

EXPERIENCE IN IMPLEMENTING AND
UPGRADING A MICROCOMPUTER
AIDED DRAFTING SYSTEM

By

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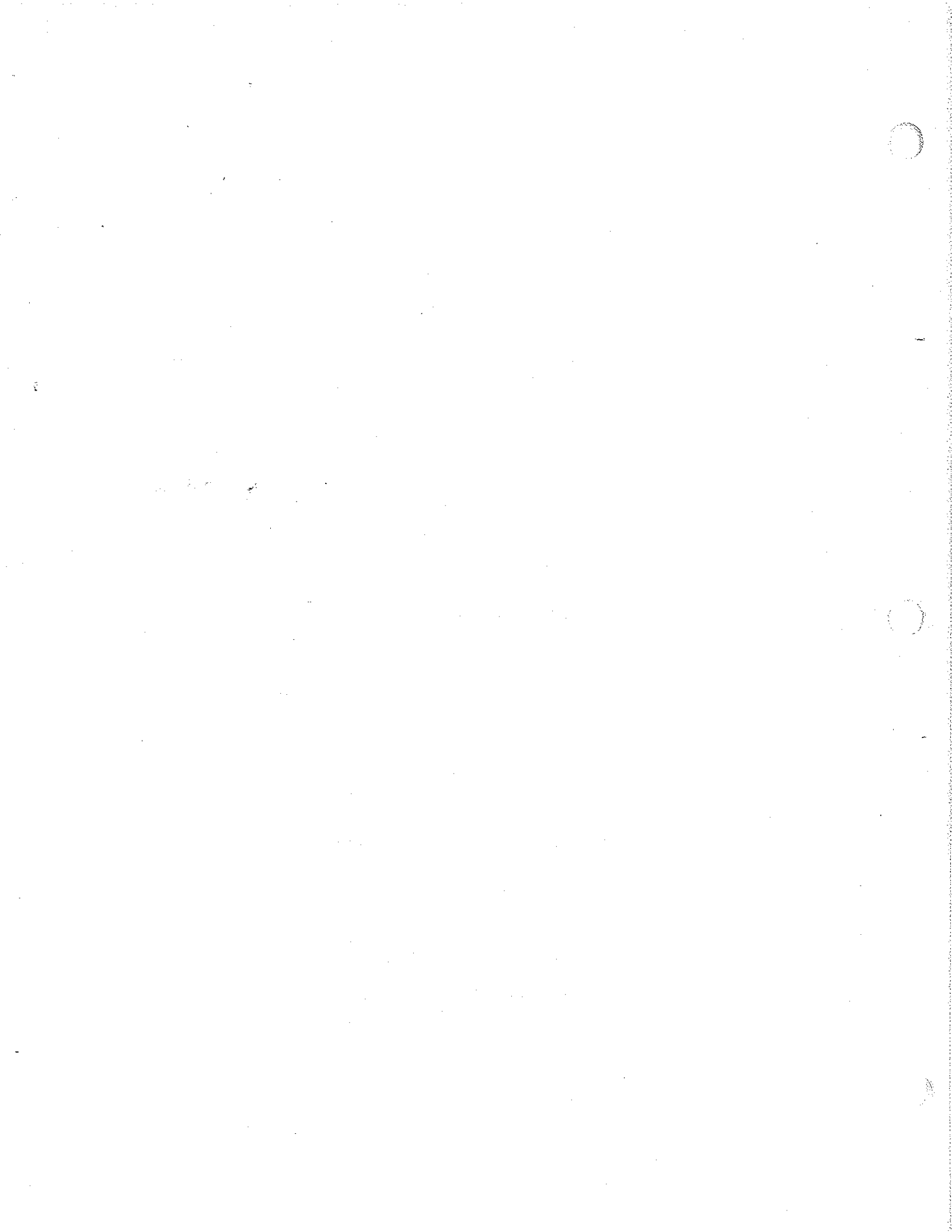
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INTRODUCTION

PURPOSE

Recent advances in microcomputer design have made possible PC based CAD systems. I hope to present a balanced portrayal of the contribution an automated Computer Aided Drafting System can make to drawing creativity. I don't want to over-exaggerate or present inflated results, but with these systems it is possible to produce engineering drawings and make revisions up to three to four times faster than the same designer can perform manually. In this paper, I want to give you the benefit of our experience to make computer aided drafting more effective. I will tell you:

1. Why you should consider using computer aided drafting over manual methods.
2. What equipment you will need.
3. What to look for in CAD software.
4. What techniques and equipment seems effective in speeding a CAD system.
5. How to get started.

It is also important that I make a disclaimer about brands of equipment and software. Our engineering group did evaluate different hardware and software for our department before settling on our present system. By far the equipment we know best is that which we selected. I have no affiliation with any of the brands I will mention. They seemed right for us, but if you are presently looking into these systems you will find what works best for you. For the record our drafting systems consist of:

- AutoCad Software
- IBM "AT" Computers
- Summagraphics Digitizer Board
- Mitsubishi 1060 x 768 Monitors
- Artist I Graphics card
- HP Plotter
- HP Laserjet Printer
- PGS Max-12 Monochrome Monitor

RECENT CHANGES IN CAD

Equipment changes

Recent improvements in speed, reliability and capacity of microcomputers has made it possible to produce drawings only formerly possible with a mainframe type system. Competition between manufacturers of plotters, digitizing boards, and high resolution monitors has made the cost of these essential components come down enough that a small office can justify a fairly sophisticated system.

The proliferation of microcomputers has made the CAD program more accessible to many users in a fashion similar to the increased use of spreadsheets, word processors and database systems. This increased use by people to whom a mainframe CAD system would not have been justifiable, has led to spin off products such as ready made symbol and equipment libraries for any engineering discipline.

TYPICAL SYSTEM COST

Mainframe systems

A state of the art computer aided drafting system costs \$100,000 or more for just the first workstation and perhaps \$60,000 for each additional workstation. This system will be fast and have many capabilities but there may be more functions than you need. For instance, we are working mainly with two dimensional flowsheets and plan and elevation drawings. Three dimensional isometric drawings are possible but constitute only a small portion of our work, therefore for us to have insisted on this capability from our system would have needlessly increased the initial cost.

Microsystems

A good microcomputer system single workstation can cost between \$10,000 and \$15,000 with most of the variance depending on what type of plotter is selected. A second workstation sharing the original plotter may cost only \$7,000 to \$10,000. The microcomputer based programs claim to have about 90% of the capabilities of a mainframe system. This lowering of the initial cost of CAD is the impetus for many small offices to investigate using CAD.

WHY USE COMPUTER AIDED DRAFTING?

The major reasons to switch from manual to computerized drafting are to:

1. Increase the speed of rendering drawings.
2. Increase the speed of revising existing drawings.
3. Improve drawing and text accuracy.
4. Provide systematic drawing, symbol and detail storage.

DECREASE DRAWING CREATION AND TURNAROUND TIME.

The most obvious reason to use Computer Aided Drafting is for increased drawing productivity. Properly applied, CAD will increase new drawing production and most especially drawing revisions by 3 times or more.

We had one example of a drawing in which a correction done in a manual way would have taken hours. On a very full steel drawing, another twenty foot bay was requested to be added to the top of the drawing. On a manual drawing, this change would have necessitated completely erasing and redoing the drawing. With the CAD system, the scale of the drawing was instantly changed from 1/4 inch to 3/16 inch thereby providing room at the top for the needed addition. After revising, the drawing was replotted and the whole process took less than an hour.

IMPROVE DRAWING ACCURACY; JOB SATISFACTION

Computer aided drafting can be a tool to improve drawing ease and accuracy. All line weights and text are uniformly drawn. The computer and plotter can produce very accurate to scale drawings and the dimensions are both calculated and depicted by the computer program.

Our experience has also shown that for the motivated designer, a CAD system can provide a high degree of job satisfaction.

SYSTEMATIC SYMBOLS AND STORAGE

Computer aided drafting provides systematic storage and retrieval of drawings. It is possible to store drawings by area and retrieve them and use them for designing a new drawing. One aspect that fascinated me when I first saw it was the repeating of an entire area, not just a symbol, using the CAD system. That is to say, you can use any area of your flowsheet, to make a repeatable block which can be inserted into any other drawing you are creating.

WHAT MAKES UP A CAD SYSTEM?

COMPUTER

When everything is working well, the computer is the part of the workstation that will be least noticed by the operator. We use an IBM 'AT' computer with a math co-processor installed. This computer is about twice as fast as the original IBM PC computer. Other computers such as the Compaq 386 are even faster.

AUTOCAD PROGRAM

The software program is the central nervous system for the whole workstation. AutoCad is interactive and graphically oriented. Interactive means real-time response; when you enter an object or move a line the change will appear on the screen immediately. Graphically oriented means you can use pointing devices such as mice or digitizer pads for most commands and not rely on typing to make a drawing.

DIGITIZER BOARD

The digitizer board is a pointing device which allows you to either point to a symbol and pick it out for entry in the drawing or it allows you to trace out the line or object you wish to depict.

MONITOR AND GRAPHICS ADAPTER CARD

There are many monitor and graphics card combinations on the market today. The features we looked for were color, high resolution and instant zooming capability. Color allows various layers of a drawing to be differentiated. Layers may correspond to piping, electrical, steel and text with each shown as a different color on the screen.

A high resolution (1024 x 760 pixels) monitor clearly depicts an entire drawing. Also, higher resolution display minimizes the need to zoom in on the video display since the monitor is able to show greater detail. Instant zoom (or hardware zoom) means that the image on the screen can be zoomed without accessing the software; i.e., the image stored in the monitor can be zoomed.

PLOTTER

We use a Hewlett Packard plotter capable of transcribing any drawing from our AutoCad files. It can plot a typical P & I drawing in about 10 to 15 minutes. It has a mechanical resolution of .00012 inches meaning the line segment that makes up a circle is only .00012 inches long. It is capable of plotting on reproducible Mylar which means you can have both the reproducible drawing and the electronic rendering on disk media as well.

OCCIDENTAL CHEMICAL PROJECT ENGINEERING EXPERIENCE WITH CAD

TYPES OF DRAWINGS POSSIBLE

About three years ago, at White Springs, our project engineering department began with one IBM PC based CAD system. As more designers became interested and capabilities improved, we chose to increase the number of workstations to fully use the designers' talents. Thus far we have not found any type of drawing which we have not been able to produce with our PC based system. Currently, four full time operators are using AutoCad for process flow sheets, process and instrumentation diagrams, electrical drawings, piping layout and structural steel drawings. They are using faster computers with higher resolution monitors to speed up drawing completion.

TRAINING

Training is very important. An operator cannot take advantage of the CAD system full capabilities without proper training. We have had people trained different ways; some have trained through self-paced learning and others have gone through more formalized college courses. Formal training following a period of self-paced learning seems to work best. It is important that the training course be tailored to the designer; i.e., electrical designers should not be trained by practicing drawing gears.

On the job training is most effective when there are two or more designers working in close proximity. If they work together asking and answering questions they can learn quickly, particularly if one is more experienced than the others.

SPEED, PRODUCTIVITY AND REVISIONS

There are excellent ways to speed up a CAD program. The effective techniques we have used include:

1. Using high resolution monitors. Although the appearance of the drawing on the screen is not related to the final resolution of the plotted drawing, it is true that the more detail visible on the full screen, the less zooming-in is necessary. Zooms and redraws are time consuming for the computer and cause the operator needless waiting time.
2. Using "AT" type computers with a math co-processor installed. The math co-processor quickens all math calculations. CAD programs are continuously doing math as each entity is drawing, resized, rotated and redrawn. Do not consider using CAD without a math co-processor chip installed in the computer. Newer computers on the market such as the Compaq 386 or the IBM OS/2'S operate at speeds 4 to 5 times faster than the IBM PC.

3. Using a large graphics tablet and light pen as opposed to an optical mouse or the keyboard. Many standard symbols can be stored and taken from the digitizer board.
4. Using a buffer or another computer to separate the computer from the plotter. One problem with microcomputer based CAD is plotting disables the computer from further design while the plot is being made. Plots typically take 10 - 20 minutes. If the plotter is serving more than one designer, a separate computer and plotter combination permits drawings to be plotted while the workstations can continue to be used for design work.
5. Using a Laserjet printer to make quick plots to avoid tying up the plotter. A typical P&ID can be "quick plotted" on a laserjet printer in about two minutes. Another possibility is to designate a person on a late shift to take drawings made during the day and plot them in the evening.
6. Creating symbols and even drawing details on the run and save them for use in other drawings. By keeping a notebook of previously saved drawings, a designer can use material already created to insert into new drawings.

COMMAND PROGRAMMING

AutoCad not only has a wide array of commands built in but it is also possible to create specialized commands using the LISP language. This is especially effective when there is more than one designer because each designer can program specialized commands others can use.

JOB SATISFACTION

It is apparent there is a high degree of job satisfaction associated with operating a CAD workstation. CAD operators enjoy quickly and accurately making drawings that are neat and well laid out. Our operators most especially seem to enjoy discovering new commands to accomplish a goal more quickly. I don't believe it is possible to "master" AutoCad because there are many commands each with its own subset of commands. The longer our people use it, the more capabilities they discover.

SUMMARY

CONSIDER WHAT YOU WANT FROM THE SYSTEM

If you need to depict flowsheets in a two-dimensional format, the system I have described will perform well. If you are looking to depict in three dimensions with the ability to rotate the drawing for different views then you will need a much more elaborate and expensive system. But don't be dazzled by features in a mainframe system which you may never use. Remember you can always upgrade your system as capabilities improve.

START SMALL AND SLOW

Start with one or two workstations and one or two designers before trying to increase the number of operators. Depending on the designer, it will take anywhere from one to four months before he or she is drawing as fast on

the CAD system as with manual methods. Don't pressure the designer by demanding immediate, spectacular results.

START WITH P&ID AND PROCESS DRAWINGS

Process flowsheets and P&ID's are probably the best drawings to start with since they seldom have scale. This makes one less item for the beginning CAD operator to be concerned about. As the drawing fills with more symbols and lines, the CAD systems' ability to move objects can really speed the revision process.

TRAINING AND ATTITUDE ARE IMPORTANT

Much of the success for the system will be determined by the attitude of the computer operator. If you have a designer who has voluntarily registered for CAD class at the local college, this person is probably motivated and will likely succeed. Otherwise, if you find you must force the designer to even approach the CAD system, then the chances of success are slim.

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