ECAN

ENGINEERING COMPUTER APPLICATIONS NEWSLETTER

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PREMIER ISSUE

Contents

What is ECAN?

ECAN covers the most dynamic computer technology used in engineering: microcomputers and desktop computers (MDCs). These computers provide an affordable entry into computer ownership as well as cost effective upgrades for timesharing terminals.

However, MDCs are limited. You should only apply MDCs to those functions where they can make significant improvements.

ECAN contains the facts you need to use MDCs effectively. It helps you match your needs with MDC capabilities. It informs you on how to obtain and upgrade an MDC.

Experiences of other engineers, available programs, guidelines, checklists, and new developments affecting MDC selection will be abundant. An advisory service will be available to answer your specific questions. In addition, references will be made to other resources such as books, magazines, and seminars.

ECAN is written for engineers with and without computer experience. ECAN contains as little computer jargon as possible. When new terms are used, they are explained in a regularly featured glossary.

If you are already using MDCs, you may consider some ECAN articles too basic. If so, you can show them to others who are not so experienced. Tutorial features are included as supplements.

I see a great need for basic information on computers and the intelligent applications of computers. I'm looking forward to bringing ECAN to you and your associates. Feedback on your experiences and opinions will be greatly appreciated.

Micro/Desktop Computing in the 1980s

Over the last five years, micro and desktop computers (MDCs) have matured. They now have the power and memory of earlier, larger computers. Development of computer languages, processors, and programs for business and engineering have elevated micro/desktop computers from toys to useful and affordable tools for the engineer.

The 1980s will bring more power and programs for engineering uses. Unit costs will continue to go down and standard capabilities will continue to expand. Program packages developed by engineers as part of their work will continue to be for sale or sharing.

MDC manufacturers have realized that good program packages, maintenance, and manuals are essential to their survival. Those manufacturers who give good support, sell more computers, which in turn brings their

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Criteria for Computer Use

It is very important that only appropriate applications of MDCs be attempted. Some criteria for appropriate applications follow. The job should be:

- Very repetitious (typing the same spec with small changes; solution by successive approximations).
- Very lengthy.
- On the critical path.
- Easily understood and definable.
- Labor intensive.
- Optimized as much as possible before computerizing.

Computer programs to do the job should already exist as building blocks or complete packages. Even if such programs cannot be obtained, it is helpful to know they are possible. Also, the cost of programs can give some indication of their complexity. More on third-party programs in future issues of ECAN.

Some erroneous criteria for MDC applications follow:

- The other guys are doing it.
- The computer is so cheap, I can't lose!
- I'll be the first one in the area with a computer!
- I'll have so much work next year that I should get a computer this year.
- I need to motivate my people!
- I need to control my people!
- I need to get this place organized!

Some pleasant by-products which help justify a computer application are:

- Your ability to react swiftly to an opportunity often creates a better competative stance or a higher profit margin.
- Shorter job cycles improve cash flow.
- A computer application can standardize or simplify a complex job so more than one person can do the same job.
- Important secondary jobs (e.g., wire lists) get done that would otherwise not be done.
- More information is extracted from computerized data than anticipated.

Glossary

This is a regular ECAN feature which defines important terms used in this issue that might be unfamiliar to some readers.

BASIC. A high level computer language which is simple and easy to learn. There is a minimum set of industry-standard instructions which is usually enhanced by each computer manufacturer.

FORTRAN. A high level computer language used for engineering and scientific work. It is found on some MDCs and most larger computers. It is well standardized; FORTRAN programs can be converted from one computer to another with little or no changes.

CRT (Cathode Ray Tube). A display similar to a TV screen composed of a matrix of dots which are excited by an electron gun to form characters or graphical images.

Intelligent Terminals. A terminal is a CRT or printer with a keyboard. It is used to communicate with a computer. Intelligent terminals have limited capabilities in programming, text editing, and sometimes graphics. Plotters, printers, and other devices can be connected for additional capabilities.

MDC (Micro and Desktop Computer). A computer which is more powerful than a programmable calculator and an intelligent terminal but less powerful than a mini or a large computer. Most MDCs are limited to a single user or a single function.

Primary Memory. Built in memory for program and data storage requiring immediate access by the computer. Access speeds are in microseconds.

Secondary Memory. (Also mass storage). Accessory memory for program and data storage requiring periodic access by the computer. Access speeds are from milliseconds to minutes. Examples are cards, magnetic or paper tape, and discs.

File. A unit of secondary memory.

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Micro/Desktop Computers and Applications

Computers fall into the following general categories.

- Multi-user computers:
  Large computers (e.g., IBM 370)
  Minicomputers (e.g., Digital Equipment's PDP 11/70)

- General purpose, single-user computers:
  Microcomputers (e.g., Radio Shack's TRS-80)
  Desktop computers (e.g., HP 9835)

- Limited, single-user computers:
  Intelligent terminals (e.g., Tektronix 4025)
  Programmable calculators (e.g., HP 65)

The computers in the second category, micro/desktop computers (MDCs), are more affordable and less complex than the mini/large computers. And, they are powerful enough to perform many of the useful functions performed in an engineering firm or department.

The third category (limited, single-user computers) contains powerful tools, but not powerful enough to perform several general purpose functions. Some intelligent terminals perform many of the same functions as MDCs, but on a limited basis.

There are some gray areas between and within these categories, so there is often disagreement on exact definitions.

MDCs generally include a processor, keyboard, CRT display, magnetic tape or disc, and some kind of printer. Desktop computers have much of this built into the main chassis. Microcomputers usually come as components.

MDCs take up no more than one desk: desktop computers on top of the desk; micros on top or built into the desk.

Some of the functions that MDCs perform are:

- Design calculations (structural, hydraulic, mechanical)
- Accounting (job costs, ledgers)
- Estimating (job costs, future trends)
- Word processing (reports, specifications)
- Inventory control (parts, resources)
- Computer graphics (charts, graphs)
- Computer-aided drawing
- Computer-aided instruction
- Data reduction (survey calculations, experiment statistics)
- Management information storage and retrieval

Most applications require special programs; some require additional or specialized equipment. But, all these applications are possible on MDCs.

Insert SUPPLEMENT into newsletter.

What is a Computer?

A simple example of a computer is the programmable calculator. It has all the components and features to be considered a computer. By definition, a computer consists of input, output, a processor, memory, instructions, and commands.

Input. The keys of a programmable calculator provide input of data, instructions, and commands. Larger computers use typewriter-like keyboards, numeric pads, card readers, and other forms of input.

Output. The display on a programmable calculator serves to output of numerical answers as well as echoing inputs as they are entered. Larger computers output alphanumeric (alphabetic and numeric) results to multi-line displays, printers, card punches, etc.

Processor. The "brain" of a programmable calculator or any computer is the processor. It is often called the central processing unit (CPU). It manipulates input data and outputs results according to instructions and commands.

Memory. Data, instructions, and commands are stored in two kinds of memory: primary memory and secondary memory.

Primary memory is built into the computer and is immediately accessable (usually in microseconds). Programmable calculators store data and instructions in separate primary memories. Larger computers store data and instructions anywhere in the same primary memory. A computer's main primary memory is usually called random access memory (RAM). Often, a computer has additional primary memories called read only memories (ROMs). ROMs contain special programs for computations or machine operations. Unlike RAM, ROM is not cleared when power is turned off.

Secondary memory stores information for later use. Since main primary memory is normally cleared when the computer is turned off, secondary memory is used to store data and programs between uses. However, the speed in which secondary memory can be accessed is much slower than primary memory (in milliseconds to minutes).

Secondary memory (often called mass storage) includes:

- Cards (paper and magnetic)
- Tape (paper and magnetic)
- Disc (flexible and hard)

Magnetic cards are the typical secondary storage media for programmable calculators. Magnetic tape and discs are typically for larger computers.

Instructions. These are the operations performed by a computer. A calculator can ADD, PRINT, READ, STORE, etc. Larger computers do similar operations but use alphabetic characters as well as numbers. A set of instructions is called a program.

Commands. These are the computer controls. The switches and buttons on a calculator are good examples: the ON/OFF switches; the button(s) to START or STOP a program or READ or WRITE a magnetic card. Larger computers use words or acronyms to perform similar functions as well as SEARCH for a data file on magnetic tape, RUN a program, EDIT a text file, etc.

Future issues of ECAN will expand areas such as programming languages, inexpensive secondary memory devices, and useful output devices.

Glossary (continued from page 2)

Text Editing. Changing files of text, program instructions, or data using editing commands. Not as automatic or specialized as word processing.

Word Processing. Manipulation of the text in reports, letters, or specifications, by changing words, moving paragraphs, automatically paging and reformating, and inserting names or paragraphs. It differs from text editing in that it uses more automatic features and keyboard control along with a full-screen display.

Micro/Desktop Computing in the 1980s (continued from page 1)

prices down and gives them price advantages over those who do not provide good support.

What new developments can you expect in the 1980s? From conversations with several MDC marketing departments, plus what I know is possible, I see quantum jumps in the power and user orientation of MDCs.

Most MDCs use cassette tape or flexible discs for secondary memory. However, 8-inch hard discs are now available with 5-30 times more storage at costs similar to flexible discs. Magnetic bubble memory will soon be available as built-in or plug-in modules at less cost, with more capacity, and much faster access than present secondary memories.

In addition, primary memory capacity will grow so that only historical information need be stored in secondary memory.

These advances will all fit as well, if not better, into existing MDC chassis. By building as much into the chassis as possible and eliminating mechanical devices, reliability will greatly increase.

The speed of the processor will also increase. Most MDCs operate internally with 1 character (8 bits) at a time. Newer processors operate with 2 characters (16 bits) and future processors will operate with 3 or 4 characters (24 or 32 bits). This greatly reduces the number of memory cycles needed to execute one instruction. It also increases the amount of data that will be handled at one time.

By essentially eliminating constraints in primary and secondary memory and greatly increasing the speed of processing, more user-oriented features will be added.

For instance, functions to prompt and guide the user will become standard. Better input translation and error correction will be developed.

MDC programming languages (e.g., BASIC) will be greatly enhanced and reside in a primary memory at all times. (They are typically loaded from tape or disc.) Other programming languages (FORTRAN, APL, PASCAL) will soon be readily available.

Enhancements, such as voice or hand written data input, are now possible and will be implemented on MDCs. Color graphics displays and plotters will be more affordable and widely used.

MDCs, when properly applied, are useful and powerful engineering tools. I look for very exciting advances in MDC technology and support. This means that you can expect them to grow as your needs grow.

Future Issues

The next few issues of ECAN will cover:

- True Costs of Computer Ownership
- Purchasing guidelines
- Application reports
- Minis vs MDCs
- MDC manufacturer's predictions
- Interviews with experts
- Book and periodical reviews
- MDCs vs. Timesharing Services

Application reports are a very important part of ECAN. If you are using MDCs in your work, please call us. We would like to include a report on your application.

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Engineers!

Are you wondering if small computers can help you?

Inside this issue of ECAN, you read about micro and desktop computers (MDCs) and what they can do. ECAN is designed to tell you about MDCs:

- Capabilities and limitations.
- Useful applications.
- How engineers are using them.
- Manufacturers.
- Accessories.
- Costs.
- Purchasing guidelines and check lists.
- Program sources.
- Consulting resources.

ECAN is edited and published by Engineering Computer Applications, Inc., consulting engineers who are deeply involved with computer applications.

The editor, Kent Johnson, is a professional engineer, consultant, writer, and instructor. He will draw on his experience and research as well as that of his associates and international "experts".

Neither the publisher nor the editor have interests in any computers, accessories, or supplies. Also, ECAN will not contain any product advertising. Therefore, the contents will be unbiased and candid.

There is no other periodical like ECAN. Most computer periodicals are geared to the computer professional or the hobbyist. Engineering journals do not have the space or the staff to provide computer information on a continuing basis. In addition, there is no independent periodical on micro and desktop computers.

You don't have the time to become a computer "expert". But you do need to know how to make best use of MDC technology.

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ECAN™ ENGINEERING COMPUTER APPLICATIONS NEWSLETTER

Monthly newsletter for practicing engineers. Editor-in-Chief: Kenton H. Johnson, PE Reprint, July 1982

Small Computers Are For Every Company

Just as numerous small firms have found, organizations of all sizes (and departments within medium and large organizations) can use small computers for many, cost-effective purposes. In **ECAN**, "small computers" refers to those labeled as personal and professional micro or desktop computers, as well as to those at the lowest end of many minicomputer manufacturer lines (micro-minis, as I've labeled them; called microcomputers by their marketing departments.)

What have small computers done, and what will they do? Small computers have:

- Served as dedicated word processing equipment to improve productivity of many organizations.
- Brought computers out from behind locked doors and air conditioned rooms, into engineering work areas and onto desktops.
- Introduced small firms to the power of computers, previously feared due to complex procedures, esoteric terms, nit-picky computer commands, and slow response.
- Standardized software for professional and some personal microcomputers on the CP/M operating system and associated computer language suppliers, thus allowing computer choices to be based on software— the most important component— rather than on the computer manufacturer.
- Created a market and supported **user-friendly** software, putting the user first for a change. This also sped up the creation of general-purpose tools such as electronic "VisiCalc" spreadsheets and simple, yet in some cases, very powerful, data management programs.
- Made high-technology computer applications, such as color graphics, computer-aided drafting and electronic mail, reasonable for most small firms.
- The low rock-bottom prices of small computers have given every person, department, and small firm the opportunity to have a computer, **if properly justified, selected (based on software), installed, and managed.**

Most **dedicated word processing systems**, such as those from CPT, Lanier, and NBI, use the same computer components as many microcomputers. Recently, those who have been able to, have announced that they can do the same things as microcomputers, i.e., run "CP/M" software.

Standardized and user-friendly software, along with the low initial expense of small computers, has revolutionized the way in which traditional computer manufacturers, such as IBM, DEC, HP, Wang, and Xerox are packaging and marketing. They are agressively appealing to the personal and professional micro/desktop marketplace, through the same channels used by the exclusively microcomputer manufacturers— retail outlets. They are also capitalizing on the CP/M-compatible software base.

These traditional manufacturers make their own computer processors, but they are using or adapting the same microprocessors (from Intel, Motorola, and Zilog) that exclusively microcomputer manufacturers are using. A fairly good endorsement from the big guys, I'd say.

The now famous, user-friendly VisiCalc electronic worksheet **first** came out in force on personal computers. It then migrated to professional micro computers,

then was just recently introduced, in any great strength, by mini manufacturers and software suppliers.

User-friendly data management concepts started with data base management systems which have been on mini and large computers for at least five years. However, the simple list management systems which are easy to set up and use, come from the microcomputer world. Coupled with powerful back-end command languages, some of these systems are excellent user tools, as well as ideal development "languages" for microcomputer software suppliers.

Compared to the traditional languages on micro or larger computers— BASIC, COBOL, and FORTRAN— data processing/management development programs can be "programmed" much more quickly with data mangement tools, and easily modified by either the developer or the user. This is much better than waiting from six months to two years for a simple report or program from the data processing department, only to find that your specs were not understood or your needs have changed.

No matter how big or small, your company is a candidate for a small computer. In the near future, you'll find small computers, especially those in the personal and professional micro/desktop categories, will be appearing, or **you** will be buying them for one or all of the following:

- Your small firm/department's central computer for engineering calculations, word processing, accounting, and project mangement— with the increasing feasibility of multi-terminal micros.
- In dedicated word processing systems or a small computer dedicated to word processing.
- Electronic mail stations.
- "Smart" terminals to larger computers with partial or full computing capability, as well as for inexpensive graphics display and plotting.
- Network controllers tying terminals, micros, and larger computer and expensive peripheral devices together.
- Providing high-speed, high-capacity, immediate-response desktop computing for those who can justify it (which may not be as hard as you think, thanks to continuing low computer prices, improved price-performance, and less expensive high-capacity disks and memory).

Traditionally, the speed, memory capacity, and disk (mass storage) capacity of currently-used micros, limited microcomputers to "small" jobs, and use by one person at a time (single-terminal). "Small jobs" means steel column design, versus a 20-story, 3-D frame analysis, or a 500- instead of a 10,000-piece inventory. Many of the larger jobs could be done, but slowly and often in many parts.

However, current microcomputer systems have been modified to use additional memory, and disk capacity has increased 4-20 times while systems' prices remain the same. Also, newer microprocessors that easily handle 10-100 times more memory and compute 2-5 times faster, are now coming out. In one to two years, the software, sales, and support will mature to the point where these newer systems will be used alongside, and with the same ease, as "current technology."

These newer systems will support several terminals, if desired. They will overlap, and perhaps out-distance the low-end micro-minicomputers, as they are now sold by traditional minicomputer manufacturers. (I'm sure these companies will come up with some surprises to remain competitive. It could be an interesting fight— hopefully, beneficial to the end user.)

The multi-terminal idea is not the only way to gain the benefits of centralization found on mini and large computers. As listed above, networking small computers together can centralize expensive peripheral devices such as high-capacity, high-speed disks, graphics digitizers and plotters, high-speed printers, high-speed data communications equipment, and new technology devices yet to mature (e.g., videodiscs and very high-speed numerical and data base processors).

Other articles in the July 1982 issue include:

- "Ellerbe Associates Uses Micros, Minis, and larger Computers"
- "HP Offerings May Blitz the Market"

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ECAN™ ENGINEERS COMPUTER APPLICATIONS NEWSLETTER

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CADD REALITIES

There are two stark realities of computer-aided design and drafting (CADD) for organizations involved in construction design, drawing production, and drawing updates (as-builts):

- Those organizations without CADD capabilities will eventually **not** be able to compete with those with CADD.
- CADD is very complex and expensive, no matter how inexpensive the first cost.

Because of these realities, engineering organizations— firms and departments— must aggressively, but cautiously implement production CADD systems. To best accomplish this, we should look at where we are headed and how to best get there.

The Ultimate Goal

CADD is part of the ultimate goal of engineering organizations— to directly involve the higher-paid professional and manager in the design and construction process.

This is best accomplished by wellintegrated design, drafting, and management, from concept through construction:

- "Design" includes simple calculations, with only numerical output, through complex analysis programs that work with or through interactive graphics.
- Computer-aided "drafting" started with simple graphical output from "design" programs which lead to complete 2-D and 3-D drafting software.
- "Management" encompasses all office systems, which include word processing and simple list management through electronic mail and sophisticated database management.
- "Integrated" means combining the more complex and mature forms of design, drafting, and management, through common databases, via networked or centralized computer systems. They may remain as separate programs, or be combined into interrelated packages.

Three-dimensional models were born out of "design," but drafting software matured and can now display a 3-D model without hidden lines and with color shading. Though 3-D color shaded models are usually not fully integrated with design software, true 3-D drafting systems can build 3-D models from which numerical data can be sent to design programs and color shaded models can be displayed in a few minutes. Some systems can cut sections through the model to create plans and elevations. Some can pull material quantities for complete, non-redundant cost estimates and bills of materials by project.

Note: The "database management" portion of management includes: time/cost accounting, project scheduling (people, materials, time, equipment, etc), cost estimating, and drawing maintenance.

Those who reach this goal first will become much more productive than those that do not. As you approach true and complete integration, production will accelerate leaving the lagging organizations further and further behind, much as industrialized countries have done over non-industrialized countries.

Those who lag behind will find it tough keeping up with competing private firms and aggressive public organizations.

In order to reach the goal, you must move quickly and aggressively forward in each of the functional areas listed above:

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design, drafting, and management. As areas mature and are functioning well, they can be integrated together. Most likely, design and drafting will be combined first, with management included later.

Once the functional areas are integrated, design and construction professionals and managers will be able to easily justify their own, dedicated desktop workstations for performing or monitoring all phases of the work.

Standardization of hardware and software interfaces will help speed the integration process, but major CADD vendors are not waiting for standardization between vendors. Proprietary systems are approaching maturity for integrated design and drafting this year. Integrated management will follow soon.

Professionals and managers have an upper limit to the number of projects they can handle manually. However, a truly integrated system will provide not only design capability tied directly into interactive graphics/drafting, but a completely integrated system provides a true project management information system that reminds, records, searches, displays, and communicates.

All this may sound blue sky and very expensive to many of you. Expensive it will be, but "blue sky" it is not. The individual components are reaching maturity, and the combinations are starting to appear.

Can You Afford It?

But if it is expensive, you may be wondering how you can afford it. As stated above, you probably have no choice. The manufacturing industry invests around ten times more per employee than your industry, and they seem to be able to afford it.

But since 50% of design and drafting organizations have less than ten people, 75% have less than 20, and 90% have less than 50, only a few organizations can readily justify expensive CADD and management systems.

What do the majority of you do? Become swallowed up by the larger organizations, or bet your carrier or private firm on low-cost systems?

"Low-Cost" Systems?

Many organizations are betting on "low-cost," usually microcomputer-based computers, software, and systems to reach their goals. Unfortunately, two major problems exist:

- Microcomputer-based CADD and management software/system vendors are not normally concerned with your long-range goals, only their short-range sales.
- The expense of implementing "low-cost" solutions is much greater than usually imagined.

I'm not a minicomputer bigot who's out to blast microcomputers. Quite the opposite, I've been preaching the microcomputer philosophy since the late 70's, but for the proper applications.

Microcomputers and well designed, programmed, and documented software, are very useful in any organization.

But for the more sophisticated levels of design, drafting, and management, you need capabilities that approach those of a minicomputer:

- Speed— computational and input/output.
- Large disk storage.
- High-speed, large-size, high-resolution output devices— printers, plotters, displays.
- Inter-workstation communications.
- Data integrity, security, and backup.
- High-level, user languages.

When you add all this "minicomputer" capability and overhead to a micro-based system, there is not much difference in the costs. "Low-cost" systems really only mean initial low-price systems. When trying to do minicomputer-type jobs, the true costs are usually not low.

The Big Problem

Computer professionals, managers, and even reputable minicomputer-level vendors

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are losing the "price-tag" battle. There are many vendors of software and systems who claim to do most of sophisticated CADD, or management functions, at a very low cost. They are capturing the imagination of buyers in all sizes of organizations. But the real cost is very high for implementing and supporting systems performing these sophisticated applications.

The actual cost of "low-cost" CADD and management systems is a well-kept secret, because the implementation and operating costs of low-priced systems are usually buried in someone's paycheck, rather than identified as a capital item, computer-professional's salary, or direct out-of-pocket expense.

The approval system for large capital expenses is much more rigorous than for use of our employee's time. We and our people can work nights, weekends, and much of our days to implement, operate, support, and deal with the limitations of less-expensive systems. This is much more difficult to monitor and regulate than capital and direct expense items.

For instance, the first year total costs of starting up and operating a production CADD system are about two to four times the purchase price of the system, over and above the purchase price. At the low-end ($25,000 or so for one workstation), the cost is usually quadruple the price. At the high-end ($200,000 or so for the first workstation), the costs are usually double the price.

These prices include: the computer, graphics display and controllers, keyboard, digitizer (pad or board), stylus/mouse/lightpen, production (D or E size) plotter, quick printer/plotter, and software. The micro CADD system usually needs an additional microcomputer to drive the plotter, since most micro software currently does not plot and do CADD at the same time.

Start-up costs for a micro or mini-based production CADD system include:

- Educating selection committee, management, users, and potential operators.
- Investigation of needs and vendors.
- Selection and purchase.
- Selecting operators and staff.
- Training operators, staff, and users.
- Conversion of standard symbols and details, as well as some existing drawings.
- Installation.
- Implementation of new procedures and standards.
- Re-organization of workflow and people to make best use of CADD and management systems.
- Billing method changes.
- Scheduling workstations and projects—heavy decision making for what goes on the CADD system.
- Development of specific software and macros.

The annual, continuing costs of a production CADD system include:

- Continuing development of specific software and macros.
- Continuous training operators, staff, and users.
- Upgrades to hardware and software.
- Supervision of operators and staff.
- Maintaining hardware, procedures, standards, symbol/detail libraries, and archives.
- Special billing procedures.
- Space, utilities, maintenance, insurance, supplies, and misc.

Options for the Small Organization

The majority of you, who are in design/drafting organizations of under fifty people, are probably wondering what real hope there is for a CADD system. Do you have to wait for micro systems to grow up, or for mini systems to be implemented on inexpensive hardware? What do you do about the true costs?

There are no simple or truly inexpensive answers. Once you know what the real costs will be, you can develop and finance realistic budgets. And knowing the real performance of micro- or mini-based systems, you can evaluate the payback.

What is usually the biggest obstacle is how to handle the large startup costs listed above.

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Good preparation is a way to handle the large startup costs. By preparing well in advance for each step in CADD startup and continuing support, confusion and inefficiencies are reduced. For instance, education at the beginning of the startup process goes a long way towards smoothing the entire CADD process. Advance operator selection and symbol/detail/drawing conversion in advance of system delivery saves many weeks of low productivity on a relatively expensive hardware/software system.

Spreading the costs is another way of dealing with the large startup costs. By financing the initial costs over two or three years, they can be absorbed by the organization then offset by higher productivity. Another way is to phase into CADD:

- Timeshare a mini-based CADD system for six months or more. The service's workstations could be used for training, as well as initial development and conversion. In-house workstations could then be installed for production work.
- Micro-based CADD may work well as a stand-alone system for: (1) training, (2) familiarization, and (3) experimentation, (4) sketches, (5) presentation drawings, (6) detail sheets, (7) non-dimensional drawings such as schematics, and (8) very routine, repetitive, straight-forward drafting.
- Some micro CADD systems can be enhanced to directly communicate with larger systems for: (1) symbol/detail input, (2) viewing drawings, (3) red-lining drawings, (4) drawing, data, and text input, (5) minor editing, and (6) remote plotting.
- When timesharing and micro systems have reached their limits, and much of the startup and training efforts are completed, you can then move into a more sophisticated CADD system. Hover, unless the timeshared or micro system is compatible with the new system, much conversion work could be necessary.

Timesharing is a way that many of you have brought in very sophisticated computer power at manageable costs. CADD timesharing is available in many areas of the country, as more services start up each month. The distant processing and support, workstation operating speed, and concentrated monthly charges are not always appreciated.

But when you consider all the resources that a good timesharing service has to offer, the costs are reasonable and the support can be found and used. Six months is a good minimum period to timeshare. Occasional needs can be well satisfied for a number of months with timesharing, especially if the compatibility and application requirements keep changing.

Use of a **micro-based, stand-alone system** for any production at all runs the risk of accruing too much of the cost and overhead of a larger system, unless use of the system is very carefully controlled. Education and a clear statement of the goals of the micro system helps, but political and personal pressures sometimes change the goals.

If your goal is to eventually move up to, or be compatible with a larger system, then you should only allow use of the micro system to generate those symbols, details, drawings, and associated data, that can be transferred to the larger system. Otherwise, there could be wasted effort and a tendency to keep using the micro system instead of the complex larger system.

Summary

Due to the true costs of CADD and other sophisticated computer applications, make sure that any system— small or large— is designed to be compatible with, and be truly upgraded to systems that will take you where you what to go.

ECAN provides information, analysis, and guidance on the application of small computers and CADD systems for professional engineers in construction design and management. Since 1979, the editor has been the foremost writer, CADD consultant, and speaker on these subjects in the construction industry. This article is reprinted with permission from the editor and ECA Inc. For more information, write to the address below.

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ECAN™ ENGINEERS COMPUTER APPLICATIONS NEWSLETTER

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Contents

ECAN provides information, analysis, and guidance on the application of small computers for professional engineers in construction design and management.

Software Exchange

This column is ECAN's central software information exchange. It is a two-way channel for software announcements, requests, and reader feedback.

Security Program from Technical Group

The Technical Group, of which CIVILSOFT is a division, is now offering PASSWORD. It provides password security for IBM PC computers (and perfect compatibles) with hard disk or only diskettes. Features include:

- One or two passwords of up to 16 characters, visible or invisible.
- Automatic inclusion in your start-up procedure.
- Locks up at start-up if proper password is not given, accompanied by an audible and written warning.
- Number of retries may be from one to nine.
- Organization name displayed during start-up.
- Easy installation and use.

A single license is $40. Site licenses are available for ten or more computers. Contact Patrick Putnam, President, The Technical Group Inc, 1592 N Batavia, Ste 1A, Orange CA 92667; 714-974-1869.

Best Friend: An Engineers' Sidekick

Elite Software Development (ESD) recently introduced Best Friend, a program similar in concept to Sidekick, but with many more features, especially for an engineer. It resembles Borland International's Sidekick: screens that pop-up over any program, a calculator, and other desktop aids.

At $85, ESD's Best Friend goes many steps further. It incorporates several features that ESD has developed and also sells as separate programs:

- File Services: list disk files with time, date, and disk space, as well as copy, rename, delete, move, "tag," view, print, sort, find, and execute, to name a few. $40 separately.
- Disk Services: operating system (DOS) disk commands plus edit a volume ID, without exiting your program.
- Electronic Typewriter: simple word processor for short documents, or to type directly on your printer, $40.
- Printer Output Redirection: a unique utility to capture output from any program and store in a file for printing later or inclusion in a document. Sold separately as P-FILE for $50.
- I/O Options: Change printer port, set serial port parameters, and set up a second printer for background printing.
- Calculator: full-function engineering calculator goes well beyond most pop-up desk-aid programs. $40 separately.

For several years, ESD has been selling microcomputer commercial and residential HVAC and energy programs. They are now

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offering short-form versions. For more information on ESD software, contact Bill Smith, President, Elite Software Development Inc, PO Drawer 1194, Bryan TX 77806; 409-846-2340.

BST Management Software Now on Full Range of Computers

BST Consultants has had a minicomputer-based Project Control/Financial Accounting System for several years, designed for use by consulting engineering, architectural, and other project-oriented organizations. They have recently released full-function versions for micros and small minis. The full range is:

- DEC VAX minis, now including the MicroVAX II.
- Prime minicomputers.
- IBM System 36 minicomputer.
- IBM PC AT microcomputer.

One of the leading A/E packages, it features accounting and fiscal management in an integrated package featuring: on-line inquiry, on-demand reporting, real-time updating, user-defined output formats, multi-task projects, as well as performance and profitability measurement at all management levels.

For more information, contact Don Silkebakken, BST Consultants Inc, 6110 Gunn Hwy, Tampa FL 33625; 813-961-3902.

EDSA Adds Program and Network License

Generator Set Sizing has been completed and added to the Electrical Distribution System Analysis (EDSA) programs. It is $395. All programs individually total $13,790, but thru May 1986, they can be purchased as a package for $6,570.

A multi-office license is $23,000, and a local area network license is $11,000. Contact EDSA at B-206, 5600 W Maple Rd, West Bloomfield MI 48033; 313-851-4474.

Beazley on Expert Systems

At a recent World Computer Graphics Conference in Washington DC, I met with Dr. William Beazley, a consultant who specializes in design automation and expert systems. He feels that expert systems offer an order of magnitude productivity increase.

He defines expert systems as "industrial applications of artificial intelligence (AI) technology for imitating decisions usually done by experts." (See the October issue for more on AI and expert systems.)

According to Beazley, "Any turnkey CADD system vendor not investigating its use will soon be obsolete." Large CADD vendors are developing expert systems to work with their existing product lines, and some micro vendors are preparing to use the technology.

Dr. Beazley went on to report on expert systems progress in the US. Major corporations are actively developing expert systems, such as: IBM, DEC, General Motors, McDonnell Douglas, and several others. Government support is coming from: NASA, the military, National Bureau of Standards, and universities.

Applications include: chemical plant monitoring, process planning, computer configuration, problem diagnosis, mining exploration, [construction engineering, safety, and management, concrete durability, welding procedures], and many other areas.

"Engineers themselves can and must develop expert systems," Beazley added. "They are the ones who understand the problems and solutions. Computer scientists can only develop the basic tools."

Dr. Beazley was formerly the CADD manager at a Brown and Root office, has taught design at the University of Illinois, and co-chairs the IGES working group on plant design. An active consultant to engineering firms, he will begin a new service in 1986 to create knowledge databases. Called knowledge engineering, "the service will enable clients to choose better applications for their systems and implement them faster.

Contact him at WGB & Assoc, 13939 NW Fwy, Ste 270, Houston TX 77040; 713-937-8227.

Why Use Computer Professionals?

Over the years, I've noticed a double standard in the engineering profession towards computer professionals. If someone were to suggest that an engineer's training, experience, and judgement were not necessary for designing a road, bridge, building, or plant, that person would be chastised severely.

But I've seen engineers appoint an engineer or technician to a computer professional's position with nary a second thought. Though many of these people have grown to be excellent computer people, the road has been rough, and the unrealized costs have been high.

Computer Professionals

Before delving deeply into the benefits of computer professionals, let's look at the typical divisions of labor. There are four main types of computer professionals:

- Operator: either for general or specialized equipment.
- Programmer: writes systems or applications software.
- Analyst: designs software.
- Manager: manages any or all the above.

Although other people in engineering companies can learn to perform some of a computer pros' activities, they are not usually interested in a **career** in computers, and in the long run, are not nearly as effective as a computer pro could be.

Operators can be trained from the clerical and technical ranks, but at a cost of months of learning time, training classes, and unnecessary mistakes. General or specifically-trained operators are available from tech schools, community colleges, and organizations similar to your own.

A professional operator has decided that operating a computer is his career and will pay attention to the many, many details of making sure your computer investment is protected, including: backups, current documentation, preventative maintenance, and perhaps software upgrades.

Engineers, technicians, and other office workers may operate the equipment's terminals and other peripherals for specific applications, but a professional operator makes sure that all computer equipment will function tomorrow and thereafter.

Programmers write the programs to make computer equipment do **your** job. This may be:

- Customizing a FORTRAN program.
- Adding a pre- or post-processor to better handle your data.
- Using the "programming" features of CADD, worksheet, and database software to speed up your production.
- Updating, testing, and releasing proprietary software according to the owner's instructions.

There is a tremendous amount of theory and practice in programming, such as: structured techniques, good documentation and user manuals, and software maintenance. Although some engineers can write a **special-purpose** program better and faster than a professional programmer, most long-term projects are poorly executed by non-computer pros, and are often abandoned later.

How many times have we or an associate offered "free" software that was written at home and given to the company? The "hard part" was done, now someone else could write a user manual, program documentation, and make changes for specific needs. Now if those "someone elses" could figure out what the programmer did.

And if the author continues to use the program, he is never satisfied with its operation or function. He makes little change after change, on company time of course, eating up unknown time and money to maintain the "free" software.

Analysts are generally advanced programmers. Or they may be people with fundamental programming training and some experience, as well as some experience in your type of engineering organization. In either case, an analyst provides a

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link or buffer between the user and the programmer, interpreting and translating the users' needs into realistic program designs.

An analyst may assume some of the programmer's documentation duties, or in many engineering organizations, he may do some programming, i.e., be a **programmer/analyst.**

Managers function best if they have done what the people do that they manage. But, sometimes an engineer or technician proves himself to be an aggressive computer user who may have taken on some programmer or analyst functions. Often, an organization pulls this person out of his environment and "promotes" him to a computer manager, instead of hiring or promoting a computer professional.

To be successful, however, he must rely heavily on the judgement of his people. To assume that the new manager can learn in weeks what took years for other mortals to learn is ludicrous at best. If he does choose to learn rather than trust his people's judgement, it is at a substantial cost to the organization. Not only are time and money expended, but there are many lost opportunities and frustrated users.

Training is performed by all types of computer professionals, for their peers and the users. The higher the level of computer pro, the higher the level of trainee. Users need to know how to push the buttons, and top management needs to know how to take best advantage of their investment.

What Do Computer Professionals Do Best?

In addition to the tasks listed under the computer pro types above, several areas stand out as those accomplished best by a computer pro who knows your business:

- Studies: feasibility, justification, selection, training, personnel, organization, implementation, and upgrades. They require the foresight of a computer pro who has been there a few times, and who knows the pitfalls and better routes to follow.
- Action: putting studies into action with the right PR, people, programming, documentation, and management.
- Operations: running computer systems for productive use now **and in the future** with the best possible chance of upgrading hardware and software as technology advances.
- Problem solution: bringing to bear a knowledge of computers, programming, analytical techniques, testing, and when to get help from specialists. The pro will help you solve problems that you are facing now or that the professional can see will be a problem in the future.

Where Do You Find Computer Pros?

I'm sure you've all run into good computer pros converted from engineers and technicians. And other other hand, you've been turned off by computer scientist who seem oblivious to your work and needs. Are there computer pros who know a good deal about your engineering and type of organization? Yes, but there are not enough to go around.

There will always be a strong demand for computer pros who know your business, and they won't come cheap. Acquiring them from other organizations is morally no different than attracting experienced engineers from elsewhere.

"Growing" your own is another way. Either training engineers to be computer pros, or indoctrinate computer pros to your way of making a living.

A third way is to find a good engineering-oriented computer pro to manage a team of operators, programmers, and analysts of various engineering orientations. It takes more centralization, but is manageable if you give his organization some lead time.

Consulting computer professionals come in many forms. Many computer consultants **are not** computer professionals, but are users or salesmen who see a good opportunity. And among the true computer professionals, there are the same levels as listed above, each well-prepared to perform a range of duties, but not all.

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To expect that a programmer knows all computer languages as well how to manage a computer facility is difficult to comprehend. And it is equally difficult to comprehend that a computer pro who has been in the same company for several years is automatically a good, objective, and widely-informed consultant.

However, both expectations are thrust upon or assumed by unsuspecting neophytes in the consulting business, whether in or outside your organization.

A good consultant knows the vendors of hardware and software for your type of organization, and is well-experienced to a certain level. His qualifications should be clearly stated in his proposals and verified in your discussions with his references. To accept anything less is to take bold chances with your organization's success and profits.

A Scenario

So you hire a consultant to write software, set up a training program, or choose a CADD system. What happens after he leaves? Who carries the ball (or torch)? Hopefully a computer pro or well-converted engineer/technician will be hired or entrusted with the follow-on. Or you can keep having the consultant back, just as you hope you consulting engineers are asked back for more work or support of previous work.

But because of the work, risks, uncertainties, and uncomfortable feelings associated with trusting a computer consultant, many organizations opt for a less-qualified, but loyal and hard-working engineer, technician, or volunteer to do the job. Hopefully, he will stay around and have the pride to make sure his work and decisions are successful.

However, the job often becomes overwhelming. The unsuspecting zealot throws up his hands and begins to trust the last group of people anyone should trust for advice and help— computer salesmen. They are free, willing, and often unaware of the complexities of implementing the wonderful systems they are selling this year.

Given the opportunity, a professional salesman will find people in his organization to answer technical questions about his software, hardware, and operation/implementation of both. But they'll only do enough to sell the package, then charge you for the real nitty-gritty of making it work.

Sometimes the computer stuckee simply assumes that well-advertised software, hardware, or systems are sufficiently flexible to satisfy most needs for the near term. So why look any further? After all, aren't computers partially magic?

Why Use Computer Professionals?

I'm sure you have a good idea of what the answer is from the discussion above. But to summarize, computer professionals do what all professionals are supposed to do— use their expertise to make things better at a cost less than doing it without the professional.

Computer pros are not as well organized as accountants, lawyers, and engineers. We have professional associations, such as:

- The poorly-named Association for Computing Machinery
- National Computer Graphics Association
- Data Processing Management Association
- International Computer Consultants Association.

We also have the Institute for Certification of Computer Professionals (ICCP, 312-299-4227), that conducts tests and awards the following:

- Certificate in Data Processing (CDP)
- Certificate in Computer Programming (CCP)
- Certified Systems Professional (CSP)

But we do not have laws that require computer professionals for certain kinds of work, nor do we have a strict code of ethics that is published and followed by all computer pros. We are a young profession with a great deal of organizational issues to deal with. Eventually we will police our own ranks and establish strong guidelines for the profession.

CAD/CAM, CAE Highlights for 1985

The October and December updates to the CAD/CAM, CAE Survey, Review, and Buyers' Guide had some interesting insights. (The following is summarized with permission.)

McDonnell Douglas Information Systems reported outstanding results. Mechanical and AEC revenues for graphics and engineering software and systems was up about 60% over last year. This is more impressive considering the computer sales slump experienced by most vendors. They attribute much of their success to the strategy of marketing on three of the most popular computers: IBM 4361s, DEC VAXs, and Data General MVs.

Personal Computer CAD/CAM, CAE sales continue to stay brisk. Vendors of these systems are continuing to depreciate the value of major vendors' large installed base by attracting novice users to much less expensive workstations. The biggest effect has been on the vendors of middle-sized systems. Bausch & Lomb and Bruning have both ceased marketing their CAD systems.

Responding to the opportunity in slow computer market, stronger CAD/CAM and CAE vendors are snapping up companies with sound products and superior R&D capabilities that have fallen on these hard times. A recent purchase was Terak by Sanders Associates, which purchased CalComp a few years ago.

IBM is now firmly established as the industry's leader overall, and continues to increase its market share. Given the turbulence in the market and vendors, customers are increasingly concerned about the stability of their vendors. Large organizations are insisting that new systems be compatible with their existing computer systems, which often includes IBM mini and large computers.

[Small organizations are eventually effected by these trends and may do well to evaluate the IBM influence now. In the AEC industry, IBM computer sales find stiff competition from DEC, Prime, and Data General, as well as small computer vendors. But IBM has strong hopes for taking this market, and may, when they really decide to attack it right. Perhaps they are simply letting the IBM PC standard do it for them. Or some other possibilities are in store for the smaller organization...]

In addition to a standalone workstation based on the Model 5080 terminal, **IBM is believed to be readying a number of other single-user systems** based on powerful general-purpose engineering workstations. These may be similar Apollo and Sun super-microcomputers.

The new workstations are rumored to be 32-bit, reduced instruction set computers (RISC) running at one to four times a VAX 11/780. Industry sources believe these new workstations will use the UNIX operating system and carry a price tag of $15,000 to $40,000 for entry-level units.

Software may come from many sources:

- CADAM Inc (the rumored Personal CADAM)
- FASTDRAFT (perhaps in a workstation powered by a PC AT)
- Other third-party vendors.

[For more on IBM strategies, Daratech's president will be leading the "IBM CAD/CAM, CAE Strategies" executive seminar in San Diego, March 6-7. Contact Daratech for more details. See you there.]

Intergraph continues to do well overall and in AEC markets. They are second only to IBM overall and lead the pack for AEC. The Interpro-32, a UNIX- and MS-DOS color workstation for Intergraph systems, was first shipped in June, and should add to Intergraph's success in the coming months. [Conversion to MicroVAX II helped a great deal in AEC markets.]

ComputerVision continues to slide. CV laid off a substantial number of people and instituted expense reductions to fight its mounting losses. The ex-leader's problems resulted from delays in moving to standard, open computer systems. [The PC-based Personal Designer is too little, too late. You should think twice before investing in a losing company, even if the Navy wants you to.]

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AutoCAD shipped its 34,000th program this October, leading the number of installations by a wide margin over its nearest competitors. Success is primarily due to its distribution network of 1,400 distributors and dealers, including IBM United Kingdom and IBM Italy.

For more information on Daratech's excellent publications and the San Diego seminars, contact Charles Foundyller, President, Daratech, 16 Myrtle Ave, Cambridge MA 02138; 617-354-2339.

An Englishman's View of US

Last year, Rob Howard, visited the US as the General Manager of The Construction Industry Computing Association (CICA) in London. His report on four US firms that he visited, appeared in the CICA Bulletin and is reprinted with permission.

"Rather than visiting research laboratories where the latest developments are being made, it was decided to visit typical engineering companies based in Florida to see their approach to using computers in relation to other office technology.

The four companies visited are members of CEPA [Society for Computer Applications in Engineering, Planning, and Architecture, Rockville MD], and our contacts were engineers responsible for CAD or other computer operations.

"**Boyle Engineering** in Orlando was of a common US size, about 140 staff, and had two Intergraph CAD workstations. These were being written-off over three to five years, typically a shorter period than in the UK. Many maps were digitised off true-to-scale aerial photographs. The inevitable IBM PC was present, running AutoCAD with an interface to Intergraph.

"**The Crom Partnership** in Gainesville used standard designs and their own labour to build prestressed concrete tanks up to 300 feet in diameter. They had used Data General systems for eight years to design and estimate, and now had finite element analysis and network analysis on the IBM PC. They were currently evaluating CAD systems on DG equipment or on [super-micro] workstations. One CAD system [DOGS] was of British origin. Quality of drawings was an important criterion.

"**Diaz Seckinger Associates** of Tampa had a large architectural practice, but the computers were used by the engineers. Their main processor was a 32-bit Stride 440 with 33 MBytes disk, costing $6,500 and serving four terminals. The main application was CLM COGO [Tampa]. AutoCAD was also being tested on an IBM PC, and they examined Sigma Design [Englewood CO] for CAD. A few Apple Mackintosh computers were being used in business.

"**Post Buckley Schuh & Jernigan** in Miami had 800 staff in their 17 offices. Intergraph had been installed in two of these, largely for work on highways. They were major users of VAX processors for engineering design and management, and had Xerox work processors and laser printers linked by Ethernet. Maggie O'Donnell, the computer manager, provided support without dictating the types of computers to be used. She estimated the cost of CAD systems at $50 per hour, but this was not yet charged to clients.

"**These visits** showed that computers are widely and realistically used in a variety of offices for word processing, management, engineering, and CAD. IBM PCs, AutoCAD, and Intergraph kept recurring, and the marketing and facilities management advantages of CAD were appreciated. But all purchases were carefully planned to pay their way in a country where recession can strike suddenly."

Inexpensive Subsequent Systems

Happy with your IBM PCs/compatibles and not feeling an urgent need to upgrade, but you want more systems? Want everyone to have a diskette-based word processor/data manager/worksheet generator to feed hard disk systems? Trying to establish a PC lab or training center? Need a system at home? Another office? As a backup system?

You may be a good candidate for **used IBM PCs or compatibles.** Many companies are upgrading to IBM PC ATs/compatibles and

want to sell their PCs or XTs. Prices vary from one-third on up, depending on their need, your horse-trading ability, and any middle-man markups.

To be on the safe side, take prosepective equipment to, or bring in a certified service man for a thorough inspection. Sorbus, TRW, and other third-party service people would be better than the service man from a retail store. If you can not get at the equipment, buy it contingent on your acceptance, pay very little to get it sent, and have it immediately inspected by your service man.

Ask the service man to tell you about:

- Third-party disk drives, tape drives, memory boards, monitors, and other accessories that may not be serviceable.
- Poorly maintained equipment.
- Other potential service problems.
- Other sources for inexpensive, but good quality used equipment.
- Good third-party accessories to upgrade your equipment and the used equipment, and where to buy them.
- Incompatibilities: run your software on the used equipment, as well as test with Lotus 1-2-3 and Flight Simulator, a couple of good incompatibility detectors.

Sources for used equipment include: PC clubs, local newspapers, computer magazines and newspapers, associates, large companies, tech schools, and colleges.

Another option for a **personal** purchase of a second system is a PC compatible from Asia (where many of our American brands are assembled), that is sold well in your area. Prices are very low. I've always been a believer that you get what you pay for, so don't count on it to be as reliable as a more expensive American or Japanese PC. Watch out for incompatibilities, and back up your work often.

Used CADD Equipment— Sell or Buy

Posthaur-Pinkert buys and sells used mini-based CADD systems. One of the few who have survived, I've had good dealings with them. Re-licensing CADD software is tricky, and they'll be happy to tell you what policies are for various vendors.

Though you can buy training, installation, and support from the used equipment's vendor, it's probably best to buy a used CADD system after buying your first system.

Contact Wayne Gunter, Posthaur-Pinkert, 12138 Piping Rock, Houston TX 77077; 713-589-2291.

Inexpensive Intergraph Workstations

Need additional Intergraph workstations on your in-house system for engineers, checkers, and supervisors to look at data or to do mostly editing? Would you prefer $5,000-$20,000 to $20,000-$45,000 per workstation?

Bentley Systems has over 100 Intergraph installations using their $8,500 software (on the VAX) to drive graphics terminals to act as Intergraph terminals. Called PseudoStation, the software drives Tektronix 4100 and compatible terminals.

The normally-used Tek terminals range from $7,000 to $13,000. Terminals that emulate Tektronix 4100s start lower and finish much lower than Tek's top end.

Bentley also offers software for your IBM PC, XT, AT, or compatible, running PC/MS-DOS 2.0 or greater, to emulate the Tektronix 4100s. The software, PseudoTerm, is $595, and requires:

- A serial port.
- An IBM, Tecmar, or Hercules graphics card.
- Matching graphics monitor.

This may add about $1,700 to your PC.

It also supports Diablo and Tektronix color ink-jet printers, and Epson printers. With a second serial port, you can use a Sumagraphics tablet or Mouse Systems mouse. PseudoTerm also emulates a DEC VT52 or VT100 terminal.

For more information, contact Scott Bentley, Bentley Systems, 3700 Market St, Philadelphia PA 19104; 215-386-6800.