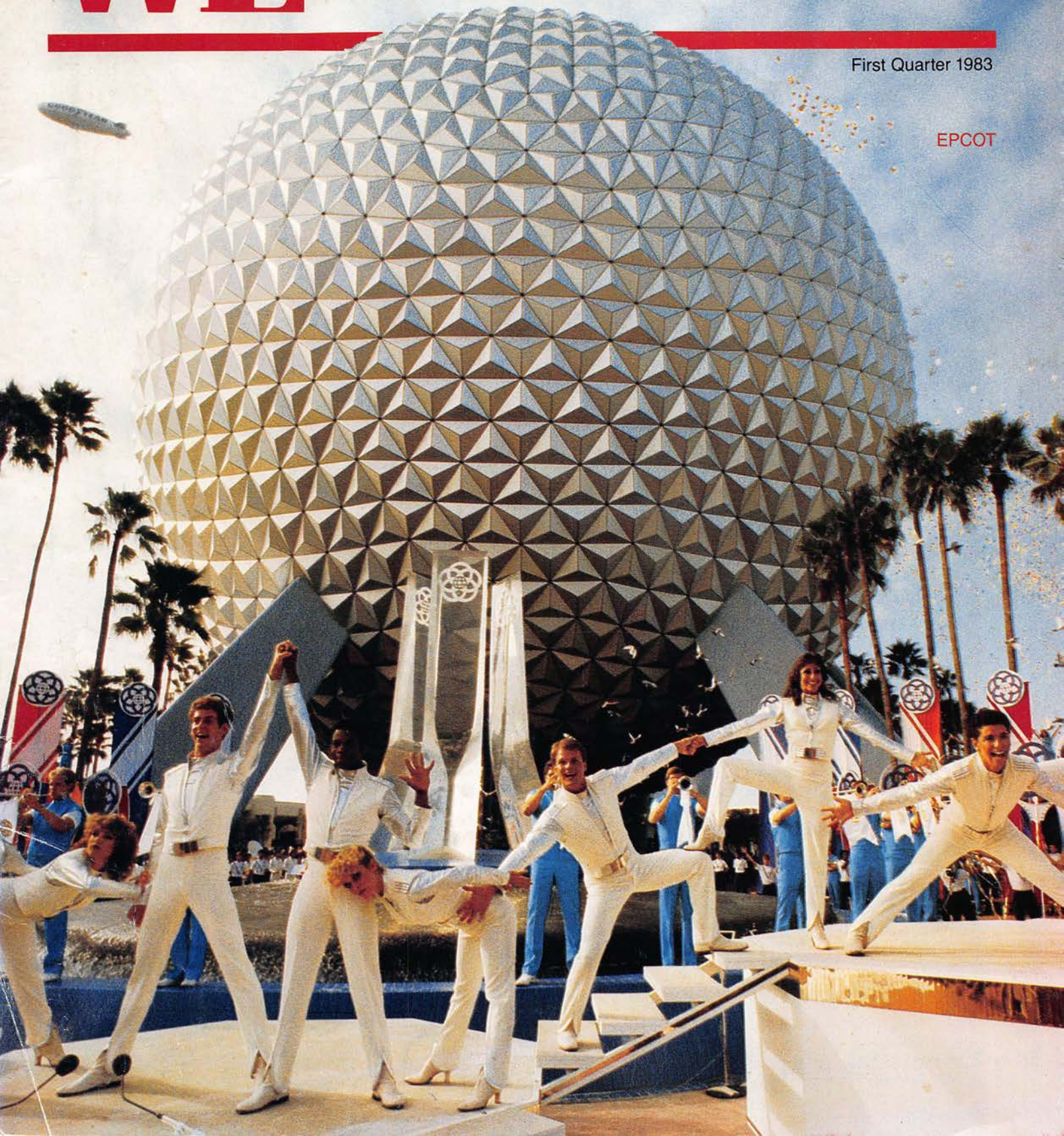
Western Electric

# WE

First Quarter 1983



EPCOT

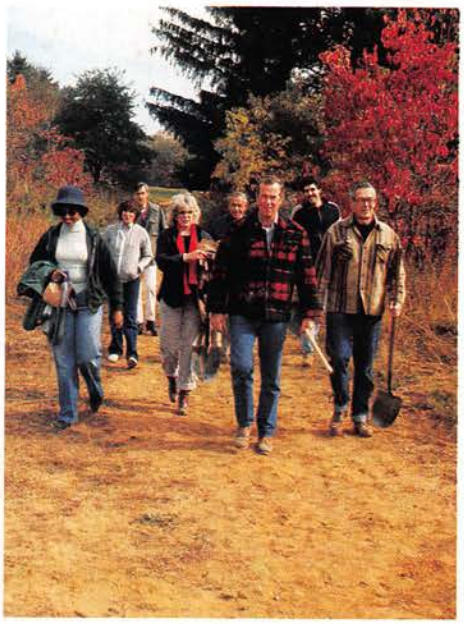
# WE People

*Gerry Sellar, president of the North Jersey Council of the Thayer Chapter of the Telephone Pioneers.*

## North Jersey Pioneers win a race against time and the bulldozer.

Armed with shovels and gloves, Gerry Sellar, president of the North Jersey Council of the Thayer Chapter of the Telephone Pioneers, and a band of Pioneer volunteers, headed for the hills of New Jersey's Watchung Reservation. Bundled against last November's cool morning air and ready for a hard day of work, this crew was on their way to dig up trees. Their mission was to rescue trees that were about to be turned under by bulldozers making a path for a new section of a highway.

It took 30 Pioneers from Western's Purchased Products Inspection and Engineering organization in Springfield, New Jersey several Saturdays last October and November to accomplish their task. Working in cooperation with the Union County Parks and Recreation Commission, the group dug up specially marked oak, black birch, white ash, black oak and dogwood trees that stood in the five mile path that would soon link Route 78. Assisting in the tree removal process were some of Western's forestry experts who have had the daily responsibility of assuring that the trees that are used to make telephone poles are of the highest quality.



*These Pioneers head for the hills.*

The end result of the group's massive effort: 350 sapling trees—at, including labor, an estimated value of $100 apiece—were removed to the Reservation's nursery where they are being cared for until they can be transplanted elsewhere in the Park.

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## On the Cover

At the Bell System's Spaceship Earth, the Walt Disney World Dancers join in the opening day ceremonies for Disney's latest theme park, the Experimental Prototype Community of Tomorrow (EPCOT) in Lake Buena Vista, Florida. For more, see page 28.

**WE**

**WE** is published for employees of Western Electric. President: D.E. Procknow; Secretary: F.C. Childs; Treasurer: R.E. Ekeblad.
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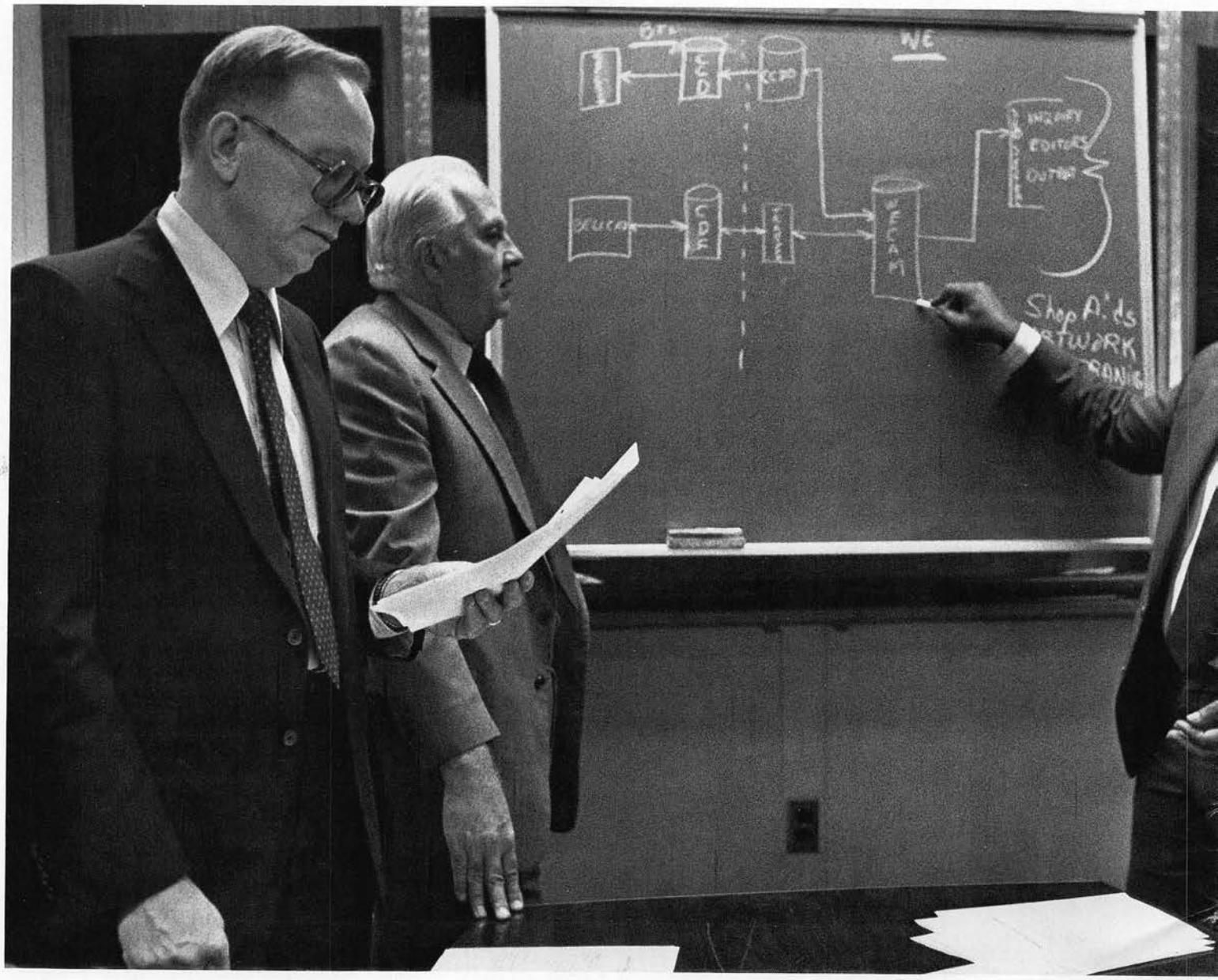
Western Electric

# Computerization Is the Name of the Game




*Photos by Tom Weber*

*The topic is WECAM. (From left) Art Ehlenberger, Carl Imbriglio, Harold Harris and Joanne DiGiovanna.*

*Linda Boucher has been heading the Merrimack Valley Works' contingent of the WECAM project.*

# *And standardization is the way we'll play it*

**By Saul Fingerman**

We live in an age of acronyms, most of which mean no more to us than the glutinous clumps of letters randomly formed in alphabet soup. Usually, we ignore them or forget them as quickly as possible. This is unfortunate, because the letters often stand for a lot more than they actually say. Take CAD, CAE and CAM, for example. On a literal basis, they stand for computer aided design, computer aided engineering and computer aided manufacturing. Implicitly, however, they spell out some of the most important elements in Western Electric's and Bell Labs' ability to meet customers' demands in the intensely competitive years ahead.

The common element in all three acronyms is *computer*, and that, as they say, is where it's at. Collectively, the three acronyms add up to a systematic technique for decreasing the design-to-manufacture interval, improving quality, increasing productivity and holding down costs—all with the help of computers.

Since Western Electric and Bell Laboratories have been using computers for over 30 years, readers may understandably wonder, "What's new?" Well, actually several things, one of which is, a computerized system that will ultimately eliminate mountains of paperwork and make the creation, storage, transmission and retrieval of all kinds of engineering information essentially a matter of pushing buttons on a terminal's keyboard. Not surprisingly, the system has its own acronym—WECAM, for Western Electric Computer Aided Manufacturing. Its aim is to mechanize many of the processes that support the engineering and manufacture of our products.

The WECAM concept is the result of the Corporate Engineering Division's response to recommendations from a task force consisting of engineering directors from each of the manufacturing divisions. Calling itself the Engineering Leadership Task Force, this group was formed to strengthen engineering in Western Electric. One of its recommendations was that the different, and, sometimes, redundant, engineering software systems used throughout the company should gradually be replaced by a single, standardized engineering system.

To bring this system into being, an initial cadre of 21 technical professionals was formed at three Western locations—Merrimack Valley, the new Network Software Center and Columbus. To stress the companywide scope of their mission, these people all report to Harold Harris, an assistant manager in the Corporate Engineering Division at Headquarters in New York. Included are "authors" of some of the very same software that they will be incorporating into WECAM—which is precisely why they were chosen.

WECAM's project manager at Headquarters is department chief Art Ehlenberger, who spends much of his time coordinating the efforts of the many and varied development activities needed to bring WECAM into being.

"Western locations have been developing software for over 25 years," he says, "and there's a lot of it out there. What we're doing is taking the best of it, enhancing it, and coalescing it into a comprehensive, standard system to meet the needs of all manufacturing locations."

All of this is easier said than done. What's involved is not simply a matter of cutting and pasting. One of the problems is that programs often reflect individual idiosyncrasies of their creators. Different locations often use different formats, different codes and, quite often, different meanings for those codes.

"It's like the different definitions of a word in a dictionary," says Ehlenberger. "If one person knew only the first definition; a second person, another; and a third person still another, they'd have one heck of a time trying to communicate."

# A Commentary on Computerization

**W. B. Marx, Jr.,**
**V.P., Corporate Engineering**

Whimsical as it may be, the title of this article is substantially true. Computerization is, in fact, the name of the game for Western Electric, and I would be hard put to visualize a successful future without it.

It's clear that the most challenging tasks we face are to choose new products wisely and then significantly shorten the time it takes to design and manufacture them. It's also clear that doing this will require not only computers—which we already have—but their optimum use in an integrated, companywide system.

When we first introduced computers into our manufacturing operations, we programmed each of them to do its own, individual job—often the control of a specific manufacturing process. Simultaneously, we were introducing them into office functions such as payrolls and personnel record keeping. In time, they worked their way into test systems for equipment much too complex for manual testing and, finally, into almost every conceivable kind of record-keeping associated with the manufacturing process. In short, they helped optimize many individual functions throughout the company.

If you think of that period as Phase I, then Phase II, which is already under way, will be the optimization of all those functions into an integrated, companywide system with compatible interfaces and a common information base. The WECAM system described in these pages is just one facet of the massive effort we are devoting to bringing this system into being—a system that, thanks to synergy, will inevitable be greater than the sum of its parts.

Our success in the years ahead will depend on a lot more than staying at the leading edge of microelectronics, photonics, software and digital techniques. Simply being ahead in new technology doesn't guarantee success. It will also take speedy and cost-effective conversion of that technology into new products and services—and that, in turn, will take accuracy of information. People are, after all, only as good as the information they get.

A good strategy for any company has always been to build on its strengths. One of our most valuable is our reputation for high quality—an intangible asset for which we spend a lot of money every year. What that money really represents is the high cost of inaccuracy. If everything we made or bought was perfect, we wouldn't have to inspect, test, rework or junk anything, and we could cut the cost of our products dramatically. What it boils down to is this: The more we can use computers to improve accuracy, the more we can reduce the cost of quality.

It will be a long, evolutionary process, and some of it will take a fair amount of adjustment or getting used to. But technology has always been synonymous with change, and Western Electric people have been taking change in their stride for over a hundred years. Only ten years ago, we had a special class of people called *programmers*—a breed apart who imparted intelligence to computers in mysterious ways. Today, however, you see people in engineering, accounting, personnel and manufacturing interacting with computers on a routine basis. And with the present pace of technological change, I doubt that it will take another 10 years until computer terminals are an integral part of most of our desk and work positions.

There's also the sticky problem of reaching agreement on just exactly what a companywide system should include. Les Newill, Manager, Engineering Information Process Development, puts it this way: "The computer," he says, "is a little like the fabulous genie in the lamp. Everybody knows how to rub the lamp and summon him forth. But then what? How do you direct that enormous power to solve your problem? For years, everybody has been using the genie differently. Well, what happens when you want to transfer some product from one plant to another, and the plants are using different software to control manufacturing processes?"

Facilitating such transfer is one goal of the WECAM group. WECAM's standardized structure will make it relatively easy to transfer engineering information from one plant to another. This could help in balancing work loads.

One of the departments working towards this end is the Merrimack Valley contingent headed by department chief Linda Boucher. Pointing out that her group is almost evenly divided between information systems people and engineers, she observes that, "there are two kinds of people working on WECAM: There are engineering people who have learned software, and software people who have learned engineering."

Boucher falls squarely into the latter category. As a systems software engineer for a large computer company, she developed computer systems for insurance companies. In 1978, she came to Western Electric, and since last April, she has been concentrating her considerable talents on WECAM, using an approach she calls *structured methodology*. "First, we define requirements," she says. "Then, we use those definitions to design a system. Next, we code programs and test them. And, finally, we implement them at the locations. Right now, we're moving into the system design stage."

"Our target date for the first operating version of WECAM, which we're calling Generic A, is early 1984," says Walter Schaeffer, the department chief heading up the Columbus and Network Software Center groups. He adds that a later, more comprehensive WECAM is referred to as "Generic B," —presumably to be followed by later revisions.

Why is the group already thinking about later versions of WECAM? Schaeffer explains: "We have an awful

*Developing a system as complex as WECAM requires a lot of attention. Here, Corporate Engineering's Les Newill and Al Maone check progress.*

lot of users, and it takes a lot of time to reach agreement as to requirements. If we aimed for 100 percent the first time out, we'd never meet our 1984 deadline. So, we're trying to be realistic by aiming for about 80 percent for the first cut. We look at new ideas and requirements, and if we see that they will take a lot of time and resources, we schedule them for a later generic."

The fact is that no software designed to be used for a long time is ever 100 percent complete: Changing conditions, technological advances and new requirements make every program an ongoing project that requires continual changes. Computer people call such changes *software support* and *maintenance*. This simple fact points up another one of WECAM's many benefits. Because only one system will have to be supported and maintained, these activities will cost Western a whole lot less money once WECAM goes on line.

Planning for later generics is the responsibility of Al Maone, another assistant manager in Corporate Engineering at Headquarters. His group works closely with knowledgeable people in other divisions and locations to make sure their needs are conveyed to the WECAM developers.

For Harold Harris at Headquarters, the most challenging aspect of his assignment is having to accommodate the different needs of many CAE/CAM users at all locations. "Add that to having your development people in different parts of the country," he says, "and everyone's management and coordination skills had better be pretty good." Smiling, he adds, "If we could put all the people involved in one room, communications would be a whole lot easier."

Since that isn't possible, the next best thing is having a project manager who spends as much time as necessary with the different groups—which is why Art Ehlenberger is on the road or telephone so much. Adding to the problems of having so many inputs is the fact that WECAM will not be a single program but rather a complete *family* of programs, all of which have to work together harmoniously. A vital member of this family is a totally unpronounceable acronym—CCDB, which is being developed by Ron Whalin's group in the Electronic Components Division under delegation from Corporate Engineering.

CCDB, which stands for Corporate Component Data Base, will be a computerized source of component information such as cost, reliability, electrical characteristics, dimensions and so on. Through WECAM, it will interface with a Bell Labs' software system called *SELECT*. CCDB will provide Bell Labs designers with information on the components Western would prefer them to use. In addition, CCDB will supply WECAM with standard engineering and manufacturing data on components.

Located at Southgate, N.J., Whalin is Manager, Divisional Information Systems Development in the Electronic Component Division (ECD). His group is creating a comprehensive system that will incorporate just about all of the ECD's software needs and capabilities. With some 136 ECD development people working on information systems, there has been a tremendous amount of software generated over the years. Whalin's mission is to pick out the best, enhance it, and tie it all together into a single, division-wide system that will standardize management and manufacturing processes for components and devices. The benefits of this massive effort are similar to those WECAM will provide for the engineering community—namely, easy transfer of data, reduced maintenance, and elimination of the costly redundancy that goes with people re-inventing the wheel at different locations.

Among other things, Whalin is working toward equipping all ECD shops with computer terminals. (See page 6.) "It's especially important to eliminate paperwork in our division," he says "because paper is a contaminant to which integrated circuits are very sensitive." Paper does, in fact, produce a deadly fallout in the microcosm of these tiny silicon chips, and anything that eliminates its use is a big plus.

"Another thing we have to do is speed up the movement of materials through our shops," says Whalin. "Our strategy is to use computers to minimize inventory and maximize material flow through."

His animated conversation is punctuated with references to numerous charts. Holding one up, he explains, "We have software for providing computer assistance for the entire integrated circuit manufacturing process, from initial analysis to final shipment, and it's all being combined into a single network, or *spider*." The chart he's holding does, in fact, resemble a spider, with each of its many legs leading to a different system. Some of the names are intriguing. There's MAMAS, which orders material when needed; PASS, which tells managers if they have enough manpower and equipment for any job; and FAC-MAN, which manages the installation and maintenance of all types of manufacturing equipment. The spider's legs even run to accounting, payroll and personnel programs. Why personnel? "The computer might want to know if a particular employee is qualified to operate a particular machine."

"What we're really doing," Whalin concludes, "is turning our hardware shops into software shops."

Les Newill sums it up with elegant simplicity. "This," he says, with a broad sweep of his hand that takes in WECAM and all of its computerized relatives, "is the future of engineering in this company."

# Computers in the Factory

## *Computers help out with just about everything we do*

The pictures on these pages were all taken at the Allentown Works, but the message they convey speaks for the entire company. That message is that virtually every phase of the design, maintenance, and manufacture of our products is receiving some form of computer assistance.

Efficient and tireless, these intelligent machines are already controlling thousands of manufacturing processes throughout Western Electric. Others are guiding human operators through difficult procedures by flashing instructions on television screens at their work stations. Still others are monitoring every stage of a product's progress through various stages of manufacture, pinpointing problems so they can be quickly corrected. And still others perform complex tests on completed products.

In many cases, the computers aren't simply doing something better or faster than human operators, but, rather, they are doing something that just wouldn't be possible without their able assistance.

Take, for example, the computer-controlled equipment called EBES, which stands for Electron Beam Exposure System. Before EBES, the masks used to fabricate the intricate web of tiny details of each layer of an integrated circuit could be made only by a much more elaborate array of optical and photographic techniques. These limited the extent to which circuit features and interconnecting paths could be reduced in size, which, in turn, limited the number of components that could be packed onto the already crowded "real estate" of the tiny silicon chips.

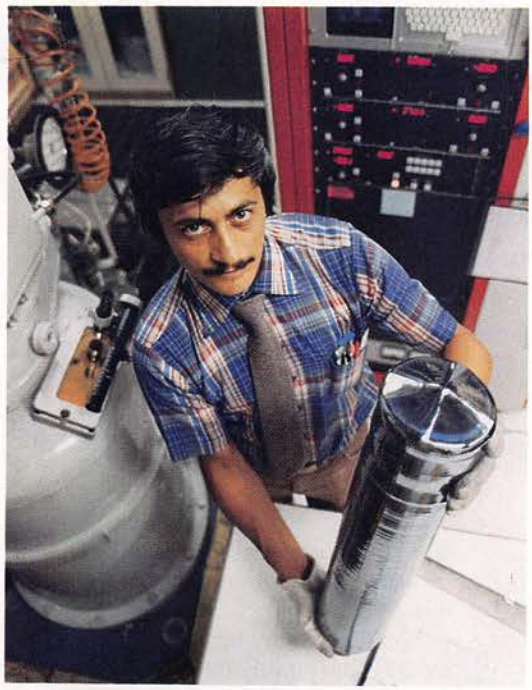
Now, with EBES, the masks are "drawn" by a beam of electrons, very much as the picture on your TV set is drawn—with one staggering difference. The dots that EBES uses to draw its pictures are so small you can fit hundreds of them into the diameter of a single human hair. Called *pixels*, these tiny dots make it possible to create masks with circuit features so fine you need a high-power microscope to see them. EBES is, in fact, one of the reasons people are talking seriously about putting over a million components onto a single chip in the not-too-distant future. It is also a process that would be totally inconceivable without computers.

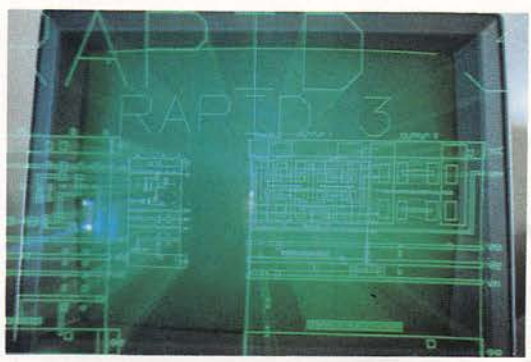
Another such process is the laser repair of solid-state memories like the 256K RAM now in production at Allentown. These memories, which are another milestone on the way towards reaching the one-million mark for numbers of components on a chip, consist of rows and columns of memory sites arranged to intersect each other like streets and avenues. Individual memory sites are accessed by using the coordinates of the intersections as "addresses." Each 256K chip is made with several spare rows and columns, any of which can be substituted for a defective one.

Under the control of a computer, a laser unerringly removes defective rows or columns by melting the "fuses" that connect them to the rest of the memory and then connecting spares as needed. Since the topographical features of the 256K memory are measured in millionths of an inch, no human operator, no matter how adept, could possible carry out such repairs. Thanks to this computerized repair technique, yields of our 64K memory chips increased by several hundred percent, and the same should hold true for the 256K chips.

Computers not only control man-

*Photos by Joe Gazdak*





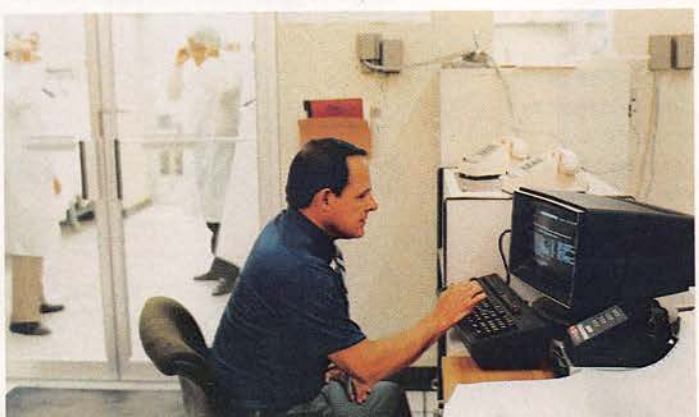

*Top. Bob Lavigna holds computer-grown silicon crystal that will be sliced into wafers like the one on the next page.*

*Above. Rapid 3 software helps engineers design masks for integrated circuit making.*

*Right. Seated near computer terminal, Meredith Young inspects an integrated circuit mask.*

*The mirror-like sheen of this silicon wafer was created by a computer-controlled process.*

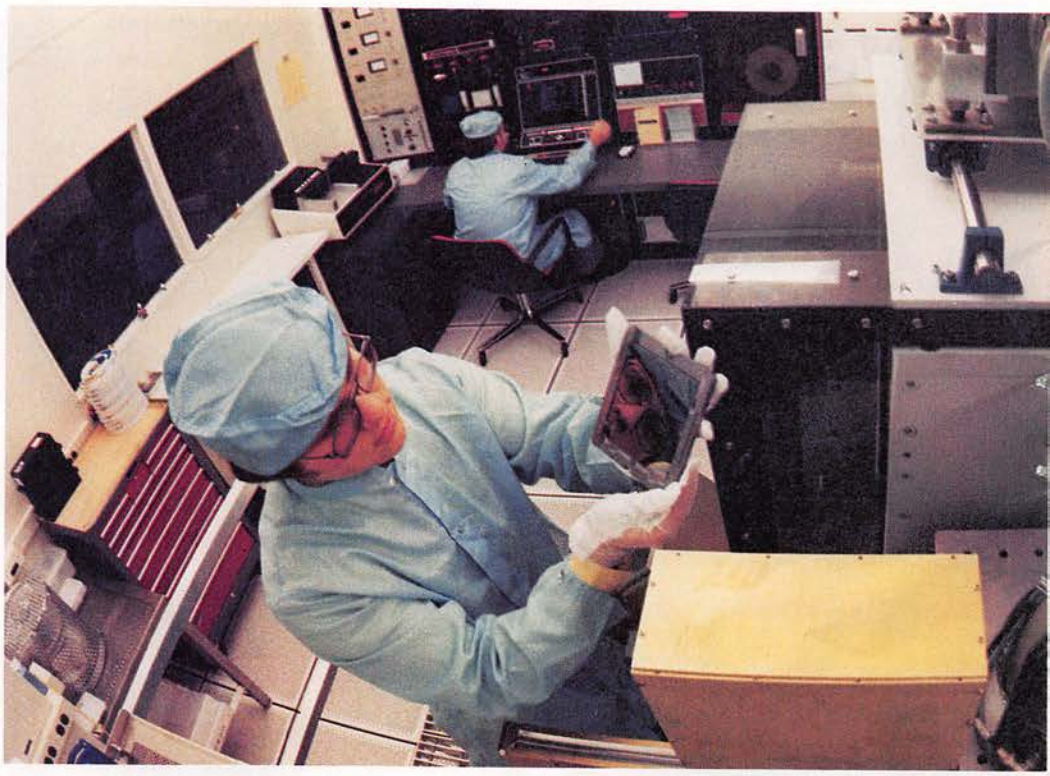
*Below. Programs are stored on tape reels like the one being changed here.*



*Above. Tony Barbera (left) and Tom Herceg man the Mask Shop Computer Information System.*
*Left. Gary Urban's computer terminal helps him keep track of wafers.*

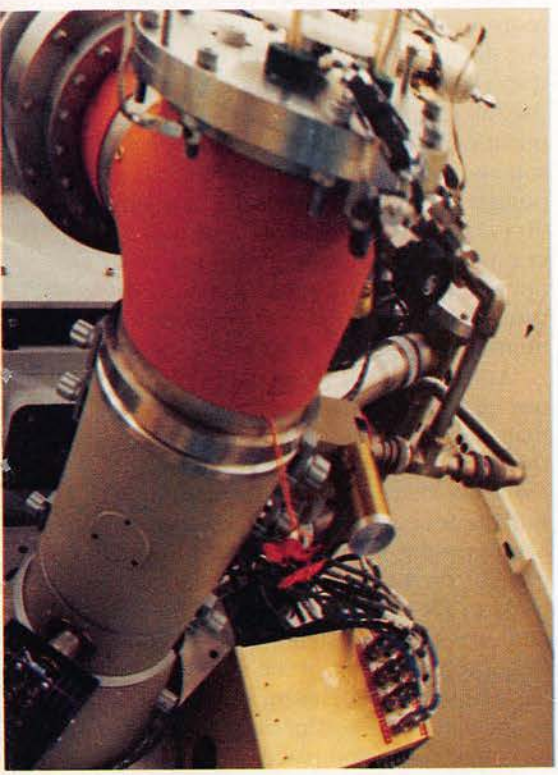
*Above. Allentown's engineers write programs in this Mini-Micro Computer Center.*

*Right. The mask Terry Zavecz is holding was "drawn" by an electron beam.*



*Left. Testing integrated circuits. Ray Baker at terminal. Behind him stands Eleanor Piccin.*

*Below. Computer terminals help process checkers Mae Louise Cross and Emma Talaber.*



ufacturing processes, but, in some cases, receive their instructions from other computers higher up in the hierarchy of mechanical intelligence. The WECAM system described in previous pages will, for example, do more than provide engineers with graphics and print information. Its centralized computer will also generate instructions for some of its smaller siblings in manufacturing shops.

In similar fashion at Allentown, two Western Electric 3B20 computers act as "host" computers for numerous process control and test functions in shops throughout the plant. Instead of having to make software changes for dozens of individual test or process control computers, Allentown engineers only have to make changes in the two host computers. If you're curious as to why *two* host computers are used, it's to avoid downtime on production lines. In computer terminology, the two 3B20s are *co-located*, meaning that one will back up the other should it develop a "headache."

Operators in Allentown's clean rooms will soon be getting their instructions and check lists from TV screens rather than from the clipboard sheets that are so hazardous to the health of integrated circuits. The computers providing these instructions will also prevent operators from making costly mistakes, such as putting the wrong batch of silicon wafers into the wrong machine at the wrong time. Each batch will have its own bar code, similar to the ones you see on packaged products in supermarkets. Computers will read these codes and "lockout" any mis-step in the lengthy sequence of operations that turns the wafers into functioning electronic circuits.

By this time, it must be clear that Allentown has a whole lot of computers doing a whole lot of different jobs. There are, in fact, over 140 minicomputers and several hundred microcomputers at the Allentown Works. The figure for microcomputers is on the vague side, because so many of the micros are "embedded" in purchased equipment and hard to count. However, if any one man would know, it would be an amiable department chief named Bill Kilpatrick, who heads up Allentown's unique Mini-Micro Computer Center.

This is a roomful of computers in which engineers can develop or upgrade software without tying up shop computers. Not only has the Center drastically reduced downtime on production lines, but more economical computers can be used in the shops, because they no longer need the additional memory required for software development.

Asked why the Mini-Micro Center had so many different kinds of computers, Kilpatrick explained that computers are like people. "Some of them are better for certain tasks than others. A computer that's good for graphics may be inefficient for word processing—and *vice versa*."

Kilpatrick wasn't always so knowledgeable about computers. Back in 1965, he headed a test group that brought in Allentown's first minicomputer. For a while, he admits, it was an uphill road in alien territory. "I grabbed all the computer books I could find and started studying like crazy."

Apparently, he learned his lessons well, because, in addition to running the Mini-Micro Center, he has created a fair amount of software since then. Not surprisingly, he is a firm believer in computer training. "Nowadays," he says, "most of my engineers go to the CEC or they take courses offered by computer vendors."

After a moment's reflection, he concludes, "An engineer who isn't computer knowledgeable today is probably not running at full capacity."

# The Data Designers

## *They may publish more "How-to-Do-It" literature than anyone in the world*

Engineers can create a product and marketers can sell it but if the customer doesn't know how to operate it, it's useless. Rarely thought of, yet vitally important, are those people that write the user guides that accompany many of today's products. Within Western Electric, an entire group, the Data Design organization in Winston-Salem, North Carolina, is devoted to assuring that employees and customers understand how to use Western's equipment to their greatest advantage. And, as the technology that creates Western's products becomes more sophisticated, so does the work of the Data Designers.

There is some documentation connected with just about every product that is made. It may be a sheet of assembly instructions enclosed with parts in a box, or a series of instructions stored on magnetic tape that explain how to use a complex software system.

The Bell System is world famous for the thoroughness and extensiveness of its documentation. To meet the Bell System's vast need for documentation last year, DDO's 540 writers and 116 editors created some 329,000 pages of documentation—from which more than 569-million page impressions were distributed. If you were able to gather all those pieces of paper together and put them into one stack, you'd need a step ladder 35 miles high to put the top sheet, on the pile.

Since June 1, 1982, the Data Design Organization has been part of General Manager Jack Pursel's Marketing and Sales Development and Support Organization. For a year and a half prior to that it had been part of Material and Account Management, and earlier, in the Government and Commercial Sales Division.

The organization now known as DDO came into being about 1952. For the first 10 years of its existence it was known as Technical Publications. Located in downtown Winston-Salem on 4½ Street, its function was to prepare technical manuals for equipment we produced for the military services, such as radar or sonar.

In 1962, a 90-day pilot program was suggested by Technical Publications Manager Chuck Deleot that resulted in AT&T asking us to take over the writing and production of Bell System Practices (BSPs). The BSPs describe in exacting detail anything anyone could possibly want to know of a technical nature about the theory and operation of the telephone network, from how to climb a utility pole and what to carry with you, to how to trouble shoot the latest No. 5 ESS. There are more than 25,000 different practices, some of which originated as early as 1925. Most of them, however, are updated as of the current year so that the whole library is in a continual state of flux.

At about the time when production of BSPs was undertaken, the organization moved into the building at Reynolda Road in the northwest area of Winston-Salem close to Wake Forest University.

While the writing and production of Bell System Practices (BSPs) still constitutes the major work of the Data Designers, special services including software guides, marketing catalogs, sales brochures, technical presentations and slide talks are becoming increasingly important not only to DDO, but to anyone in the company concerned about selling our wares on the open market.

"Two aspects of our job are changing and will change even more as the reorganization of the Bell System proceeds," says Gordon Lahey, Manager, Engineering-Data Design. "One is the audience to whom our publications are directed, and the other is the tone of these publications. We're becoming more marketing oriented. Whereas our documentation used to come after the sale, now it's a vital ingredient in the sales process. And it has to be meaningful not only to the craftsperson and engineer, but also to the purchasing agent and planner. Roughly 90 percent of our readers used to be craftpersons and engineers in the Bell operating companies. With the divestiture of the exchange companies, those numbers are bound to change."

"At the moment about 30 percent of our effort goes into projects other than the BSPs and it seems likely that this aspect will grow," says Bill Voiers, Assistant Manager-Documentation, Billable Services. "One of the biggest problems the software designer has today is documentation," he continued. "He can develop programs, but he needs help in teaching others how to get the most out of the system that has been designed. It's an area almost as specialized as that of designing the program in the first place.


*A cross section of the staff at Reynolda Road. Each person represents about 100 co-workers. Back Row, left to right: Will Willard, pressman; Glen Mitchell, Department Chief; Lee Powell, senior technical writer (project coordinator); Bill Debnam, photo technician; Shirley Swearington, data entry equipment operator. Front row: Tootsie Morton, assignment coordinator (print shop); Barbara Harrison, technical illustrator (computer graphics); Jane Ingram, editor; Sam Peters, technical writer; R. S. White, cover artist; John Vogt, senior computer operator. Foreground: Teresa Ball, data entry equipment operator.*

"You must understand," Voiers continued. "In this case we're not designing the software. We're developing the documentation — the user guides — those sorts of things. That's our area of expertise — making the product or service useful and usable by the customer. That's not easy. You're dealing with many different levels. What may be good user documentation for a clerk typist may be useless to an engineer or a manger."

But this too is changing. At least we're in the early stages. More and more telephone operating functions are computerized. The system itself indicates on a CRT where and when it needs attention. The book in the office will be backup.

"The direction we're heading," Gordon Lahey said, "is toward putting more and more user guides on-line. Then the user can determine and access from a terminal only that portion of the documentation that is needed. Instead of looking it up in a book, the user types out a few instructions on a keyboard and a few seconds later — voila! — The requisite information appears on the TV screen. Moreover, it is a lot easier to update this computer based information. A lot of paper and a lot of time is saved."

What Lahey was talking about is not something far off. It is here now. While we were interviewing Glenn Mitchell one of his people came in to report: "I finished shipping the Human Factors Engineering Handbook today." What he had done was to transmit the documentation in to the customer's computer in Bedminster, N.J. There was no exchange of papers whatsoever.

Lahey summed it up: "we demonstrated in the past that we were in the forefront of the documentation business with computerization of typesetting and computerization of graphics (our MAGIC ™ documentation support system). Now we're taking a giant step to computerization of text — leave it in the computer — why put it on paper at all?"

# The Data Designers

*Cover Artist R. S. White has been with the group for 30 years. He started when they were located downtown on 4½ Street and their main product was manuals for military equipment.*

*Editor Jane Ingram discussing a problem with Senior Technical Writer Lee Powell, who acted as project coordinator on the software user guide project. Jane is concerned primarily with sentence structure, grammar, spelling and format as contrasted with technical content.*

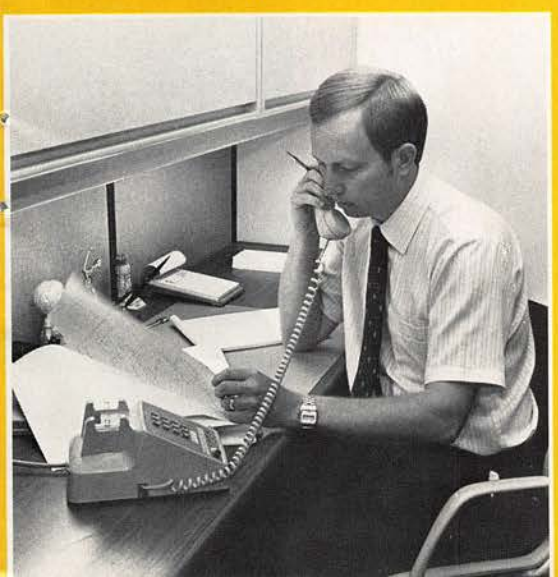
*Photographer Bill Debnam shoots 500 to 600 negatives a day on this huge Borrowdale enlarging and reducing camera. The negatives serve as printing plates for most jobs.*

*Barbara Harrison has been an illustrator with Western Electric for 15 years, the past six using computer graphics. A complex drawing can be done in 45 minutes if she has a photo or tracing to work from. Complicated drawings with poor visual references can take a week.*

*Senior Computer Operator John Vogt handles all of the typesetting and a lot of graphics on his computers. He has up to 80 different jobs running at any particular time.*

*Shirley Swearington is known as a data entry equipment operator. Her job is to type the text on the computer terminal keyboard and insert the appropriate formatting commands for computer typesetting.*

*Technical Writer Sam Peters has been with Western for 13 years. Source material for his projects comes from Long Lines designers, programmers and engineers with whom he consults in person and by telephone. He preserves the interviews on tape and collects any written matter his sources may have. Writing a user guide for a software project can take five to eight weeks. Most writers are not engineers, although most hold technical degrees.*

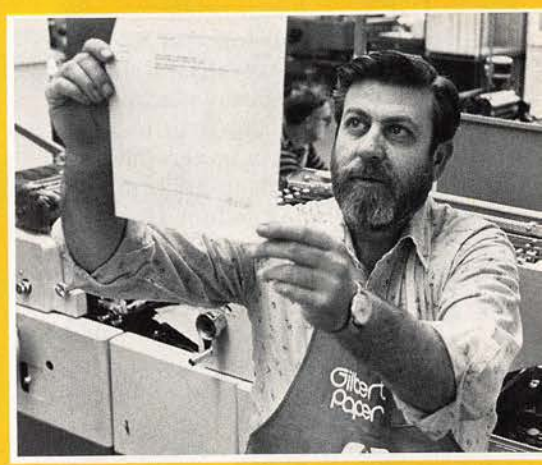


*Tootsie Morton, assignment coordinator in the print shop, is shown here lending a hand at one of the collating machines. Smaller jobs are printed in house, collated here, and then placed in loose-leaf binders for distribution. Big runs are printed outside and distributed largely through the Information Distribution Center in Indianapolis.*

*Glenn Mitchell is one of 30 Department Chiefs in charge of writing groups at Reynolda Road. Each department contains 20 or so writers, who specialize in one particular type of equipment. Glenn's area is software.*

*Teresa Ball is putting a new user's guide on line. A user perhaps hundreds of miles away can tap into his computer and pull off from a terminal what information he needs either on a CRT or a printout. This may be a glimpse at the future. It's easy to keep the guide up to the minute and it saves a lot of library shelf space and paper.*

*Pressman Bill Willard is checking that the printing is correctly oriented. His press prints one side then flips over the sheet and prints the other. The printing must be correctly aligned to allow sufficient space on the left for binding or hole punch.*



# The Many Faces of Software

**By Lydia Whitefield**

## *Software is the result of hard work seasoned with creativity*

The muted sound of fingers meeting terminal keyboards rises from the honeycomb of offices that characterizes the Network Software Center. Venture into that maze and you will find offices populated usually by two people, most of whom are staring intently at the images on their cathode ray tubes. Many appear to be so deep in concentration that they are able to shut out everything and everybody.

Like a conductor bringing a hundred instruments together to produce one sound, these writers of software programs are logically piecing together a guide that will give the hardware—the computer—all the information it needs to perform harmoniously a function. Like any writer, the creator of software refers primarily to his or her imagination for guidance.

The term software refers to all the ideas that create the languages, instructions and programs required to operate a computer. These ideas take form on memory devices such as magnetic tape, disc, punched cards or in integrated circuits.

At Western Electric, software, when properly married to its hardware, can, for example, set up the path for a call to be switched across the country, store messages for later transmission and check trunks for malfunctions.

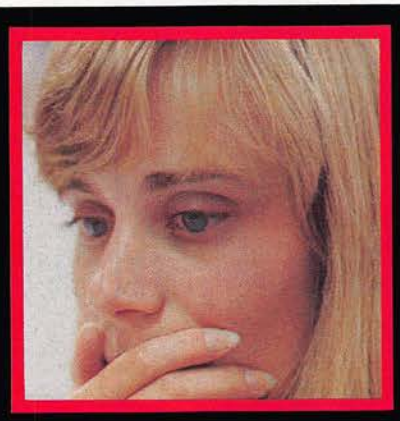
"Software development is a time-consuming, creative process," explained Ron Tevonian, director of Project Management at the Network Software Center. "Today, software is as vital to Western Electric's business as hardware. It is software that allows us to add features and to update many of our products. This type of modernization used to be a costly process involving the changing of wires, relays and other components. Software has given us the ability to make our hardware more versatile, and hopefully more attractive to our customers."

Western Electric has used commercially developed software to aid its payroll, accounting and manufacturing functions for the last 25 years. However, it was in 1965, when the first electronic switching system (ESS) went into service, that Bell System-developed software was introduced to the communications network. Since then, more than 2,700 ESS offices have been added to the network and are handling approximately 50 percent of the nation's telephone traffic.

In 1975 the first "intelligent" private branch exchange wholly controlled by an integral computer—the Dimension® PBX—was introduced. In the eight years since it went into service, 37,000 Dimension PBXs and 200,000 smaller systems have been placed in operation. Considering our "smart" terminals, together with the ESS network, the Bell System probably has the largest commercial software base in the world.

The software that controls Western Electric's communications systems is called "generic" software. The generic programs are the instructions that control and organize the activities of the hardware. Through the generic, features such as residential call conferencing, call forwarding and call waiting can be offered. It will be through the generic that future features like banking and shopping at home will someday be available.

There is a second type of software provided by Western called the Office Data Assemblers (ODA). It is the ODA that provides a massive file of information on the unique characteristics of each ESS or private branch exchange. It identifies the quantities and location of hardware components and provides



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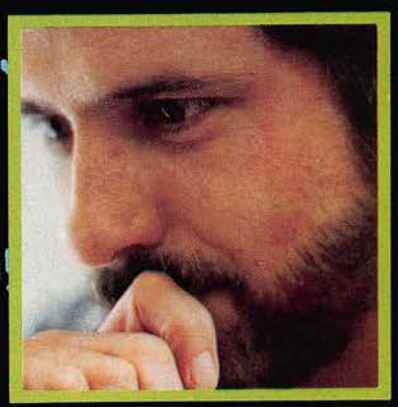

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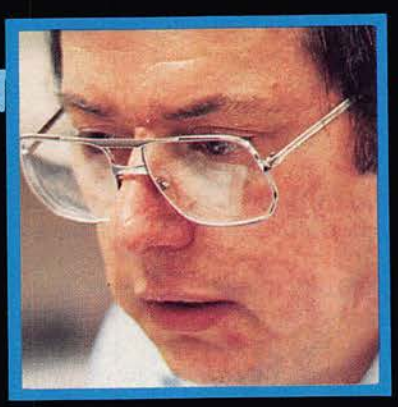


all of the customer-related data such as phone number and type of service.

The same generic programs can be used in similar hardware. For example, the generic for all No. 1 ESSs can be the same since the hardware in all these systems are similar. However, the ODA for each system is different.

Generic programs are developed by Bell Laboratories, although Western Electric is now responsible for some of the mature systems. The production of the ODA is handled entirely by Western Electric.

It is important to remember that there is not a single program that can perform all the functions required to process a call; in fact, while the end result of software development is several magnetic tapes, stored on those tapes is the information from hundreds of specifically written subprograms.

Imagine the task of the development team assigned the responsibility of creating software that can process thousands of calls simultaneously without a malfunction. To give you an idea of the immensity of such a project, Western Electric's long distance switch, the No. 4 ESS, requires 2 million lines of coded information to keep it running. Within the No. 4's memory there are instructions that, within a split second, can recognize what kind of equipment is in the 10,000 square feet of a central office, select one of the 107,000 trunks on 600 frames for the proper connection, define the characteristics of the trunk and send the call on the proper route. Throughout the entire process, diagnostic and maintenance subprograms are constantly working to insure that the call goes through uninterrupted.

This diagnostic software detects problems either in the hardware or call processing software and keeps the system running while sending messages to repair people. This portion of the generic may easily represent half of the software required.

All of these thousands upon thousands of instructions are individually entered by a programmer at a rate of 2 to 30 lines of code per day. To speed the job, the software is broken into a number of modules and divided among a group of programmers.

Surprisingly, this phase of software development—the coding of the information—is only 20 percent of the entire process. The majority of development time is devoted to establishing the requirements, creating a design and testing.

During the requirements and design phase, a development team determines how to meet the customer's specific needs. It is from the imagination of this group that new software features are actually created.

There are a number of questions that must be answered during this period. The group must decide how

*The Software Production group at the Network Software Center works, primarily, on the production of the ODA for the No. 4 ESS. They are one of several groups throughout the company that have the responsibility for producing ODAs.*

*This "code walkthrough" is one of the many periodic reviews that are conducted to verify that programs are being developed in accordance with their design.*


*Gloria Chriske (foreground) and Pat Crawford keep track of software schedules.*

the sub-programs will be built and how they fit and work together. The instructions needed to send the correct information to the computer and how that data will be structured are also determined.

Mistakes made during this phase are difficult and costly to correct if not detected until later. Therefore, the proposed design is reviewed by specialists ranging from system engineers to customer representatives.

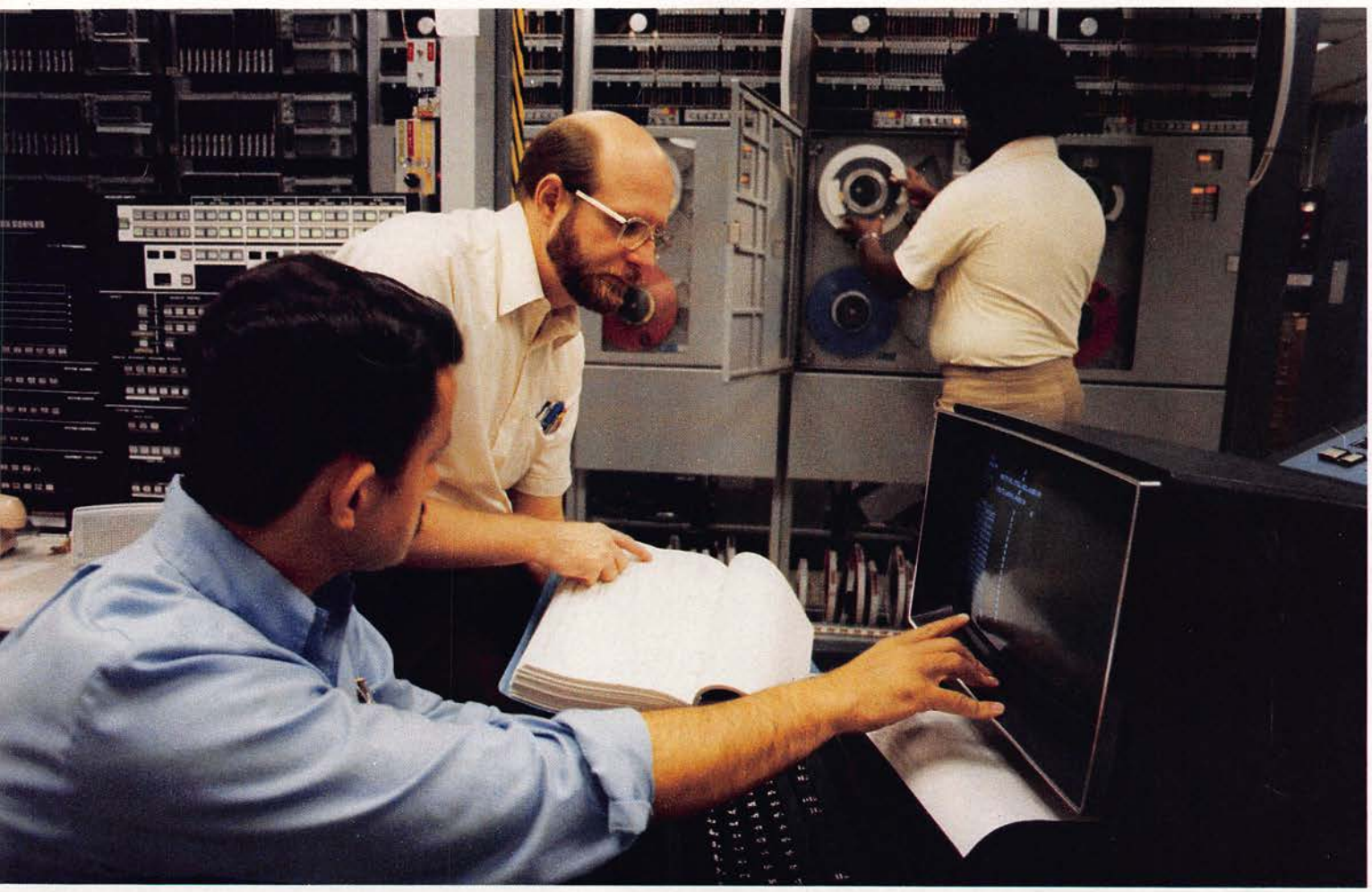
When the design is completed, the software is broken into pieces and divided among a team of programmers. At this point the newly written information is actually coded in a language that the computer will understand.

When the coding is completed, the pieces are re-assembled and the testing phase begins. Since there is a margin for error when the software is being pieced back together, exhaustive testing is of critical importance. One out-of-place piece of data and an entire switching system can be put out of service.

Recent statistics have shown that the testing has paid off. In a speech to the employees of the Network Software Center, Ian Ross, the president of Bell Labs, stated that "Bell System switching equipment has a record of one-thousandth of a percent of downtime. Compared to the one precent of downtime typical for commercial installations, we are a thousand times better than any commercial processor." It was a glowing testimony to the quality of Bell System software and hardware.

Still, industry-wide, software suffers from an image problem linked to ongoing productivity problems. The significance of the problem was underscored when Ross, in the same Software Center speech, predicted that, "Learning to manage software will be as revolutionary as the invention of the transistor."

"The Bell System has made great strides in software management," stated Dave Carbaugh, director of Network Engineering and Software Development at the Network Software Center. "We have introduced many structured methodologies to our de-



velopment process. However, there is still no way to automate the writing of a good book. The same is true in writing a good program."

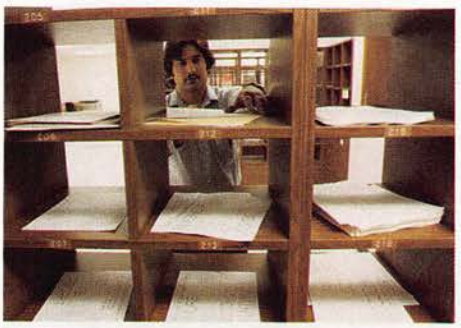
Tevonian added, "Part of the problem with the software industry is that in its early days, programming was approached not as a science but as an art. Early programmers were so intrigued by the power of their hardware and so enthralled in their writings, that the last thing on their minds was documenting what they were doing. The end result of their work was programs with amazing capabilities. However, if another programmer came along and wanted to make modifications it was virtually impossible for him to decipher the work. It was even difficult for the original programmer to remember what he had done in the early stages of the development and why he had done it. It was simpler to start from scratch. What was happening was that we were re-inventing the wheel. The industry has learned its lesson. Today, documentation is a way of life."

While he believed that part of software's image problem stems from the fact that "software lives largely in a world accustomed to the rigors of hardware manufacturing," Tevonian concluded that "Bell System software can only benefit from its hardware surroundings. Western Electric has successfully manufactured quality hardware for more than 100 years. Our reputation as a leading hardware manufacturer is unquestioned. As we learn to apply to software the same critical eye we used to make us a leader in hardware production, our management of software will grow, too, to be the very best."

If there is any question about Tevonian's prediction on the future success of Bell Labs and Western Electric software, one need only look at the commitment that is being made to the product. At Bell Labs, nearly half the staff is dedicated to software development. Last September, Western demonstrated its intention of staying on the leading edge of this growing technology when it opened the Network Software Center. Located In Lisle, Illinois, the entire five building complex is devoted to the development of software for the network.

However, the future capabilities of software still lies in the imaginations of the programmers. "I think what many of us are looking for," Carbaugh said, "is the communications software equivalent of the hoola-hoop. That is a product, like the hoola-hoop, that is inexpensive for us to develop that our customers will clamor for."

*Dan Driessen (sitting), Larry Mulcahey (left) and Leo Smiley (right) conduct a final test on software for an ESS.*



*Picking up printout is a daily routine at the Software Center.*

Where will the software hoola-hoop of the future come from? It's probably an undeveloped idea in the mind of some programmer right now. More than likely it will surface as the programmer sits at his CRT, locked in concentration, alone with his data and imagination.

*Fred Wallitsch welcomes guests.*

# *Opening Day*

*(Middle): More than 500 employees and guests attended the Software Center's opening day ceremonies. (Above): Employees take a look at articles selected for the time capsule that was created to mark the opening day.*

The Network Software Center in Lisle, Illinois was dedicated on one of those days that ignores the official close of summer. By midday last September 30, at about the time the dedication ceremonies began, the temperature had climbed to a near record breaking 83°. It appeared that the Center's General Manager Fred Wallitsch had somehow agreed with Mother Nature to roll out the red carpet for Western Electric to take an official step toward assuring that this nation's communications network will continue to be supplied with the very best services.

In his opening remarks to the more than 100 business, civic and government leaders, and some 500 of the Center's employees, Wallitsch called the new facility "the closest you can get to the world of tomorrow—today." Joining him on the podium in the courtyard of the five building complex were James Thompson, the Governor of Illinois; Donald Procknow, president of Western Electric; Ian Ross, president of Bell Laboratories; and Bill Weiss, the president of Illinois Bell.

"The software that is developed here," Procknow said as he formally opened the Center, "will be responsive to the needs of the operating companies and to the communications network. The challenge we face here and as a company is the challenge to stay on the leading edge of technology, to keep ahead of our competitors and to make sure that this communications network continues to be the best there is anywhere in the world."

At the conclusion of the formal ceremony, guests got an inside look at what's going on in the new structure. The combination of the striking architecture and the intriguing technology, drew favorable reviews from the visibly impressed visitors.

"This is really a very handsome building," commented a police officer assigned to protecting the Governor. "I understand what software is but I sure don't understand how it works."

An Illinois state legislator made an impromptu speech on the benefit of the universal emergency phone service at the E 911 display. "Just the other day," she told the tour "I saw an accident on the tollway and I stopped to help. When the ambulance was called there was some confusion about what community's ambulance should respond. If there had been a coordinated 911 service, such as this one, that would never have happened."

A member of a Lisle civic organization marveled at the fiber lightguides used to interconnect the units of the No. 5 ESS display model. "It's incredible to think that such a delicate piece of glass could be capable of doing so much."

At the close of that summer-like day, it was apparent that here were quite a few who felt they had actually had a glimpse of tomorrow—today.

# What Do You Know About Software?

*Algorithm*

*Drawings by Bill Canfield*

One of the keys to removing the mystery from a new or specialized field is getting to appreciate its jargon — the technical shorthand used by practitioners. Common words can carry a lot of freight, while awesome acronyms sometimes are merely a fancy facade for a simple concept. This quiz is designed to take the sting out of some fancy buzzwords.

Q. What is the difference between hardware and software?

A. The computers themselves — the electronics and machinery — are referred to as hardware, but the directions that make the hardware perform its designated operations are known as software.

Q. What is an algorithm?

A. An algorithm is a fixed step-by-step procedure designed to lead to the solution of a problem in a finite number of operations.

Q. What does downtime mean in the world of computers?

A. Downtime refers to any period of time in which a computer is not functioning.

Q. What is the difference between a bit and a byte?

A. Bit is a short for *b*inary *d*igit (either of the characters 1 or 0). Byte is a group of eight adjacent bits that are operated upon as a unit.

Q. What is the Mnemonic Code?

A. It is the verb part of primitive software languages. It is relatively easy for programmmers to remember because its terms derive from standard English, e.g., MPY for multiply and ACC for accumulator.

Q. Which is the shorter time — a nanosecond or a picosecond?

A. A picosecond is only one thousandth of a nanosecond — which in turn is only one billionth of a second itself.

Q. What is meant by machine language?

A. Electronic devices respond to electrical signals. Machine language — the language of the computer — is based on a code of electrical pulses, or bits, timed by an electronic clock in the computer.

Q. What is a floppy disc?

A. It is a type of magnetic storage unit used in computer systems for permanent retention of operating data. Floppy refers to the fact that the disk is not rigid.

Q. What is the difference between a digital processor and a digital computer?

A. The processor is the "brain" or controlling mechanism of a computer.

Q. What is a high-level language?

A. This is a language used to program the computer that is closer to basic English than it is to machine language.

Q. What is meant by peripheral equipment?

A. This refers to the input/output devices and auxiliary storage units of computer systems — anything from a teletypewriter keyboard to a high-speed printer.


*Bits and bytes*

Q. Is software patentable?

A. In order to protect their enormous investments in specific programs, companies have attempted to patent software packages — with only limited success. While assembly languages have been awarded patents, most specific programs have not.

Q. Does software enable the computer to think?

A. Not really, although some people feel it depends on what you mean by "think." The essence of a computer's operation is its ability to compare two values, then to take the next step based on the result of the comparison (or to repeat the original operation over and over until the desired condition is met). And it does all this very quickly and accurately.

Q. What makes up a data base?

A. Almost anything that can be categorized mathematically. Usually, data base refers to the master files of operating statistics that are used by an organization to carry on its business — such things as sales, earnings, personnel data and material costs, or telephone subscriber records. In the case of a telephone central office computer, the data base — or Office Data Assembly — is the information that allows the generic program to do its job.

Q. What is meant by time sharing?

A. What is shared is the computer. A number of users at remote terminals have access to the same computer, but their individual tasks can be handled very quickly so that the various users can be accommodated virtually simultaneously.

Q. How is software measured?

A. Generally in lines of code. The first ESS machines that went into service in

*Downtime*

*Serial access*


*Nanosecond and picosecond*

*High-level language*

1965 had about 100,000 lines of code. The equivalent local-toll machine today has about 700,000 lines of code, and the big toll switches are running on something like 1.4 million lines of code. Most video game programs by contrast run on a hundred lines or less.

Q. How many lines of code does a programmer produce in a day?

A. Nationally, the figure runs from 2 to 30 lines of code per day, although it should be pointed out that programmers spend a relatively small portion of their time actually writing programs. Most of their time is spent planning and collecting data.

Q. Who or what is the Unix* system?

A. The Unix system is a computer program developed by Bell Labs initially to do software development. It has subsequently evolved into a general purpose operating system for a wide variety of applications.

Q. What is an absolute address?

A. Specific identification that designates a particular location in storage or any other data destination or source.

Q. Who invented software?

A. Like many great concepts, there is no one person to whom the development can be attributed — but rather a number of people in the World War II era made important contributions. Certainly one of the most important was Dr. John von Neumann. In 1945 he suggested that operating instructions (the program) as well as data, be stored in the computer's memory and that the computer be made to modify these instructions under program control.

Q. What is meant by serial access?

A. This pertains to storage of data in the computer's memory. It means, for example, that the fifth element can only be reached by first accessing and discarding the first four elements. It contrasts with direct access or random access. It's slower because more data is accessed sequentially than is necessary.

Q. What is a decision table?

A. A chart giving all the conditions to be considered in deciding what to do next in a program, together with the action to be taken.

Q. How do you "debug" a computer program?

A. To debug means to detect, locate and remove errors in programs or malfunctions in equipment. A lot of debugging must be done by trial and error, running the program on a computer to find out what does and doesn't work.

Q. How do you count to 10 in binary code?

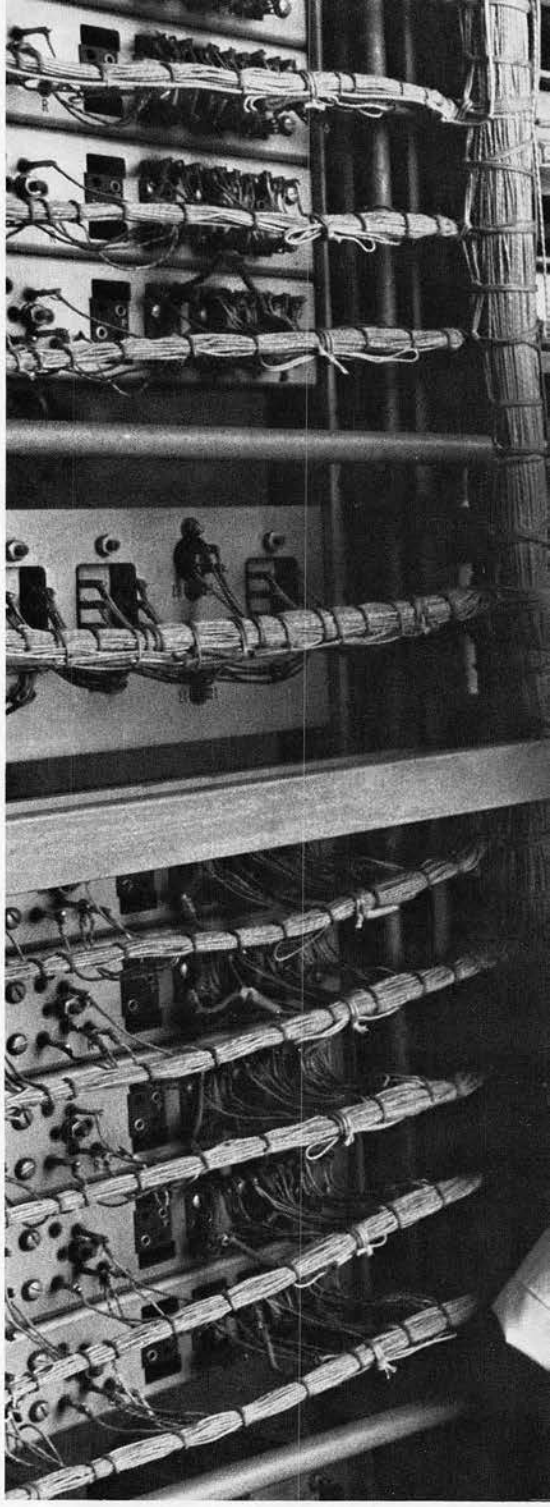
A.

| | | | |
|---|---|---|---|
| 1 | 0001 | 6 | 0110 |
| 2 | 0010 | 7 | 0111 |
| 3 | 0011 | 8 | 1000 |
| 4 | 0100 | 9 | 1001 |
| 5 | 0101 | 10 | 1010 |

*Debugging*

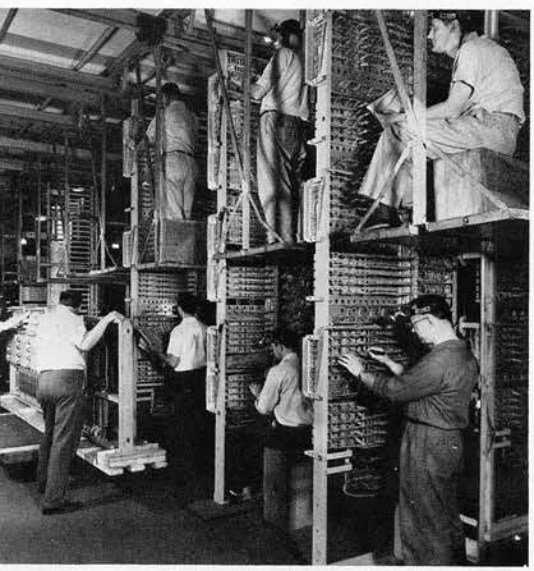
*Trademark of Bell Laboratories

# The Last Panel Office



## *Panel switches were mechanical marvels, and we'll never see their like again*

Think of *1942*. You can tell how old you are by what that year brings to mind. If the first thing that pops into your head is the zany movie that satirizes America's entry into World War II, you either hadn't made the scene yet, or you were too young to know what was going on. On the other hand, if the first thing you think of is the *real* war and how it affected your life at the time, you're probably older than you care to admit. Smack in the middle of this last category, even though he doesn't look it, is Terry Davis, a veteran installer who has been working out of Western Electric's Northeast Region for the last 40 years.



*Panel installations took as long as two years and a lot of manpower.*

When you say "1942" to Terry, he thinks not only of the war, but also of the switching system he cut his installation teeth on when he joined Western in that year. The switching system is called *panel*, and the reason he thinks of it a lot lately is that he recently finished dismantling a panel switch in the Bigelow office in downtown Newark, N.J. Now, this wasn't just any old panel office: This was the *last* operating panel office in the Bell System, and it was only fit and proper that Terry work on it because he's the last panel man in the Northeast Region and, perhaps, in the entire country.

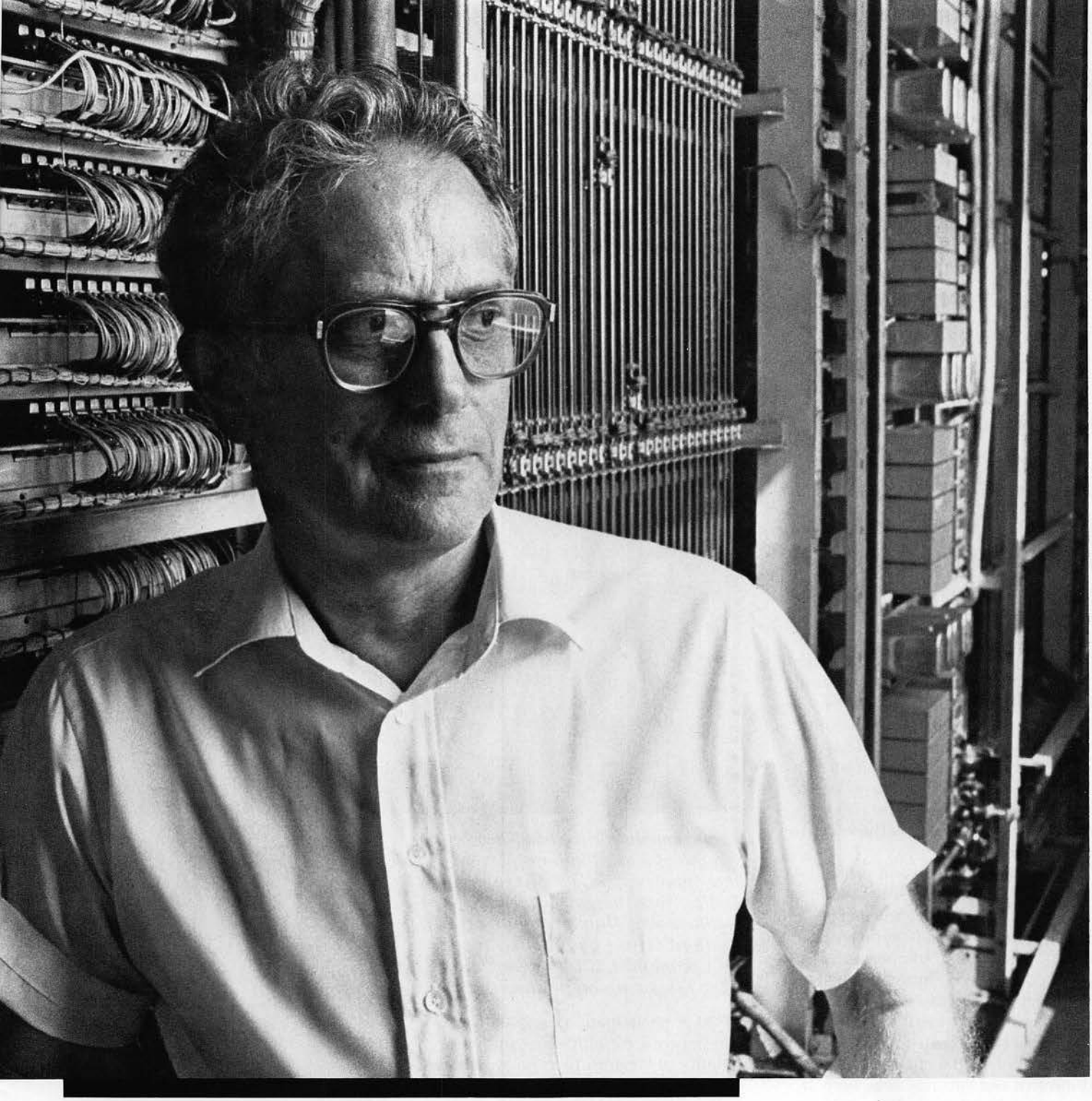
Panel goes back to the age of F. Scott Fitzgerald, flappers and speakeasies. Developed in the early twenties, it was designed to replace the big manual switchboards in metropolitan switching offices. The first one was cutover in 1921, and the second was New York City's well known Pennsylvania exchange.

Basically, panel consists of thousands of contact points in vertical columns. These are opened and closed by dozens of "elevator" rods that move up and down as a number is dialed. At the same time, rotary selector switches spin one way or another. With all this activity, an operating panel switch was a sight to behold — a mechanical marvel unlike any telephone switch ever made before or since. It had more moving parts than a high-performance automobile engine, and all of them had to fit together with as much precision. In fact, when Terry reminisces about panel switches, his conversation is apt to be well sprinkled with words like *gears, clutches, motors* and *drives*.

A panel system has all of those things and more. Before you could start one up, you had to get them all into perfect alignment with each other. That's one of the reasons a panel installation took about two years and a lot of manpower.

"About 200 guys would come in and do the iron work first," says Terry. "Then, about six months later, you'd drop down to 100 guys doing the assembly and wiring."

Now, when Terry says "assembly," you have to understand that he means just that. Panel switches were shipped in pieces, almost like kits. Every elevator rod had to be separately installed,



*Installer Terry Davis and the last operating panel office.*

and every rotary switch spring had to be individually cut to fit. The 12-foot high frames had to be made perfectly level, and, when this was achieved, they were cemented in place to keep them that way. Even the gauges used to level them were special. "They cost a small fortune," says Terry, "and there were only three of them in the whole country."

Terry learned panel on the job from installers who were all perfectionists. "They had to be," he explains. "After we'd finish a job, telephone company inspectors would check every nut, bolt and wire connection — and they wouldn't sign off until everything was exactly right."

"Panel men were master craftsmen," says Terry's boss, Ed Murden. "That's why those old switches managed to keep working night and day for over half a century."

Nowadays, Terry works on newer things, like electronic switching systems and lightwave equipment. "You have to keep up with the times," he says philosophically, while noting that the newer systems are much easier to work on. "A lot of the new stuff is just plug-in," he says. "With panel, you had to scrape the insulation off tens of thousands of wire ends and hand solder each and every one of them."

"Panel", he concludes, " was tough," but he's clearly speaking with affection. Nostalgically, he reels off the names of long gone panel men in the same reverent tones sports fans use when they talk about their heroes of yesteryear. But, when the last panel man was asked if he'd provide this story with a neat ending by retiring with the last panel office, he was quick to shrug off the idea.

"Maybe, in about five years," he says. "Maybe."

# Quality of Work Life

**By George Gray**

*Photos by Chuck Lewis*

## *It's been described as "tapping the brainpower on the shop floor."*

"I never thought I'd live to see the day," said a CWA Union official, "when Western Electric plant managers and the union presidents would gather under the same roof in anything but an adversarial relationship." He was commenting on an historic conference on the Quality of Work Life process held recently in Dallas. The conference was co-hosted by the company and the union.

Times have changed and probably nowhere more dramatically than in the union-management arena. This does not mean that antagonisms have disappeared, that suspicions and fears have been replaced by sweetness and light, that grievances are all behind us. But there is a new spirit of cooperation between company and union. Indicative of such a change is a recognition that our survival as a company may depend on how well we succeed in utilizing the full potential of our work force. One participant at the Dallas meeting described it as "tapping the brainpower on the shop floor." There is also a realization that today's worker is less authority oriented than the worker of 50 years ago, when the famous Hawthorne Studies first focused on the subject of human relations in the work place. Today's worker is still concerned about pay and benefits and job security, but participation in decisions affecting the work and the work environment are on the priority list as well.

What's in QWL for the average worker? A CWA official put it bluntly:

*Arrangements for the historic meeting were handled in large part by these four people: Jack McCafferty, Dallas Works bargaining agent; Judith Stokes, Human Resources, Guilford Center; Charles Hecksher, CWA economist, Washington; and Gene Knight, union president, Dallas.*

"Worker participation on QWL teams can improve the efficiency and profitability of Western Electric. And when Western does well, we do well in collective bargaining."

Quality of Work Life grows out of an agreement that was negotiated during bargaining in 1980. The company and its major unions subsequently agreed on a series of nine basic QWL principles and endorsed the idea of establishing QWL teams at company locations. (See box on page 27.)

During a series of meetings each committee developed a plan of action for disseminating information to the locations that it represented. The next step was to prepare training and orientation packages that will insure that locations have the necessary support to implement QWL when both the union and management agree that their location is ready.

*Dr. Mike Maccoby, outside consultant to both AT&T and the CWA, has been a QWL advocate since 1972.*

Evidence of the enthusiasm and commitment by both the company and union was apparent at the recent Dallas meeting where the Quality of Work Life concept was explained. This day and a half conference was designed to inform, educate, and discuss the Quality of Work Life process. This

*Participants at the Dallas meeting on QWL spent a lot of time in small-group sessions. Here the people from Merrimack Valley are talking about how theory meshes with local conditions.*

meeting was attended by the general manager, an operating manager, the company bargaining agent, the local union president, and the union bargaining agent from nine manufacturing locations represented by the CWA.

The nine locations were: Atlanta Works, Burlington Shops, Dallas Works, Kansas City Works, Merrimack Valley Works, New River Valley Plant, North Carolina Works, Phoenix Works, and Richmond Works.

A guest speaker at the Dallas conference was Dr. Michael Maccoby, Harvard professor and consultant to both AT&T and the CWA. He indicated that QWL mounts a frontal assault on the "one best way—my way" brand of management. Maccoby said, "QWL cannot succeed on the shop floor if management remains hierarchical, if supervisors are just puppets and policemen. They must join with their employees to make things work."

One definition of Quality of Work Life is the solving of problems where they occur, when they occur, by the people who have to live with the solutions.

Dr. Maccoby, who has been working with QWL since 1972, indicated some pitfalls in implementation. "QWL is a delicate process and lots of things can go wrong," he said. "If results don't occur immediately, there is a tendency to thrash around looking for quick fixes rather than letting the teams find themselves. The relationships between union and management members can become highly charged and adversarial, depending on personalities. Some people try to control the process rather than allow it to work. They are afraid QWL is going to get away from them, that people will make mistakes and affect the bottom line. There is a tendency to cut corners on training.

"The biggest pitfall is the loss of top level support either because a manager transfers or because business results turn sour."

The conference provided an opportunity for the participants to voice and discuss their concerns regarding QWL. These concerns included: How would a union official who supported QWL overcome the "sweetheart look?" Are we being steamrolled into something? Are we giving away the store? How do we get out gracefully if it doesn't work? Is it changing management into a popularity contest? What are the dangers in implementing QWL in some universes and not in others?

Some of these concerns are the result of misunderstandings about QWL and it may be easiest to resolve them by telling what QWL is not. It is not a substitute for collective bargaining. It is not a productivity gimmick. Team meetings are not designed as gripe sessions or an opportunity for lowering the boom on unpopular bosses. QWL is not a panacea for all problems facing the business. It is a long, slow process aimed at developing trust and reciprocal relations to replace antagonism.

There are still many questions in need of answers. A company official

said that he had attended four meetings on QWL before he began to understand the real intent. "It was like trying to get your hands around smoke," he said. "I saw the interaction of people, but I was missing the point. When people sit down and have an honest conversation, labor-management relations improve. We can all find reasons why things can't work. What we should be looking for are ways to change the process of problem solving to make sure things do work."

Company president Don Procknow has endorsed the QWL process. He and the corporate vice presidents were briefed on the subject last summer by Dr. Maccoby.

Mr. Procknow had this to say afterwards: "As we enter a new era in which our corporate relationships and our products and markets are certain to change, we should not overlook or ignore the good advice employees can offer when given the chance to participate actively in decisions about their work. As long as we recognize that this involves a long-term commitment, Quality of Work Life efforts are good for the company and good for employees."

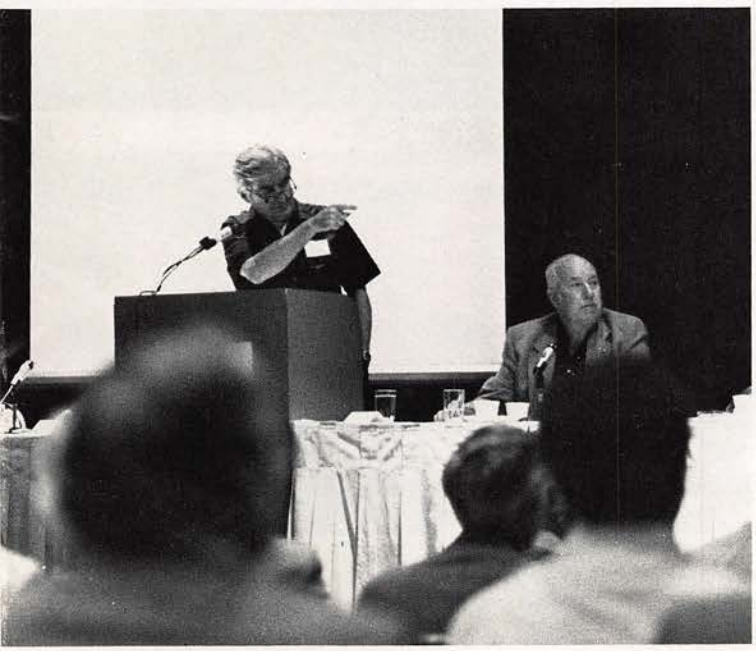
Glenn Watts, President of CWA and one of the country's leading advocates of QWL had this to say: "Today, American industries and American workers are under increasing pressure from overseas competitors. We need to learn to be more flexible, more imaginative, more creative to meet this challenge of changing economic conditions and new markets if we are to survive and prosper as the world's foremost economic power. We cannot do that if labor and management are locked into rigid ways of doing business; but I am convinced we can do it if both sides have the will and the willingness to gamble in the present in order to win the future."

In closing the meeting, a union official made some optimistic observations. "QWL can work. It requires give and take and a willingness to listen to each other's viewpoint. I'm hopeful that as you go back to your locations, you'll step back and take a look at what's been said here. It's necessary for us to get this started. Not tomorrow necessarily, but soon. I've known Western Electric most of my life—from the perspective of an employee and from across the bargaining table. I have the feeling we can meet any crisis ahead of us."


*Hugh Chandler, a member of the corporate steering committee on quality of work life, handles the chalk during a small-group session on pros and cons.*

*The contingent from New River Valley included plant manager Bill Kadereit, bargaining agent Steve Ruppert, and union president Ron Wheeler.*

*Jim Griggs (pointing) from Guilford Center and the CWA's John Price, seated right, were conference co-chairmen.*



## Statement of Principles

Joint steering committees were established about a year ago. These committees are composed of an equal number of management and union representatives. Each steering committee established its own charter which included the following nine principles:

(1) The essential component of Quality of Work Life (QWL) effort is a process which increases employee participation in the decisions which affect their daily work and the quality of their work life. Specific local concerns and local problem-solving should be the basic of QWL efforts.

(2) The goals of QWL efforts are:
   (a) to employ people in a profitable and efficient enterprise.
   (b) to create working conditions which are fulfilling by providing opportunities for employees and groups at all levels to influence their working environment.

   The pursuit of these goals is guided by the basic human values of security, fairness, participation and individual development.

(3) QWL holds as a basic tenet that employees are responsible, trustworthy, and capable of making contributions when equipped with the necessary information and training. Management and the union seek to better acknowledge, employ, and develop the potential of all employees and are committed to providing the necessary information and training to encourage maximum contribution to the success of QWL.

(4) QWL efforts must be viewed as a supplement to the collective bargaining process. The integrity of the collective bargaining process, the contractual rights of the parties, and the workings of the grievance procedure must be upheld and maintained. The process of implementing an improved quality of life at work shall not infringe upon existing employee, union, or management rights.

(5) Authorized representatives of the union shall participate in the planning, development, implementation, and evaluation of specific QWL activities which involve union-represented employees.

(6) Voluntary involvement by management, the union, and employees is essential to the success of mutual efforts. Participation in specific QWL activities shall be voluntary. Individuals shall have the right to participate in or to withdraw from such activities without penalty.

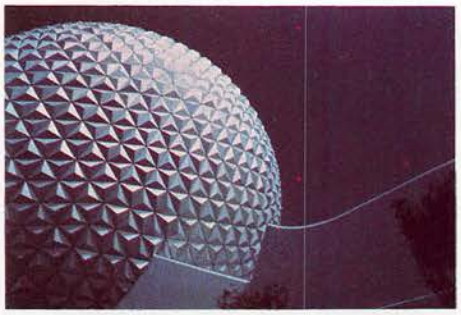
(7) Innovations which result from the QWL process will not result in the layoff of any regular employee or negatively affect the pay or seniority status of any union eligible employee, whether he or she is a participant in the process or not.

(8) The success of QWL efforts requires a spirit of mutual respect and trust among employees, management, and the union. Each party must give serious attention and consideration to the needs and values of the other parties. Management, the union, and employees must respect one another's legitimate needs and constraints. The success and maintenance of Quality of Work Life requires flexibility and continuing support and leadership from management, unions, and employees at all levels.

(9) Quality of Work Life is not a "program": there is no universal or one best approach. It is a process which has great potential, but it can't be the answer to all the problems of employees, the union, or the company.

# EPCOT

*Proving that technology can be fun*




*Visitors to the Bell System's Earth Station get a chance to use the World-Key Information Service.*

*A musical exhibit depicting the Age of Information entertains a visitor to FutureCom.*

*(Top): The Fountain of Information is the centerpiece of FutureCom.*
*(Middle): This walkthrough maze for children is a large representation of a microchip.*
*(Bottom): Interactive video "games" explain communications technologies.*


A young man, deep in thought, leans over a computer that looks like a commercial video game. His fingers tap the sides of the screen as he contemplates his next move. Suddenly, he smiles and strikes. Using the keyboard below the screen, he types, "Peter Piper picked a peck of pickled peppers." He grins defiantly, stands back and waits. "Peter Piper picked a peck of pickled peppers," warbles a deep voice from within the screen. "That's great!" says the surprised young man. He walks away, somewhat defeated but amazed.

This talking computer, known as the Phraser, is an Interactive Electronic Display that combines Bell Labs' latest speech synthesizer and newest software in order to make a computer "say" almost anything typed into it. The display is one of the many features of FutureCom, the Bell System exhibit in Walt Disney World's newest theme park, EPCOT Center—the Experimental Prototype Community of Tomorrow—in Lake Buena Vista, Florida.

Other electronic games in the exhibit offer a look at Western Electric manufacturing processes and products. Visitors can take the "wheel" of a Chip Cruiser and battle contaminants that can destroy a microchip or test their memories against Western's newest memory device, the 256K RAM that can hold 256,000 bits of information on one chip. They can also participate in a demonstration of video teleconferencing or obtain information about the current events in 50 states by using a touch sensititve television screen in front of a giant telecommunications network map.

FutureCom is one of several pavilions a visitor reaches after traveling in the Spaceship Earth, an 18 story geosphere that was presented by the Bell System. Visitors to the spaceship are transported back to the Stone Age and, then, through the magic of Disney engineering, travel through the history of communications. The ride ends with a journey into space and through a simulated telecommunications network.

As visitors leave the Spaceship Earth, they enter EPCOT's main information center, Earth Station, also presented by the Bell System. Beyond Earth Station are 500 acres dotted by pavilions devoted to the themes energy, transportation, agriculture and imagination. There is an entire section—World Showcase—designed to exhibit the achievements of the nations of the world.

Visitors considering a walk around the sprawling Center should wear comfortable shoes. However, there is no need to carry a guidebook. In Earth Station, and throughout the Center, information on attractions, special events, shopping areas and restaurants can be obtained through an electronic information retrieval system known as WorldKey Information Service (WKIS). Developed by Bell Labs and Western Electric, in cooperation with the staff of Walt Disney World, WKIS allows visitors to obtain audio visual information, in Spanish or English, simply by touching certain pictures on a television screen.

The system is a demonstration of how Information Age technologies such as software, lightwave and microelectronics can be used to combine voice graphics, text and video com-

*Periodically, FutureCom's mural of the United States is transformed into a fiber optic light display of the nationwide telecommunications network.*

*Located in the World Showcase, this WorldKey Information Service kiosk stands ready to supply arriving visitors with information on attractions.*

*(Top): The companies that make up the Bell System are listed in this display.*
*(Bottom): The Nomad™ cordless telephone captured the interest of this young visitor.*


munications in one information system retrieval system.

All of the data needed for the system is stored in a centrally located computer that is connected by lightwave transmission facilities that were designed, assembled and installed by Western Electric.

Peter Krawarik, the technical manager assigned to the EPCOT project, explained that there were several reasons for choosing the lightwave system over copper cables. "The fibers that go into a lightwave system are made of glass and transmit only light," he said. "This makes them immune to electrical interference—an important characteristic to consider when you have the large amount of power needed to operate the Center's pavilions. Other interference could come from lightning strikes. The Lake Buena Vista area receives the second largest incidence of thunderstorms in the country.

"Another advantage of fibers," he stated, "is in quality. The information carrying capacity of optical fibers permits broadcast studio quality on the television screens, which is not easily available with traditional cables."

Jack Kelsey, a senior engineer who worked on the design, assembly and testing of the system at the Merrimack Valley Works said that all reports indicate that the system is working very well. "We've had no problem," Kelsey said. "In fact, WorldKey is getting more use than expected and it's still performing well."

*A technician checks a laser video disk. A microprocessor-controlled laser beam finds the proper place on the disk and "reads" the information the visitor calls for.*

# High Achievers

## *The only thing junior about these achievers is their age*

*Lee Miller is always ready to greet a potential customer.*

Lee Miller has studied the art of selling and it shows. After only a few weeks with the Unique Antique Graphics Company, he has become one of the company's leading salespersons. Lee attributes his success to conventional sales techniques. He makes a conscious effort to create a good first impression by wearing a business suit, carrying a briefcase and always being courteous. He can answer any question about his product and is persistent in his attempts to make a sale. In fact, the only thing that distinguishes Lee from other successful salespeople is his age—he is 15 years old.

Lee is employed by one of the 8,000 companies nationwide that are participating in Junior Achievement, a non-profit organization dedicated to providing students with a realistic experience in America's free enterprise system. Companies are sponsored by a local business, although each is actually owned and operated by the students in the program.

The Unique Antique Graphics Company is sponsored by Western Electric's Cleveland Service Center and operated by 31 students from the Solon, Ohio, High School. As a sponsor, Western agreed to recruit advisers among employees. It is the advisers' responsibility to guide the students in their attempt to organize and successfully operate their company.

Fortunately for the students of Solon High School, Western Electric has a team of volunteer advisers that have compiled over 34 years experience in Junior Achievement programs. That experience, combined with an interesting product, the practical application of an expanding technology and salespeople like Lee Miller, has made the Unique Antique Graphics Company truly unique. Their product—framed labels from century-old vegeta-

*Ken Atwell (left), V.P. of marketing, and Herb Lichtman (center) review the week's sales with the help of Herb's computer program and adviser Tom Ramsay.*

*Adviser Chuck Mitchell asks company members if the finished product meets their quality standards.*

ble cans and cigar boxes—may not sound like a major revenue producer. Yet, company sales have climbed to just over $6,000 in three months. What is the appeal? According to antique dealers in the Solon area, these labels have joined the ranks of the "collectibles" and have captured the interest of both individuals and corporations.

However, the real appeal is best explained in the sales pitch given by the company's president, Herb Lichtman. "These labels are 100-year-old pieces of art," said the 14-year-old chief executive. "The craftsmanship that went into them is extraordinary. An artist had to draw the illustration in reverse on a piece of stone. This process, called stone lithography, required one stone for every color on the label. Sometimes as many as 22 stones were needed for a single illustration.

"An illustration might be whimsical or it might depict a historical event or figure. All of the labels are printed on 100 percent rag paper and some are edged in gold leaf." He concludes with an explanation of how the labels are carefully framed and of the guarantee of authenticity that is included with each label.

Every employee of the Unique Antique Graphics Company is responsible for selling the framed labels and each is as well-briefed and articulate as Herb Lichtman. The students received sales training, as well as schooling in areas such as bookkeeping, market planning and supplies procurement from the Western Electric advisory team of Jim May, Chuck Mitchell, Larry Watson and Tom Ramsay.

"This is one super-qualified group of advisers," said Tom Herschel, program director for Junior Achievement of the greater Cleveland area. "That's why we offered them this product.

"There is no other Junior Achievement company in the country making and selling this product. We didn't know how well it would do in the marketplace. And it's a complicated product. Take, for instance, the procurement part of the business. We figured out ahead of time that producing framed labels would require purchasing materials from nine different suppliers. That can complicate matters for a group that has never run a business before. Knowing the problems we might encounter, we felt we needed the experience that this Western Electric team could provide. Believe me, they have done it very well!"

However, a modest Jim May, an adviser with 16 years experience in J.A., is quick to point out the strong points of the students who make up the company. "Today's teenagers seem to have a better understanding of what a good education will do for them in the future," Jim said. "This group typifies that statement. They are one of the smartest bunch of students I've ever worked with. Take for instance Herb Lichtman. He developed a computer program that plots sales and marketing goals for the company and the individual salespeople. According to Tom Herschel, our company is one of the first Junior Achievement companies in the nation to use a computer to assist us in our regular business operation. Look at Lee Miller. He puts on a business suit and rides his bike to his prospective clients. If you ask him if he sells door-to-door he will emphatically tell you that isn't where the money is. Lee seeks out local businesses that have reception areas that may need a little extra decorating. He has sold framed labels to all of the town's funeral homes for their smoking rooms. He is so convincing that a local florist offered him a job when he is old enough. Almost every member of the company has this type of enthusiasm and initiative. That's why they are the top J.A. company in the Cleveland area. The teachers and parents should be proud."

However, James Kotora, Solon High School principal, doesn't dismiss the role of the advisor so lightly. "Having advisers from a successful business like Western Electric come in and work with these students is just great. It gives new depth to the classroom experience," explains Kotora.

"Look at it this way. If I bring a professional baseball player like Johnny Bench into the classroom to talk about catching, all eyes and ears of the young players are going to perk up. Sometimes a few minutes with a known pro can be better than 55 minutes of a teacher's lecturing about a philosophy. That's what the advisers from Western are—known professionals. In addition, they are giving students a hands-on experience of running a business in a non-threatening environment—no threat of grades or homework. It's all personal initiative and we at Solon High School are thankful to these advisers for this opportunity."

The Network Software Center Opens. See page 19.

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