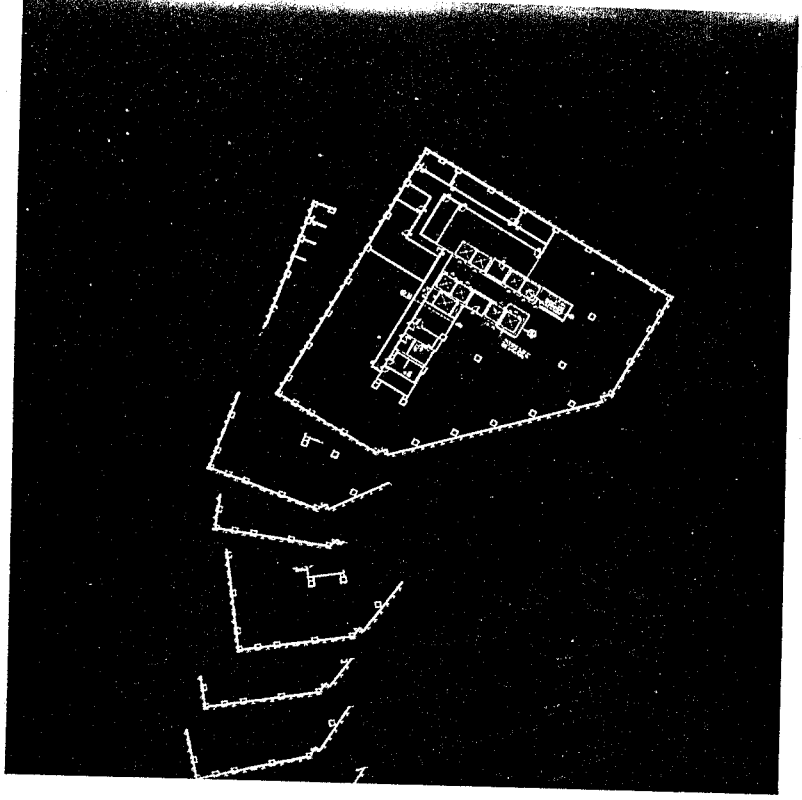


Computers have not and will not replace paper in the A/E office in the foreseeable future, but increased automation have had a revolutionary impact on traditional reprographic methods.

The Future of Reprographics

As in every other facet of design, the microchip is revolutionizing reprographic techniques. The days of pin registration and blueprinting are not over, but the end is in sight.

by Robert Conrad

Reprographics is in a transitional period between the traditional manual and optical systems of today and the digital and electro-optical and optical systems of tomorrow. We are in a period of rapid change, accelerated not only by the impact of computer-aided design and drafting, but also by the advent of new technology in hardware communications and materials.

Reprographics departments have frequently been characterized as resistant to change, new ideas and new or unfamiliar technology. This has been particularly true in the areas of drafting media and techniques for creating and disseminating prints, specifications and intermediates. In many large organizations drafting standards specifically require media and ink combinations that do not allow adaptation of new technology. For instance, many large design firms specify certain inks on a polyester base for their final drawings. This policy does not allow for newer high adhesive toners and films recently released for use with laser and electrostatic type plotters.

The Roots of Reprographics

During the 50s and early 60s, there were revolutionary changes in reprographics, such as: the rapid adoption of microfilm aperture cards for drawings, distribution and printing; the adaptation of offset printing for volume specification printing; the introduction of a variety of xerographic cameras, plate makers, microfilm printers and Xerox's high speed Copy Flow film and paper printers; and the replacement of most blue print machines. Diazo equipment, currently called blue line or white print machines, have allowed low cost wide format reproduction of prints and intermediates, but still suffer from the need for special chemicals, venting, paper and film.

Offset printing still exists, but has been largely superceded by copier duplicators and by other duplicating technology. Micrographics has reached a plateau of acceptance and use, and is likely to be displaced by a combination of optical disk and microfilm scanning systems.

It is difficult to say which one of these technologies has had the most impact, but it is likely that the introduction of low cost offset and versatile xerographic copying and blowback equipment has been essential to almost every facet of reprographics, from small offices to large aerospace firms and government agencies.

Conservatism

The conservatism by distributors as well as users in the adoption of new types of hardware has frequently been significant in reprographics. For instance, wide xerographic reduction copiers were first built by the U.S. operations of Xerox. When Fuji-Xerox and other Japanese companies improved the concept to allow same size and enlargement duplication as well, Xerox took many years to recognize that there was a need and to introduce the product into the U.S. and Europe.

This has been even more true in the adoption of new types of paper and film media. Since its introduction in the 1960s polyester base materials have proven increasingly popular, but are not used by the majority of organizations. Traditional cotton vellums continue to be the standard for most architectural and small engineering firms during this period. The use of specialized silver films, with process cameras and pin registration systems saved millions of dollars for large building designers.

Manufacturers in Japan and Europe were unable, until recently, to enter the drafting and reprographics media market in the U.S. at least partly due to indifference and resistance to innovation by many distributors and major users. Fortunately, this is changing and quality supplies and hardware from Japan and Europe are being sold in increasing numbers.

Reprographics Today

As previously mentioned, reprographics is in an important plateau of change and transition. The wide xerographic copiers introduced in the U.S. from Japan and Europe have been widely accepted, and have substantially upgraded the quality, versatility, and through-put of large reprographic departments. These giant machines, like the Xerox 2080 and Shacoh, typically cost $50-100,000 and lease for thousands of dollars per month. Some predicted that they would significantly reduce or eliminate the use of high volume blue line machines, but quite the opposite is true.

Most of these machines have been used to generate high quality, intermediates, vellum and film. The reduction capability has been used by many large engineering firms to replace expensive camera work using silver films. Second generation machines, such as the Océ 7500 and Xerox 7080, not only do reduction work but make multiple copies at very high speed.

Automation has also reached the blue line and microfilm printer industries recently, but mostly with hardware innovations from Europe and Japan. European manufacturers of high volume blue line and microfilm blowback machines have been adding productivity features for a number of years.

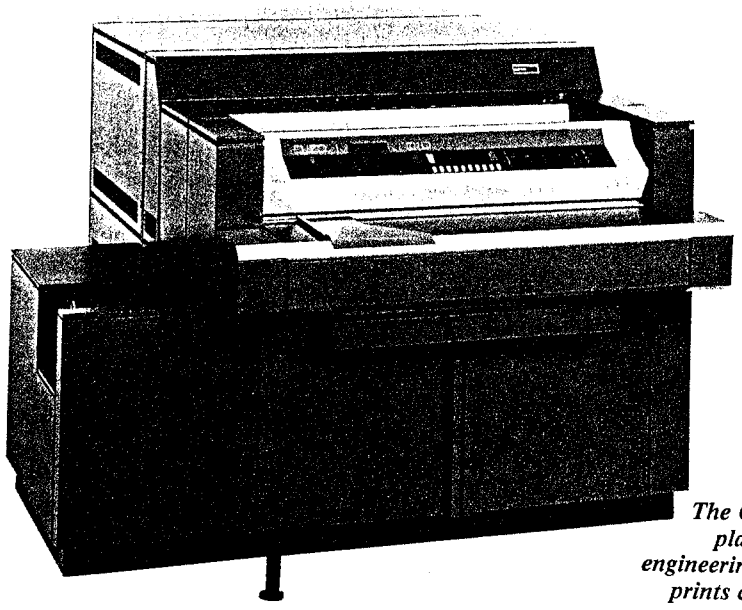
Specification Printing

Most specification printing is probably still done on offset presses and copier duplicators. A major wave of innovation in this area is low cost laser printers that can do high quality type setting and graphics on personal computers and small office systems. Recent announcements from Apple Computer, Canon, Xerox and others allow for a combination of text and graphics to be printed on any page.

Other trends dramatically impacting reprographics today include the introduction of scanning systems to digitize or transmit drawings; the widespread use of low cost pin-plotters at the department level; of the use of satellite blue line and xerographic copiers for wide printing; and the introduction of high volume raster monochrome and color plotters. Each of these trends will be increasingly important in the near future, and some, like scanning and color raster plotting, will have an accelerated impact for five to twenty years.

One problem with increased use of color is the difficulty in copying color prints in sizes larger than 8½ by 11 inches or in accurate colors. Some present color copiers use traditional wet film or instant paper technology, while others use dry or liquid toners. It is not practical to produce photographic quality color without using photographic papers, and until recently none of the color plotter or copier companies were adapting these papers for their machines. It is probably easier to redraw a large color plot than to copy it, but the total computer and plotter time may eventually justify wide color copying capability.

Currently, wide format scanners are just beginning to be utilized in computer-aided design and reprographics. The process to digitize and edit any D or E-size drawing often requires an hour or more. This makes most of these systems impractical for use in volume drawing restoration or the conversion of very large drawing files, although they are being use to do just that in many locations.



The Océ 7500 plain paper engineering copier prints copies of up to E-size originals on roll or sheet form.

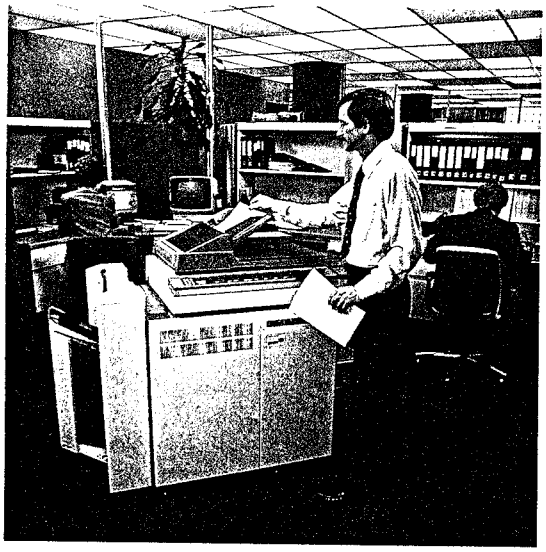
The trend towards very low cost wide xerographic copiers is just beginning and is stirring much interest in the reprographics community. The Xerox 2510 is the first example of this type of machine. It is designed for low cost and low volume printing in a small office or department. Its primary advantages include low cost, ease of use and ability to use plain papers and vellum.

Both pin plotters and the newer raster plotters produced by Benson, Calcomp, Tektronix, Versatec and other vendors are having a dramatic impact on the reprographics and design communities. The increase in wide drafting plotters has

caused a tremendous increase in the number and type of supplies.

Not only has there been a dramatic increase in the total number of inks, toners, and pens required, but there also has been an introduction of speciality papers introduced for the first time in the U.S. market. These include so called natural translucent papers which are widely used in Europe for use with standard inks and low power diazo machines. These papers were once used in the U.S. before, in WW I and II, but have not been seen except in speciality coated paper until recently.

Ink jet papers are produced in the U.S., Europe and Japan and have a



Kodak's IM 40 encorporates scanner technology to digitize paper originals for electronic text manipulation.

tendency to be complex and expensive. The ink jet printers give excellent color rendition but are generally too inaccurate and unreliable for drafting applications.

Another trend that is becoming prominent in some applications is the use of so-called composite or multilayered films in drafting and reprographics. The most popular of these products is a multilayered polypropylene product that has a beautiful drafting surface. It is priced between polyester and vellum. In the future, anticipate a wider variety of composite and so called non-woven papers and films using artificial fibres and materials.

The last recent trend needing recognition is in the potential use of wide area and local area networks to communicate both data and images throughout an organization. These networks are already being used to scan, transmit and print documents and x-rays throughout offices and hospitals. These same networks have already been used to connect work stations, files and plotters between departments and computers.

The Future of Reprographics

The next ten years will be a period of accelerated change marked by the introduction of many new technologies and the demise of some old ones. Three of the most important base technologies for the present and future are the microprocessor, low cost lasers and plain paper copier printers. New technologies that will have vast impact on the reprographics environment include the following:

- Raster input devices including scanners and sensing devices to translate small and large documents into analogue and digital signals.
- Optical and magneto-optical disc and other ultra high-density storage devices that will allow the replacement of paper drawings, documents, lists and catalogs. These devices come in several basic types, they are: Video disc-based systems (CD ROMS), write once read many (WORM) technology discs and eraseable disc technology (which is just now emerging).
- Raster output devices being developed for a growing number of technologies and applications that will allow them to compete with both pin plotters and expensive wide copiers. The technologies here include: ink jet, dielectric, laser xerography and ion deposition. The net effect of this will be a much wider range of low cost plain paper printer plotters and printing devices as well as more expensive ultrafast or high performance special devices using coated papers for color and other applications.
- The conversion of present analogue optical devices to digital input, output and control. This will include the use of digital image processing to automate cameras, copiers and other types of exposure devices. This trend has already begun with the development of process cameras that can do pin registration graphics from computer input with the use of a laser writing device. It also is appearing in A and B-size copiers that can do a wide variety of enlargement, reduction, editing and cut and paste work using digital techniques.
- Wider acceptance and use of network and translation devices between machines, departments and buildings that allow free exchange of graphics, data and images. These include current systems like Ethernet, and future systems with higher capacities such as the MAP Network System, developed by Intel and General Motors for factory automation. These types of systems, today, are relatively expensive to attach to low-cost machines unless they are clustered, but will be increasingly practical within the next five years.
- Highly intelligent and user-friendly displays that allow the merging of images, texts and graphics. These devices already exist, but will become increasingly accepted with the new products available from Apple Computer, IBM and Xerox.
- The accelerated use of plain paper copier technology will appear in a much wider diversity of D and E-size copiers duplicators with a wide range of price, performance and function. These devices also will appear as plotters for attachment to PC and work stations within the next 6 to 24 months.
- An increase in the use of new technology papers, films and imaging chemicals. Of particular importance will be new materials for color, imaging and plotting, as well as new synthetic high strength papers and multilayered composite films.

Technological Impact

Some of the major impacts of these technologies include the following:

- The accelerated replacement of

traditional blue line machines with xerographic satellite copiers and automated high performance copier duplicators that can enlarge, reduce and perform other specialized reprographic functions in one pass. The first generation of engineering copiers and the later Xerox 2080 and Shacoh devices have actually increased the use of speciality papers and films such as cotton vellums, but next generation could have the affect of eliminating many requirements for these specialized supplies.

• The transfer of most centralized printing to multipurpose plotters could occur in the next ten years or after. Even small and medium size firms are anxiously looking for a way to get around the plotting and printing bottle neck, caused by their CAD systems, pen plotters, and traditional outside services. In the future it will be possible to create multiple copies of drawings in blue line, black line, or multiple colors through the use of new technology raster printer plotters, or off line printing systems that can accept floppy disc or other digital input. There is definitely a need here, that need is likely to be a major trend, but is unlikely to replace reprographics or service organizations completely.

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• A gradual replacement of traditional microfilms and paper base storage with those based on optical disc and other archival technologies. This is already occuring at major military and government installations and at least a dozen corporations including Boeing, General Electric, Pratt & Whitney Westinghouse. Present optical disc systems are sold by a handfull of specialized firms such as Filenet of Costa Mesa, California. These pioneering

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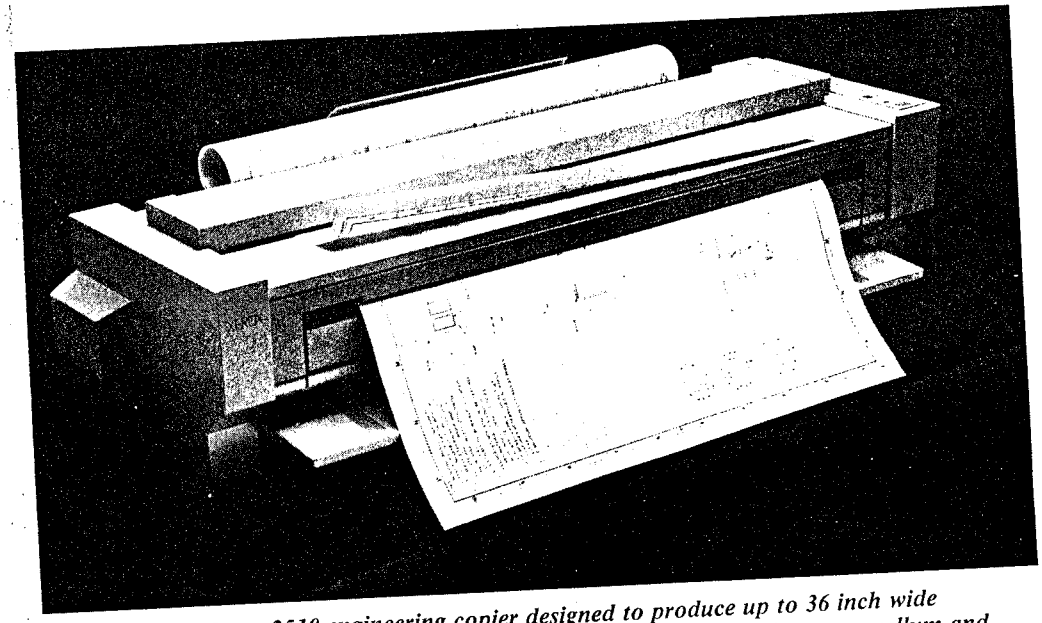
firms have recently been joined by such industry leaders as, AT&T, 3M, Tab Products, Minolta and Canon. Other microfilm and computer firms including Bell and Howell, Eastman Kodak and IBM appear to be readying some type of system for introductions in the next few years.

• The development of new types of document transmission and editing systems will dramatically increase communications and other functions within large design and engineering organizations. One example is a device already sold by Versatec, a division of Xerox. This device scans a microfilm aperture card to generate a electronic image that can be transmitted quickly to a remote printer/plotter or be displayed on an editing work station. The scanner works very quickly since it does not have to do the raster to vector conversion, which is necessary on most wide scanners used for data base conversion.

• Drawing restoration will have many new tools using both analogue and digital techniques. Presently, traditional process cameras, microfilm equipment and xerographic printing equipment are used in most drawing restoration. It is possible, for instance, to delete unwanted background and enhance line density by using any of the above systems.

Intelligent Reprographics

The future is going to be more diverse with more tools for drawing update and restoration in both the reprographics and design areas. Some of these tools have already been mentioned. Two of the most exciting are, the intelligent copier/printer using low cost scanning technology and the flatbed raster to scanners. These later devices are produced by a wide variety of companies, including Optigraphics and Tektronics. They can digitize a drawing for input into a CAD database, allow an operator to do editing or restoration at a CRT, and convert most or all hand lettering to data using OCR software.



The Xerox 2510 engineering copier designed to produce up to 36 inch wide copies of originals, sepias, bluelines and composites on plain paper, vellum and polyster film

These systems are exciting but time-intensive. Eventually, artificial intelligence and more sophisicated digital processing techniques will speed the process and lower the hardware and personnel costs. Even more exciting to a typical design in a reprographics department is a likelihood of a fully digital scanner/copier system that would allow high speed scanning enlargement and reduction, cut and paste, editing and restoration functions automatically or with a minimum of operators intervention.

• An additional ongoing trend will be the continued automation of specification and bid printing in narrow formats. Current high speed copiers and duplicators already process tremendous amounts of intelligence to manage and process complex print jobs. This trend towards more sophisticated paper handling and finishing equipment as well as more intelligence will continue with no limits of application over the next few years. In addition, it is likely that some of the power of image scanning technology and laser printing will be coupled with the power of these highly intelligent duplicators at more affordable price ranges. This will allow outside service organizations as well as larger in house shops to offer faster and more professional service. These devices will be capable of merging variable graphics data from floppy disc or magnetic tape with text and generate complete high quality typeset documents. There is no technology on the horizon that will obsolete this type of system.

For the architectual engineer who wants to do things affordably and differently, communicate your interest and needs directly to major vendors and product planning staff's by letter. Often, these organizations are hungry for insights concerning user needs, new or improved products. Usually, the wants of large organizations are easily discovered, while the desires and needs of the small design office seldom get heard.

Finally, it's important to bring in outside professionals for management and technology audits at least every one to two years, in the case of large organizations, and every five years for smaller companies. This is important to bring fresh ideas and perspectives to old or nagging problems. I have found in the past that there is a tremendous amount of interest among users in making new or different applications of their technology, about which the users had been told by major vendors were impractical or impossible. Yet, one thing you learn in Silicon Valley is that anything is possible if the user is determined to find the correct technology. As always, the secret is in knowing where to look for the solution.

Robert Conrad *is a management and marketing consultant, author and lecturer on a variety of management and technology issues. He is a founder of* Aspen Consulting Group *of Los Altos, CA. He has twenty years' experience in the field of imaging and graphics.*