CROSSOVER

Implementing PC-Based Computer-Aided Design (CAD) in Architecture --

featuring ***AutoCAD®***

AutoCAD®

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Microcomputer Consultation, Sales, Installation, Training, Software Integration and Full Support

- CAD/CAM to CNC
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INTRODUCTION TO COMPUTERS & CAD

The architectural drawing provides the most important communication link between design and construction. During the design and engineering phases, reducing drafting time and increasing accuracy is of great importance to all concerned.

Conventional drafting methods retard progress in drawing repetitive details, compiling bills of materials or parts lists, redrawing lost or ruined originals, doing corrections, or making revisions and engineering changes. These weaknesses, coupled with demands to produce more and better drawings in less time, have led to the development of computer-aided design (CAD).

CAD involves using the computer as a tool in making, checking, correcting, and revising drawings. It is used for converting a rough sketch into a finished drawing, performing engineering calculations, producing material takeoff lists and bills of materials, cost estimation, project scheduling, drawing storage, and many other functions. All these tasks represent critical elements in moving a product from the idea phase to the finished-product stage.

Traditional draftspersons spend about two-thirds of their time "laying-lead". Only one-third is spent for all the other job functions combined, including design. CAD changes this, with drawings and design changes being completed much more rapidly.

CAD applications are tremendously powerful tools. The speed, ease, and accuracy with which a drawing can be prepared and modified offer a huge advantage over "hand" preparation. These systems relieve the draftsperson and designer from tedium, freeing up more time to examine many more options and concepts prior to finalizing the design of a product.

Besides speeding the drafting process, CAD replaces some of the basic techniques that draftspersons have developed. The draftsperson is no longer concerned about line weights, lettering, and repetitive tasks. It enhances creativity while quickly performing the design process, and has proven to offer a minimum of 30 percent time savings in drawing production. This means you can potentially expect to earn at least 30 percent more for services or attempt a greater number of possible design solutions. The more complex the drawing, the more CAD is an advantage, with more powerful computer processors and enhanced versions of software packages leading the charge.

The key to the flexibility of any computer system is its software. This concept can be understood by drawing an analogy between a computer system and a stereo system. Regardless of how well designed and assembled the hardware components are, it will only sound as good as the recorded music.

AutoCAD® Advantages

AutoCAD® brings this sophisticated CAD technology, previously available only on much larger and costlier systems, to the microcomputer user. It is so powerful and yet cost-effective that it is now the most widely-used CAD software in the world, with hundreds of third-party software companies providing add-on products for industry-specific applications that increase time-savings even further.

There is virtually no limit to the kinds of line drawings you can prepare using AutoCAD. If a drawing can be created by hand, it can be generated by AutoCAD. Interestingly, no advance technical computer knowledge is required to use it effectively; practice and a thorough understanding of its features are the keys to proficiency.

With AutoCAD, you can work out design problems early in the development process to put ideas into production faster. The drawing performance that it delivers for its price, combined with its operation on standard microcomputers, means a quick and sizable return on your investment.

AutoCAD makes it easy to test more ideas and explore multiple solutions, leading to significantly improved time-to-completion figures. Its price/performance lets you put CAD on more employees' desks and its quality design features extract more value from the drawings you create.

AutoCAD Functions -- Once you've created an AutoCAD drawing using basic items (entities) such as lines, circles, and text, other program functions let you modify the drawing in a variety of ways. You can erase or move entities, or copy them to form repeated patterns. If you make a mistake, or want to try another alternative, AutoCAD allows you to back up and try another approach. It also provides drawing aids that help you position entities accurately. All commands may be accessed and inputted in several different ways, so that you may become most comfortable and proficient in using its powerful features.

AutoCAD's powerful visualization capabilities help you make better decisions earlier in the design process. Practically anything you draw can be viewed from any angle in just a few keystrokes. You can change the view displayed on the screen, or display information about the drawing and its elements.

AutoCAD works for you; it doesn't put anything into your drawing "on is own". Drawing errors can be easily corrected and revisions can be made without starting over. A completed drawing looks identical to the one carefully prepared by hand and, when used with the proper equipment, AutoCAD can greatly improve accuracy. It produces clean, precise final drawings, with every element appearing exactly as specified.

Making AutoCAD Easier to Use -- When AutoCAD was created, its developers realized that companies have their own standards and each draftsperson a unique work style. Therefore they created an open architecture system, allowing you or your AutoCAD consultant (***Crossover Technologies, Inc.***) to customize and extend many of its features to suit your specific requirements. You can:

- Define your own screen, pull-down, icon, tablet, and pointer button menus to automate the operations you perform frequently.
- Create script files to automate lengthy command sequences.
- Define your own text fonts, dot-dash linetypes, and hatch patterns.
- Create custom symbols and parts libraries.
- Create prototype drawings with custom default settings.
- Customize the HELP file.
- Use DXF or IGES files to transmit your drawing geometry to other programs for analysis, or to create drawings from data generated by other programs.
- Generate slide files from your drawings, for inclusion in documents produced with desktop publishing software.
- Execute external programs while editing a drawing.
- Use AutoLISP to perform calculations, automate repetitive tasks, create new AutoCAD commands, or redefine existing commands.

Add-Ons -- Not everyone needs to be an AutoCAD expert, but almost everyone involved in design or production should be able to use the program in order for your firm to obtain maximum productivity from it. Designers especially should be involved, as AutoCAD can show significant time savings in the design phase of a project. You may want to consider a third-party, add-on software package to aid those in your office who need to use AutoCAD, but who are not likely to spend a lot of time learning it. These add-ons automate some of the more frequently used functions of a particular application. They can also provide ready-made office standards for symbols (blocks) and layers. Add-ons shouldn't be viewed as the only means of using AutoCAD within your office, but rather as an aid to casual users and as a partner to your own custom applications.

Block Libraries -- Blocks are a powerful tool for architectural as well as construction industry applications. Using blocks, you could develop libraries of standard components or details of buildings, place them into drawings "on the fly", and modify them to suit a particular job. Or use a part several times in one drawing, changing the orientation or size slightly for each situation -- such as windows, doors, furniture or fixtures in an architectural drawing.

Many manufacturers of both residential and commercial building products, such as *Anderson* and *American Standard*, now have their product line in an AutoCAD-compatible format, making it easier than ever to insert predimensioned product blocks containing all relevant attributes into your drawings.

- Global Update -- Blocks also allow the global update of graphic entities. Suppose you contracted with *Red Roof Inns* and you came up with a specialized fixture layout for their bathrooms. Dozens of drawings contain blocks of the old fixture layouts. By redefining the definition of this block, the entire set of old graphics are automatically revised simply by redefining the criteria associated with the name.
- Reduce Drawing Size -- One feature of creating blocks is that all of the parts are referenced by one name. This saves drawing time, disk space and access time for repetitive drafting tasks.
- Attributes -- AutoCAD's attributes feature allows you to attach written information to blocks. If you asked someone in construction about "attributes", you would probably receive a blank expression, but they now use schedules and spreadsheets to evaluate this same information contained in manually-prepared drawings. If an attribute is defined for a block, upon insertion the block can ask the operator questions about itself or automatically assume default values. Different attribute data may be entered each time we use the block. Part numbers can be linked with design components, or electrical specifications can be attached to schematic symbols.

Associative Databases -- Some users may be surprised to learn that AutoCAD isn't just a drafting program, but is also a database manager. Extracting attribute information from AutoCAD's associative databases saves time and open doors to sophisticated document management and control techniques. They also serve to increase productivity by making data available to applications such as materials requirement planning , financial management and many others. Because computers and the software that runs on them are so common, integration of spreadsheets, database managers, and AutoCAD is fairly easy. You may also want to integrate AutoCAD into a desktop publishing system to produce proposals, reports, and other documentation.

Surface Modeling -- AutoCAD also provides surface modeling features that can be used to describe complex surfaces. These capabilities make AutoCAD useful for a much broader range of design problems than the 3-D wireframe systems commonly available today.

AutoLISP -- AutoLISP was created by the developers of AutoCAD to help you modify AutoCAD, save time and boost productivity. It provides the tools to write customized programs to control virtually every aspect of drawings and their associative databases. More importantly, AutoLISP's flexibility allows for custom routines to be created for special situations and to have them executed exactly the way you specify. This can save you hours and weeks of time -- which is why you want AutoCAD in the first place!

AutoLISP routines can be created that customize text entry, make global changes to drawings, create basic geometric constructions, or simply eliminate repetitive, time-consuming steps in particular drawing situations.

For example, a desk block could be sized differently in the drawing for both for clerks and managers; the block could then ask for the name of the manufacturer or its cost. The answers can then be extracted to a text file and/or used in a database program to tally all of the manufacturers who meet a certain cost criteria from a drawing containing 200 such desks. Using block attributes, a facilities manager could thus track furniture for a company and find out who has it, the date purchased, when to replace it, or who manufactured it.

Dimensioning -- AutoCAD provides an extensive and flexible set of dimensioning tools that allow the user to annotate drawings to a variety of standards. Dimensions are associative by default, so they will automatically update themselves as the drawing is edited, or they can be updated explicitly by the user.

Drawing Exchange - AutoCAD Release 10 drawing files may be transferred between UNIX, DOS, OS/2, AEGIS, VMS, and Macintosh systems without translation, so they can be shared in a network of different types of computers without conversions of any kind. For computer systems using software other than AutoCAD, drawing interchange files may be read and written in the Initial Graphics Exchange Standard (IGES) format.

In short, if AutoCAD doesn't do exactly what you want "out of the box", chances are good it can be stretched and molded as your needs dictate. To be as productive as possible with it, you will definitely want to develop custom applications *(see page 15)*.

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MANAGING AutoCAD PROJECTS

AutoCAD has a way of enhancing everything you do, both good and bad. Since it's capable of reproducing work rapidly, it's very easy to multiply errors until they're out of hand. This also holds true for project management. Poor management tends to be magnified when AutoCAD comes into the picture. If the users cannot properly manage information such as blocks, layers, and symbols, problems arise.

On the other hand, a smoothly running, well-organized project is reflected in the way AutoCAD enhances your productivity. In fact, good management is essential for realizing productivity gains with AutoCAD. The better managed a project is, the fewer problems arise, thereby reducing the time required to get results.

Discussing CAD management procedures in your project kickoff meetings can help get people accustomed to the idea of using it. Exchanging information with your external support team regarding your CAD system standards is also an important step in keeping a job running smoothly from the start.

Drawing Archiving - Companies archive drawings for several reasons. First, a design of a product could affect the health of your product end-user. To avoid legal problems you should keep detailed and accurate records of the design of that product, including each and every version. With product liability lawsuits being everyday occurrences, the archival of drawings is critical.

Second, future drawings can incorporate designs from previous jobs. Third, unique variations are possible with simple alterations to the existing designs.

Archiving means more than just putting files off to a floppy disk or tape, and then saving them for future reference. It is a process that begins with the name given to a file when a design or drawing is begun. If you have kept every design or drawing you have ever done, it can't help you if you can't find it. If, on the other hand, you give the drawing file a name which you'll recognize later, you can easily look it up and cut down your design time tremendously.

HARDWARE CONSIDERATIONS

Performance Factors - Operator fatigue and lack of productivity can be directly traced to the speed at which the CAD station and software operates. To the uninitiated, anything produced through the magic of CAD is simply wonderful. The honeymoon doesn't last long, however, as the operator's skill level increases to the point that he/she is kept continually waiting for even the simplest commands to be executed during complex drawing sequences.

By investing in reliable, fast hardware initially, you can eliminate many of the bottlenecks that were prevalent in microcomputer-based CAD stations only a year or two ago. Key items to look for in a state-of-the-art microCAD system are:

- Speed rating of the microprocessor -- The higher the numbering sequence of the chip and its rating in terms of MegaHertz, the faster the computer will operate. At present, the fastest machines are 80386-based computers operating at 33MHz, to be eclipsed by 80486 speed demons operating at 50MHz and beyond in the not-too-distant future (these later units are brand new as of 11/89 and early models run at 25MHz).

- Access speed of the hard disk; since AutoCAD Release 10's program and drawing files cannot fit into system memory (RAM) all at one time unless you have megabytes of memory available, AutoCAD must read portions of files from the hard disk periodically during a drawing session. Additional milliseconds seem like minutes to the seasoned operator; therefore, a disk access speed of 28 milliseconds or less is good, with 19ms and under being desirable.

- Presence of disk caching; a memory cache acts like a small electronic storage area that holds extra data each time a hard disk access is made. More often than not, this extra data is the same information that the software program will require next. Since the data is close at hand and an additional disk seek is not required, access time is dramatically increased.

  Of the two types of disk caching prevalent today, software-controlled caches are slower than RAM caches that are built-in directly on the computer's main system board. Also, the larger the cache, the better, with a cache of at least 64K being desirable. The speed of the caching microchips and their location within the computer can also be a factor, although a somewhat smaller one.

- Speed and special capabilities of the video graphics adapter. Beyond ergonomic furniture (which we'll discuss in another section), this is the real determining factor in any CAD system as to operator fatigue. It cannot be stressed enough that the speed at which the operator receives video feedback from the system is critical; on larger projects, time spent on screen regeneration can total up quickly in terms of lost productivity.

- The use of a virtual, or RAM, disk. Since the AutoCAD program is larger than available conventional RAM memory (640K maximum; this is electronic memory -- not to be confused with the physical storage size of the hard disk), Autodesk programmers split it up into separate portions, called overlay files. Each time a different overlay is required, AutoCAD makes a seek to the hard disk where its files are stored, thereby slowing down operation.

  Extra RAM memory can be configured, however, to act as a temporary electronic storage area for the overlays. Access is immediate; the operator is virtually unaware of this "behind the scenes" file-swapping activity.

- Memory Enhancement - The last factor to be examined in the performance arena is the total amount of system memory. To get the most out of AutoCAD, it is extremely important that you use the correct values for special DOS settings for your particular configuration of hardware and software. You can save a lot of time in AutoCAD when available RAM is used in the most efficient way.

  While AutoCAD will run with 512K of memory (640K if you intend to use AutoLISP or many third-party packages, which you should), the program can use additional RAM to reduce disk accesses and increase processing speed for large drawings. When you're editing a small drawing, much of AutoCAD's work is done in RAM, without requiring any mechanical hard disk access. As the size and complexity of the drawing increases, temporary files are created to hold various types of information about the drawing. Portions of the drawing are then swapped back and forth, or "paged", to these files to make room in RAM for other portions.

In a typical microcomputer system, the first 640K of conventional memory is used by the DOS operating system and the programs that run under its control, such as AutoCAD. The next 384K (totaling one megabyte of RAM) is used by video adapter boards, diagnostic programs, and special device drivers; it is not available for software programs to use. It is the additional memory beyond the one megabyte point, therefore, that AutoCAD can use to dramatically increase its performance.

In fact, AutoCAD can use up to 4 megabytes total of additional, extended and/or expanded memory (there is a difference). The special version of Extended AutoLISP that comes with AutoCAD Release 10, however, can use up to 14 megabytes of extended memory. Both types of memory are available on memory boards that can be added to your system at a later date. Better computer systems, however, allow installation of four to eight megabytes of this additional memory directly on the main system board for faster speed. Most, but not all, 80386-based PCs make use of single inline memory modules (SIMMS), which generally provide better performance and are easier to install than conventional 256K or 1MB DRAM chips.

Any RAM that is set aside for a virtual (or RAM) disk cannot be utilized for file paging as described earlier; it is best, therefore, to properly equip a CAD workstation with sufficient additional RAM to meet both enhancement requirements. ***Crossover Technologies*** recommends a minimum of 4 megabytes of RAM for each CAD system we sell, although AutoCAD will run with less (see note next page).

- Display Systems -- Display resolution, which indicates the level of sharpness and is measured in pixels, can have a great influence on your ability to work quickly. Better quality, higher-resolution monitor/video card combinations are often used in CAD/CAM applications to reduce the jagged appearance of lines. They also offer greater detail since more data can be simultaneously presented. This enhanced display representation helps you create a more accurate drawing by also allowing more precise placement of objects on the screen.

But as resolution increases, the amount of information on the monitor also increases, requiring more time for display retrieval. The newest video boards use special high-speed chipsets to overcome this problem, resulting in extremely quick display updates. These same cards can display 256 colors simultaneously at resolution of 1024 x 768 and greater. Unlike less-expensive, traditional monitors used for tasks such as wordprocessing, these video controllers operate in a non-interlaced mode, resulting in less screen flicker at the same time they're updating the display faster. This is an important human factor, for it greatly reduces eye-strain and operator fatigue.

Even though these higher-resolution display systems represent a larger initial investment, in the long run they can save you money in time spent panning, zooming in on drawing details, processing data or regenerating the screen display information.

Whatever your situation, you should consider upgrade ability and system enhancement because technology changes daily. Many factors other than initial investment influence the selection of a computer system, including service and technical support. It is important to take a long-term view of your computer and how it integrates into your facility.

SPECIAL NOTE: As of 11/89, Autodesk, Inc. has announced three new versions of AutoCAD for PC-compatible microcomputers. The first is AutoCAD 386, designed to overcome the 640K RAM limitation of DOS. While it offers an outstanding 50% increase in performance over AutoCAD Release 10, it requires a minimum of 4 megabytes of RAM. AutoCAD OS/2, running on the new operating system that may eventually replace DOS, will require a total of 8 megabytes, including the 4 megabytes required by OS/2. Finally, AutoCAD Release 11 is also due out shortly, which offers true network support. Since memory pricing has been dramatically reduced over the past few months, investing in several megabytes of memory doesn't represent quite nearly the investment it did only 1 1/2 months ago -- good news for users of graphic-intensive applications like CAD.

Crossover Technologies, Inc. is quite experienced in upgrading all types of PCs, both old and new, with additional memory. The firm's CAD technicians are also extremely knowledgeable regarding how to correctly reconfigure AutoCAD to make the best use of this additional memory.

HUMAN FACTORS

Fear of the Unknown - When a CAD system is installed and operational, the next step is to acclimatize the staff to it. This can be the most difficult task of all. In nearly every office, there is at least one key person who resists the use of computers, usually out of apprehension or skepticism. This can be a tremendous problem, especially if that individual is at management level, although nearly anyone involved in a project can have a negative influence. CAD proponents must try to encourage a positive attitude toward the system's capabilities and its implementation.

Job Replacement - CAD does not eliminate drafting positions. Draftspeople make drawings, using the computer as an additional production tool, just like a template which helps you to draw more accurately and quickly. The computer will relieve him or her of the more tedious, repetitive aspects of his/her job, thereby allowing more time to be spent on the more important elements of the job. Computers may be faster, more accurate, and reliable, but they have two critical shortcomings:

1) They cannot reason and think as a human being can. They make decisions based on mathematical logic, but cannot apply common sense, make judgments, or use intuition.
2) They cannot adapt or innovate during a problem-solving process. An incorrectly-programmed computer will keep making the same mistakes until it is reprogrammed.

"But, I know nothing about computer programming!" - Computer programming is a highly-specialized field requiring in-depth training. Programmers write the programs used in computer drafting systems, whereas draftspeople are usually considered system users. This means that they operate the hardware and supply the computer with the information that it needs to do a job. Except for occasionally creating certain custom drawing routines (perhaps using AutoLISP, AutoCAD's built-in programming language) that can run from within the CAD package, they do not develop the actual program in practice.

Personnel Training - Learning to operate a CAD system can be time consuming. At first, the operators won't be as productive as they were when everything was done manually, nor can they perform miracles overnight. Once a good working knowledge of the program is acquired, they will still have to incorporate it into day-to-day work activities. It will take a month or two to get to a point where the operators are entering drawings with any proficiency, depending on how much time is regularly

spent learning. It helps to have a real project they can work on while they're in training. A job might be selected that doesn't have a tight schedule, so that if anything goes wrong, enough time is available to make corrections. An alternative is to operate two drafting teams during this period, with the first group using CAD and the other continuing to do manual drafting.

Experience has shown that new AutoCAD users may expect to become semi-skilled with the program within three to six months, usually depending on management's ability to set realistic demands and the time available for practice on the system. Training programs and seminars, both internal and external, are the best way to get "ramped up" as quickly as possible. Beyond our own AutoCAD training program offered in connection with our *AutoCAD Authorized Dealer* status, ***Crossover Technologies*** can recommend useful training aids such as video training tapes and books that help bring operators "up to speed" much more quickly.

Ergonomics - Perhaps the most overlooked productivity factor is the computer operator's comfort. Too many times, the computer is placed in a makeshift workstation environment with no consideration at all for the user. But the computer system is only as good as the person operating it. If the operator isn't reasonably comfortable while using the computer, it won't matter how fast it is or how well he/she knows the program. A poor workstation setup can cause eyestrain, headaches, backaches, and fatigue, all of which lead to lack of concentration and loss of productivity. Other medical symptoms, such as Carpal Tunnel Syndrome that affects the wrist and hand, can result from improper operator positioning at the workstation.

Lighting should be arranged so that no glare occurs on the monitor, yet enough light should be available to read drawings and notes. Good ventilation will help keep both the computer and operator working at optimum levels. A convenient place for hard copies of notes and drawing prints should be part of the workstation. You might consider using a monitor stand that lifts the monitor off the table surface, freeing space for documents. The keyboard, monitor, and mouse/digitizing pad should be placed comfortably and at proper operating levels. Above all, a comfortable, adjustable chair is a must. ***Crossover*** can set you up with relatively inexpensive, specialized furnishings from a variety of manufacturers that can make your work environment much more comfortable, thereby increasing productivity and earnings.

"Turnkey" or "Turkey"? - The minute difference between the words "turnkey" and "turkey" all too frequently spell the difference between a properly-specified, successful computer installation or a dismal failure that causes nothing but frustration.

Services provided by a full-support vendor based on its comprehensive CAD/CAM experience are a key advantage of a turnkey system purchase. Vendors such as ***Crossover Technologies, Inc.***, provide a single, unambiguous focus of responsibility for CAD/CAM hardware, software, productivity-enhancing utilities and applications. In addition, full-support vendors offer education, consulting, support and service programs that cover such things as proper system management and application development. Such services have proven to be less confusing than other sources that often give erroneous, conflicting advice based on their inexperience with CAD systems in real-world situations.

Turnkey services generally begin before a buyer decides to purchase a system. Prior to offering a proposal, a full-support vendor evaluates the buyer's application, organization, work environment and other considerations. They determine if the company is willing and able to adjust its organization and operating procedures to make the system work. The vendor also outlines reasonable expectations of performance, benefits, payback, and service. Five basic types of services are generally provided in the turnkey package as part of the formal agreement: *hardware maintenance, software maintenance, application assistance, management assistance, and education.*

The turnkey approach is even useful for those who possess a degree of computer aptitude and have already conducted preliminary research in the CAD/CAM marketplace. The old adage that "two heads are better than one" certainly applies when selecting and implementing complex computer systems for any application. Indeed, the silicon and software industries change daily. No one, regardless of their effort, can expect to keep up with the vast amounts of new CAD-related information, especially if they're not involved in the computer industry on a fulltime basis. Lack of specific knowledge can mean substantial differences in learning curve periods, user productivity levels, and missed opportunities for additional company earnings.

Even if company personnel were to invest the time necessary to become as fully knowledgeable as the full-service vendor team, it would mean that valuable time would most likely be directed away from those people's primary job responsibilities. Although many people like to take the "do-it-yourself" approach to some projects, in the long run it's usually less expensive and faster to hire trained professionals. This is just as true for computer installations as it is for plumbing or shadetree auto mechanics. The corporate vice-president may know how to repair each piece of shop equipment, but is it really the best use of time management and other resources?

SYSTEM SUPPORT

Part One - External

It helps to have knowledgeable people that you can turn to when questions arise. As mentioned previously, the full-service vendor who sells CAD systems is also a qualified source for technical support, as is the case with *Crossover Technologies.* A good vendor can save you several times the sales commission just in person-hours your office might spend trying to solve hardware and software problems.

Although you may get a deal on the AutoCAD software from discount resellers, you may be left in the cold when you need training or have questions. You should also be aware that simply because a firm may be an Authorized AutoCAD Dealer, they may have little real experience in properly configuring the software for your working environment. This situation eventually leads to higher costs for you than if you had purchased the system from a full-service company that specializes in CAD applications.

If your company is making its initial computer purchase, has just recently acquired computers, or has several microcomputers being used for applications other than AutoCAD, many questions will arise that may require general support. The technical support team you select will most often be more familiar with computers than with the ins and outs of your profession, but will be able to answer highly-technical computer questions in the context of your application. They'll also be able to show you how business productivity may be increased through proper selection and usage of off-the-shelf computer software and accessories, as well as provide expertise on software customization and integration.

The support team can help you set up an efficient file organization and management system, something that can become a nightmare if left unattended. They should also offer training and phone support, which is a must with a program that has as much depth as AutoCAD. It is recommended that your AutoCAD operators join and attend meetings of an AutoCAD users' group. Finally, you should consider a good service contract, especially if you are using some of the more exotic display systems and output devices.

Customization - Out of the box, AutoCAD is a general tool designed for a wide variety of disciplines. Users should take advantage of customization features provided by full-service vendors in order to get the most from the software. Such customization is typically implemented by defining menu items or function keys and/or by adding specialized, third-party add-on software. Some firms, such as *Crossover Technologies*, also design libraries of part symbols so that new designs can be drawn merely by entering a few elements. Systems such as these are not rapidly implemented, however, and must be developed with full co-operation of the user.

Part Two - Internal Support

Perhaps even more important than a good vendor is an individual within your company who knows the system thoroughly. Running a CAD system is not a simple clerical task. It takes clear thinking and good organizational skills.

The computer draftsperson must be knowledgeable in the use of orthographic projection, axonometric projection, sectioning, auxiliaries, dimensioning, visualization, thinking in three dimensions, and knowledge of the drafting standards.

The In-House Computer Liason - In addition to these traditional skills, the individual will need to develop a basic understanding of computers in general. The computer draftsperson must learn the various components of a CAD system and how they interrelate, and how to use such components as mice/digitizing tablets, monitors, keyboards, plotters, and printers.

Ideally, everyone closely involved in your drafting and design projects will be a proficient AutoCAD user, but it is impractical to expect everyone to give time to system management. Usually one person is chosen to act as the in-house computer liason, and when the going gets rough, this key person is indispensable.

In a smaller office, the in-house liason may be the design staff, production staff, and computer journeyman rolled into one. The point is: to really take advantage of any CAD system, the company should have some onsite "know-how". Senior management should be aware, however, that the role of the in-house liason requires a large amount of time away from other tasks he or she is required to perform. Therefore, it is important to keep this under consideration when scheduling work or managing costs on a project.

The in-house liason should be a trained architectural professional, rather than someone from the computer industry. However, the designate should be willing to develop some computer knowledge. The liason will need to work closely with the external support group to solve problems and implement new features to the CAD system. It's also a good idea to bring in the external support team periodically to work with the liason on the development of custom applications or to advise on new accessories or software enhancements. This could be achieved in a scheduled monthly "idea session", or whenever the need arises.

AutoCAD users are encouraged to sign up to CompuServe, where Autodesk, Inc., runs a regular user forum available around the clock. By linking the company's CAD system up with this service via an inexpensive modem device and communications software, the liason can send questions out to this huge network comprised of AutoCAD users across the country and two full-time Autodesk employees who monitor forum activity. In either case, viable solutions to hardware/software/application problems are usually available back out on the forum within a 24-to-48 hour period. The *Autodesk Forum* is also a great place to keep up on interesting CAD application news and to get direct access to a myriad of AutoCAD-enhancing utilities contributed by fellow CompuServe subscribers.

Part Three - Publisher Support

Autodesk, Inc., publishers of AutoCAD, support their products with a continual development effort. After you've invested in AutoCAD, you may expect regular upgrades at reasonable prices. These enhancements are the result of extensive input from AutoCAD users like yourselves. Autodesk listens to your needs and responds with enhanced product features and performance that make it easier to do your job better. AutoCAD's widespread support has made it a worldwide standard in a wide variety of design applications.

SPECIAL NOTE: Through January 25th, 1990, owners of any prior release of AutoCAD (except Release 9) may upgrade to AutoCAD Release 10 for only $500. This fee includes a **FREE copy of AutoSHADE**, the rendering package that works directly with AutoCAD. See your ***Crossover Technologies*** representative for details.

Source Material

Inside AutoCAD, Release 10 --
D. Raker and H. Rice, New Riders Publishing, Fifth Edition

Mastering AutoCAD -- George Omura, Sybex

The AutoCAD Database Book --
Frederick H. Jones and Lloyd Martin, Ventana Press

Course manual, Henry Ford Community College

CompuServe

AutoCAD Release 10 Reference Manual -- Autodesk, Inc.

AutoCAD marketing brochures -- Autodesk, Inc.