reduce their upfront costs. They design their custom and semicustom circuits, send the masks to silicon foundries for fabrication, then package the chips in-house. They cannot be considered custom design houses, since they offer regular product lines. DATAQUEST believes that as customization increases we will see more start-ups using a variety of fabrication arrangements.

# START-UP COMPANY PROFILES

As shown in Table 3, this newsletter provides profiles of the 29 semiconductor start-ups since 1981. Our previous newsletter (March 1982) covers the 22 start-ups that were established between 1977 and 1981. For your convenience, these 29 profiles are categorized by product line.

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## Table 3

## SEMICONDUCTOR START-UPS, BY MAJOR PRODUCT LINE

	This Newsletter (1981-1983)	Previous Newsletter <u>(1977-1981)</u>	Total <u>Companies</u>
Custom, Semicustom, and Foundry	10	11	21
Array Devices, Inc. Array Technology, Inc. Custom MOS Arrays, Inc. Cypress Semiconductor, Inc. LaserPath Corporation Lattice Logic Micro-Linear Silicon Compilers, Inc. Telmos, Inc. Weitek Corporation			·
Memory & Logic	.6	4	· 10
Altera Semiconductor Exel Microelectronics, Inc. International CMOS Technology			
			(Continued)

# Table 3 (Continued)

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# SEMICONDUCTOR START-UPS, BY MAJOR PRODUCT LINE

	This Newsletter <u>(1981-1983)</u>	Previous Newsletter <u>(1977-1981)</u>	Total <u>Companies</u>
Memory & Logic (Continued)			
Lattice Semiconductor S MOS Systems, Inc. Zytrex Corporation			
Memory & Logic Poreign Subsidiaries	3	O	3
Modern Electrosystems, Inc. (Hyundai) National Microelectronics Corp. (United Microelectronics) Tristar Semiconductor (Samsung)			÷
Captive	0	2	2
Gallium Arsenide/Josephson Junction	3	2	5
HYPRES, Inc. Iridian Microwave Corporation Microwave Monolithics			
<u>Digital Bipolar</u>	1	Ó:	1
Bipolar Integrated Technology			
Linear	2	2	4
Elantec, Inc. Maxim Integrated Products, Inc.			
Discrete	2	1	.3
IC Sensors Texet Corporation			
Wafer Scale Integration	2	0	2
Mosaic Systems Wafer Scale Integration	*		:
Total	29	22	51

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Source: DATAQUEST

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## CAD/CAM IMPLICATIONS

In the DATAQUEST CCIS Newsletter Number 47, titled "CAD/CAM 1983: Momentum" dated 7 February 1984, we discussed the significance of functional implementation in VLSI as becoming more and more widespread in the CAD/CAM, computer, and graphics industries. This trend is due, in part, to the 51 semiconductor start-up companies described in this newsletter. Approximately 42 percent of these semiconductor start-up companies are involved in designing or manufacturing customized or customizable chips. Custom chips translate into specialized functional VLSI implementation, thus higher performance and lower hardware costs. We believe that other significant CAD/CAM impacts from the semiconductor boom are:

- Expanded need for sophisticated design tools (EDA)
- Many sources for semicustom and full custom designs

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 System-level design engineers that design on silicon (semicustom) with EDA systems

## Custom, Semicustom, and Foundry

1.	Array Devices, Inc.	President: George Cone (AMCC founder)
	8808 Balboa Ave.	VP Operations: Bruce Rosener (Burroughs)
	San Diego, CA 92123	VP Engineering: Charles Whorl (Honeywell)
	(619) 278-8780	

Array Devices was established by the founder of Applied Micro Circuits Corporation (AMCC), George Cone, in September 1982 and is a wholly owned affiliate of Solitron Devices, Inc. The major thrust of the company will be in gate arrays using 2.5- to 3.0-micron H-CMOS, double metal silicon gate process technology. It now produces commercial 3,500-gate H-CMOS arrays, hybrid digital circuits, and digital logic, and plans to introduce 6,000- to 8,000-gate arrays and field programmable logic arrays (FPLA) in 1984. The company offers a high-speed CMOS process using 4- to 5-micron geometries. It is in the process of acquiring Solitron Device's California division, which includes a 36,000-square-foot fab facility from AMCC.

2.	Array Technology, Inc.	President: Bill Robson (AMCC)
	992 So. Saratoga-	VP Engineering: Bill O'Neil (AMCC)
	Sunnyvale Rd.	VP Sales: Jim Schenck (California
		Devices)
	San Jose, CA 95129	VP Technical Support: Gary Robson
	(408) 252-9900	(Computervision)

Array Technology was established in March 1982 by two former AMCC employees. The company specializes in custom and semicustom CMOS devices and gate arrays using surface-mounted assembly, infrared solder reflow, and vapor phase processes. It is internally financed.

3. Custom MOS Arrays, Inc. 211 Topaz Street Milpitas, CA 95035 (408) 946-9111
Presidents: Handel Jones (Rockwell) VP Engineering: Ian Liu (Interdesign) VP CAD Software: Shi-Ping Fan (National Semiconductor Board Chairman: Chan Desaiguodar (California Micro Devices)

Custom MOS Arrays was established in July 1982 by its parent company, California Micro Devices, which provided \$4.0 million in start-up funds. The company offers custom CMOS gate arrays (400-3,100 gates), using 3-micron geometries and H-CMOS technology, as well as standard cell and full custom design services using 2- to 3-micron geometries. CMA recently signed an exclusive licensing agreement with Ricoh of Japan to develop a line of silicon gate CMOS gate arrays and standard cell products. The company offers completely integrated CAD, which allows 100 percent placing and routing, and the option of moving from gate arrays to standard cell. CMA is currently raising \$10 million in private placements for CAD equipment and office administration.

4.	Cypress Semiconductor	President: T.J. Rodgers (AMD)
	3920 Freedom Cir., Suite 201	. VP Marketing: Lowell Turriff (AMD)
	Santa Clara, CA 95050	VP R&D: Fred Jenne (AMD)
	(408) 727-9965	VP Engineering: Steven Kaplan (AMD)
	Will move in 2/84 to:	VP Manufacturing: Michael Starnes (Intel)
	3901 North First Street	Marketing Applications: Dane Elliott
	San Jose, CA	(SEEQ)
		VP Assembly: Fritz Beyerlein
		(independent)

Cypress Semiconductor was formed in November 1982 and received \$7.5 million in venture capital from the Kleiner, Perkins, Caufield & Byers (KPCB); Mayfield Fund; Sequoia Fund; Sevin-Rosen Partners; and J.H. Whitney & Co. In addition, it has \$12.5 million in equity leasing. The firm will specialize in a standard product line of high-perfomance CMOS RAMs and PALs using a 1.3-micron N-well CMOS process. Its first RAM products will appear in the second quarter of 1984, followed by CMOS PALs jointly developed with Monolithic Memories. The company will move to its 61,300 square-foot San Jose facility in February 1984 and expects to triple its staff to 350 employees by 1985.

5. LaserPath Corporation Principal Founder: Morgan Johnson 1977 O'Toole Ave., Suite 109 San Jose, CA 95131 (408) 946-7203

LaserPath was founded in July 1983 with \$1.0 million in start-up capital from Crosspoint Venture Partners. The company will operate a logic design and prototyping center that is set up for quick turnaround, and will sell machinery compatible with CAD equipment. No wafer plant is planned.

Lattice Logic
 9 Wemyss Place
 Edinburg, Scotland
 031-225-3434

President: John P. Gray VP Applications Software: Irene Buchanan VP Systems Software: Peter S. Robertson VP Engineering: David Eglin

Lattice Logic began operations in 1982 and specializes in CAD software for gate arrays, standard cells, and Mead-Conway style designs. The company offers IC design services, VLSI design software, and silicon brokerage services.

7. Micro-Linear	President: Alan B. Grebene (Exar)
920 W. Fremont Ave.	Executive VP: Norman J. Miller (MMI)
Sunnyvale, CA 94087	VP Engineering: James L. McCreary (Intel)
(408) 733-5200	VP Operations: Abraham Korgav (SEEQ)

Micro-Linear was incorporated in January 1983 and began operations in The company specializes in analog and combined October 1983. analog/digital semicustom LSI circuits, using mask-programmable device ? arrays and analog "standard cells" for low-cost, quick turnaround design. It will introduce its initial semicustom LSI products during the second quarter of 1984, using both bipolar and silicon-gate CMOS The company will conduct product technologies. design, CAD. metal-masking, thin-film deposition, testing, and pilot assembly at its 45,000-square-foot permanent facility in San Jose beginning in April 1984 and use a foundry for front-end wafer processing. The company received \$4.0 million in venture capital and private investments from Adler and Company, Fairfield Ventures, Oak Investments, and Riordan Associates.

8. Silicon Compilers, Inc. 105 Albright Way Los Gatos, CA 95030 (408) 370-2008 President: Phillip A. Kaufman (Intel) VP Marketing/Sales: Dennis Sabo (National Semiconductor) VP Product Development: Steven Johnson (Scientific Calculations) VP Engineering: Edmund Cheng (Intel) VP Architecture: David Johannsen (Cal Tech) Board of Directors: Carver Mead (Cal Tech) Gordon Bell (Encore) Brook Byers (KPCB)

Chairman: L. John Doerr (KPCB)

Silicon Compilers began operations in 1981 to develop design automation systems for systems engineers not experienced in IC design. The company specializes in custom ICs, such as the EDLC Ethernet controller licensed to SEEQ, the MicroVAX I processor developed for Digital, and a graphics controller developed with Sun Microsystems. Silicon Compilers completed its second round financing in 1983, raising \$5.5 million. Principal investors were General Electric Venture Capital; Kleiner, Perkins, Caufield and Byers (KPCB); L.F. Rothschild; Morgan Stanley; and Robertson Colman.

9.	Telmos, Inc. 740 Kifer Road	President: Dr. Jean Hoerni (Eurosil) President: Dr. Luc Bauer (Eurosil)		
	Sunnyvale, CA 94086 (408) 732-4882	Director Wafer Fab: Michael Powell (Fairchild)		
		Director Engineering: Paul Nance (Eurosil)		
		Director High Voltage Technology: Dr. Peter Shackle (N/A)		
		Worldwide Marketing & Sales: Murray Siegel (MMI)		

Telmos began in January 1981 with \$0.8 million in start-up capital, subsequently raising \$18.1 million in private placements and \$8.0 million in lease lines. It offers two advanced technologies: analog/digital semicustom silicon gate arrays and high-voltage D-MOS/ silicon gate CMOS integrated on the same chip. Telmos has foundry services with 2-micron, double-poly, two-layer metal CMOS silicon gate technology. It is capable of working on both sides of the MPU as a complete interface source, covering the range from the sensor through the interface logic, and picking up again on the MPU output, interfacing the logic into the high-voltage outputs for actuator or control applications.

10. Weitek Corporation 3255 Scott Blvd., Bldg. 25 Santa Clara, CA 95054	President: Arthur J. Collmeyer (Calma) VP Component Mfg.: Godfrey Fong (Hewlett-Packard)		
(408) 727-6625	VP Technical Marketing: Chi-Shin Wang (Hewlett-Packard) VP Product Development: Saul Goldstone (Calma)		
	Mgr. Product Engineering: Edmund Sun (Hewlett-Packard) VP Sales: Jim Girand (Calma)		

Weitek Corporation began operations in January 1981 with \$1.0 million in start-up capital from InnoVen Capital, followed by \$3.5 million in additional financing from Sutter Hill Ventures and others. Weitek began as a custom design house, specializing in gate arrays, standard cell, and full custom circuits, but shifted to producing specialty semiconductors such as high-performance arithmetic processors. VLSI components are designed and marketed by Weitek, with wafer processing done by Intel and Toshiba. The company has introduced parallel multipliers and multiplier-accumulators sold as pin-equivalents to AMD's and TRW's digital signal processing circuits, and has provided shaded graphics ICs to Computervision and Tektronix. A 3-micron NMOS chip set delivering 10 MFLOPs of 32-bit floating point computation is being developed.

# Memory & Logic

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President: Rodney Smith (Fairchild)
VP Engineering: Robert Hartmann
(Source III)
VP Technology & Operations: James Sansbury (Hewlett-Packard) VP Finance: Paul Newhagen (Source III) Marketing Manager: Michael Magranet (Source III)

Altera Semiconductor was formed in June 1983 after receiving initial venture capital funding from Alpha Partners of Menlo Park. Altera will enter the merchant semiconductor market with a family of electrically programmable logic devices using floating gate CMOS technology. Design and layout of the initial product is complete, and first silicon wafers are expected in the first guarter of 1984. Altera eventually intends to operate its own wafer fabrication facility, but will initially obtain<sup>3</sup> these services on a subcontract basis. The company expects to raise additional financing in the first guarter of 1984.

12.	Exel Microelectronics, Inc	2. President: B.K. Marya (SEEQ)
	2150 Commerce Drive	Director Marketing: Sam Young (Hitachi)
	San Jose, CA 95131	Applications Manager: Alex Goldberger
	(408) 942-0500	(Signetics)
		Worldwide Sales: Terry Speizer (Inmos)

Exel Microelectronics was founded in February 1983 by two former employees of SEEQ Technology. The company received \$5.5 million in financing from Hambrecht & Quist and eight other venture capital firms, in additon to \$1.0 million from Sirjan L. Tandon, B.K. Marya's uncle, and a guaranteed base line of \$11 million. The firm offers  $16K E^2PROMS$ using 2-micron, NMOS process technology on 4-inch wafers and will introduce 2-micron, double-poly CMOS  $64K E^2PROMS$  and microcontroller and peripheral circuits in early 1984. Currently, it is leasing a 7,500-square-foot wafer fab line from Nitron in Cupertino, and building a \$20 million 6-inch wafer fab plant in San Jose, which will be in operation during the first quarter of 1984. The third round of financing will be completed in January 1984.

13. International CMOS Technology	President: Drew Osterman (National Semiconductor)
806 Selkirk Place	VP Finance: Lawrence Yaggi (Perkin-Elmer)
Sunnyvale, CA 94087 (408) 973-0795	Process Engineering: Samuel Wang (National Semiconductor) Design Engineering: Dhaval Brahmbhatt (National Semiconductor) Product Line: Donald Robinson (National Semiconductor)

International CMOS Technology started in October 1983 and is currently seeking \$5 million in venture capital. It has 40,000 square feet of R&D facilities and plans to have a pilot R&D production line by mid-1985 and a manufacturing facility shortly thereafter. The company will specialize in nonvolatile memories and electrically alterable logic arrays.

14.	Lattice Semiconductor Corp.	President: Rahul Sud (Intel)
	10300 S.W. Greenburg Road Portland, OR 97223	Executive VP: Ray Capece (Rosen Research)
	(503) 246-2726	Strategic Marketing: John Posa (Electronics Mag)
		Design: Jerry Moench (Motorola)
		Plasma Technology: Brendan Cremen (Harris)
		Operations Planning Manager: Brian Sheets (Inmos)

Lattice Semiconductor was established in April 1983 to design and manufacture ultrahigh-speed NMOS and CMOS semiconductor memory and logic components for computers. The company has received several million dollars in financing from Floating Point Systems, Inc., Louisiana-Pacific Corp., a consortium of Norwegian investors, and others. Currently occupying a 7,500-square-foot advanced design center, Lattice is expanding into a 50,000-square-foot wafer fab facility in Beaverton, Oregon. Beginning in April 1984 it will offer samples of its high-speed static and nonvolatile memories and logic chips, which offer reprogrammability, using 2-micron CMOS process and 6-inch wafers.

15. S MOS Systems, Inc. President: Dan S. Hauer (Micropower/ 50 West Brokaw Rd., Fairchild) Bldg. 7 Director Marketing: David O. Perry San Jose, CA (Elmo Semiconductor) 95110 (408) 993-1212 Director Engineering: John Conover (Siliconix) **VP Finance & Administration:** Fumiyoshi Kanazawa (Epson America) Director Liaison: Yoshi Maeda (Suwa Seikosha)

S MOS Systems was formed in November 1983 to produce LSI and VLSI CMOS products for computers and telecommunications OEMs. The company is backed by Suwa Seikosha, the major manufacturer of SEIKO watches, which has a work force of 10,000 and \$1.3 billion in sales. Initial products include 16K static RAMs and 64K and 256K mask ROMs, to be followed by VLSI static SRAMs, MPUs, and peripheral circuits, all using CMOS processes and 2- to 3-micron geometries. S MOS will offer a unique super-silicide selectox silicon gate process and a VLSI "building block" approach to build semicustom gate arrays and standard cells. Midwest and East Coast design centers will have satellite links to the San Jose headquarters and to Suwa Seikosha's Fujimi plant in Japan. The Fujimi plant, of which S MOS will be allotted up to one-third capacity, currently produces 6,000 5-inch CMOS wafers and 35,000 4-inch CMOS wafers per month. Marketing, sales, and engineering will be housed in San Jose. 16. Zytrex Corporation 224 North Wolfe Road Sunnyvale, CA 94086 (408) 733-3973 President: Howard Souza Executive VP & VP Marketing: Steve Markoe (Synertek) Senior VP Technology: Frank Wanlass (Ultra Logic) VP Product Development: Paul Kageyama (Monosil) VP Design Engineering: Robert Plachno (Mostek) VP Operations: Chuck Vath (Siliconix)

Zytrex was founded in May 1981 and went public in June 1982, raising **\$8** million in public financings through June 1983. The company specializes in high-performance CMOS memory and logic, CMOS octal interface circuits, and CMOS PALs, using a 2-micron, double-metal, ion implanted complementary extra-fast (ICE-MOS) process that involves an 8-mask, dual-layer metal process. Recently, Zytrex offered its Octal Interface family, which consists of 53 devices ranging from gates, flip-flops, and latches to transceivers, counters, and decoders. Next year it will introduce CMOS hard array logic (first quarter), CMOS PALs and bipolar PROM equivalent families (second quarter), and DSP and microprocessor families (second half). The company has received \$1 million in lease financing for an additional 30,000 square feet of offices and production testing.

# Memory & Logic Foreign Subsidiaries

17. Modern Electrosystems, Inc. Executive VP & CEO: Dr. Myung S. Bae 482 Oakmead Parkway (Xerox) Sunnyvale, CA 94086 General Manager Semiconductor Operations: (408) 720-1700 Yong Lee (Fairchild) Business Planning Director: Rolf Seebach (Precision Monolithics)

Modern Electrosystems is a subsidiary of the Korean conglomerate, Hyundai, which provided \$40 million in start-up capital. The company was incorporated in March 1983 and had a groundbreaking in July 1983 for its Clara R&D facility, 100,000-square-foot Santa which contains 10,000 square feet of fab facilities. The company is basically an R&D and manufacturing arm of Hyundai, but will sell NMOS and CMOS memories and microcontrollers in the merchant market. Production is expected to be 50,000 5-inch wafers per year at the Santa Clara fab and 300,000 5-inch wafers at the Korean fab. The company just purchased \$5 million worth of Eaton-Optimetrix wafer steppers and an Eaton Nova ion implanter.

18. National Microel	ectronics	NMC President: Tony Yu (Signetics)
Corp.		UMC President: Bob Tsao (Electronics
3056 Scott Blvd.		Research & Service Organization - ERSO)
Santa Clara, CA	95050	VP Operations: I.D. Liu (ERSO)
(408) 727-9306		VP Marketing: Troy Speers (AMI)

National Microelectronics Corporation (NMC) was formed in May 1982 as a subsidiary of United Microelectronics Corporation (UMC), a Taiwanese

company. The company produces telecommunication circuits, MOS memories (ROMs and SRAMs), and microprocessors, using mostly CMOS, 3.0-micron design geometry and double-poly technology. It second sources AMI products in Asia. NMC has a 5,000-square-foot design facility in Santa Clara and uses UMC's 100,000-square-foot facility in Taiwan, of which 20,000 square feet is fab. UMC plans to add 20,000 square feet of stepper fab in 1984.

19.	Tristar Semiconductor	President: Dr. Imsong Lee (consultant)
	5150 Great America Parkway Santa Clara, CA 95050 (408) 980-1630	<pre>VP Marketing &amp; Sales: Ronald Engelbrecht (Oki Electric) VP Process Engineering: Dr. Ilbok Lee (National Semiconductor) VP &amp; General Manager: Dr. Joon Lee (Zilog)</pre>
		(01103)

Tristar Semiconductor began operations in July 1983 as a subsidiary<sup>2</sup> of Samsung Semiconductor and Telecommunications Ltd. of the Samsung group, a Korean conglomerate that provided \$6 million in start-up capital and \$7 million in lease financing. The company will produce NMOS and CMOS memory (64K DRAMS, SRAMs), and 16K  $E^2$ PROMS will be developed with Exel Microelectronics. A 5,000- to 6,000-square-foot wafer fab is being prepared with \$10 million in capital equipment, including Perkin-Elmer and Nikon stepper equipment. A 2-micron geometry process will be used on 5-inch wafers.

## Gallium Arsenide/Josephson Junction

20.	HYPRES, Inc.	President:	Dr. Sadeg Faris (IBM
	175 Clearbrook Road	Watson Lab	) }
	Elmsford, NY 10523 (914) 592-1190	Directors:	Christopher Brody (N/A) Stephen Clearman (N/A) Franklin Johnson (N/A) Henry Kressel (N/A) William Miller (N/A)

HYPRES, Inc. was founded by Dr. Faris, a former IBM research scientist, in August 1983 and received \$2.2 million in financing from Adler & Co., Asset Management Associates, Pincus & Co., Inc., and E.M. Warburg. Under an IBM license, the company will develop and market ultrahigh-speed signal process equipment based on superconductivity technologies, including Josephson junctions and Quiterons. While at IBM, Dr. Faris was credited with inventing the Quiteron, a three-terminal superconducting switching device that operates at cryogenic temperatures  $(-459^{\circ}F)$  with little power dissipation. The Quiteron potentially alleviates the problem encountered in developing Josephson junction computers, which led to IBM's de-emphasis of its program. The company already produces all-niobium devices at its 10,000-square-foot facility and is putting together a management team.

21.	Iridian Microwave Corp.	President/CEC	D: George Archuleta
	9172 Eton Avenue	(Systron Dor	ner)
	Chatsworth, CA 91311	Controller:	Bill Sharp (Amdahl)
	(213) 700-0901		

Iridian Microwave was founded in January 1983 as a spin-off from Systron Donner, a producer of microwave components. The company produces GaAs FET amplifiers, dielectric stabilized oscillators, and integrated microwave subsystems at its 20,000-square-foot plant in Chatsworth. Microwave research is conducted at its Technical Development Center in Santa Clara. The company aims to be an active microwave component and subsystem supplier for the Defense Department. It offers octave band, multioctave, narrow band, and low-noise configurations for radar and communications applications.

22. Microwave Monolithics President: Dr. Daniel Chen (Rockwell) 465 East Easy Street Simi Valley, CA 93065 (805) 584-6642

Microwave Monolithics began operations in April 1982 and has been doing R&D work for government agencies and OEMs. The company specializes in GaAs monolithic microwave ICs (MMICs) for direct broadcast satellite (DBS) television receivers and Department of Defense Microwave specialty circuits as well as custom GaAs circuits. It has sputtering and fine line capabilities for 0.5-micron geometries. Currently, the company is privately financed and is negotiating its first round of outside financing. It plans to start production operations before the end of 1984.

# Digital Bipolar

23.	Bipolar Integrated 🥒 👘	President: George Wilson (Tektronix)
	Technology	VP Marketing: Les Soltesz (Intel)
	14155 S.W. Brigadoon,	Technical Director: Jim Pickett
	Suite B	(Tektronix)
	Beaverton, OR 97005	Circuit Design: Ken Schlotzhauer
	(503) 626-3329	(Tektronix)

Bipolar Integrated Technology (BIT) was formed in July 1983 and plans to design high-speed digital bipolar ICs. The company is currently seeking its first round of financing and expects to begin operations by January 1984. BIT will initially operate as an IC design house and will rely on foundry services; eventually it will operate its own wafer fabrication plant.

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## <u>Linear</u>

24.	Elantec, Inc. 1996 Tarob Court	President: Al Vindasius (National Semiconductor)
	Milpitas, CA 95035 (408) 945-1323	VP Marketing & Sales: Jerry Zis (Intersil) VP R&D: Barry Siegel (National Semiconductor)
		VP Administration: Terry Treadwell (National Semiconductor) VP Quality & Reliability: Dean Coleman
		(Mational Semiconductor)

Elantec, Inc., was established in July 1983 by four former employees of National Semiconductor. The company received \$2.7 million in start-up capital from five venture capital firms. It will specialize in high-performance monolithic and hybrid analog circuits for the commercial and military markets, especially wide-band, high-slew-rate, and high-power operational amplifiers. Production is scheduled for the first quarter of 1984. Elantec, Inc., has 6,500 square feet of thick-film fabrication, assembly, and test facilities at its 16,000-square-foot Milpitas location.

25. Maxim Integrated Products,	President: Jack	Gifford (Intersil)
Inc.	Other officers:	Fred Beck (Intersil)
510 North Pastoria		David Folgar (Intersil)
Sunnyvale, CA 94086		Dick Hood (Intersil)
(408) 737-7600		Same Oche (Intersil)

Maxim Integrated Products was formed in May 1983 by former employees of Intersil's Analog IC Product Division. The company received \$4.9 million in venture capital from Bessemer Venture Partners; Brentwood Associates; DSV Partners, Venad; Merrill, Pickard, Anderson, Eyre; and Overseas Venture Capital. Using SIFAB's fab facilities, it plans to introduce a family of analog IC products by mid-1984.

## Discrete Devices

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26.	IC Sensors	President: Don Lynam (Foxboro/ICT)
	430 Persian Drive	VP Engineering: Janusz Bryzek (N/A)
	Sunnyvale, CA 94086 (408) 745-1814	Wafer Fab Manager: Manny Rossell (Foxboro/ICT)
		Manufacturing Manager: Bill Geene (Foxboro/ICT)

IC Sensors spun off from Foxboro/ICT of San Jose, California, in September 1982. The company is 75 percent financed by the founders. It currently produces 10,000 units of pressure-sensing chips; solid state pressure sensors, transducers, and transmitters; and bipolar processes for mechanical devices on a weekly basis. End users are OEMs in the medical blood pressure, pneumatic control, and automotive industries. IC Sensors leases an 8,000-square-foot fab building with 4,000 square feet of fab area in Sunnyvale and plans to boost production to 20,000 units by mid-1984. 27. Texet Corporation 301 E. Ridgemont Drive Allen, TX 75002 (214) 727-1111 President: Frederick C. Ochsner, Jr. (Texas Instruments)

Texet Corporation was established in June 1983 and received between \$12 and \$14 million in start-up capital from several French banks and insurance companies. The company will specialize in power ICs, advanced power MOS FETs, and custom power chip designs. Production will begin in the first quarter of 1984 at its MOS FET wafer processing plant in Allen, Texas, and its assembly plant in St. Michele-sur-Meurthe, France. It offers vertical diffused MOS FET technology and 4- to 5-inch wafers.

# Wafer Scale Integration

28. Mosaic Systems	President: Robert R. Johnson (Burroughs)
1497 Maple Way	VP Electronics: Herbert Stopper
Troy, MI 48084	(Burroughs)
(313) 643-4820	VP Architecture: C.C. Perkins (Burroughs)

Mosaic Systems was established in early 1982 and received start-up capital from Advanced Technology Ventures, Energy Conversion Devices, Evans and Sutherland Computer Corporation, Hambrecht and Quist, Ivan E. Sutherland, Sutter Hill, and VenRock. The company specializes in wafer scale integration with a proprietary process for electronically programmable discretionary wiring that can be used by hybrid type silicon-on-sapphire packaging of chips on silicon wafer substrates or for previously manufactured wire monolithic wafers. Through its licenses from Burroughs and Energy Conversion, Mosaic Systems has developed a wafer hybrid-interconnection package (WHIP) that operates at any temperature. WHIP prototypes will be offered in spring 1984, with full production by the fall.

29.	Wafer Scale Integration	President: Eli Harari (Synertek)
	4633 Old Ironside Dr.,	VP Technology: Steven Su (Synertek)
	Suite 420	VP Marketing: Terry Leader (Synertek)
	Santa Clara, CA 95050	
	(408) 988-8500	

Wafer Scale Integration began in July 1983 and is negotiating \$25 million in start-up capital. The company will produce custom devices and special nonvolatile memories based on an advanced CMOS process. Using a novel approach to wafer scale integration, it will develop wafer-sized memory systems. In August 1983 the company began building a standard cell library for nonvolatile memories using 2-micron CMOS designs.

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Beth Tucker Sheridan Tatsuno

RESEARCH NEWSLETTER

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CAD/CAM 1983: MOMENTUM

# TRENDS BECOME REALITIES

Sen M Dataquest

During 1983, DATAQUEST reported on many trends involving the world of design and manufacturing automation. These trends included the use of 32-bit processor technology, distributed intelligent workstation architecture, local area networking, third-party software, specialized graphics processors, functional implementation of VLSI designs, and acceptance of electronic design automation products.

Through its broad and comprehensive client base, DATAQUEST continues to obtain and analyze new technological information and to report to its clients on the diffusion of those technologies and their impact on the design and manufacturing marketplace. DATAQUEST believes the emerging trends in 1984 include:

- New companies entering the standalone workstation market, delivering a new era of high-performance products
- Implementation of application-specific integrated circuits to off-load compute-intensive tasks from the host processor
- Integration of multiple-vendor local area networks--LAN "meshing"
- Increased vendor and user awareness of the need for improved and sophisticated information management systems
- Acceptable interactivity levels utilizing solids-modeling software technology
- IBM'S omnipresence

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## MAJOR TURNKEYS

These companies represent multiple-application vendors that are responsible for the majority of the revenue expended within the CAD/CAM markets other than computer manufacturers.

## Applicon

The company reached a major milestone in 1983 in the delivery of its three-year, \$22 million R&D investment, BRAVO. BRAVO, written from scratch, represents a totally integrated set of software solutions that run on the VAX 11/730, 11/750, and 11/780. In addition, Applicon became the first major turnkey vendor to offer its software bundled or unbundled. Applicon also signed a license agreement with Algorex for nonexclusive rights to PCB design software.

## Auto-Trol

Transition and recovery were the two major factors in the past year for the leading turnkey vendor of distributed architecture systems. Auto-Trol returned to profitability and attained revenue growth of 21 percent after six consecutive quarters of revenue losses. DATAQUEST believes this success is based upon two major factors: the acceptance of the AGW Apollo-based systems and the solidification of the executive management team. In addition, Auto-Trol announced the formulation of a European partnership with Selenia, a computer-integrated manufacturing vendor. Auto-trol also began a \$7 million R&D project with Michael Leesly Consulting Inc., of Austin, Texas, to develop a fully integrated process plant design system.

# <u>Calma</u>

A number of major events occurred this past year at the Santa Clara, California, turnkey corporation. The first was the implementation of a new executive management team that brings decades of General Electric management experience. The second was the announcement of the company's DDM and DIMENSION III product lines on the Apollo. In addition, Calma purchased a portion of Comstat General Integrated Systems, renamed TEGAS Systems, for an estimated \$14 million. TEGAS is well known for its logic simulation software. DATAQUEST believes that Calma must formulate a solid product development strategy in addition to solidifying its choices of computer hardware vendors in order to clearly differentiate its product offerings.

## Computervision

CV reported record revenues of \$104 million for the third quarter, an increase of 31 percent from the previous year. CV also announced a \$40 million OEM agreement with Sun Microsystems and a Value-Added Remarketing Agreement (VAR) with IBM. In addition, the company purchased

the Organization of Industrial Research (OIR), to attain the exclusive marketing rights to OIR's Group Technology and Process Planning software for CAD/CAM applications. CV also acquired GRADO Software und Computer Systeme GmbH, of Munich, West Germany, for specialized PCB software packages. The year 1983 marked the initial implementation of productivity centers specifically staffed and equipped to support regional territories. CV also acquired Cambridge Interactive Systems, of Onited Kingdom, for its plant design software the offerings. Computervision announced a joint effort with Digital Equipment Corporation to link CV CAD/CAM systems to the VAX environment. DATAQUEST believes that CV must continue to implement its long-term product strategies in order to provide its user base and sales prospects with a clear understanding of the company's multiple product offerings.

## <u>Intergraph</u>

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Intergraph reported year-end revenues of \$252 million, which included fourth quarter revenues of \$84 million. In addition, the company ended 1983 with a backlog of \$131 million, of which hardware represented \$108 million. DATAQUEST believes that Intergraph's biggest problem in 1983 was its inability to volume ship its color workstations because of a shortage of a high-speed custom logic chip. These workstations likely represent a large portion of the reported \$108 million hardware backlog. DATAQUEST believes that Intergraph is formulating a standalone architecture strategy to enter the market of distributed systems. The question to be answered is whether Intergraph will remain with a single hardware source (Digital Equipment) or perhaps follow with a non-Digital Equipment distributed standalone architecture.

#### MCAUTO

Two major events happened this past year at MCAUTO. The first was the announcement of a newly formed organization to deliver AEC products. The second was a VAR agreement with IBM to offer products tied into the XT/370 and PC/XT. In addition, MCAUTO announced three new modules to complement its CAD/CAM robotics product offering, PLACE. These modules are COMMAND, ADJUST, and BUILD. DATAQUEST believes that a joint marketing agreement with Vectron for PCB software and the addition of an expanded AEC product line will complement an already strong mechanical/manufacturing product line at MCAUTO.

#### TURNKEYS--OTHER

In addition to the top six turnkey vendors with a full range of CAD/CAM applications mentioned above, a host of other turnkey companies compete in the CAD/CAM marketplace with niche or single-application products. The companies listed below generally have dedicated systems and staff to address their specific applications.

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# CADLINC, Inc.

As its name might imply, the company links CAD with CAM. CADLINC's approach is unique in that it sells a 68000-based standalone system with the main emphasis on CAM applications. We estimate that CADLINC's 1983 revenues were approximately \$6 million.

#### Cadnetix, Inc.

Shipments of the company's 68000-based PCB workstation began in late 1983, with year-end revenues estimated to be \$1 million. Cadnetix was formed in late 1981 and developed a product to address the full range of automated PCB design.

## Daisy Systems, Inc.

Daisy announced its initial public offering in June 1983. Its calendar 1983 revenue increased 431 percent over 1982 revenue, reaching \$28.4 million. The company continued to expand its product offerings with the introduction of the Megalogician, a simulator engine expected to be shipped beginning in the first quarter of 1984.

## Mentor Graphics Corp.

Mentor released its prospectus in December 1983 and made its initial public offering in January 1984. In September 1983, Mentor acquired California Design Automation, Inc., a Sunnyvale-based software company that developed software for gate array placement and routing. Mentor introduced the MIDAS 7000, a logic analyzer that interfaces with the IDEA line of EDA systems. We expect Mentor to report 1983 revenues in excess of \$25 million.

#### Metheus Corp.

Metheus signed a \$24 million agreement with Korean-based Hyundai Electronics Industries for the sale of Metheus's Omega and Lambda products. The Lambda EDA system, which generated an estimated \$4.5 million in revenue for Metheus, was shipped during the second half of 1983.

# Racal-Redac, Ltd.

Redac introduced its VAX 11/730-based PCB design system in 1983. We estimate that Redac's 1983 worldwide revenue was \$67 million, with approximately 63 percent from European sales. Look for Redac to make a push for a stronger presence in the U.S. PCB CAD market.

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## Scientific Calculations, Inc.

At Autofact in November, SC formally announced an agreement with IBM under which SC will run SCICARDS on an IBM 4361 or 4381 host processor using the IBM 5080 terminal. SC also announced at Autofact a proprietary workstation to run SCICARDS, with a list price of under \$100,000. SC continues its hold of the PCB CAD market, with an 8 percent market share in 1983.

## Silvar-Lisco

At the DA conference in June 1983, Silvar-Lisco announced that it will sell and deliver an Apollo workstation running the SL-2000 EDA software packages. The company continues to expand its customer base, with over 75 companies using SL-2000 software for logic design and simulation, and/or gate array or standard cell placement and routing.

# Telesis Systems Corp.

With approximately \$15 million in 1983 revenue and over two years of shipping its PCB CAD system, Telesis is no longer the new kid on the block. In 1983, Telesis introduced a graphics processor for its PDP/11-based standalone system. It also announced Mechanical Application Software that is presently used to create manufacturing drawings.

## Valid Logic, Inc.

Valid's 1983 revenue increased 440 percent to approximately \$16.07 million, compared to 1982 revenue of \$2.63 million. Valid introduced the SCALDSTAR, its custom physical layout system, in the spring of 1983 and made its initial public offering in August.

## Versatec

Shipments of the Expert 1000 and 2000, Versatec's PCB and mechanical design systems, respectively, began in mid-1983. Versatec signed an agreement with the Diversified Systems, Inc., service bureau under which Diversified will install 50 Expert 1000 systems for PCB design.

# DESIGN CENTERS

Although one cannot rationally label a semiconductor manufacturer a CAD/CAM company or CAD/CAM service bureau, many IC houses are establishing design services and centers. These centers are offered as a service to increase IC revenues. Design centers typically have a staff of electrical engineers using CAD/CAM or EDA systems. In fact, some pieces of software are often developed by foundries for their own specific process technology.
The major EDA vendors have established agreements with many of the semicustom companies under which the EDA companies have access to the design parameters or libraries of the foundry and/or the foundry uses the EDA system in it's design centers. This complementary relationship expands the sales potential for both companies. DATAQUEST expects to see more such agreements formed during 1984 and in the years to follow.

#### START-UPS

The CAD/CAM and related industries are heavily dependent on applying technology to specific applications. As such, many opportunities exist for start-up companies with new ideas and different approaches for software engineering, hardware design, applications, and even new design methodologies.

DATAQUEST'S Semiconductor Industry Service currently tracks at least 16 1983 start-up IC firms; the number of CAD start-ups is not quite that high. Nonetheless, the number of new companies entering the CAD/CAM industry during the past three years that are still in existence and growing strong is a good indication that the CAD market is broad and diverse enough to support many players.

We currently track the development of the following companies, all of which came into being during 1983: Adra Systems, Inc.; Automation Technology Products, Inc.; Celerity Computing, Inc.; Cericore, Inc.; Interleaf Corp.; Mosaic Systems, Inc.; Parallax Systems, Inc.; Parsec Computer Systems, Inc.; Personal-CAD Systems, Inc.; Qubix Graphics Systems, Inc.; Vector Scientific, Inc.; and Vulcan Software Corp.

DATAQUEST believes that during 1984, and in future years, the CAD industry will experience some level of shakeout. However, because of the innovations new companies bring to the industry, we believe that more acquisitions and mergers will occur than actual fallouts.

#### COMPUTER COMPANIES

Led by IBM, which surpassed Computervision to become the leader in CAD/CAM market share and revenue in 1983, computer companies continue to penetrate the CAD/CAM market through OEM sales. This rapid market penetration is the result of several factors. Foremost is the widespread acceptance of 32-bit minicomputers and distributed processing systems. Standalone workstations are also rapidly becoming a major factor in CAD/CAM. Another significant factor is the standardization and portability of operating systems along with the improvement of communications protocols. The majority of the companies in this area are using Unix-based operating systems and Ethernet communications protocols.

DATAQUEST believes that the number of end users whose computational needs are being met is increasing. As this becomes more apparent and widespread, we believe the emphasis will shift to improved information management systems, not just computational strength.

## Apollo Computer

Buoyed by numerous OEM agreements and the phenomenal market acceptance of its distributed processing workstations, Apollo continues to lead the pack with the introduction of two new products based on bitslice processing. Estimated revenue for 1983 was \$85 million. DATAQUEST believes Apollo will increase its presence in the CAD/CAM environment because of its state-of-the-art system technology and the widespread industry demand for more sophisticated, faster, and lower-cost engineering workstations. However, viable competition in the standalone workstation market will be seen in 1984 from companies such as CADMUS, MASSCOMP, Mosaic, and Sun Microsystems.

# Control Data

In late 1983, CDC reorganized all of its CAD/CAM/CIM-related activities into the Computer-Integrated Manufacturing Division. At the same time, CDC announced a line of turnkey CAD/CAM systems that supplement its traditional CAD/CAM Cybernet ICEM (Integrated Computer-aided Engineering and Manufacturing) services. The ICEM 120-40 is a single-user system that employs a 16-bit processor and sells for under \$50,000. The ICEM 120-70 is a multiuser system employing a 32-bit VMS. The most powerful system, the ICEM 800, can support more than 40 workstations. The ICEM Ergonomic Workstation, which will be available in several versions in mid-1984, was also introduced. CDC opened several design centers and has signed several third-party software listing agreements. CDC's marketing approach is to provide a total CAD/CAM solution. With estimated CAD/CAM-related revenues of \$85 to \$90 million in 1983, DATAQUEST believes CDC can become one of the top computer companies in CAD/CAM if it is able to implement and support its marketing approach on a long-term basis.

#### Data General

In 1983, DG announced the addition of the MV10000, the MV4000, and the GW 4000 Expert Workstation to the ECLIPSE MV family. DG also introduced two new versions of its MV8000 computer, one of which uses 64K RAMs and the other the new 256K RAM from Nippon Data General. The DESKTOP GENERATION series of professional computers were introduced in July. The series handles engineering and office functions, including word processing and CAD. DG also instituted an aggressive third-party software program. Presently, DG has agreements with 50 major software vendors for various application packages. DATAQUEST believes DG's presence in the CAD/CAM market will continue to expand as a result of the company's continuing improvements in product integrity and reliability, its increasingly broad range of computer products for CAD applications, and its software philosophy.

### Digital Equipment

Digital's VAX family of computers continues to sell well in the CAD/CAM environment and the company's third-party software agreements with major CAD software vendors (VLSI Technology, Scientific Calculations, Phoenix Data Systems, etc.) continue to foster sales of the VAX line. Significant product announcements in 1983 included the VAXstation 100 and the MicroVAX. The new MicroVAX provides slightly better performance than the VAX 11/730 at half the price. Digital is well positioned in the CAD/CAM market. However, DATAQUEST believes increased competition from Apollo, Sun Microsystems, Data General, and IBM, coupled with the late arrival of the new VAX product line, could affect Digital's market share and revenue growth. DATAQUEST also believes that the delivery of the new VAX product family is critical to the company's meeting the new wave of competition.

### Hewlett-Packard

HP began shipping the HP9000 workstations in January 1983. The company reports that more than 1000 have been shipped to date. Through an agreement with Metheus Corporation, HP now offers a high-resolution (1,024 X 768) graphics display controller for the 9000. HP also introduced the EGS/200 graphics system to run on its 200 series computers. The EGS/200 can be used for 2-D mechanical and electrical drafting. HP has an impressive group of third-party software packages available for its computer products. In addition, the company established the Engineering Productivity Division to address CAD software for both in-house use and outside sales. The new division is an integral part of HPs corporate strategy, the Manufacturer's Productivity Network (MPN), which emphasizes total organizational integration.

#### IBM

IBM's long-awaited entry into the color graphics terminal market didn't surprise anyone, but the price of the 5080 sure did. The introduction of the 4361 and 4381 computers will definitely have an impact on the VAX-based CAD environment. IBM's various agreements with Computervision, McAuto, and Scientific Calculations further exhibit IBM's strategic marketing plan to become the standard for CAD/CAM applications in the future.

#### Prime Computer

Prime introduced several new products during 1983, including the PW200 family of workstations, the PW150 graphics terminal, and the THEMIS interactive simulator program. In addition, Prime signed exclusive marketing agreements with Ford Motor Company to sell PDGS (Product Design Graphics Systems) and Lundy Electronics for its Ultragraf workstation. The significance of these agreements is that they give Prime an impressive capability in the nonelectronic manufacturing area. Prime also announced several new CIM products. It appears that Prime is basing its long-term product strategy on being a complete supplier of CAD/CAM/CIM integrated computer products. Several top sales and marketing management people left Prime during 1983 to form Encore Computer.

#### Sun Microsystems

Sun and Computervision entered a three-year agreement that includes an exchange of technologies, cooperation in future product development, and joint manufacturing of intelligent workstation products. Sun could realize \$40 million in revenue over the next three years based on this agreement alone. In 1983, Sun's revenue was fairly equally distributed between OEMs, end-users, and universities/laboratories. Sun also announced hardware and software enhancements to its family of networked workstations and is actively pursuing third-party software packages for its workstation products. Like Apollo, Sun's products are multipurpose. However, Sun's products use "off-the-shelf" technology in contrast to Apollo's proprietary approach. DATAQUEST believes Sun's standardized product approach significantly enhances its prospects in the CAD/CAM market.

## PERSONAL COMPUTER-BASED CAD

The principal advantage of PC-based CAD systems is that application packages are not device dependent. During 1983, the prices for PCs decreased considerably, the quality and capability of the PC increased, and more than a dozen software companies announced and delivered PC-based CAD application packages. Presently, the market for PC-based CAD systems is in the areas of facilities planning and schematic drawing, primarily because PC performance is not adequate for compute-intensive CAD applications.

DATAQUEST believes that within the next two years, new markets for PC-based CAD systems will open up due to the expected increase in performance and functionality of these systems.

#### GRAPHICS COMPANIES

There were two significant announcements in the graphics segment of the CAD/CAM industry in 1983. Foremost was the announcement by IBM of the 5080 raster-scan color graphics workstation. The 5080 will be a strong competitor of IBM plug-compatible vendors, especially in light of IBM's aggressive pricing and leasing on the 5080. The majority of the IBM plug-compatible graphics vendors immediately responded to the IBM announcement by reducing prices on their workstations to remain competitive. DATAQUEST believes that the IBM plug-compatible vendors such as Adage, CGX, Spectragraphics, and Vector General will still have an advantage over IBM in the next 18 to 24 months because it is unlikely that IBM will be able to ship units in sufficient quantity to meet demand. This 18- to 24-month window should enable IBM plug-compatible vendors to develop new products and marketing strategies.

Perhaps as equally significant as the IBM announcement was the introduction of VLSI graphic image processors. These new processors relieve the host computer of compute-intensive graphic image manipulations by carrying out the manipulations in specialized hardware. DATAQUEST believes that these application-specific processors will significantly change the future designs of graphics display devices in addition to providing a more palatable acceptance of solids-modeling software applications.

### Adage

Adage introduced the DC4250 color raster graphics workstation and a new raster graphics controller in 1983. The company signed an agreement with Intermetrics Inc., an international software and systems engineering company, to develop and manufacture software tools and application packages for Adage's products.

# <u>CGX</u>

CGX introduced its first two graphics display terminals, which are IBM software and hardware compatible. CGX's products are unique in that each workstation has a dedicated graphics controller.

#### Evans & Sutherland

E&S introduced new system interfaces and three new members of the PS300 family. Late in 1983, E&S reduced the price on the PS300 by almost 50 percent. The company also signed a multiyear OEM agreement with MCAUTO for PS330 sytems to be incorporated in MCAUTO's R100 workstation used for robot simulation and plant design. E&S also became the majority shareholder in Cadamation, Inc., a producer of custom CAD software.

#### Lexidata

The year 1983 was a transition period for Lexidata. The company has a new president, Andrew Knowles, and is developing new product marketing strategies to diversify from its heavy dependence on OEMs.

#### Megatek

Megatek introduced the Whizzard 3355, a high-performance 2-D graphics system. Deliveries are scheduled for the first quarter of 1984.

#### <u>Parallax</u>

A recent start-up, Parallax introduced a family of graphic display controller boards with solids capability for the DEC LSI-ll and the Multibus systems. The company's major customer is CADMUS. Parallax has under development a high-resolution, high-performance display controller.

### Ramtek

Ramtek introduced several new CAD products in 1983, including the RM9465 compact graphics and imaging display; the 6411 color raster display; and the 20/20 modular, software-based, configurable color graphics display generator. Ramtek also signed an OEM agreement with CDC for the 20/20 and received a \$1.8 million contract from Harris Corporation to supply displays and controllers.

#### Raster Technologies

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Raster signed a \$1.5 million OEM agreement with Auto-trol in 1983. The company expanded its Model One System and added two new versions, the 110 and the 180. The Model 110 is a low-cost, high-performance system, and the Model 180 is an ultrahigh-performance system offering 5 to 10 times the performance of the existing Model 140. All Model One Systems are directly supported by MOVIE BYU, ANSYS, and PATRAN-G.

#### Seiko

Seiko's high-resolution hard copy unit was predominant in the 1983 CAD/CAM market.

#### Silicon Graphics

The company introduced the IRIS workstation, which incorporates the "geometry engine," a proprietary graphics processor with processing capability greater than 10 MIPS. The geometry engine is packaged as a standalone Unix-based workstation that supports Ethernet.

#### Spectragraphics

Spectragraphics introduced the System 1500 multistation graphics workstation. In addition, Spectragraphics's System 1250 has been engineered to emulate the IBM 5080. Both of these products significantly enhance Spectragraphics's competitive position in the graphics market.

# **Tektronix**

Tektronix introduced the 4115B color raster-scan graphics terminal. TekniCAD, a general-purpose drafting system for the TEK 4100 was also introduced.

# Weitek

With the introduction of the "Tiling" engine, Weitek has positioned itself as a supplier to many of the existing CAD/CAM vendors. The innovation of application-specific integrated circuits (ASICs) has been made possible with the use of VLSI technologies. Weitek, an innovator in micro technology, will be delivering floating point chip sets, array processors, and other ASIC products.

> Wendy Ledamun Jim Newcomb Beth Tucker

Contaction Dataquest

CCIS Code: Newsletters, No. 46

RESEARCH

NEWSLETTER

### ELECTRONIC DESIGN AUTOMATION YEAR-END SUMMARY

#### INTRODUCTION

The electronic design automation (EDA) segment of the CAD/CAM market celebrated its second birthday in 1983, and what a party. Revenues in 1983 increased an incredible 312 percent over 1982 revenues, while unit shipments increased 345 percent.

The companies joining in the celebrations were not in existence three years ago. In the short time since they were conceived, formed, and operational, they have changed the way the electronic engineering community designs, or wants to design, electronic products. The EDA companies offer engineering departments the increased productivity that the IC CAD systems offered the layout designer working with drawing boards and rubylithe. Furthermore, with the increasing acceptance of application-specific integrated circuits (ASIC) and standard cell and hierarchical design methodologies, companies selling EDA systems have an ever-expanding target market.

#### 1983 RESULTS

DATAQUEST estimates that 1983 EDA revenues were approximately \$86.2 million. Table 1, our worldwide EDA forecast, indicates that 1988 market revenue will exceed \$1,150 million and that shipments will increase to 18,529 systems.

Table 2 shows DATAQUEST 1983 market share estimates. Daisy Systems, Inc., Mentor Graphics Corp., Valid Logic, Inc., and Silvar-Lisco have a combined market share of 92 percent. Each of these companies had a full year of product deliveries. On the other hand, Metheus Corp., Cadtec, Inc., and CAE Systems, Inc., with a combined market share of 8 percent, only began shipping a product in the second half of 1983.

Although Daisy Systems' 1983 revenues were \$28.4 million, and the highest of all seven companies, DATAQUEST believes that the market is still too young to name a long-term market leader.

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### EDA SCENARIO

The EDA segment is extremely competitive. It is not unusual for vendors to discount systems from 10 to 30 percent in order to gain a sale. Perhaps more significant than the discounting activities, however, is the technology competition.

For example, Mentor's acquisition of California Automated Design, Inc., provides Mentor with gate array placement and routing products for semicustom designs, and enlarges the size of Mentor's software engineering staff. Valid Logic made an unsuccessful bid to acquire HHB/Softron, developers of the Cadat simulator products. Shortly after Valid's announcement, however, Mentor announced a third-party software agreement with HHB. Daisy introduced an internally developed product called the Megalogician, its super-fast simulator engine.

DATAQUEST believes that several phenomenon will occur as the EDA industry matures. Not all new or existing companies will survive. Furthermore, we believe that the EDA market will experience a larger than normal level of mergers and acquisitions. EDA products are technology and application intensive. Therefore, in addition to strong management, marketing, and sales, the winners will need state-of-the-art products. Rather than allowing a company with a technologically good product to fold, we believe that the major EDA vendors, or even those companies just entering the market, will acquire technology.

Start-up companies monopolized the 1983 EDA market. However, DATAQUEST believes that established major CAD/CAM, graphics, and computer companies will soon enter the market. The EDA market, at this relatively early stage, will not support companies with me-too products. Winners in the EDA marketplace must be flexible, think quickly and accurately, and continously provide leading-edge solutions. Thus, companies will continue to compete on a technology basis.

#### MAJOR TRENDS

EDA systems provide more than mere schematic capture capabilities for electrical engineers designing on silicon. The systems provide a tool that allows an engineer to <u>create</u> electronic products, at the silicon and systems level. Major 1983 product announcements clearly support the vendors' efforts to provide comprehensive design tool solutions. Solutions range from front-end design automation, to process-dependent design libraries, to office automation, to printed circuit board CAD applications, to testing, to silicon compilers. For the present, the major EDA vendors are racing to address the broad spectrum of general industry requirements. As time goes on, however, major vendors will begin to differentiate themselves and their products by addressing the requirements of a specific market niche rather than the the entire industry. DATAQUEST expects non-U.S. markets to grow as a percentage of total revenues. Table 3 is our estimate of worldwide revenues by geographic region. Major EDA vendors are establishing sales offices throughout Europe and distributorships in Japan and other Far East countries. We expect the major vendors to make concerted efforts during the next several years to establish market share and dominance in the non-U.S. markets.

The evolving buyer behavior will also become more apparent. Companies using EDA systems are gradually changing from an evaluation buying mode with limited system usage, to more widespread system usage within a given department. We believe that major EDA system users will begin to accelerate system installations and thus allow more engineers to create more products using design automation tools. Nevertheless, we do not expect mass purchases (i.e., an EDA system for every engineer), to occur within the foreseeable future.

## CONCLUSIONS

DATAQUEST forecasts that 1984 revenues will increase 155 percent, reaching \$214 million, making the EDA segment the fastest growing segment of the entire CAD/CAM market. Although revenue percentage increases will decrease.from year to year, we expect the EDA segment to maintain an average compound annual growth rate of 68 percent through 1988. The EDA vendors exhibit aggressive personalities, with lofty, attainable goals. Look for their third birthday celebration to be even more spectacular than their second year celebration.

Beth W. Tucker

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# EDA WORLDWIDE FORECAST (Nillions of Dollars)

	<u>19</u>	81	<u>1982</u>	1	<u>1983</u>	<u>1</u>	.984	1	<u>985</u>	1	986		<u>1987</u>		<u>1988</u>	19 19 <u>C</u>	83- 88 <u>AG</u>
Revenue	\$	1	\$ 21	\$	86	\$	214	\$	374	\$	560	\$	815	\$1	,150	67	.98
Systems		3	268	1,	,194	3,	133	5,	314	8,	057	12	,410	18	8,529	80	.68

# Table 2

# EDA 1983 MARKET SHARE ESTIMATES (Millions of Dollars)

Company	Revenue	<u>Market Share</u>
Cadtec	\$ 1.0	1.2%
CAE Systems	1.0	1.2
Daisy	28.4	32.9
Mentor	26.0	30+2
Mętheus	4.8	5.6
Silvar-Lisco	9.0	10.4
Valid Logic	16.0	18.6
Total	\$86.2	99.38

Source: DATAQUEST

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# Table 3

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# GEOGRAPHIC REVENUE FORECAST (Millions of Dollars)

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
United States	1.0	17.0	68.2	164.2	268.9	383.4	533.5	751.1
Europe	-	3.9	14.4	33.2	61.2	100.4	146.8	208.0
Japan	-	-	3.6	16.6	40.0	70.6	118.7	168.5
Rest of World	<del>```</del>		<del></del>		3.7	5.6	<u>16.3</u>	23.0
Total	1.0	20.9	86.2	214.0	373.8	560.0	815.3	1,150.6

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Source: DATAQUEST

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CCIS Code: Vol. I Newsletters, No. 45

RESEARCH

NEWSLETTER

### CAD/CAM USER SURVEY

DATAQUEST recently conducted a survey of CAD/CAM system users to analyze the CAD/CAM marketplace based on the U.S. Government Standard Industrial Classification (SIC) system. The objective of the survey was to determine the distribution of CAD/CAM systems by SIC group, by application area, and by percentage of system function use. The importance of this distribution analysis is that it indicates the high use areas where DATAQUEST believes there will be continued higher growth rates for CAD/CAM systems in the future.

The survey was distributed to Applicon, CADAM, Calma, and Computervision system users. DATAQUEST gratefully acknowledges the cooperation of the chairpersons of these user groups in distributing guestionnaires.

#### MAJOR SURVEY FINDINGS

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Because responses to the survey questionnaire were not evenly distributed across the user groups, the data may be skewed. However, DATAQUEST believes the major survey findings presented in this newsletter are representative of the industry.

- The largest percentage of users of CAD/CAM systems are in the Electrical and Electronic Machinery, Equipment, and Supplies industry group (34 percent).
- Mechanical engineering represents the highest percentage of all system applications (65 percent).
- Most systems are used for drafting functions (60 percent).
- 4. The average CAD/CAM installation consists of four systems with 22 terminals, based on the reported 1,366 systems installed and 6,964 terminals in use.

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#### SURVEY SUMMARY

The following pages provide a description of the survey and the detailed results of our findings.

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#### SIC Industry Code

DATAQUEST identified eight SIC groups that we believe to be representative of the CAD/CAM user community. In cases where a respondent designated more than one SIC, DATAQUEST determined the firm's primary activity and assigned the appropriate SIC. In the final analysis we added two additional non-SIC classifications. The classifications are defined as follows:

### 28 Chemicals and Allied Products

This major group includes firms producing basic chemicals and firms manufacturing products by predominantly chemical processes.

# 34 Fabricated and Structural Metal Parts

This major group includes firms engaged in fabricating ferrous and nonferrous metal products such as metal cans, tinware, hand tools, cutlery, general hardware, nonelectric heating apparatus, fabricated structural metal products, metal forgings, metal stampings, ordnance (except vehicles and guided missiles), and a variety of metal and wire products not elsewhere classified.

# 35 Nonelectrical Machinery (farms, construction, metal working, and electronic computer equipment)

This major group includes firms engaged in manufacturing machinery and equipment other than electrical equipment and transportation equipment. Also included is electronic computers and peripheral equipment and/or major logical components intended for use in electronic computer systems.

# 36 <u>Electrical and Electronic Machinery, Equipment, and Supplies</u> (transmission, distribution, apparatus, communication)

This major group includes firms engaged in manufacturing machinery, apparatus, and supplies for the generation, storage, transmission, transformation, and utilization of electrical energy.

#### 37 Transportation

This major group includes firms engaged in manufacturing equipment for transportation of passengers and cargo by land, air, and water.

#### 371 Automotive

This Transportation subgroup includes firms engaged in manufacturing or assembling complete passenger automobiles, trucks, commercial cars and buses, and special-purpose motor vehicles.

#### 372 Aerospace

This Transportation subgroup includes firms engaged in manufacturing or assembling complete aircraft, and firms primarily engaged in research on and development of aircraft.

### 381 Cartographic

This Measuring, Analyzing, and Controlling Instrument subgroup includes firms engaged in manufacturing engineering, laboratory, and scientific instruments, including nautical, navigational, aeronautical, surveying, and drafting equipment and instruments for laboratory work and scientific research.

# A Colleges and Universities

This group includes institutions of higher learning that use CAD/CAM systems in teaching environments.

#### **B** Service Bureaus

This group includes firms providing CAD/CAM services to individual firms engaged in various types of businesses.

As stated earlier, the Electrical and Electronic Machinery, Equipment, and Supplies industry group is the major user of CAD/CAM systems (34 percent). The Nonelectrical Machinery industry group is the next major user with 22 percent. The remaining 44 percent is divided among the remaining eight industry groups identified by DATAQUEST.

The major industry distribution by SIC is shown in Figure 1.

# Figure 1



CAD/CAM SYSTEMS MAJOR INDUSTRY DISTRIBUTION BY STANDARD INDUSTRIAL CLASSIFICATION (SIC)

Source: DATAQUEST

# APPLICATION BY SIC

DATAQUEST defined six major application categories for CAD/CAM systems. These are:

- All Applications (ALL)
- Mechanical (ME)
- Integrated Circuit (IC)
- Printed Circuit (PC)
- Architecture, Engineering, and Construction (AEC)
- Mapping and Others (MAP)

The majority of CAD/CAM systems are used for more than one application. The most prevalent application combinations are Mechanical/ Printed Circuit (ME/PC) and Mechanical/Architecture, Engineering, and Construction (ME/AEC). Mechanical engineering represents 65 percent of industry-wide system applications, followed by printed circuit engineering with 28 percent.

The percentage distribution of applications of all SICs is shown in Figure 2. Application distribution by each SIC group is shown in Appendix A, Table 1.



Figure 2 CAD/CAM SYSTEM APPLICATIONS

(ALL SIC GROUPS)

(Percentages of applications by SIC add to more than 100 percent because in many cases more than one application was designated.)

Source: DATAQUEST

### SYSTEM USE BY SIC

DATAQUEST defined four major functions for CAD/CAM system use. These are:

- Drafting--Capturing design data on the CAD system
- Design/Modeling--Designing product and creating model with design parameters for analysis

- Analysis--Analyzing design data in model
- Manufacturing--Utilizing design data for manufacturing applications in CAM or CIM

Drafting functions clearly predominate CAD/CAM system use with 60 percent of the industry total. Design/modeling follows with 29 percent, and analysis and manufacturing, with 6 percent and 5 percent, respectively, round out industry use.

A cross-tabulation of function by application finds that mechanical applications are drafting intensive; IC applications are about evenly divided between drafting and design/modeling; PC applications use both drafting and design/modeling with a greater emphasis on drafting; and Architecture, Engineering, and Construction is highly drafting intensive. None of the application areas use the analysis or manufacturing functions to any great degree.

Figure 3 shows the percentage of system function use by all SIC groups. The percentage of function use by each SIC group is shown in Appendix A, Table 2. Appendix A, Table 3 presents percentages of function use by application.

Wendy A. Ledamun

Figure 3

CAD/CAM SYSTEM USE (ALL SIC GROUPS)



Source: DATAQUEST

## APPENDIX A

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# Table 1

# CAD/CAM APPLICATION USE BY STANDARD INDUSTRIAL CLASSIFICATION (SIC)\* (Percentage)

	Application								
SIC	ALL	ME	<u>1C</u>	PC	<u>AEC</u>	MAP			
Chemicals and Allied Products	0	33.0	0	8.0	66.6	0			
Fabricated and Structural Metal Parts	3.0	81.0	3.0	13.0	29.0	3.0			
Nonelectrical Machinery	0	88.0	29.0	58.0	16.0	5.0			
Electrical and Electronic Machinery, Equipment, and Supplies	7.0	43.0	36.0	44.0	14.0	3.0			
Transportation	11.0	89.0	0	33.0	22.0	11.0			
Automotive	4.0	87.0	0	9.0	13.0	0			
Aerospace	7.0	70.0	30.0	58.0	13.0	3.0			
Cartographic	0	25.0	25.0	25.0	25.0	75.0			
Colleges and Universities	2.0	83.0	17.0	17.0	50.0	0			
Service Bureaus	2.0	50.0	0	17.0	50.0	17.0			
Industry Average	3.6	64.9	14.0	28.2	29.9	11.7			

\*Percentages across SICs add to more than 100 percent because in many cases more than one application was designated per system.

Source: DATAQUEST

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# APPENDIX A

# Table 2

# CAD/CAM SYSTEM FUNCTION USE BY STANDARD INDUSTRIAL CLASSIFICATION (SIC) (Percentage)

	Function							
	Design							
	Drafting	Modeling	<u>Analysis</u>	Manufacturing				
Chemicals and Allied Products	64.17	32.08	2.92	0.83				
Fabricated and Structural Metal Parts	61.71	26.10	4.26	7.81				
Nonelectrical Machinery	62.16	28.41	3.88	5.55				
Electrical and Electronic Machinery, Equipment, and Supplies	54.31	33.69	5.44	5.43				
Transportation	68.89	18.67	6.78	5.67				
Automotive	55.00	24.48	10.43	10.09				
Aerospace	56.82	25.20	6.05	10.27				
Cartographic	65.00	27.50	5.00	2.50				
Colleges and Universities	67.50	21.67	9.17	1.67				
Service Bureaus	60.00	25.00	11.67	3.33				
Industry Average	61.55	26.28	6.56	5.31				

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Source: DATAQUEST

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# APPENDIX A

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# Table 3

# CAD/CAM SYSTEM FUNCTION USE BY APPLICATION (Percentage)

	Function								
		Design/							
Application	Drafting	Modeling	<u>Analysis</u>	Manufacturing					
ME	61.0	22.0	6.0	11.0					
IC	44.0	43.0	7.0	6.0					
PC	53.0	38.0	2.0	7.0					
AEC	81.0	15.0	4.0	-					
Industry Average	59.75	29.5	4.75	6.0					

Source: DATAQUEST

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CCIS Code: Newsletter No. 44

NEWSLETTER

RESEARCH

#### COMPUTERVISION ANNOUNCES STRATEGIC PRODUCT PLAN

Dataquest

#### INTRODUCTION

As we noted in a DATAQUEST newsletter of August 17, 1983. Computervision has announced a strategic product plan that includes the addition of both high- and low-end products that will run on hardware not previously included in Computervision's product line. Since the publication of that newsletter, Computervision has sought to provide a more accurate view of its new product plan and to clear up some misrepresentations of its plan. It has been achieving these clarifications through discussions with its upper management and through a financial analysts' meeting held in conjunction with the AUTOFACT V Trade Show during the week of November 14. We believe that Computervision's clarifications provide a precise definition of the company's strategic direction during the next four to five years, and indicate some significant changes for the company in the areas of both strategic and product planning.

#### BACKGROUND

As Figure 1 indicates, Computervision rose from the pack in the mid-1970s and early 1980s to become the premier turnkey CAD/CAM company in the industry. Spearheaded by an aggressive management team that lead the company from its inception, Computervision became the dominant force in the mechanical segment of the marketplace and had a strong market presence in all the other application areas as well. Computervision's broad installed base includes most Fortune 500 manufacturing companies, and the company can take a good deal of credit for the acceptance of commercial CAD/CAM systems as design tools that has occurred to date (especially in the area of mechanical design).

In the mid-seventies Computervision rigorously pursued a policy of hardware vertical integration and was the only company in the CAD/CAM industry to design and manufacture virtually all the major hardware components of its system. This strategy was extremely successful from a financial point of view, making the company far and away the most

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Source: DATAQUEST

profitable in the business and relatively free of long-term debt. As a result, the company was one of the great success stories of Wall Street in the 1970s and early 1980s, with stockholders' equity in the company increasing from less than \$40 million in 1978 to more than \$170 million in 1982.

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Until the 1983 announcement of the 32-bit CDS 4000, Computervision systems were cluster workstation-type systems based on 16-bit minicomputers of the company's own design. With the advent of 32-bit technology within the CAD/CAM industry in 1981, Computervision sought to develop its own 32-bit minicomputer upon which to base its basic graphics/design product, upgrading its basic CADDS4 software product offering to CADDS4X, which is designed to be a higher-performance product within the 32-bit environment. However, the arrival of the CDP 4000, which is being shipped in quantity during the fourth quarter of this year, comes almost two years after products of this technology that are being shipped by some competitors of Computervision.

In 1982 Martin Allen, who founded Computervision in 1969, moved from the office of president and CEO of the company to chairman of the board. With Mr. Allen's departure, the top management team has now come to include several key people new to both the company and the industry. Only Philip Read who is senior vice president in the office of the president remains from the original group that brought the company to predominance.

#### COMPUTERVISION'S STRATEGIC PRODUCT PLAN

Before discussing the substance of Computervision's strategic product plan, we need to mention that we consider it extremely important for three reasons.

First, it is critical to note that what the management of Computervision first presented on August 8 and subsequently amplified on November 17 was not a product announcement but rather a strategic product plan. Although specific new products including IBM and Sun Microsystems hardware will be announced in the first half of 1984, the company has at present announced only its mid-range strategic product plan to the world. We believe this to be an important distinction because revealing a corporate strategic plan to the press and financial community is not only unique but unprecedented certainly in the CAD/CAM industry. We believe that Computervision's management, especially new company president James Berrett, felt it necessary to reveal a coherent new product strategy because of concerns that were emerging in both the financial and end-user communities over the direction the company was taking. With the next generation of its core product very late to market and a new top management team in command, Computervision felt the need to explain its future direction to investors and users of its product, even before details on those products were available. In our opinion, Computervision has accomplished a great deal by taking this approach. Although some questions may still remain about Computervision's approach, it appears to us that the basis for the company's strategic thinking has been clearly laid out so that it can be evaluated by those on the outside who may have had some concerns.

The second reason that Computervision's announcement is important is that it marks a departure from the company's previous policy of strict adherence to hardware vertical integration. We believe that with computer and graphics technology advancing as rapidly as it is today, all turnkey companies must allow themselves some latitude by showing more flexibility in the area of potential product offerings. We believe that the current management at Computervision has set a valuable precedent for the company.

Finally, this strategic product plan is of major importance because it demonstrates that Computervision plans to expand its existing product line to include offerings in the area of manufacturing automation on the one hand, and low-end design tools on the other. We believe that there is a logical product migration route for the company to take, both from the point of view of the Computervision installed base and new markets that the company has not previously pursued.

# <u>Plan Details</u>

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Figure 2 outlines Computervision's strategic product plan.

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CDS 4000 and Designer 5X Core Products

The company is currently shipping the most recent generation of its traditional "core" product, the CDS 4000. This product consists of a 32-bit computer of Computervision's design; a 16-bit dedicated display processor with Instaview workstations, also of Computervision's design; and CADDS 4X, the newest generation of the company's CAD/CAM graphics software. The company will also continue to offer a 16-bit computer-based system, the Designer 5X, which stands alone and is not a part of the CDS 4000 product line. CADDS4X software is common to the CDS 4000 and Designer 5X products

Computervision also says that it does not plan to migrate its CADDS4X software to either IBM or Sun Microsystems Computers. This means that, for the foreseable future, Computervision's "core" CAD/CAM graphics product will continue to operate only on the proprietary computer hardware developed by Computervision.

#### "Product Data Management" Products

Perhaps the most noted aspect of the original August 8 announcement of Computervision's strategic product plan was the signing of a major contract with IBM. Not only was this the largest contract to date under IBM's new Value Added Remarketer (VAR) program, but it also marked a major departure from Computervision's hardware vertical integration policy. While the first products designed to run in the IBM environment (to be announced in the first half of 1984) will incorporate 43XX series IBM computers, Computervision has stated that its agreement with IBM includes related IBM computers and peripherals, opening the possibility of future products based on IBM 370XT, 5080, or other hardware products. Since the original August 8 manoungement. Computervision has been careful to note that the large-scale system product resulting from the integration of IBM technology and Computervision hardware and software technology will have all the application capability for graphics, modeling, and drafting of its core products. The large-scale system will, however, offer a greater magnitude of data base management capability for product engineering and manufacturing data bases. The future integrated system is designed to take advantage of MIBM's relational data base management capabilities and will include software to perform such tasks as drawing revision control, drawing management, and group technology. Computervision has indicated that products developed by its recently acquired Organization of Industrial Research (OIR) will play an important part in this product line.

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#### Data Communications Products

In addition to this new product area, Computervision has also announced a plan for data communications products based on standalone engineering workstations developed jointly by Computervision and Sun Microsystems. Again Computervision has emphasized that it will not migrate the CADDS4X software into this standalone workstation environment. Instead, products in this line will perform such tasks as schematics and logic design, space layout, drafting, and some nongraphics functions to "share product information." Products developed by Cambridge Interactive Systems (CIS) and Grado, two other recent Computervision acquisitions, will play an important role in this product line. Computervision has stated that it does not feel that microprocessor-based workstations will have the performance of the state of

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satisfactorily run software of the complexity of CADDS4X until 1985 or 1986. Computervision has stated that all of its "data communications" and "core" products will have communication links with its "product data management" products, although details of these links have not been announced.

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### Figure 2

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Source: DATAQUEST

#### Elgure 2

### ANALYSIS

DATAQUEST believes with the Computervision's atrategic product plan announcement was an innovative and bold approach aimed at solving some potentially threatening problems facing the company. With new people in key management positions and significant product development delays in the area of 32-bit technology, the company felt the need to present the financial and user communities with a coherent strategy that lays out the company's product development plans for the future - In addition; in the areas of product data management and data communications, the company has shown a migration path that is a logical extension of its traditional "core" products and should provide for growth both within the existing customer base and within new markets. No. 1

We believe, however, that there are still a number of major issues facing the company. Computervision believes that the architecture of its CDS 4000 system, with the 16- and 32-bit computers connected by a bus structure is in keeping with future trends in distributed processing and the maximum utilization of 32-bit technology for background functions such as analysis and simulation. However, the CDS 4000 32-bit system still requires integration with a 16-bit minicomputer that is dedicated to graphics functions, whereas Computervision's competitors can perform both graphics and nongraphics functions within a single 32-bit system.

the state of the transferred In addition, it is our perception that competition is now so strong, with technology progressing so rapidly within the computer industry itself, that Computervision, as a turnkey CAD/CAM vendor, will in the long run have difficulty remaining competitive with Its proprietary 32-bit hardware product offering. DATAQUEST believes that over time Computervision will have to evaluate the possibility of providing its CADDS4X customers with a migration path to nonproprietary 32-bit-computer technology.

Another related issue is third-party software. Computervision plans to offer 8 to 10 third-party software packages through 1984, while competing products running on Apollo, Data General, and Digital Equipment systems number in the hundreds. DATAQUEST believes that one of the major advantages of 32-bit computer architecture in the CAD environment is the ability to plocally perform analysis, exsimulationy wands where computation-intensive tasks. Consequently, another major challenge facing Computervision is providing its customers with the third-party . . . . . . . software packages they need. 1.2000

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We need to add, however, that Computervision's announced policy regarding third-party software is to provide "added value," especially with respect to software graphics interfaces. This policy should mean greater utilization of third-party packages by Computervision users, as opposed to other turnkey vendors that offer CPU compatibility with a large number of third-party software packages, but little in the way of adding value to those packages within their own system environments. Because Computervision's CPU and operating system are both proprietary, however, the company cannot hope to offer as many third-party packages as are offered by its competitors.

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We also believe that standalone microprocessor-based CAD/CAM graphics and modeling systems will be a requirement that Computervision will face in the near future. Early success by Auto-trol and future strong competition from Applicon, Calma, and Integraph will probably drive this market very rapidly, and all the major turnkey companies will need to be active in this market during the next two years. Computervision's strategic product plan has apparently set the company on a clearly defined course for the next five years although, as is always the case in the CAD/CAM industry, it is a course not without its problems and dangers.

Timothy O. Gauhan