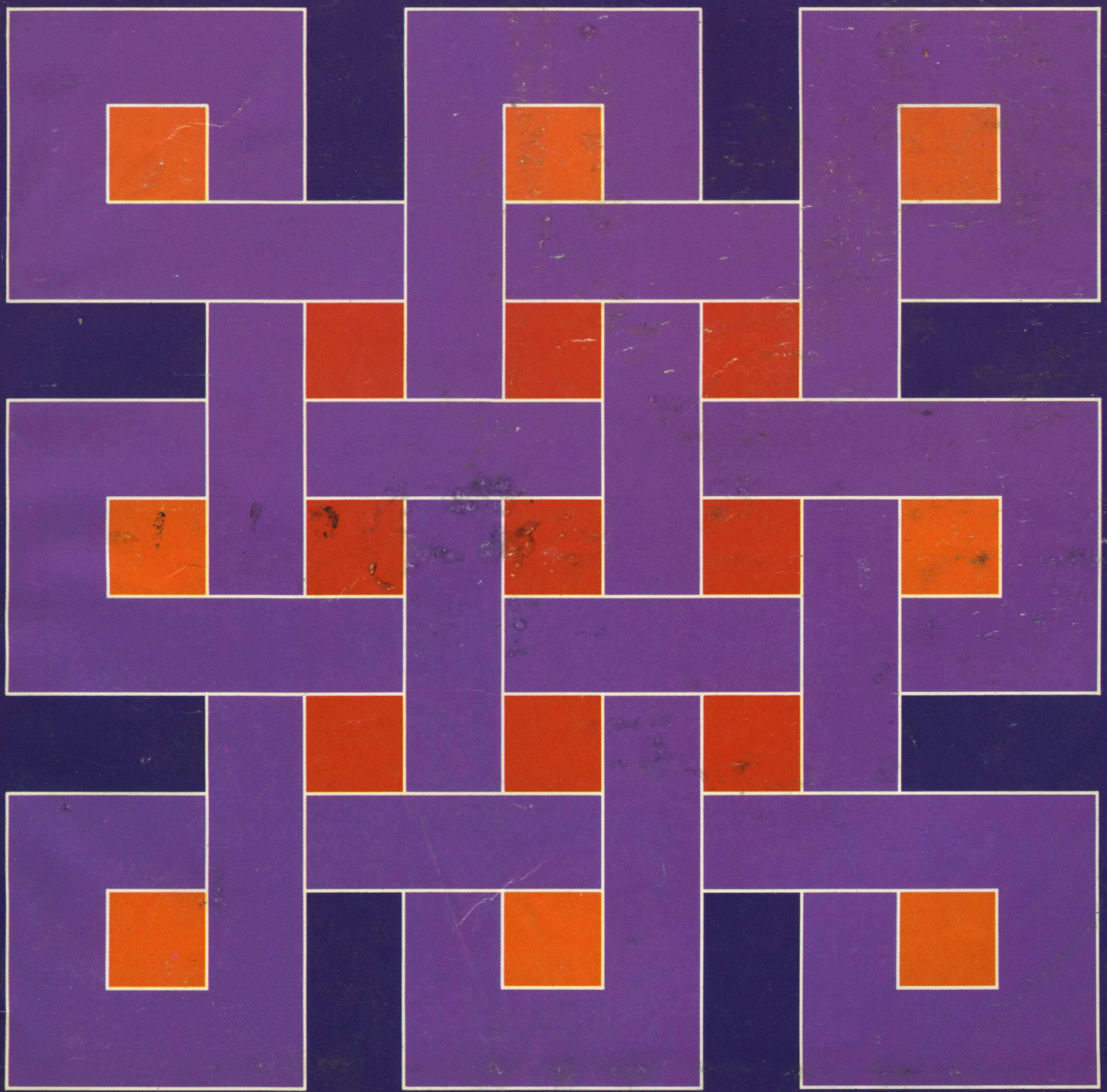
DATAMATION®
1957 77 1977
February

COMPARING COMPUTER ARCHITECTURES



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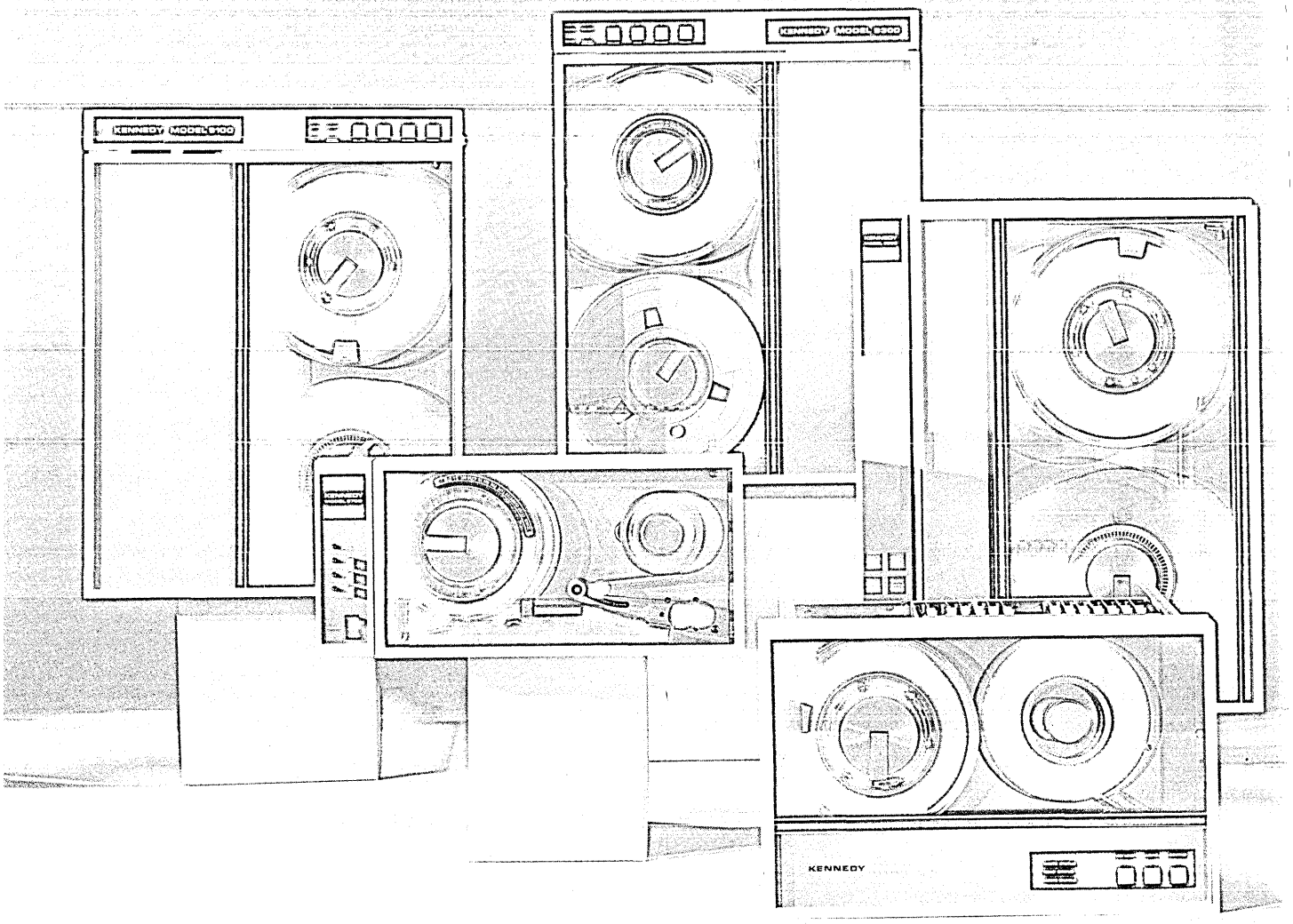

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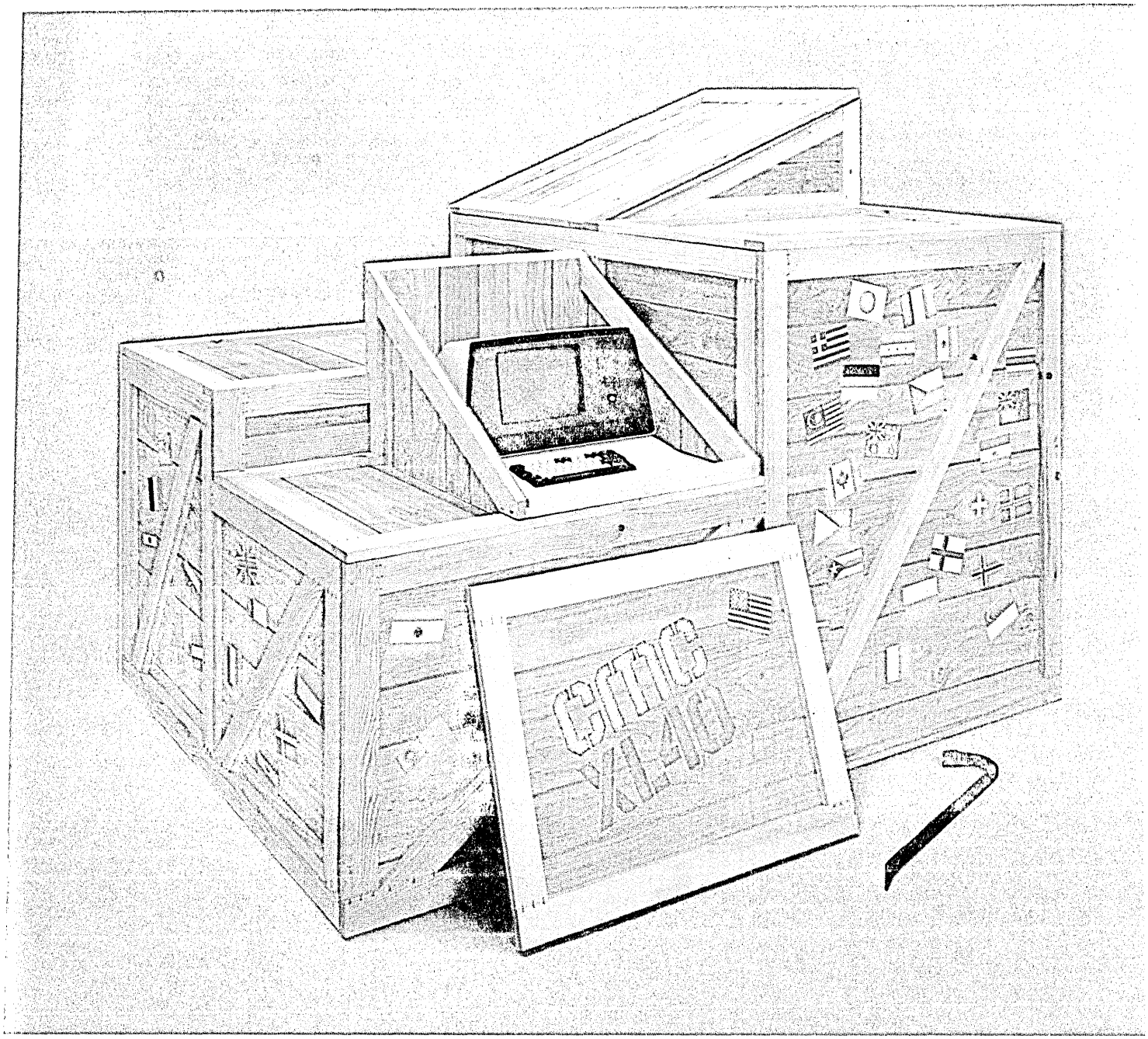

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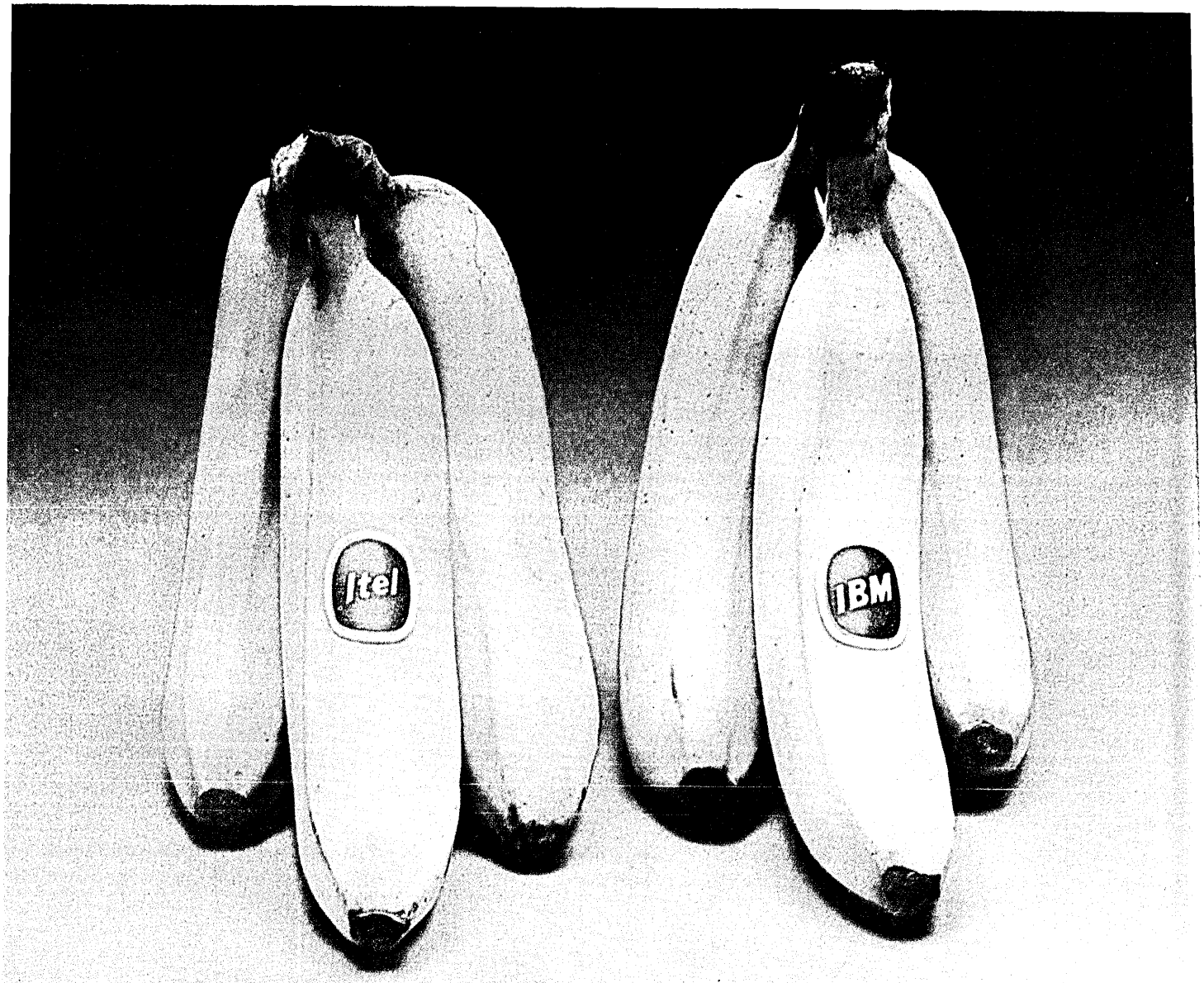

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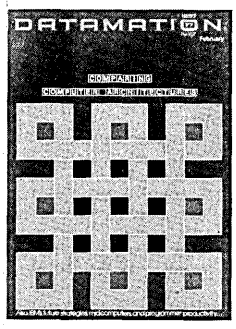

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STARAN classifies crops over 26 times faster for NASA.

When NASA installed Goodyear's STARAN® associative processor at the Johnson Space Center, their goal was to improve speed and volume of image processing for the LACIE (Large Area Crop Inventory Experiment) program. The challenge was classifying billions of data bits from satellite images to help LACIE personnel determine wheat acreage.

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In only 8 minutes, STARAN classifies approximately 7.6 million acres into 10 distinct classes of data. Previously, it had taken conventional computers over 3½ hours to categorize these same images.

By combining content addressability with parallel array arithmetic, a unique capability to process thousands of picture elements at once produces dramatic improvements in image throughput. That's why the STARAN processing system is unmatched in its ability to solve complex problems involving operations on many similar data streams or high-speed searches of many similar file records.

So before you invest a lot of money in a high data rate digital system, invest a little time to look into STARAN. It works for NASA. It can work for you too.

For complete information, write to Wayne Brubaker, Goodyear Aerospace Corporation, Akron, Ohio 44315. Or call him at (216) 794-3631.

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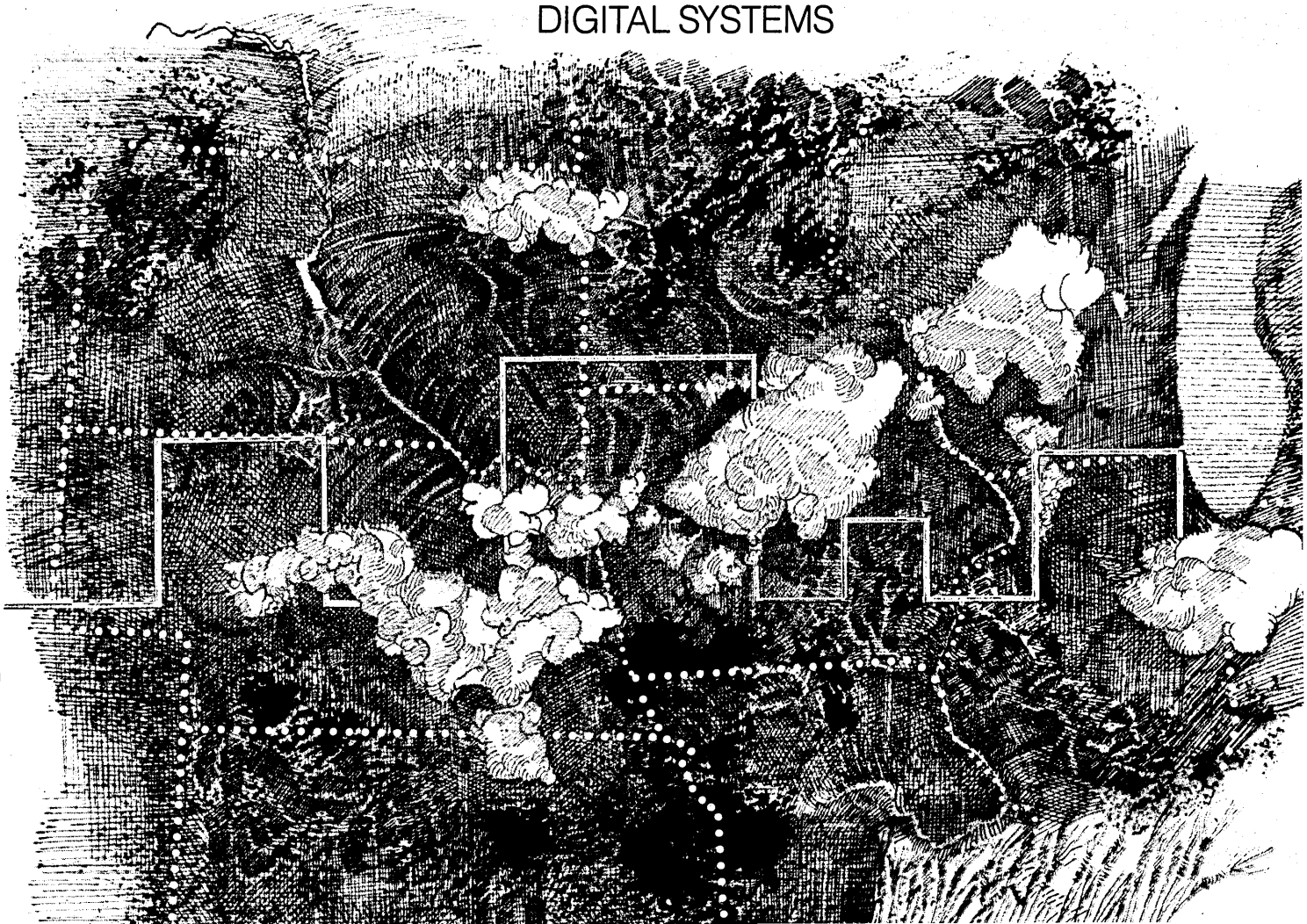
GOODYEAR

DIGITAL SYSTEMS



Looking Back in DATAMATION.

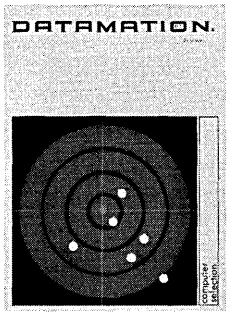
January-February, 1958

Patents: Notice to cease infringement of his patent rights have been sent to leading manufacturers of digital computers by John T. Potter, president of Potter Instrument Co., Plainview, N.J. The patent covers the use of magnetic cores for storing and retrieving data, a method employed by most major computer manufacturers.

Schools: Western Data Processing Center at UCLA soon will have a 709, given to the university by IBM. The corporation also has agreed to share the cost of a $750,000 research building, which will house the computer.

The Outlook: For all its benefits, "mass production" has tended to yoke millions of people to repetitive jobs requiring a fraction of their ability. Computers offer the hope of removing this corrupting influence on our national character. But the automatic age will not come easily. It is my opinion that our existing tax structure runs counter to the principles on which America's future depends.—James R. Bradburn, vice president, Burroughs Corp.

February, 1967



Time-Sharing: Large time-sharing centers will not replace free standing machines and will not perform all the functions of all the machines that are running today. There will have to be huge amounts of user oriented software written and new markets developed. The industry, misinformed about a number of facets of time-sharing, is correct in the supposition that some form of really large time-sharing utility will exist in 1975 or so.—Harris Hyman.

IBM: The complaint of service bureaus that universities with educational discounts from IBM are undercutting their prices for these services are among those aired before the Justice Dept. as part of the antitrust charges being toted against IBM. Others relate to pricing, the delivery of equipment in non-sequential model order, and on-line services. Justice is studying the case. ❋

Distance is the name of the game.

In golf, the distance a low handicapper gets off the tee makes him hard to beat. And "distance" in a computer ribbon – the kind of distance you get with Roytype's Gold Scanoptik™ computer ribbon – gives you the same advantage.

Gold Scanoptik ribbons not only "drive" for distance, up to a million lines per ribbon, they give you a print-out that is jet black, crisp, clean and nonsmearing, character after character. In fact, the writing quality of Gold Scanoptik ribbons is so good, major utilities and other commercial customers have reported rejection rates as low as 1/2 of 1%! And the Gold Scanoptik ink formulation doesn't "dust" on impact, downtime and maintenance are held to a minimum.

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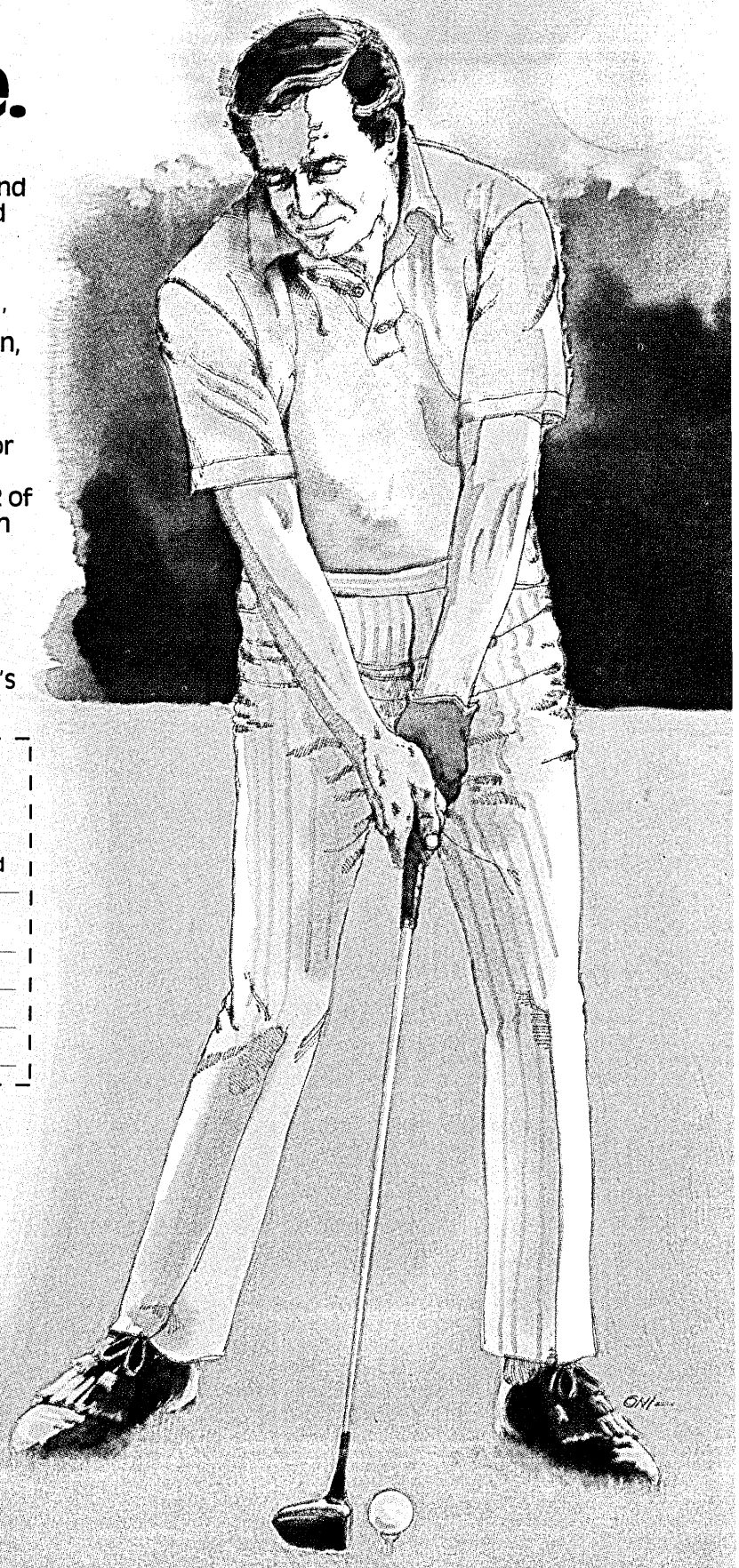


CIRCLE 80 ON READER CARD

The Distributed Systems Environment:

Guess who's staking out the lion's share?

Sculpture, incorporating state-of-the-art CML computer circuit components, created expressly for Honeywell by Jack Rindner.

Distributed systems. Everybody's talking about them – exciting new computer systems that let you put computer power wherever you need it in your organization.

Distributed systems. Chances are they're going to be important to you. So it's important for you to know who's in the best position to help you grow into them. It's Honeywell.

Honeywell, by announcing several important new products, laying down disciplines, and supporting standards, has taken a responsive approach to distributed systems:

The Honeywell Distributed Systems Environment.

This is where it's all going to happen. The environment within which Honeywell hardware, software, and data communications can be combined into a system that allows you the flexibility of distributing your processing, while still maintaining standardization and control. A system that will help you produce the right data in the right place, and make it available to the right people at the right time.

We've been working toward the Distributed Systems Environment for years. With time-sharing, transaction processing, data base management, data communications, and networks of processors and minicomputers and terminals. It's time we took the wraps off.

We've expanded Series 60 with several new processors.

The new Model 66/85 is a high-technology top-of-the-line extension of Series 60 large-scale systems. It uses new high-speed Current Mode Logic (CML) integrated circuits, revolutionary micropackaging of the new circuits, and many other design innovations to improve price/performance while reducing size.

Three new models bring better price/performance and added peripheral capacity to the middle range (Level 64) of Honeywell's Series 60 line.

Minicomputer technology upgrades specialized processor performance.

Based on Level 6 minicomputer technology, Honeywell's new DATANET 6678 front-end network processor is equipped with advanced communications software and protocols. More compact than previous models, it offers faster instruction execution, and higher performance.

Honeywell's Level 6 and System 700 minicomputers are also particularly effective when functioning as remote network processors – such as remote batch and/or remote job entry systems or message concentrators.

Better data management software.

Honeywell's new Data Management-IV for Level 66 users provides all the necessary data base management functions, including a personal interactive query feature that makes it easier for the right people to get the right data.

Broad range of terminals.

Honeywell's new distributed systems terminal, DST 6/500, is a powerful unit for the remote user who needs extensive local processing and communications capabilities. Other units include multifunctional video terminals in single-station or clustered versions.

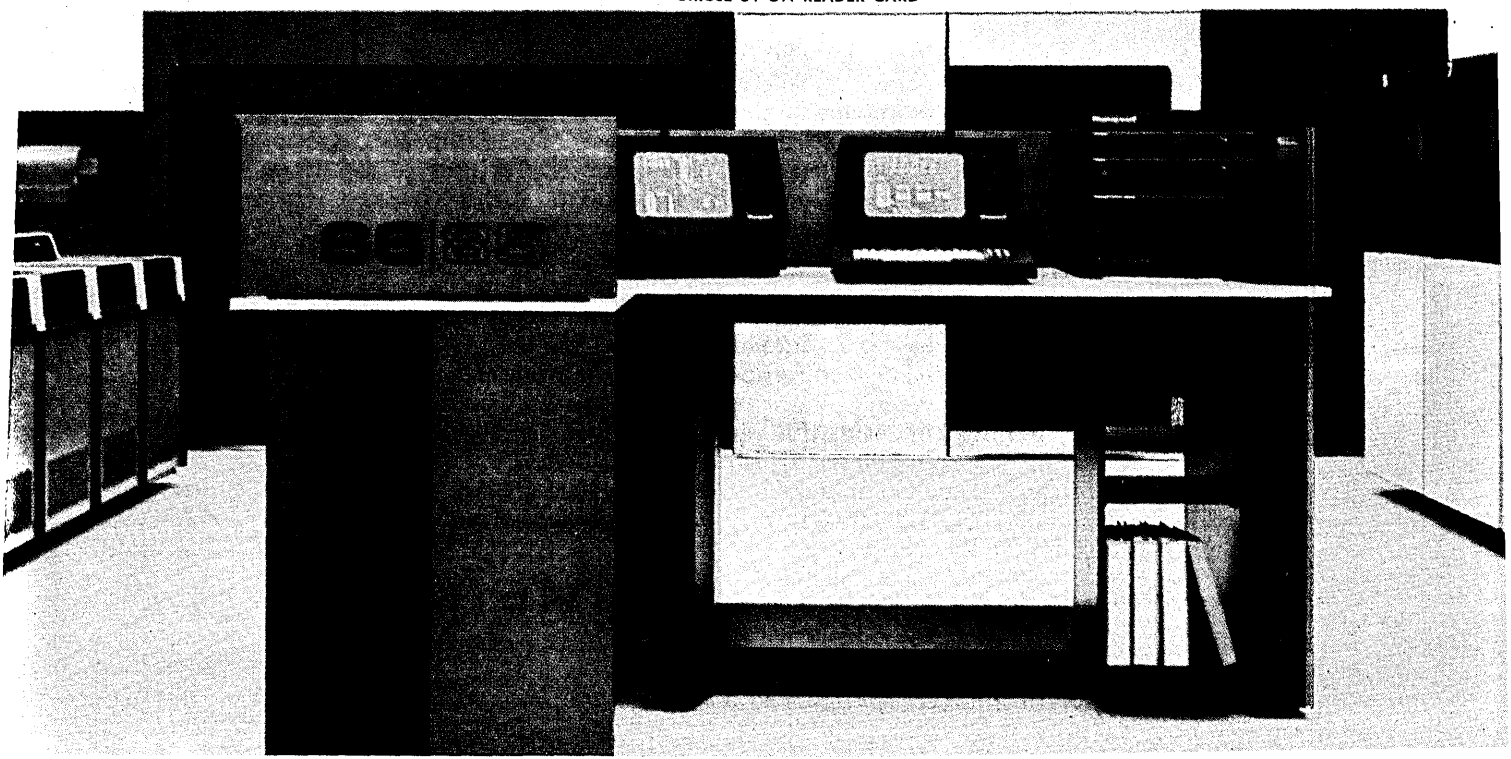
After all, when you're after the lion's share, you don't pussyfoot around.

Honeywell's Distributed Systems Environment. It's the best place to build a system that works the way you work.

Honeywell

Honeywell Information Systems, 200 Smith Street (MS 487), Waltham, Massachusetts 02154.

CIRCLE 64 ON READER CARD



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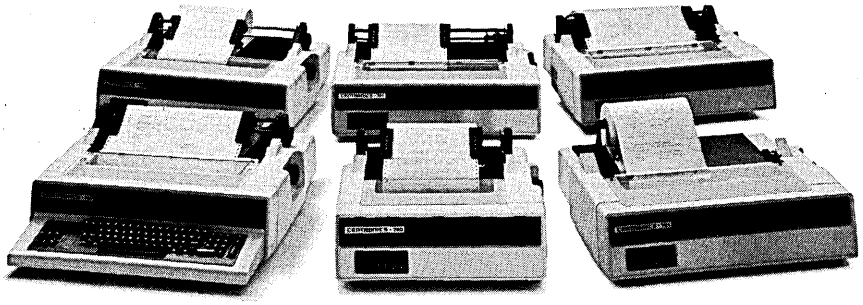

The New Centronics 700 Series.

Now, the features that make our model 700 the best, lowest-priced serial printer are available in a *family of seven* models: uncomplicated modular construction; the reliability of fewer moving parts; high parts commonality; and low price. All of which means a lower cost of ownership.

The new 700 family covers a full range of serial printer requirements: 80- and 132-column format; 60 to 180 cps speed range; bi-directional and logic-seeking operations; and 110-300 baud KSR and RO teleprinters.

Like all Centronics printers, the 700 family is better because we back them with a wide choice of customizing options and accessories. More than 100 sales and service locations worldwide. Centronics' financial stability, and dependability proven by more than 80,000 printers installed.

Simplicity of design, full range capabilities, and better back-up make our 700 series printers simply better. Centronics Data Computer Corp., Hudson, N.H. 03051, Tel. (603) 883-0111. Or Centronics Offices in Canada and throughout the world.

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letters

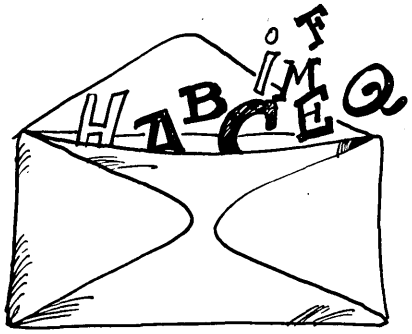
Centralized bottle-up

Although I agree with Mr. Wagner's concept of decentralized computing (November p. 86), I believe he has overlooked several important considerations. Just as hardware costs have decreased for small computers, the larger machines have also come down in price. The problem with many centralized computer facilities is that management has not passed these savings to its users either in the form of lower costs or increased capacity. As Mr. Wagner states, central facilities are usually run to optimize hardware costs rather than human costs and hence operate like a bottled-up super highway. Simply increasing the availability of the computer would make a dramatic change in the service level to its users. This can be solved by a policy decision that would be no more difficult to make than the decision to decentralize using minicomputers.

More important, I believe, is the concept of decentralizing the centralized facility . . . time-sharing service companies have been offering this capability to their users since 1968. There is no reason that all computer users cannot enjoy this service. The user can make his or her own decision about how to solve his or her own problems—whether to use a standard programming language or a software package, whether the program is to run interactively or in a batch mode, and on and on.

There are also drawbacks to committing to a small decentralized minicomputer installation. Several have been mentioned, including the current availability of software. But even when this is rectified, the quantity and diversity of the software that a given mini installation can maintain will always be a problem and the centralized facility will probably always be one step ahead of the mini in this area. If the user's needs are simple, then a mini will be the answer. But if there is complexity and diversity, both of which may evolve over time, then the ability to address the user's changing requirements is important. For example, a newly introduced mini is set up to solve the user's accounting needs . . . but now he wants management planning aids. He must start the search for a package to do financial planning. The next logical step is to tie this to his accounting system. If the financial planning package cannot be run on the mini, he is in trouble. The user would like to see graphical output from this planning process but cannot justify the cost of purchasing a quality plotter. Again he must go elsewhere. The end result is that each small group of users is doing software and installation management instead of leaving this to one centralized group of "professionals."

The well run centralized facility will provide many alternatives that suit the user's needs best, even when his needs change. I disagree with Mr. Wagner's



statement that the computer "is not all things to all men." It is at its best when it can be. Only then can the user feel confident that his choice today will be applicable to tomorrow's problems.

I am not a diehard supporter of the large mainframe, but we should all be aware that decentralized computing is not limited to the mini and is available today. A well run centralized installation can provide a cost effective decentralized service.

HAROLD FEINLEIB
National CSS, Inc.
Norwalk, Connecticut

Limiting the librarian

Editorial changes drastically altered the implications of our paper "A Computerized 'Librarian'," (December p. 61). The qualifying phrase "For A Batch Environment" was omitted from the end of the title, and text describing our group was changed to read as if all of Exxon Production Research were being represented. Both changes imply a scope far beyond our original manuscript . . . Datamation's wording erroneously implies that the efforts of our group, a fraction of the total programming staff, have set policy for all of Exxon Production Research Co. This change leads the reader to believe that the entire company is engaged in using the programming techniques described in the paper and that all or a majority agree with our conclusions. Neither statement is true. There are many programming groups within our company, and both batch and interactive terminals are extensively used, as are various source maintenance programs.

R. A. BAKER
Exxon Production Research Co.
Houston, Texas

We regret that neither the original paper nor the published version sufficiently qualified the size of the group being represented. Our apologies for confusing the issue. The batch restriction, on the other hand, seemed well described in the text.

Serpent's tooth

Mr. Liu (A Look At Software Maintenance, November p. 51) clearly has the command of his subject. In the spirit of the Cretan proverb, "only those the snake has bitten can tell each other how it feels," Mr. Liu has clearly been there.

One point he made, though, engorged my hood with venom. He says: "There is no evidence that a programmer with seven years of experience can design or write a better program than one with three years of experience." If this were true, there would be no need for salary increases beyond the third year. But it's not true. The good technicians I've talked with over the years continue to grow. Programmers must incorporate broader technology and learn from their past mistakes, from successes of their own and of others. I have found that experienced programmers write correct programs, do it quickly, generate efficient code, and document clearly. Three years isn't enough to top out in skill level, even with a phenomenal training program.

This is not to close our eyes to mediocrity. There are folks around who are not effective. Until licensing or professional exams like CDP become industry requirements, there is another way . . . each individual manager has the responsibility of keeping his own area clear of deadwood. Mr. Liu may, on reflection, wish to disassociate himself from that point . . . fortunately, the tenet is not critical to his very fine presentation, so he may shed it without loss, as the serpent does to grow.

LAWRENCE H. COOKE, JR.
Midlantic National Bank
West Orange, New Jersey

Mr. Liu responds: To understand programmers productivity, one must first understand the basic dp learning curve. The dp learning pattern indicates that after three years the additional gain in technical knowledge for an average programmer is statistically insignificant. This concept is further supported by several leading commercial programmer knowledge survey tests in which the general tendency is to provide multiple evaluation standards for programmers with experience ranging from less than one year, one to three years, and "over three years" grouped as one large classification.

Test drive a robot

I would like to correct some inaccuracies in your report on AIC's ROBOT (December p. 182). ROBOT is not yet

letters

interfaced to System/2000. The only DBMS currently supported is ADABAS, which provides an efficient "memory" and other DBMS support for the system. ROBOT is more comprehensive than previous natural language processors by virtue of its applicability to any subject area, but the real advance is in the fact that it is the first such system that is completely packaged and practical. No special skills are required to put up new files or applications. The system requires less than 120K bytes and less than one cpu second to answer a request, and is by no means limited to one file or data base at a time. Finally, the three month trial for ROBOT is currently offered without charge, although this may change in the future.

PAUL KRAUSS
Artificial Intelligence Corp.
Kensington, Maryland

Underwhelmed by IBM

Your December editorial, describing Paul Armer's experience as a potential witness for CalComp in their suit against IBM, says that Paul was overwhelmed by IBM's discovery request for "every document, every paper, every scrap of material generated as a result of his long involvement with the field." I thought you might be interested in hearing from a CalComp witness who endured the experience Paul resisted.

You might be mollified to learn that the production of documents is not as painful as it might be. Though I was served with a subpoena which asked that I bring with me or produce for inspection all of my documents, in fact I did not have to move any documents anywhere. I have file drawers and bookcases full of such documents in my home, where I work, and IBM arranged, at times convenient to *me*, to come here and copy the material of interest to them. The IBM representatives were polite, anxious not to trouble me, and careful to leave my documents in the condition and order in which they found them. I was paid my normal consulting fee for that small fraction of the time they were here, which required me to answer questions or help them locate material. None of my documents had to leave my premises.

You may also be interested to learn that IBM was here for 43 hours over a period of five days; that three to six IBM representatives were present during that time; that they brought three microfilm cameras and a xerographic copier to use in copying documents; that they copied over 16,000 pages (according to an estimate by a CalComp representative); and that judging from their apparent familiarity with those documents when they took my deposition and cross examined me on the witness stand, at least one person must have read all 16,000 pages.

And I am only one witness in one trial.

MONTGOMERY PHISTER, JR.
Systems Consultant
Santa Monica, California

Fortran standards

Dennis M. Merrill's Forum (October 1976, p. 191) "Let's Hear it For FORTRAN Too!" struck a responsive chord. I only hope the X3J3 Committee of the American National Standards Institute heeds his suggestion for the inclusion of block structures with a minimum of new syntactic units. His combination of the DO and the IF statements is a long overdue streamlining of the language.

Another modest syntactic change which I would like to suggest involves

relaxation of the strictures which surround the DO statement itself. For example, at present it is possible with some FORTRAN compilers to write:

```
      DO 10 I=N,1
      U=V+W
10    X=Y+Z
      DO 20 I=2,N
      A=B+C
20    D=E+F
```

and have only the "DO 10" block executed when N=1 and only the "DO 20" executed when N=2. Of course this would be considered a mistake by those compiler writers who have decreed that "the DO loop will execute once regardless of the values assigned to the control parameters." This group has earned my eternal enmity for sentencing me to endless writing of the construction:

```
      IF(N.LE.0) GO TO 40
      DO 30 I=1,N
30    A=B+C
40    CONTINUE
```

Perhaps someday the standard will insist on testing the loop parameters *before* executing the loop (and not at the end of the loop). Aside from the reduced wear and tear on my second finger it would make the rudimentary block structure illustrated in the first example more generally acceptable.

Better yet, let's relax the limits on the syntax of the "V=n_1,n_2,n_3" portion of the DO statement so that:

1) The n's may be any arithmetic expression, and

2) The "V=n_1,n_2,n_3" can be replaced by a logical expression which determines if the DO loop (group) should be executed at all (once).

3) The "V=n_1,n_2,n_3" can be entirely omitted per Merrill.

The example written by Merrill as:

```
      IF(I.EQ.J)DO 10
      A=B+C
10    D=E+F
      ELSE: DO 20
      U=V+W
20    X=Y+Z
      CONTINUE
```

could also be rendered with the number 2 change above as:

```
      DO 10 I.EQ.J
      A=B+C
10    D=E+F
      DO 20 I.NE.J
      U=V+W
20    X=Y+Z
```

I also hope as block structures come to FORTRAN that the block terminators are identified with statement numbers. Not only is it more in keeping with traditional FORTRAN syntax, but it will provide unambiguous correspondence between a block's beginning and its end. Anyone who has bullied his way through someone's ALGOL or PL/I (without labeled ends) can appreciate the clarity that begin-end labeling lends to the code.

FORTRAN needs to grow with the new developments in programming, but let's hope it retains the spartan simplicity that lends itself to rapid coding.

DONALD N. ANDERSON, Ph.D.
Anchorage, Alaska

Mr. Merrill will be pleased to learn that the proposed new FORTRAN standard was modified in July by ANSI Committee X3J3 to include my proposal for an IF-THEN-ELSE construct similar to the one he suggested.

An example of the syntax is:

```
IF (I .EQ. 1) THEN
  A = B + C
  D = E
ELSE IF (I .EQ. 2) THEN
  P = Q + R
ELSE
  CALL SUB
  X = Y - Z
END IF
```

WALT BRAINERD
Manager, Product Support
T10-East/Large Systems
Burroughs Corporation
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*

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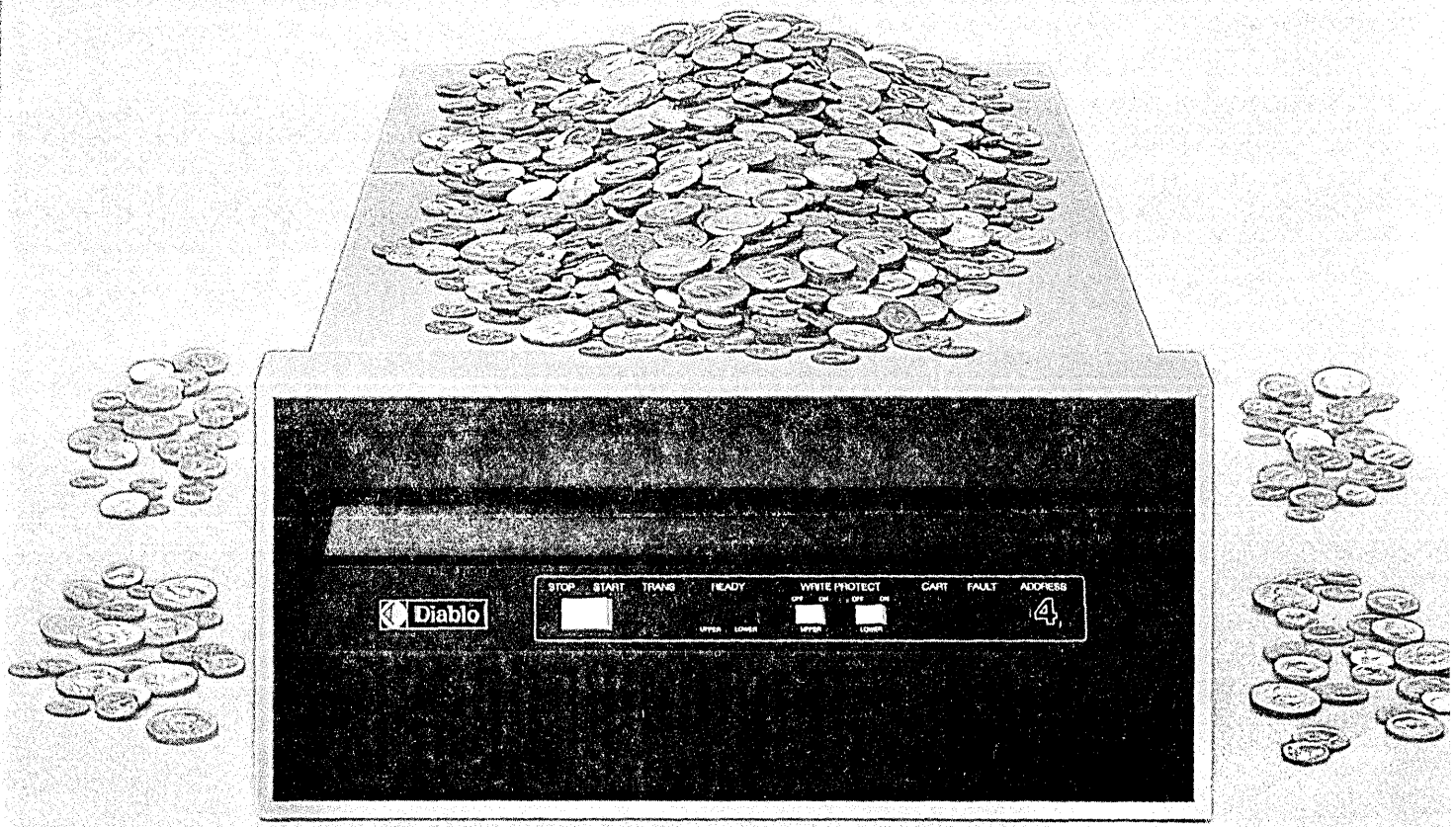

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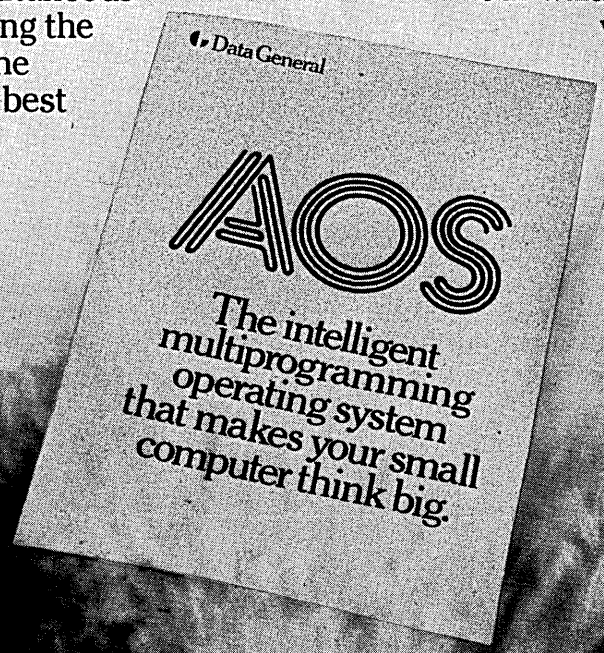

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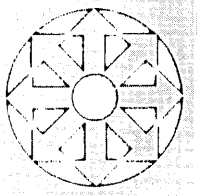


LOOK AHEAD

"FS" TRICKLING INTO IBM ANNOUNCEMENTS

Another scenario about IBM's future products has "Future System" (FS) trickling in over the next five years or so. The first step--breaking up most of MVS into selectable units--already occurred in 1976 (August '76, p. 102). In 1977, the next two steps will occur: a more powerful replacement for the 168, due out soon, which employs a new generation of electronics (like Amdhal's) and dedicated processors (e.g. an input/output processor, a file processor, and a simpler cpu working out of a common memory). Each processor will run its own selectable units. In 1978-79, smaller dedicated processors and improved selectable units appear.

The new generation of electronics and software then gradually moves down the product line, first replacing the 158 in 1978-79 and the 138 and 148 about 1981. More and more selectable units of the operating system software will be broken off, and probably separately priced until only the central resource management core remains. This core of MVS will be replaced in 1981 by a new operating system, probably based on virtual machine principles and implemented in a super fast control store. At that point--voila, FS.

SINGER'S NOT THROUGH WITH COMPUTERS YET

A group of users of Singer Business Machines equipment is unhappy with the Singer Corp. It feels Singer didn't live up to some promises when it dropped the business machines operation. The users are thinking lawsuit and are working toward that end with the Chicago law firm, Jenner and Block. Donn W. Sanford, whose company, The Sanford Organization, administers the affairs of Forum International, the users group for Singer Business Machines equipment users, is acting as a coordinator between the unhappy users and the law firm, but he's made it quite clear that Forum as an organization has no interest in the proposed litigation.

"Forum has no ax to grind," said Sanford. He declined to name the unhappy users or to say how many are involved, only that if it comes to a suit it will be a "multi-plaintiff" suit. He did say that most of the complainants are users of Singer's System 10 computer. They have a healthy target. Singer, now rid of its money losing operations, posted net income of $35.8 million in the fourth quarter of 1976.

SENATE MAY BE CONSIDERING ALTERNATIVE TO BELL BILL

How about a new communications reform act? Tired of listening to AT&T's anti-competitive jingoisms, some newly enlightened congressional legislators are considering exactly that--a pro-competitive alternative to Ma Bell's widely touted Consumer Communications Reform Act. This behind the scenes movement to draft alternative telecommunications legislation has been slowly picking up steam, especially in the U.S. Senate where a bill may be surfacing within several months.

Ostensibly designed to cut away the bureaucratic red tape hobbling telecommunications marketeers, the rumored proposal would streamline Federal Communications Commission procedures. Also bundled into the bill would be reforms aimed directly at Ma Bell--on the Uniform System of Accounts, cross-subsidization, and federal vs. state jurisdiction.

Among several prominent senators looking into the draft bill is Sen. Gary Hart (D-Col). While still not actively promoting the pro-competitive legislation, he's indicated his interest in seeking Bell bill alternatives. Meanwhile, since convening in January, the House has racked up close to 30 new Bell bills, and that's despite optimistic industry predictions that the monoply measure would garner substantially fewer sponsors this year.

OTP ON THE CHOPPING BLOCK

Newly elected President Jimmy Carter apparently plans to follow through on his campaign promise to cut back the burgeoning federal bureaucracy. One of the first victims, the ill-fated White House Office of Telecommunications Policy, is already on the chopping block.

Under a proposed reorganization plan, promoted by two Carter transition staffers, the seven year old telecommunications authority would be sliced into three operating units, with the main policy functions being shifted to the newly created White House Office of Science and Technology Policy. OTP's other responsibilities for government communications coordination would be merged into the already overburdened and understaffed Office of Management and Budget. Still another agency, the Commerce Dept.'s Office of Telecommunications, would handle OTP's so-called Radio Spectrum Management

program. Along with the shifts would be sharp cuts in personnel, and its $8.5 million FY funding would be cut to less than $3 million.

Said one government source: the office "has been slowly dying over the past year. In the last few months," he said, "OTP was reporting only to a very low level functionary on the (White House) Domestic Council staff. It got to the point where the office, for all intents and purposes, didn't exist anymore."

HONEYWELL OFF TO A BIG START WITH 66/85

Metropolitan Life Insurance Co. has purchased one of the new 66/85 Honeywell systems after excluding IBM from the bidding. "We didn't feel IBM should be asked to compete," explains Richard Conlan, sr. v.p. for the insurance firm which traditionally has used both Honeywell and IBM equipment. "We had our own internal reasons for making this decision." The $11.1 million Metropolitan installation represents the second 66/85 sale for Honeywell and will replace a number of Honeywell 8200s. A Midwestern manufacturing company received the first order, and Honeywell claims it has already sold as many of the new systems as it can manufacture in 1977.

SWITCH FOR QANTEL?

Qantel Corp., Hayward, Calif., producer of small business computer systems which has proclaimed long and loud that it is a hardware maker and not a software house, may be changing direction. A major announcement expected some time this spring is expected to include applications software. Qantel is calling its efforts "a common sense" approach.

HO-HUM EFT REPORT DUE FEB. 23

Due out late this month, the interim report of the National Commission on Electronic Fund Transfers isn't expected to contain any earth-shattering recommendations. What it contains are piecemeal "positions" on security and privacy, the government's role as a system operator, and the legal and regulatory hangup of branch banking. The bombshells, if any, will come from Commission critics who are anxiously waiting the report results on Feb. 23 to begin firing away.

And these critics appear to have a well stocked arsenal of ammunition. Plagued by internal politicking, the 26-member Commission is reported to have had difficulty reaching agreement on some of the stickier EFT issues, preferring instead to stonewall them. Fueling this internal dissention, according to one banking industry source, has been the commissioners' "general displeasure" with executive director John B. Benton and his staff. Fed up with Benton's "organizational" procedures, some of the more irascible members supposedly grumbled early last year about axing the troublesome executive director. That probably would prove particularly appealing to certain congressional critics who have contended that Benton, formerly of TRW, couldn't handle the job.

OVERSEAS BUYERS MOVING TO BIG COMPUTERS

In the international user community, 1978 and 1979 will be the big years for computer buying, according to preliminary results of Datamation's international budget survey, appearing in the March issue International Supplement. More than half of 80 respondents will be moving on to bigger systems during these years, most staying with their current vendor.

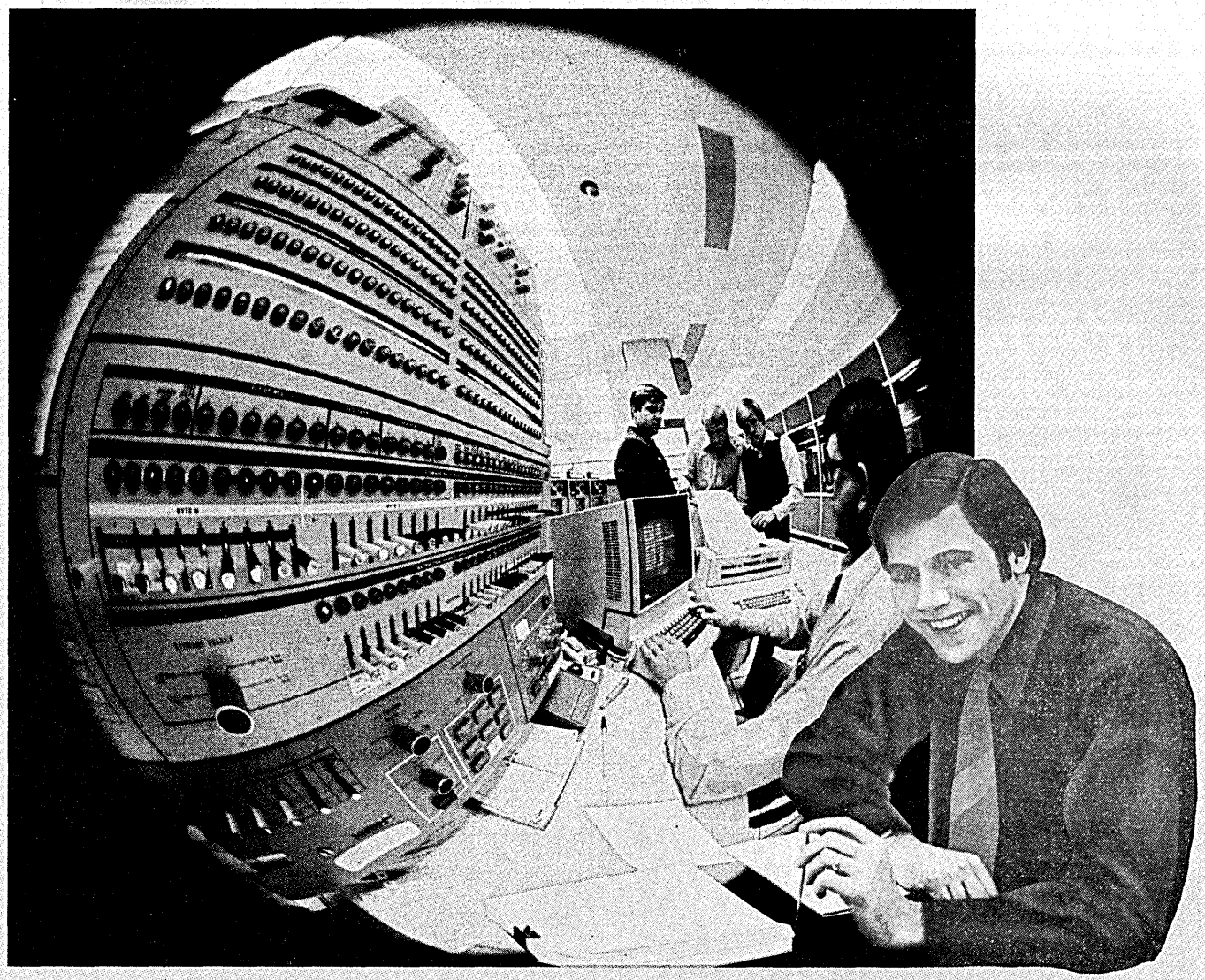
But 1977 won't be a slow market, since planned hardware additions rank equally with inflation in reasons given for budget increases. Most users are upgrading current systems with added memory, peripherals, and terminals.

While plug-compatible cpu offerings are in initial phases abroad, the overseas IBM users show a surprising willingness to consider offerings by Amdahl Corp. and Itel. Four of 40 already plan to buy them, while an additional five definitely are looking. It seems many more could be convinced to have a look-see if the pcm makers could show strong service and support in their countries.

STOCK TRANSFER SYSTEM: PROBLEMS OR A DISASTER?

Citibank's vice president John Gould vehemently denies reports that the bank might seek new bids for another system design in securities processing, but he concedes that the Interdata 8/32 cluster installed at the bank has been a source of considerable trouble. "We've got a pretty lousy image on the Street relative to stock transfer," says Gould, but adds that not all of the problems are due to Interdata's equipment. He said

(Continued on Page 162)



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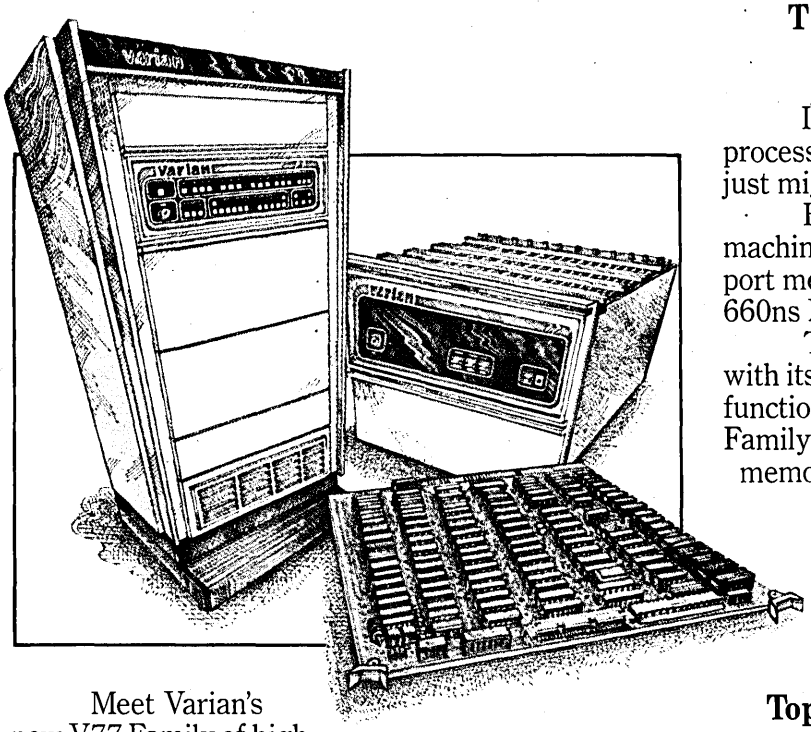

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Big machine features include a fully micro-programmed architecture, an 8-register CPU, a 32-bit arithmetic capability, powerful set of 187 instructions, hardware multiply/divide, direct memory access, programmed I/O, real-time clock, and a teletype/CRT controller.

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How our mini's speak fluent mainframe.

You won't waste any time or money training our new V77 Family how to communicate with your mainframe. Or developing your own control programs.

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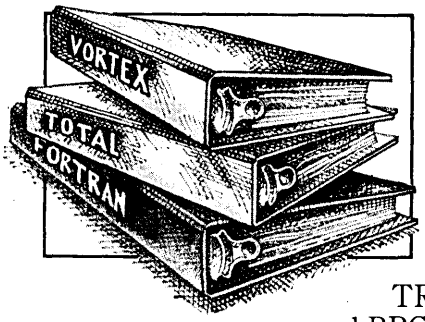
TOTAL, a highly efficient, network-type data base management system, is now available as a VORTEX II subsystem.

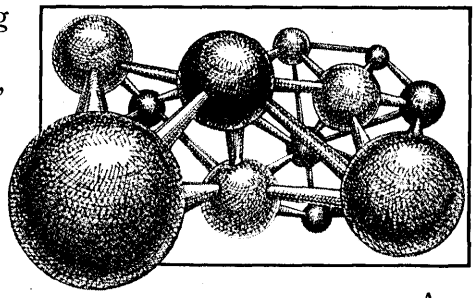


Usually found on only larger computers, TOTAL allows you to define and access your data base with powerful, high-level language processors like COBOL, FORTRAN IV Level G, and RPG-II. Opening the door to large libraries of already developed applications programs.

The benefits of a well-structured family.

Our new V77 Family represents more than just a continuing commitment to total hardware and software compatibility. Because it's a commitment to solving basic price/performance needs on several different levels.

For those needing more computing power, there's a V77 that's an affordable, high-performance solution.



For those wanting less wasted overhead, there's a less expensive, high-performance alternative.

Plus an attractive new V77 discount plan designed to give even modest-volume OEM buyers a big break.

Finally, for those with special multiprocessing or distributed data processing requirements, there's an entire V77 Family. Specifically engineered to work well together—through shared memories, intercomputer I/O bus lines, and shared communications channels—as new cost-effective replacements for typical "patchwork" systems.

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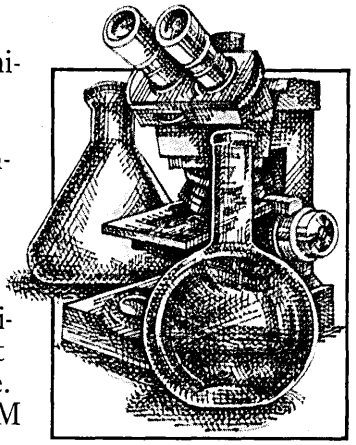

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In 1975, two VDM firsts: a minicomputer with a data base management system equivalent to those for large computers, and, the first 64K word semiconductor memory package on a single board.

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For additional V77 Family planning literature, contact any of the 38 Varian offices listed below, or Varian Data Machines, 2722 Michelson Drive, P.O. Box C-19504, Irvine, California 92713, (714) 833-2400. In Europe, contact Varian Associates Ltd., Molesey Road, Walton-on-Thames, Surrey, England, Telephone 28971.

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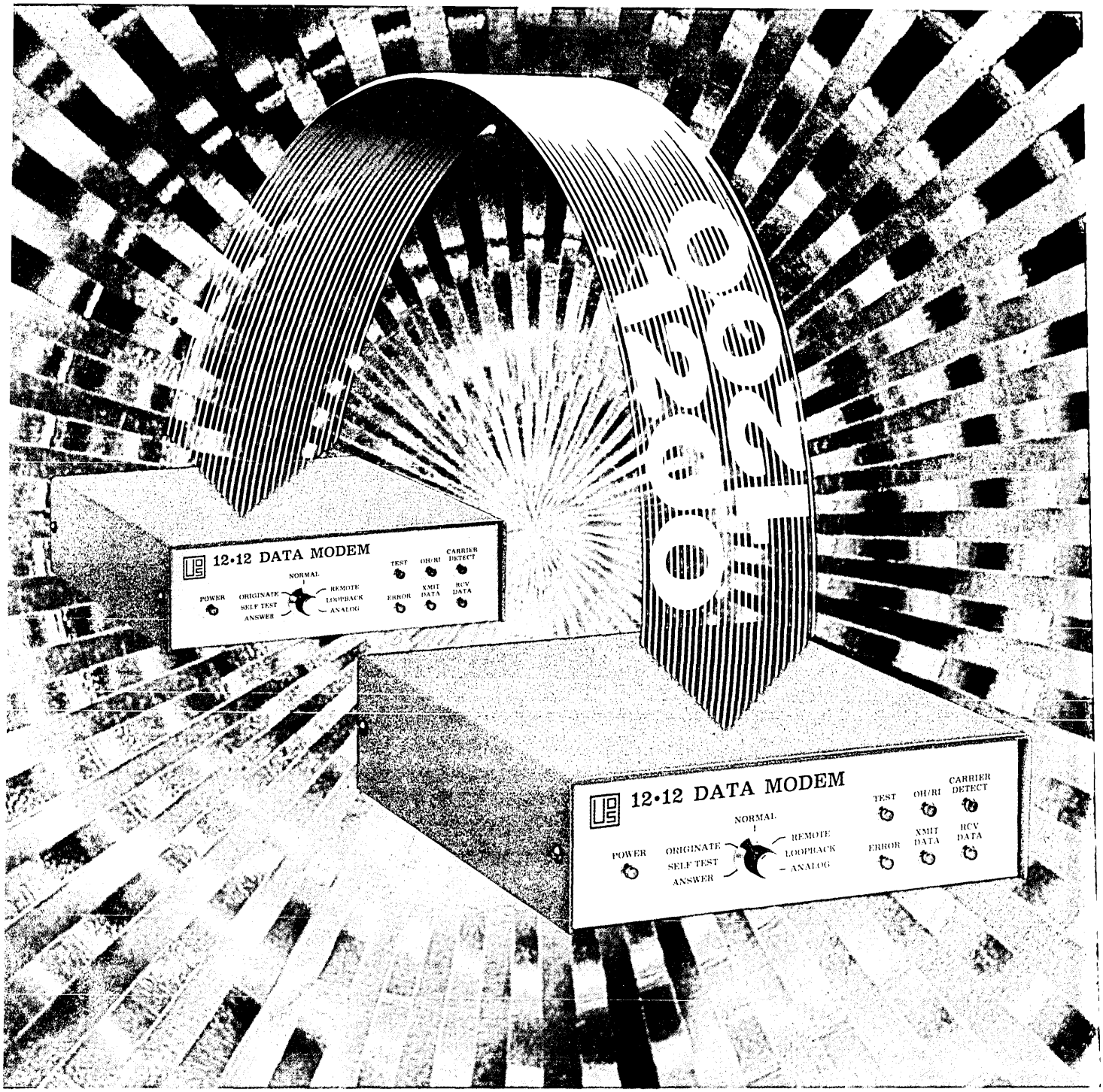

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people

The Gap Can Be Closed, But...

Gil Jones is retired from IBM in accordance with the company's policies governing top executive tenure. Sixty last month, Gilbert E. Jones is still energetic and disciplined. He looks less like the 38-year veteran, vice chairman of the board stereotype, and more like the driving marketing executive and internationalist, roles that took him to the top of IBM.

Jones's career has had the kind of rapid, steady progression to which young IBMers learn to aspire. He joined IBM as a sales rep soon after graduation from Harvard in 1938. He took time out to serve in the Navy during the war, then rejoined IBM and first surfaced at corporate levels in 1953 when he became executive assistant to the president. Three years later he was sales manager for the corporation. After another three years he won the presidency of the prestigious Data Processing Div.

Jones's international career coincided with IBM's period of greatest growth and reorganization overseas. He moved over to IBM World Trade in 1961 as vice president. There he was, in essence, the inside man while Arthur K. (Dick) Watson was the corporation's ambassador and outside contact. "He had a dream, and he was able to project it to governments and to IBM chiefs in foreign countries," Jones recalls. "He was a statesman like his father." Watson left Jones and a small group of exceptionally competent men the task of day-to-day management. They worked under the premise, as Jones notes, that "the best guys are the hardest to manage."

The independent thinkers and leaders assembled under the World Trade flag subjected themselves individually to tremendous work discipline. Jones is often credited with bringing a disciplined, orderly approach to the collection of relatively independent, scrappy country organizations that made up World Trade.

These foreign companies had been relatively autonomous through the forties and fifties. But with the rapid growth patterns and the proliferation of more complicated products as computers entered the scene, discipline, as well as innovation and drive, was necessary. Jones and his people brought two important ingredients to the World Trade recipe. The first was the importance of scheduling. "You can't have a project without also having a schedule for the time it goes into production," he reiterates. Second was cost. "Without knowing what the cost would be, you can't have rational development." That discipline changed development completely in World Trade, permitting the "one-world" product line and a structure of control and coordination that is the envy of most other companies. Jones stresses that while it may have been American engineering and development management that put the emphasis on getting the product at realistic cost and schedule, the Europeans scored particularly high on individual inventiveness. "The European engineer is every bit as good as or better than his American counterpart,"

GIL JONES
. . . energetic and disciplined

Jones says, then smiles as he adds: "Particularly in programming."

With a similar discipline and drive in World Trade marketing, the international organization grew from a country-by-country punch-card firm through the 1401, then the 360 era, and into the 370s. Its revenues grew tenfold in that decade, from about $300 million to almost $3 billion.

International business has become much more complicated now, and more important as well. The orderly growth in World Trade helped the international organization achieve more than half the corporate profits, and half the revenues. As the seventies began Jones was elected to IBM's main board, then became chairman of World Trade. In February 1974 he became vice chairman of IBM's board of directors.

Jone's classic and meteoric IBM career was not without mishaps—and these, too, are part of the cultural knowledge of IBMers. He is the most visible graduate of the "penalty box," a unique IBM institution that permits sinners to redeem themselves after a suitable incarceration. While Jones was still head of dp the population of customer engineers in the U.S. sagged (someone down the line worked too hard to cut down maintenance costs), which resulted in morale problems among overworked CE's, and some jeopardy to the company's vital standards of service. The company righted the imbalance quickly, and Jones spent nine months in a tiny office with few visible duties. After a short transitional job he went into the World Trade executive position in late 1961. He has told the story himself at a number of gatherings. Its message is clear: keep trying.

When Jones returned to the corporate fold in 1974 his international know how must have been a help at top corporate levels. With the fluctuating dollar and rapid changes in other currencies, at a time when the international business was even more important, IBM had to tread very carefully. Jones says the major reasons for the shift from leased to purchased systems have been the rapid changes in technology, inflation (and the resulting fact that users can no longer be sure their monthly price-tag will remain the same), and a similar effect from currency fluctuations. The structure of international labs and factories helps buffer the currency effects to some extent, but the situation is still complicated. Jones points out that a mythical product announced at, say, $100 would initially have its prices everywhere in the world within $5 or $6 of the U.S. price. But as currencies and manufacturing sites change, some products can become imbalanced over the years by as much as, say, $20 to $35. The company tries to keep the prices as similar as possible, but price controls in eight major countries complicate the matter still further.

Today, while most companies (encouraged to some extent by their friendly neighborhood computer vendors) are trying to decentralize (or at least distribute themselves a little, IBM in Europe seems to be centralizing to some extent. "IBM Europe is becoming more of a single entity," Jones explains. "You find a new organization of functions today."

Dick Watson deserves credit for the formation of World Trade and selection of autonomous and often fiercely independent country leaders who were deeply rooted in their own countries and able to root IBM just as firmly in the postwar era. Jones and his team are known among World Traders as the ones who brought the order and discipline necessary for the ten-fold growth. He, in turn, gives credit to the third

generation, Jacques Maisonrouge and the Americans and Europeans now involved with World Trade, for today's more efficient organization.

"We can't afford to do everything in every country," says Jones. Ten years ago World Trade applied this concept to manufacturing and development. Today it has moved out even further. "It used to be that when a machine came off rent in France, we'd recondition it in France and try to put it back into another site in France," says Jones. "Then we discovered that if you could recondition all Aspen tape devices, for example, in one place, even though you pay more transportation costs, it's much cheaper than doing it at 50 places. Similarly, the countries save money by doing paperwork in only a few places with order entry terminals at branch offices."

Because the lines are clearly and carefully drawn between country organizations and the European organization, Jones believes the heads of IBM national companies see the virtues of centralizing functions to cut costs. "The country president has to wear more hats than his U.S. counterpart," says Jones. "He has to know the computer business, to be a financial expert, and also an expert in industrial relations. He has to be a multinational expert, a European Economic Community expert and a tax expert. This approach helps him keep down costs and eliminate duplication of effort and staff."

Looking ahead, Jones thinks IBM will try to keep the same organizational structure tomorrow that it has today. The company is trying to get more Europeans into management at Armonk, and to develop more Americans who understand European operations. After Jones leaves, chairman Frank Cary may have a more direct interface to World Trade, though the new organization makes president John Opel the contact point for Maisonrouge.

"Cary has done a fantastic job getting to know Europe," says Jones. Cary has been abroad a dozen times in the past two years. In the sixties, the parent company almost never saw the country managers, but these days they are often invited to meetings of the corporate management committee. "We're much closer as a result," says Jones. "Jacques Maisonrouge and I have consciously tried to keep Armonk as close to the countries as possible so we understand what the product requirements are and what the differences are in Europe. Europe is more than half the pie, after all. Maisonrouge forced Armonk to be more multinational than ever before. I've done a little myself. We've been working as a team."

A new team already is visible in Europe, with Maisonrouge in the ambassadorial role.

Tom Watson and Vin Learson, Jones's predecessors in the new retire-at-sixty top echelons, have worked hard at retirement, with research projects, yachting, trips, university involvement, and socially responsible activities. Although his avocations tend towards less competitive things than yacht racing (such as fishing and photography), Jones is likely to follow the same pattern to some extent. He has been working with the Council of Economic Development on such projects as studying the effects of Eastern European trade, or Japanese trade on the U.S. economy. He has become vice chairman of CED, and will spend more time on such projects. He's also planning to work more closely with the Columbia Business School and his alma mater, Harvard,

With all these activities, though, it is obvious that Gil Jones will miss the pace of life at Armonk. The policy of retirement at sixty makes room for new ideas, new faces, new attitudes which can move more quickly through the company, but it also means that IBM loses some portion of the knowledge and energy of vital men like Jones who understand the corporation because they played a major role in building it. The gap he leaves in the organization can be closed, but it will be a long time before anyone else can actually fill Gil Jones's shoes.

In New Posts

RONALD J. FRIEDSAM was named director of large systems and components on the corporate product management staff of Burroughs Corp. . . . National Data Corp., Atlanta, named ORAZIO MANZI-FEPATER vice president of cash management and GREGORY LEWIS vice president of credit card services . . . J. F. MAGOSIN, JR., was elected vice president, marketing, for Automated Financial Systems, Inc., King of Prussia, Pa. . . . DAVID L. JAMES was elected president of P G Data Center, Inc., Garretsville, O. bank service corporation . . . JOHN STEELE, formerly with Ferranti, joined Data Logic Ltd., Greenford, Middlesex, England, as a senior consultant . . . Control Data Corp. named A. THOMAS BASSETT, JR., vice president and group executive for its Data Systems Group . . . DR. W. DAVID PENNIMAN of Battelle's Columbus Laboratories was selected by the International Institute for Applied Systems Analysis (IIASA) for a 12 month research assignment involving international information networks and their impact on multinational organizations . . . KEN C. CANHAM was appointed manager, programming and systems, Computeristics, Inc., the data processing subsidiary of Uniroyal Inc. . . . RICHARD B. KENNEDY was named director, computer systems and services for Norton Co., Worcester, Mass. . . . TRW Communications Systems and Services named DONALD G. KOVAR to direct a new Technology Research Center and ROBERT L. UNDERWOOD as manager of retail market planning and development . . . NORMAN N. FELDMAN was appointed vice president and general manager of the newly created Large Information Systems Div. of Honeywell Information Systems, Inc., Phoenix . . . OLIVER J. DE SOFI, manager of data processing and communications for National Bank of North America, New York City, was named a senior vice president of the bank . . . CARL ABRAMSON was named director of technical development for Bowne Time Sharing, New York City . . . MARTIN D. ROBBINS, formerly vice chancellor of the University of Denver Research Institute, was elected president of EDUCOM, a nonprofit educational corporation which promotes resource sharing in the application of computing and other technology in higher education . . . DONN W. SANFORD was named executive director of MINI (Minicomputer Industry National Interchange). . . . ROBERT B. COX, a member of the engineering staff of Threshold Technology Inc., Delran, N.J., since 1971, was named chief engineer for the manufacturer of speech recognition systems . . . PATRICK L. SCHIAVO joined The Seamen's Bank for Savings, New York City, as vice president in charge of the Systems and Data Processing Dept. . . . DONALD K. SEARS was promoted to director of data processing of Aero Mayflower Transit Co., Indianapolis, Ind. . . . WILLIAM F. BOGGS, former systems marketing manager for E. H. Research, joined Datatron, Inc., Irvine, Calif. to direct overseas sales . . . DONALD M. DECKER was named assistant general manager of Interdata, Inc. Oceanport, N.J. . . . SANDRA K. HOOVER was named installation manager, Methodist Hospital, Jacksonville, Fla. . . . ROGER FLICKE was promoted to general manager of the Phoenix Operations Center of Advanced Computer Techniques. ❋

Background photographed near Dornie, Scotland.

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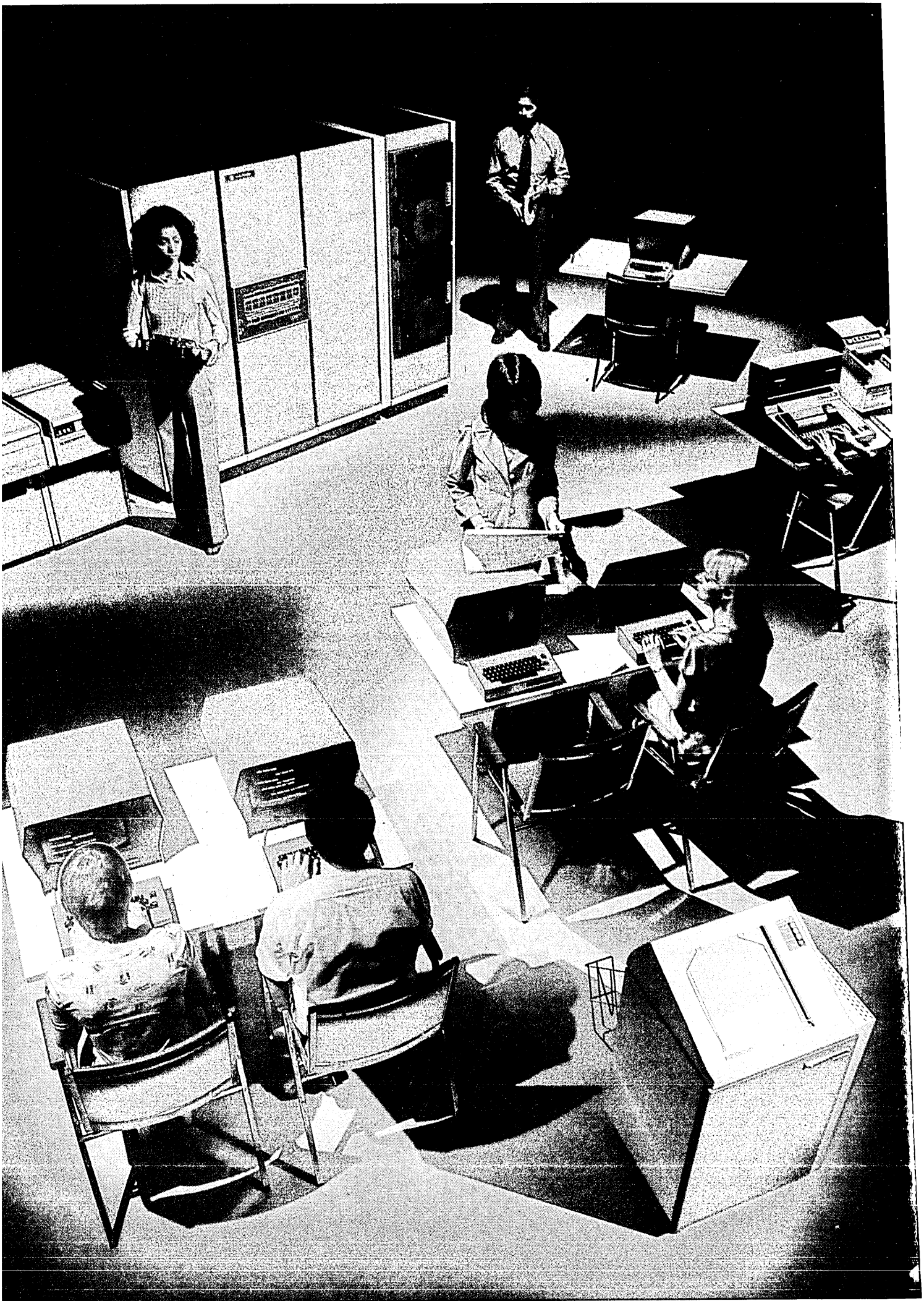

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HARRIS

COMMUNICATIONS AND INFORMATION HANDLING

calendar

MARCH

Conference on Privacy Legislation, March 2, Sacramento, Calif. Proposed privacy legislation governing the use of computers will be examined at this one day conference sponsored by the Sacramento chapter of the DPMA in conjunction with the 2nd annual Computer Equipment and Services Show. Fee: $55 member; $65 non-member. Contact: Sam Price, Univ. of California, School of Medicine DP, Davis, Calif. 95616, (916) 752-3234.

EDP Auditors Association, March 11, San Francisco, Calif. A one day meeting to discuss prevention and detection of fraudulent access to data. Emphasis will be on practical application of traditional audit techniques, with a session on data security also planned. Fee: $45, member; $55 non-member. Contact: Joel Friedman, EDP Auditors Assoc., P.O. Box 6843, San Francisco, Calif. 94101, (415) 546-8200.

Simulation Symposium, March 16-18, Tampa, Fla. The advancement of the art of simulation is the goal of this forum for the exchange of working experience in digital computer simulation. There will be an opportunity for comprehensive understanding of various techniques through organized question and answer periods. A survey of the range of applications and a display of the literature available in the field will also be given. Fee: $100; student, $50. Contact: Annual Simulation Symposium, P.O. Box 22621, Tampa, Fla. 33622.

American National Metric Council Conference and Eposition, March 21-23, Chicago. With a theme of Trans Metric, planners have prepared a 2½ day program giving metric experts and novices guidance in the change to the metric system for business, industry, and education. The latest in metric tools and training aids will be displayed as well as demonstrations of metrication in use. Fees: subscribers, $85; non-subscribers, $100; add $10 for on-site registration. Contact: George B. Buchanan, American National Metric Council, 1625 Massachusetts Ave., Washington, D.C. 20036, (202) 232-4545.

Data Processing Technology: 1977-1981, March 23-25, New York. This is the third annual technological survey and forecast of equipment, software, services, and data communications for the next decade. Workshops will discuss anticipated technological developments and the impact of that evolving technology. Fee: $295; discount for teams. Contact: Diane Summers, AIIE Seminars, Dept. PR, P.O. Box 3727, Santa Monica, Calif. 90403, (213) 450-0500.

Interface '77, March 28-30, Atlanta. Implementation and management of data communications operations and debates on the issue of competition and the Bell bill will highlight the 5th annual data communications conference and exposition co-sponsored by DATAMATION magazine. Leading professionals will chair discussions on product and service updates, networking, technology, and specific applications. A tutorial for newcomers and refresher courses will also be presented. Products, equipment, and services will be displayed by over 150 exhibitors. Fees: $95, three days; $50, one day; team discounts available. Contact: Interface '77, 160 Speen St., Framingham, Mass. 01701; toll-free (800) 225-4620; in Massachusetts, (617) 879-4502 (collect).

APRIL

West Coast Computer Faire, April 15-17, San Francisco, Calif. A conference and exposition on personal and home computers, this is the first such convention to be held on the West Coast. The conference portion of the Faire is expected to offer 50-100 tutorials, formal and informal presentations, and discussion sessions. The exposition will place a variety of "homebrewed" personal computer systems on display, as well as presenting a display of exotic computer systems, components, and peripherals available from commercial vendors. Prizes will be offered for the most outstanding homebrewed computer exhibits. Contact: Jim Warren, Star Route Box 111, Woodside, Calif. 94062, (415) 851-7075.

SCS Conference on Transportation, April 19-21, Ann Arbor, Mich. Sponsored in cooperation with the Federal Highway Administration Office of Research, the conference will focus on the use of simulation in all phases of transportation research and development. Papers to be presented cover such topics as surgical intensive care unit simulation, interrelationship of memory size, and military operations terrain effects simulation. Contact: Dr. James Bernard, Dept. of Mechanical Engineering, Michigan State Univ., E. Lansing, Mich. 48823.

ADAPSO Management Conference, April 18-20, Washington, D.C. The three day conference will offer sessions on selling to the government, affirmative action programs, the economic climate for small business, opportunities in the minicomputer business, EFTS, and customer software. Contact: ADAPSO, 210 Summit Ave., Montvale, N.J. 07645, (201) 391-0870.

Small College Computing Symposium, April 22-23, Duluth, Minn. The symposium is directed towards introducing college faculty to the various uses of computers to enhance college classroom instruction. Fee: $30. Contact: John E. Skelton, Computer Center, University of Minnesota, Duluth, Minn. 55812, (218) 726-7587.

ON THE AGENDA

DataComm 77 Conference and Exposition, March 9-11, Washington, D.C. (800) 225-3232. **4th Annual Computer Architecture Symposium, March 23-25,** College Park, Md. (202) 767-2903. **Nepcon 77 West, March 1-3,** Anaheim, Calif. (312) 263-4866.

CALL FOR PAPERS

Data Communications Symposium, Sept. 27-29, Snowbird, Utah. "The Path Toward Widespread Use of Networks" is the theme of this conference sponsored by ACM and IEEE. Papers are requested on the impact of networks, progress of computer manufacturers in data communications, techniques in security and the impact of new technology on data communications. Papers on related topics in data communications are also invited. Four copies of a completed paper and a 500 word summary should be sent by March 15 to Frank E. Heart, Bolt Beranek and Newman, Inc., 50 Moulton St., Cambridge, Mass. 02138. ❋

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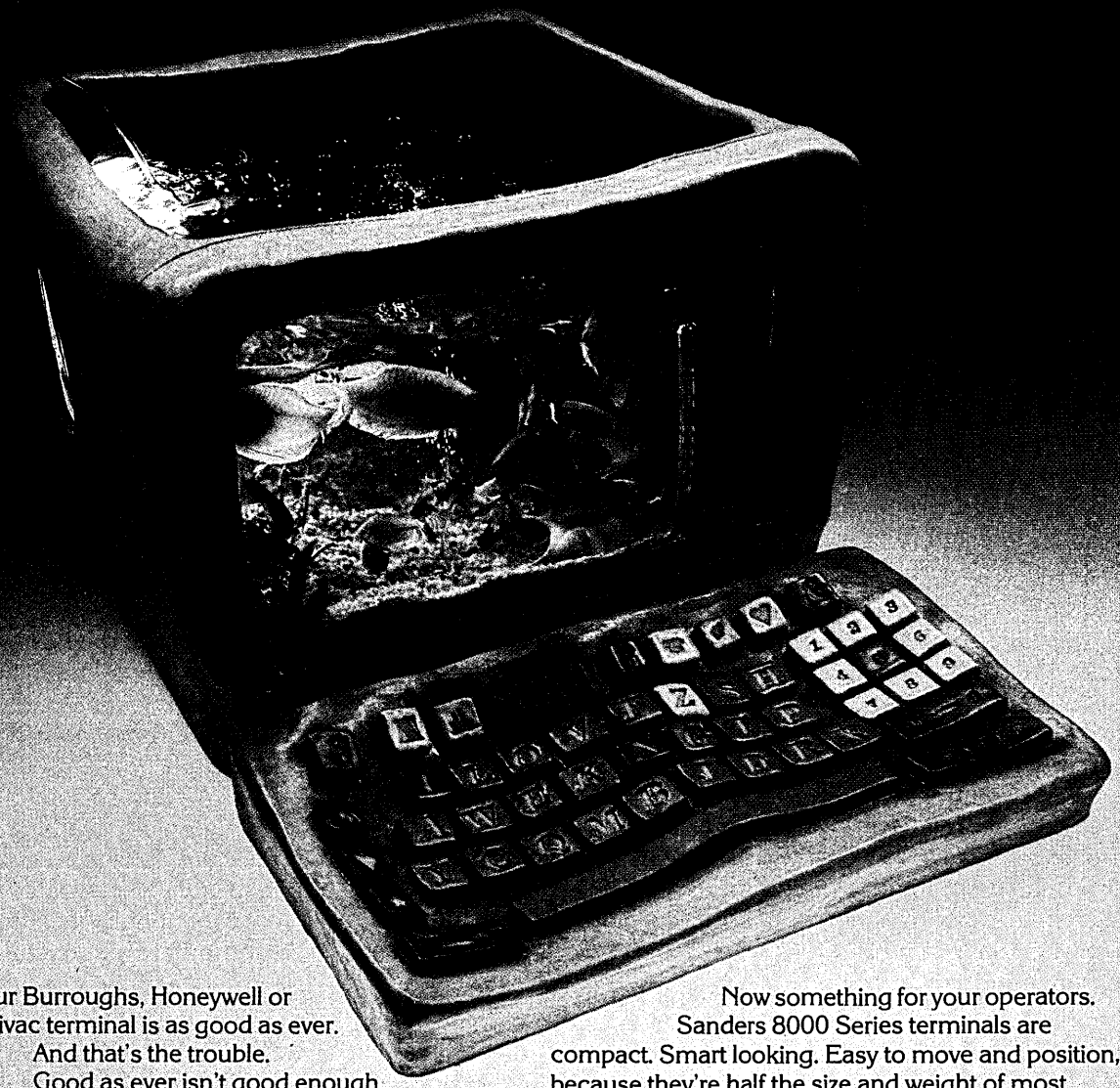

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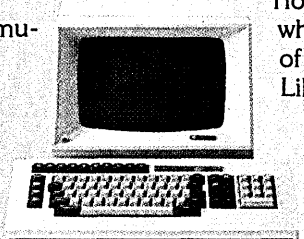

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Distributed Processing Today. In 1977, hundreds of distributed processing networks are serving American corporations in such industries as retailing, transportation, manufacturing, wholesale distribution, banking, insurance, stockbrokerage and medical services. In implementing distributed processing, these companies have learned that optimal performance requires remote display/processing systems flexible enough to be precisely scaled to the needs of each individual site.

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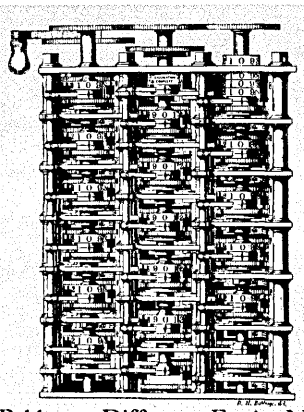

Babbage's Difference Engine No. 1

1970 by Four-Phase Systems. At each site, a cluster of keyboard/video terminals share a single processor ... and terminals can easily be added or removed to suit the site's functional requirements and transaction volume. Four-Phase Systems has built and installed more clustered display processing systems than any other manufacturer.

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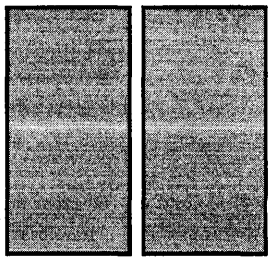

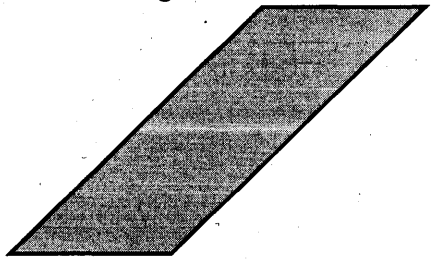

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books

Compiler Design Theory

by Philip M. Lewis, II, Daniel J. Rosenkrantz, & Richard E. Stearns
Addison-Wesley, 1976
647 pp. $18.95

This major addition to the growing set of texts on compilers "constitutes an essentially complete design theory for the lexical and syntax portions of a compiler," based on attributed translation grammars (from the Preface). The inclusion of output symbols and attributes in a grammer allows the description of much of socalled semantic processing and code generation to be expressed in the formal model, making these processes easier to understand. The authors have introduced these concepts of attributes and output symbols in a careful, intuitive, lucid manner. Moreover, the development in the book of the design of a compiler for a subset of BASIC (called MINI-BASIC) lends credence to their model and provides a concrete, realistic example to help the reader understand the theory.

The book is rather unconventional in that it attempts to describe a theoretical and formal approach to compiler design in a nonformal, intuitive style,

> Any aspiring compiler writer . . . should not be frightened at the word **theorem**, and should understand what a proof is.

in order "to make [the concepts] understandable to a wide range of readers." There are no numbered definitions or theorems; theorems are sometimes called "facts"—instead of proving theorems, one sometimes "establishes facts" in a largely informal intuitive manner. Algorithms are usually given at a high level, in English.

To a large extent, the authors have succeeded. The book *is* readable, although slow moving, and the reader should be able to understand the concepts pretty well. Whether this is the right approach is a matter of taste. While informality can be a good thing, it can be overdone. In my opinion, any aspiring compiler writer (or programmer for that matter) should not be frightened at the word *theorem*, and should understand what a proof is. The programming world suffers from just such a lack of rigor and formality. At this time, when programmers are beginning to be asked to understand and use correctness-proof ideas for programs, as well as to be more precise, it seems that our textbooks should do the same.

After a short chapter outlining the ideas underlying compilers, the authors devote three chapters to lexical analysis. Ch. 2 covers the usual introductory material on finite state machines, Ch. 3 discusses their implementation, and Ch. 4 develops the lexical analyzer for the compiler for MINI-BASIC.

Ch. 5 discusses pushdown machines, while Ch. 6 introduces contest-free grammars, regular grammars, and the relation between regular grammars and finite state machines. A grammar is given for MINI-BASIC.

Ch. 7 does an excellent job of introducing "attributed translation grammars" and how attributes can flow "up" or "down" a syntax tree. Specific examples for translating arithmetic expressions, assignment statements, and conditional jumps help explain the ideas nicely.

It should be noted that *parsing* according to a context free grammar has not yet been introduced. Quite rightfully, translation is expressed in terms of the leftmost derivation of a sentence; *how* to construct the leftmost derivation is a harder problem to be tackled later.

The next three chapters are devoted to the topic of top-down processing: Ch. 8 discusses LL(1) grammars and parsers for them, recursive descent, and error repair; Ch. 9 discusses additions necessary to process attributed grammars in top-down fashion; Ch. 10 develops a top-down processor for MINI-BASIC.

Chs. 11-13 discuss bottom-up processing. Quite nicely, these three chapters are completely independent of Chs. 8-10, so that an instructor can elect to cover either top-down or bottom-up parsing, or both.

Ch. 14 describes a code generator for MINI-BASIC; while the last, Ch. 15, surveys code optimization briefly. Most of the chapters are followed by numerous helpful exercises.

The book has its disadvantages. One major design error, in my opinion, concerns the order of presentation of material. Pedagogically, it is best to introduce grammars first as a means for formally defining part of the syntax of a programming language, and then to show how easy it is to construct a recognizer or parser from the grammar. However, this book presents these ideas in the opposite order.

Certain topics in compiler construction have been covered very slightly or not at all. For example, various methods for structuring symbol tables are hidden in Ch. 3 on implementing finite-state machines, while processing declarations in block structured languages appears, as if an afterthought, in Ch. 14 on code generation. Discussion of what information must go into the symbol table is limited to the MINI-BASIC compiler, as is the discussion of allocation of runtime storage and code generation. There is no mention of various internal source program forms, and nothing on interpreters. The nine page survey on code optimization can do no more than mention the various kinds of transformations which might reduce execution time.

To be sure, the preface states that the book constitutes [only] an essentially complete design theory for the lexical and syntax portions of a compiler, but this lack of material on important practical topics might make it harder to use as a text for a course which is to cover the whole set of topics needed for constructing compilers.

In spite of these disadvantages, the book does a pretty good job of doing what it is supposed to do: cover basic mathematical theory (and its application) underlying the design of compilers. It deserves to be on the compiler writers bookshelf, and should be studied by instructors of compiler writing courses.

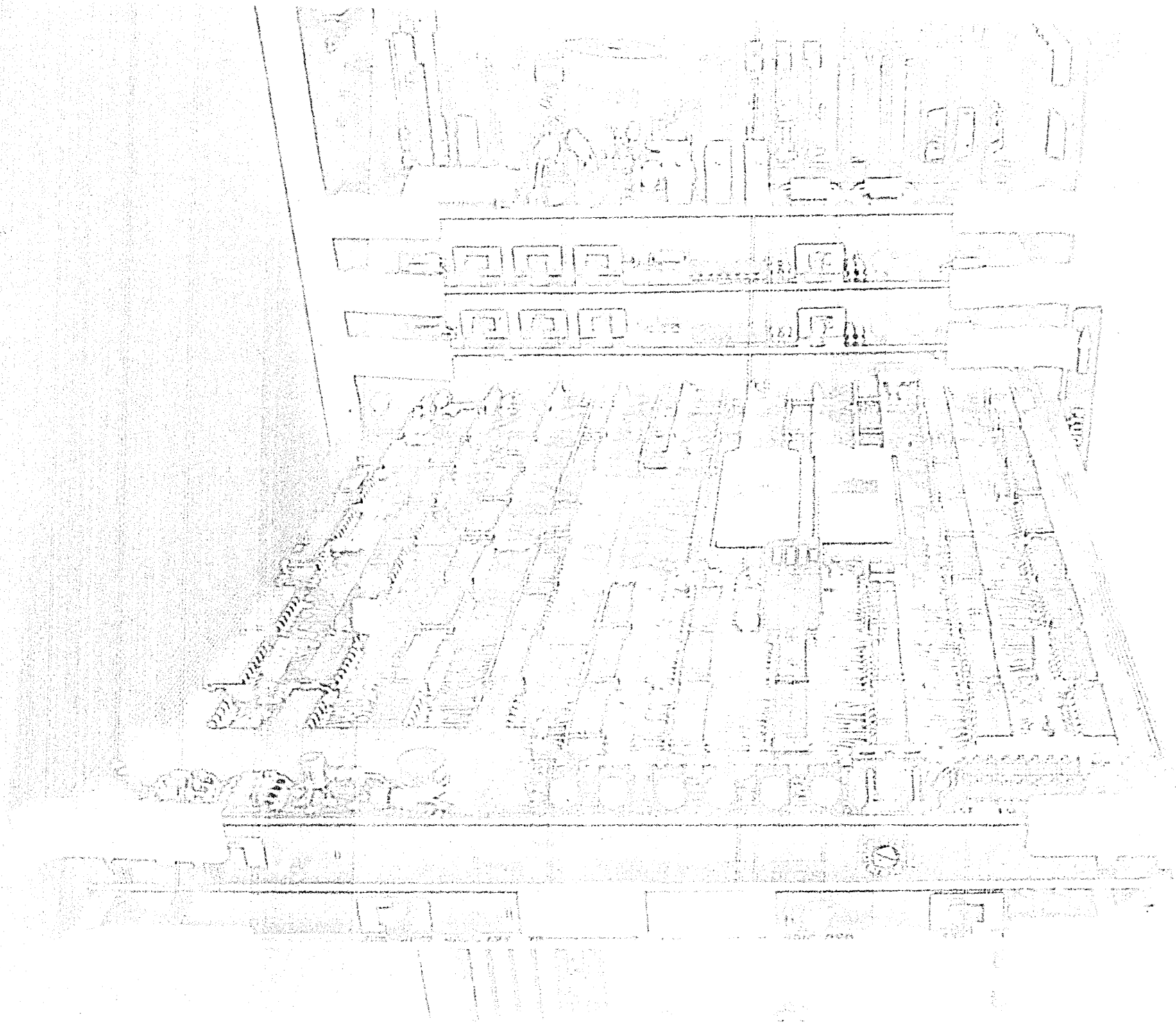
—**David Gries**

Dr. Gries has been an Associate Professor of Computer Science at Cornell University since 1969, and is author of "Compiler Construction for Digital Computers."

reports & references

Industrial Micros

A new report, *The Industrial Microcomputer Market,* predicts that the industrial application market for microcomputers will expand from estimated sales of $4.5 million in 1975 to $1.1 billion in 1985. The 240-page forecast examines microprocessors and read on memories as applied to manufacturing, electric, gas, and other end user indus-



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CIRCLE 62 ON READER CARD

tries. It assesses the relationship between original components manufacturers and intermediate suppliers in servicing the end user, and projects share of market for original manufacturers to intermediate customer to end users through 1985. The book includes chapters on application and technology trends, and analyzes products, markets, and suppliers. Price: $650. FROST AND SULLIVAN, 106 Fulton St., New York, N.Y. 10038.

Control Audit

Should computer controls be of concern to dp managers? Should auditors give special attention to those controls? In dealing with these questions, *Computer Control and Audit* takes a practical approach to the analysis of a variety of controls for computerized and manual information systems including applications, development, on-line systems, data bases, minicomputers, computer abuse, and operational auditing. The book is designed for use by computer systems developers, internal auditors, user management, operations management, public accountants, and educators. Price: $20; $15, IIA members. Publications Department, INSTITUTE OF INTERNAL AUDITORS, 5500 Diplomat Circle, Orlando, Fla. 32810.

Modeling and DBMS

The efforts of over 60 edp professionals who participated in the IFIP TC-2 Working Conference are collected in the 418-page book *Modeling In Data Base Management Systems.* This collection of their papers deals with issues of data base management and modeling of interest to those involved in the design and implementation of an efficient DBMS, or data modeling in general. The book includes chapters on architecture for the next generation DBMS, design of logical data base structure, information management concepts for use with DBMS interfaces, and concepts for modeling information. Price: $35 U.S. NORTH HOLLAND PUBLISHING CO., P.O. Box 103, Amsterdam, The Netherlands.

Structured Design Guide

For the beginner or the experienced designer, structured design techniques can be overwhelming. This 64-page book provides a "cookbook" of information on the structured design techniques, guidelines, and strategies, and covers the steps of structured design in order of performance in developing a system or program. There is a 26-page glossary. Printed on 4 x 8 inch plastic pages, The *Deltak Structured Design Reference Guide* is $20. DELTAK, INC., 9950 W. Lawrence Ave., Schiller Park, Ill. 60176.

Text Editing Guide

Storage Technology Corp. has prepared an instruction book for the initial training of operators of their DEC System 10 text editing facility, which other DEC users may find useful. The information is partial, with other options and facilities available in almost every case, but the instructions will work, and the inexperienced terminal user can do productive editing almost immediately. Price: $10; discount for multiple copy purchase. STORAGE TECHNOLOGY CORP., Information Services Div., 2270 S. 88 St., Louisville, Colo. 80027.

Technology Trends

An update of a previous edition, *Trends in Computer Technology* reviews the past, present, and future trends in hardware development and software generation. The bibliography studies prospects and problems in the development of computer technology and reviews trends in the Soviet Union. The 26-page book contains 64 abstracts, of which 21 are new entries. Price: $25. NATIONAL TECHNICAL INFORMATION SERVICE, 5285 Port Royal Rd., Springfield, Va. 22161.

Data Entry User's Guide

Everything starts with data entry, and it's one place where the people problem is just as significant as the equipment problem. Volume one of the 600-page reference book, *Data Entry Today,* includes individual sections on state of the art, equipment, source data automation, selection, and case studies. Volume two includes comparison charts and technical evaluations of 50 major data entry products with a description of each of the equipment submarkets. There is a glossary and a list of manufacturers, with their addresses.

This service was previously offered as reference or college course material on a continuously updated basis. It is now offered on a one time, nonupdating basis. Price: $75; discount for multiple copy purchase. MANAGEMENT INFORMATION CORP., Dept. F, 140 Barclay Center, Cherry Hill, N.J. 08034.

Data Entry Survey

The *1977 Users' Survey of Data Entry Equipment* is now being prepared by Management Information Corp. Users of keypunch, key to tape, key to disc, or key to cassette equipment, OCR readers, optical mark sensing equipment, alphanumeric display terminals, point-of-sale equipment, data recorders, and other data collection devices are invited to participate in the survey. All participants will receive a free copy of the findings. For a survey form, contact MANAGEMENT INFORMATION CORP., Box C, 140 Barclay Center, Cherry Hill, N.J. 08034.

Small Business Computers

The 68-page reprint from Datapro 70, *All About Small Business Computers,* provides detailed specifications on 228 low cost computer systems, and analyzes users' experience with more than 1,700 installed systems. The report also summarizes the capabilities and limitations of the systems and guides selection of the most suitable equipment for specific applications. Comparison charts describe data formats, processing and storage facilities, peripheral equipment, software, pricing, and availability status of systems from 96 vendors. Price: $12. DATAPRO RESEARCH CORP., 1805 Underwood Blvd., Delran, N.J. 08075.

vendor literature

Batch Terminal Plotting

Houston Instruments, which has managed to interface its line-up of plotters to most every computer developed in this region of the universe, now proudly announces via a new brochure, that it has more or less invaded the remote batch terminal market. Specifically, the model 7/734, a 4.5 ips plotter said to be field installable in less than an hour, can be attached to the Control Data 734 remote batch terminal. The brochure describes how the terminal can be used for graphics plotting, giving examples of actual plots, and presenting a typical block diagram of the signal pattern from the host computer through transmission, modem, interface, and teleprinter or plotter. Features described include hardware and vector generation, automatic detection of transmission errors, and operating conveniences. HOUSTON INSTRUMENT, Div. of Bausch & Lomb, Austin, Texas.

Mini APL

One of the more interesting subjects dp management is concerned with is the proliferation of high-level languages on minicomputers. This vendor has put together an eight-page brochure describing APL, an IBM-developed language, as implemented on the HP 3000 II series of data processing systems. APL is being used more and more for business, educational, scientific, and engi-

Now Norden gives DEC's PDP-11/34 all the muscle it needs to work in any military environment.

Announcing the new PDP-11/34M in half ATR and full ATR versions

First of a family of military computers to spring from the union of Norden's experience in high technology military electroni and DEC's leadership in minicomputers.

The PDP-11/34M has the muscle for sever environment operation, meeting airborne (MIL-E-5400), shipborne (MIL-E-16400), and land based (MIL-E-4158) specs. It's packaged in a compact half ATR chassis or a versatile full ATR chassis each with cooling and mounting options.

Fully compatible with PDP-11

The PDP-11/34M is completely compatib with DEC's commercial counterpart. Thus the most extensive, proven software in th mini-computer industry is now available on a true military computer. Powerful, efficient operating systems cover single user, time-sharing, real-time, and multi-function choices included in RT-11, RSX-1 and RSTS/E. High level languages includ MACRO-assembler FORTRAN, FORTRAI Plus, COBOL, BASIC and BASIC Plus.

Extensive features

The Norden PDP-11/34M comes with the extended PDP-11 instruction set (over 40 instructions); multiple register architecture; hardware stack processing; multipl priority level vectored interrupts; and integral direct memory addressing (DMA

What's more, the PDP-11/34M can be con figured with up to 124K words of byte parity core memory using 16K or 32K word modules, and with a memory management system for program protection – plus a floating point processor for high speed number crunching.

In addition, it boasts integral CPU and memory diagnostics. And large selection of peripherals and interfaces.

An unbeatable combination

Add it up and you get a military computer so muscular, so powerful, and so easy to use, it makes the others look like underachievers. To learn more, write or call Marketing Manager, Computer Products Center, Norden Division, United Technologies Corporation, Norwalk, CT 06856 (203-838-4471)

PDP-11 data processing with military muscle

NORDEN

Division of
UNITED TECHNOLOGIES®

CIRCLE 85 ON READER CARD

source data

neering applications involving the manipulation of large data arrays. A special section describes the HP 2641A APL display terminal, designed expressly for APL usage. HEWLETT-PACKARD CO., Palo Alto, Calif.

FOR COPY CIRCLE 233 ON READER CARD

Media Storage

If you're like most users, you're probably up to your pockets in floppy discs or magnetic cards—maybe even both. This vendor would like to suggest to you—via a new data sheet—a method of storing either 500 magnetic cards or 100 diskettes in its File One roll top storage cabinet, or 200 magnetic cards or 40 diskettes in its File Two product. THE MORLEY CO., Portsmouth, N.H.

FOR COPY CIRCLE 232 ON READER CARD

Modem Catalog

One of the major sources of Bell, IBM, and CCITT compatible modems describes its product line in a 24-page catalog complete with technical information and details on nationwide service provided by General Electric's Instrumentation & Communication Equipment Service. The products described span the range of 300, 1200, and 2400 baud equipment; the VA3400, a full-duplex that operates on dial-up or two-wire dedicated lines; multiple data sets; and multiple calling systems. Also described are the company's four regional diagnostic test centers and the firm's quality assurance program. THE VADIC CORP., Mountain View, Calif.

FOR COPY CIRCLE 234 ON READER CARD

Intelligent Terminal

One of the first companies to enter the intelligent terminal market is now making available a 28-page product specification on its newest product, the System 700. The document contains a physical description of the 12-bit MSI/-LSI processor, purpose and use of the equipment, programming considerations, and a listing of optional peripheral devices that can be appended to the 700 line. The System 700 is delivered either as a totally turnkey installation, including all application software, or as a user programmable system. Up to 73K words of memory can be contained beneath the skin of the terminal. MEGADATA CORP., Bohemia, N.Y.

FOR COPY CIRCLE 237 ON READER CARD

Electronic Publishing

The TEXT II electronic publishing system for newspapers is described in a 28-page document prepared by a manufacturer of systems being installed throughout the world. TEXT II automates many common newspaper operations. Editors, ad takers, and production personnel enter data into a computer via keyboards in their video display terminals. Under computer control, ad or editorial copy is prepared for composition, management reports are generated, and billing is accomplished. Copy for news, classified, and display advertising is stored, sorted, and prepared for photocomposition in the designated fonts, in justified and hyphenated lineage, and in proper column widths. SYSTEM DEVELOPMENT CORP., Santa Monica, Calif.

FOR COPY CIRCLE 235 ON READER CARD

Information Service

Your plea for a list of information sources to help keep business managers on top of the computer age has been heard—or more likely overheard in this age. *Personal Information Services for Business Managers* lists the numerous monthly newsletters designed to keep managers up to speed on all aspects of data processing. Other services explained in the brochure include a data entry manual, a management seminar for data entry supervisors and their managers, and a guide to evaluating dp facilities. The newsletters are written in some language called "plain English," rather than "technicalese." MANAGEMENT INFORMATION CORP., Cherry Hill, N.J.

FOR COPY CIRCLE 236 ON READER CARD

courses

Basic dp

Computer-phobia got you down? Confused by the jargon and mystery of your own dp facility? Lose your fear of computers by learning what they can and can't do at this 3-day course. *Fundamentals of Data Processing for the Non-Data Processing Executive* will be held in New York (March 28-30) and Kansas City, Mo. (April 18-20). Price: $410, members; $470, non-members; discount for teams. AMERICAN MANAGEMENT ASSOC., 135 W. 50 St., New York, N.Y. 10020.

Performance Auditing

A workshop for those concerned with the growing cost of computing and the difficulties in controlling cost-effectiveness, *How to Conduct a Performance Audit of Your Computer System* will be held in Newport Beach, Calif. (March 7-11 and May 2-6), San Francisco (March 21-25), and New York (April 18-22). Price for the 5-day course (includes course materials and luncheons): $595. KESTON-BARNETT ASSOC., 1010 Rockville Pike, Rockville, Md. 20852.

TTI Seminars

Several 3-day seminars are scheduled in the Washington D.C. area. *Satellite Data Communications* will be held March 2-4, chaired by Norman Abramson. *Understanding Performance Evaluation* is scheduled for March 7-9, led by Peter Denning. *Computer Networks* will be chaired by Leonard Kleinrock March 23-25. Price (includes textbooks, course notes, three luncheons, and refreshment breaks): $485; discounts for prepayment and groups. TECHNOLOGY TRANSFER INC., P.O. Box 49765, Los Angeles, Calif. 90049.

periodicals

Telecommunications Quarterly

The assessment of the social, political, and economic impact of the expansion of telecommunications is the focus of the international quarterly journal *Telecommunications Policy*. Regular features will include articles and papers by experts on broad issues as well as specialized topics, conference reports, book reviews, and editorial comment. The journal will also cover the assessment, control, and management of developments in telecommunications and information systems, and key areas of policy research. Subscription: $78. IPC BUSINESS PRESS LTD., 205 E. 42nd St., New York, N.Y. 10017.

Personnel Management

Computer Personnel Management is a monthly newletter designed to help the edp manager understand and solve people problems in the data processing environment. Scheduled features include training of edp personnel and data entry operator motivation. A "How Others Are Doing It" column will feature discussions of problem-solving with reader feed-back encouraged by use of a postage-free form. There will also be news items relating to new government regulations, book reviews, and coverage of seminars of interest to personnel managers. Subscription: $60, one year; $100, two years. MANAGEMENT INFORMATION CORP., 140 Barclay Center, Cherry Hill, N.J. 08034. ❋

Should your access control system be DIGITAL OR CARD?

The answer to that is the system you can work with most easily. And at Sargent & Greenleaf, we think when you compare the two, you'll find digital systems are more flexible. Here's why.

With a digital system you can change your combination whenever you want—every shift or every day for example—and you can change it yourself. Then, simply notify people of the new combination.

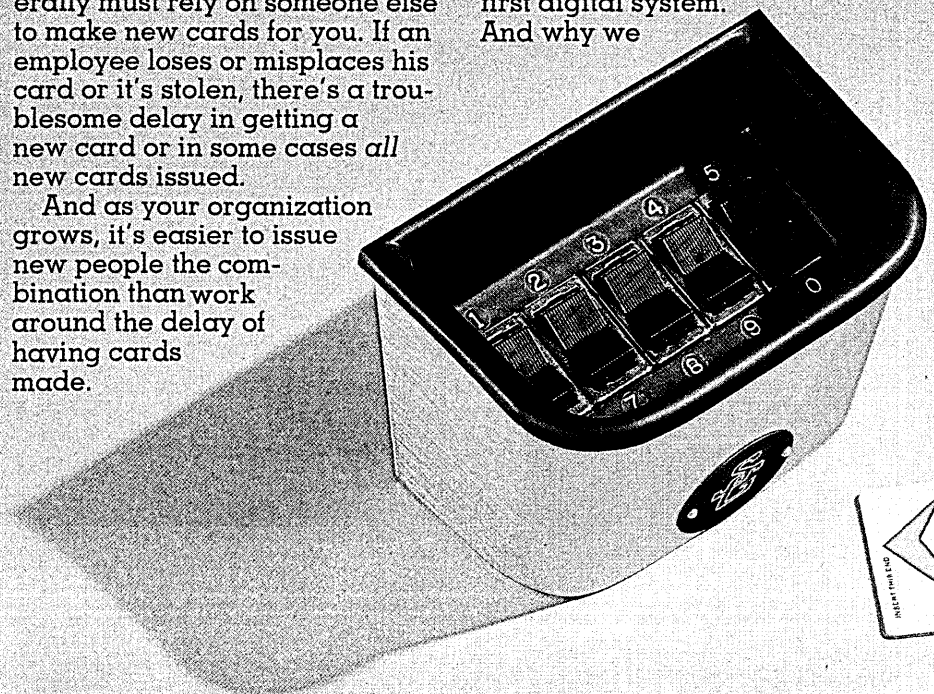
With a card system, you generally must rely on someone else to make new cards for you. If an employee loses or misplaces his card or it's stolen, there's a troublesome delay in getting a new card or in some cases *all* new cards issued.

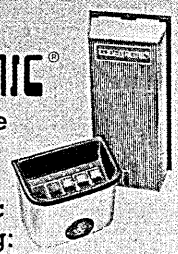
And as your organization grows, it's easier to issue new people the combination than work around the delay of having cards made.

With a digital system, there's never a problem about what to do with old or lost cards. And while it can be said that it's easier to transmit a combination than a card with your name on it, even most sophisticated cards can be duplicated in a matter of minutes.

At Sargent & Greenleaf, we feel the flexibility of changing the digital system *yourself* makes it the easiest to work with. That's why we developed the first digital system. And why we now believe our Code/Tronic access control systems are the most secure and flexible you can install.

We'd be happy to send you a brochure about the Code/Tronic, about the nationwide service network that backs it up, and about us—Sargent & Greenleaf. Over 100 years ago, we started inventing things like the key changing combination lock and the time lock.





CODE/TRONIC®

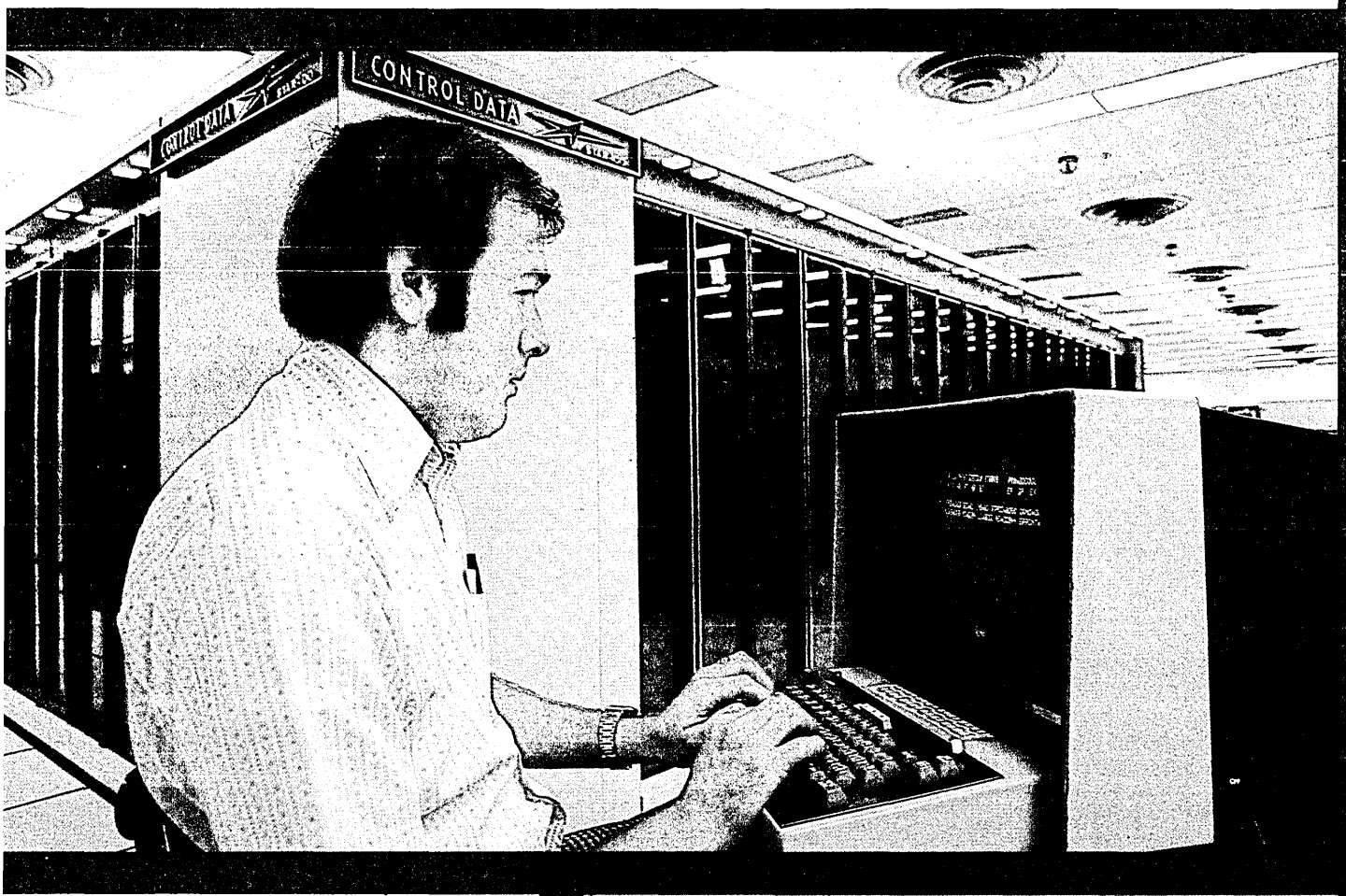
Ask anyone in the security business about us. Then, ask for the Code/Tronic brochure by writing: Sargent & Greenleaf, One Security Drive, Nicholasville, Ky. 40356.

SARGENT & GREENLEAF, INC.

CIRCLE 91 ON READER CARD

Ask Control Data

for a custom configuration of off-the-shelf computer systems.

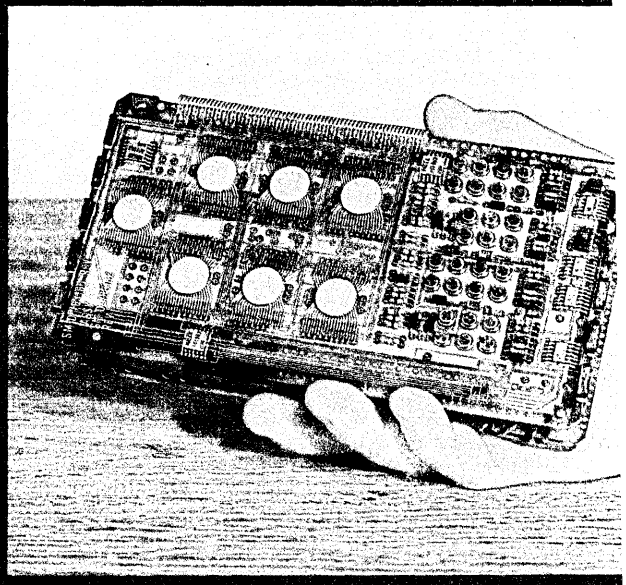


CDC® STAR is the powerful vector-processor that handles 100 million operations a second! The future is here today!

The CDC CYBER 170 "family" handles as few as 1 million instructions per second or as many as 8 million. Our CDC CYBER 70, Model 76, handles 15 million!

Worldwide airline and bank networks, among others, process hundreds of thousands of messages a day with CDC CYBER 1000 Communications systems.

CDC can make a general purpose military computer this small from "off-the-shelf" components.



We have it.

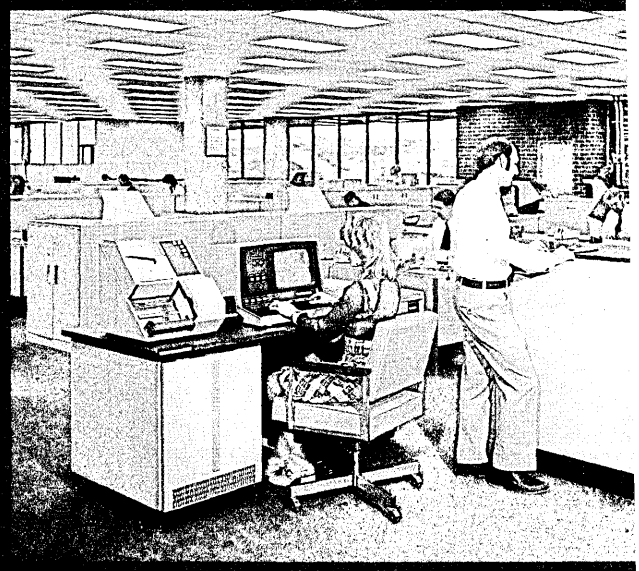
No other computer company (including IBM) offers Control Data's range of computing power. So we can help you define your problem, then assemble the system you need from "off-the-shelf"—instead of saying, "Take what we've got!"

If you need a 16-bit general-purpose military mini that squeezes 4K words of memory into a box you can hold in your hand, we have it.

If you need a combination of terminals, minis, mainframes and peripherals that can process your data most conveniently and cost-effectively, we have it. And a lot more.

What's more, Control Data's Network Operating System (which controls CDC system processing routines) is compatible throughout the full range of CDC® CYBER 70 and CDC CYBER 170 systems. So, if you start with any medium-size CDC CPU, we'll help your system grow as your computer needs grow, with operating software that's compatible throughout.

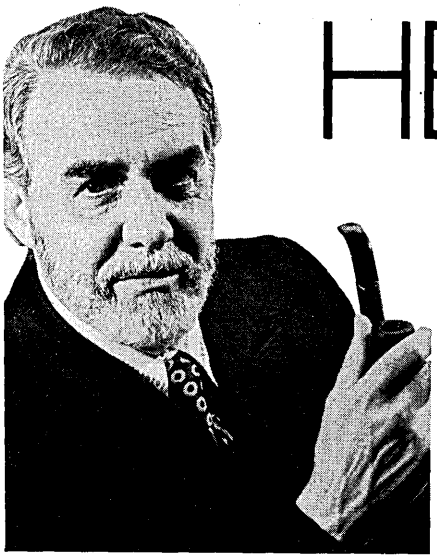
Want a company that's willing to configure "off-the-shelf" computerware into a system that fits your needs? Ask Control Data. Call your local CDC Representative or write B. G. Robertson, General Sales Manager Systems Marketing, Control Data Corporation, P.O. Box 1980, Twin Cities Airport, St. Paul, MN 55111.



Our CDC CYBER 18 works as a stand-alone mini—or interfaces with the CPU for cost-effective distributed processing.

CONTROL DATA CORPORATION

CIRCLE 12 ON READER CARD



HELLO AMERICA

Permit us to Introduce ourselves

We're ICL Inc., a newly-formed division of International Computers Limited of the United Kingdom

We're here in the U.S. now — and we're entering your marketplace with a range of data processing and data capture equipment wide enough and deep enough to satisfy all your application requirements; be they in industry, commerce or government. So we want to get to know you.

Here are a few statistics: International Computers Limited (ICL) is the largest non-American owned computer manufacturer in the world. ICL has over 6,000 computers in operation within all major countries, and has an employee base of approximately 30,000 persons worldwide. In 1976, the Company had over $475 million in sales and an overall growth rate of over 20%, with a profit increase of over 40% compared to 1975.

You see, we're not kidding. (Everyone knows the British have no sense of humor.) Indeed, we're a very serious company. Serious about our business and about yours. So serious, that we have made a major commitment to be here and to provide the best mix of data processing equipment available from any single company anywhere. That commitment involved the establishment of a major manufacturing facility in this country, a nationwide service organization setup, and sales offices across the country.

So here we are. In the United States, in Canada, in the Caribbean, and in Latin America. We're in the Americas to stay. Because we've learned to mix.

Now that we've introduced ourselves to you, we hope you won't be shy. Call (Collect) 212/486-7400 to introduce yourself personally to Eli Hiller, our Vice President in charge of sales. He'll be delighted to meet you. He'll also tell you how you can meet our people in the regional office nearest you.

Call or write. Or simply fill out and mail the coupon below. We promise to bring the right mix.

I'm interested in hearing more about ICL Inc.
☐ Please have your representative contact me.
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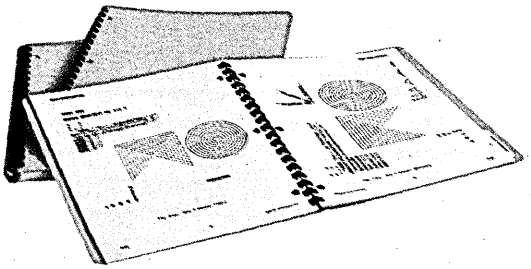
"As the first interactive small plotter, it was the only intelligent choice."



The 4662 contains its own character generator, alpha rotation, and page scaling, thus minimizing support software. Proven graphic and plotter software is provided by Tektronix.

Problem: Until now, no small plotter could carry on an intelligent conversation.

Because most B-sized plotters have been pretty much the same: slow, unreliable, and dumb. Even with large off-line plotters you can wait hours, even days, for results . . . and if there's a mistake—start over.

Solution: Tektronix' new microprocessor-based 4662. For interactive plotting, page scaling, digitizing, and camera-ready output. Just $3995.†

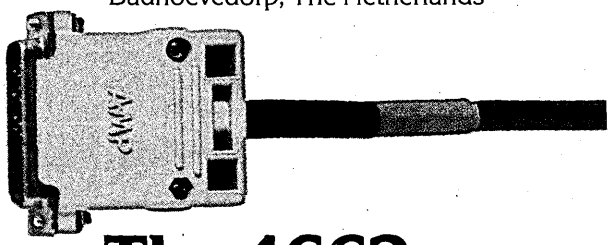
The 4662 is the first smart buy among 11"x17" flatbed plotters. Its digital design and vector generation offer exceptional accuracy and repeatability without drift or slidewire dirt build-up. Its 1600-byte buffer lets the host work while the 4662 plots . . . at speeds up to 22 ips.

It's the first B-sized plotter with graphic input. Digitizing capability and built-in joystick mean you can input corrections in seconds, experiment with designs, and run off camera-ready copies practically as fast as you load paper.

It's plug-to-plug compatible with virtually any RS-232 system . . . from minis to mainframes. You can plot circles around any other B-sized plotter, for about the same price as the competition.

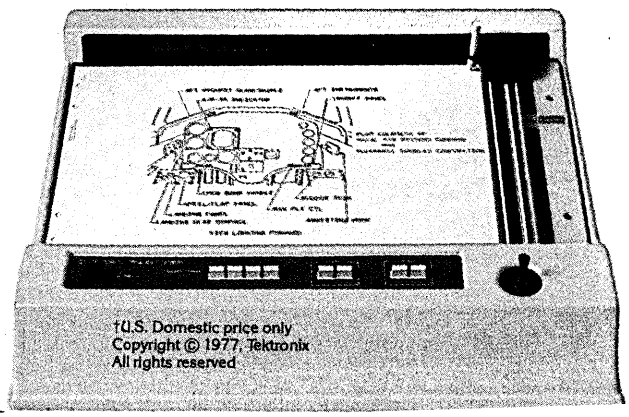
Want immediate action on the 4662? Call toll-free: (800) 547-1880

Tektronix, Inc.
Information Display Group
P.O. Box 500
Beaverton, Oregon 97077
Tektronix Datatek NV
P.O. Box 159
Badhoevedorp, The Netherlands



The 4662. Plug it in. It speaks for itself.

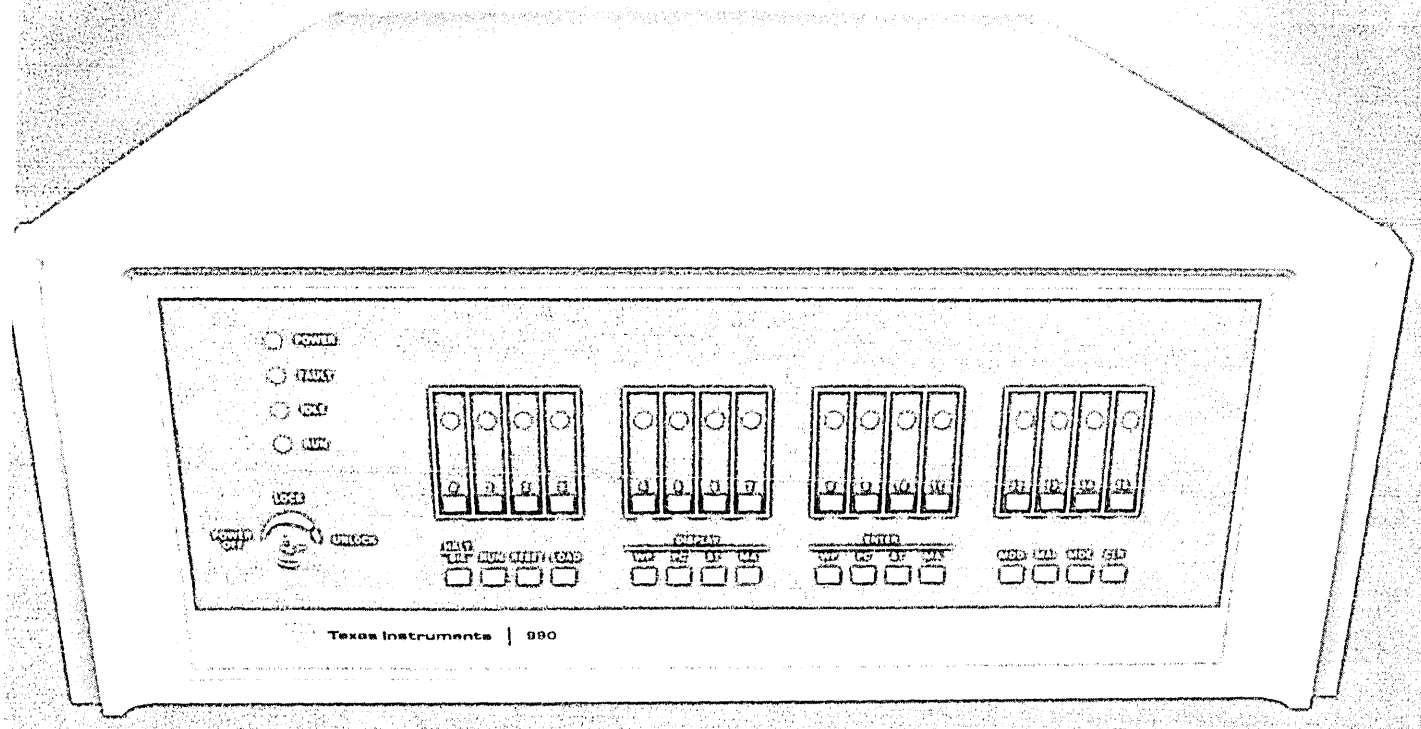
TEKTRONIX®



CIRCLE 54 ON READER CARD

†U.S. Domestic price only

990/10 OEM minicomputers.



Built, backed and priced to sharpen your competitive edge.

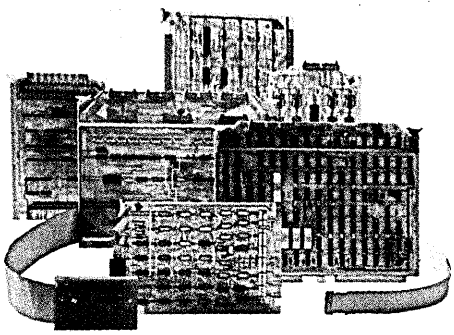
TEXAS INSTRUMENTS.

The 990/10 minicomputer from TI brings superior value to both you and your customers.

Starting with field-proven hardware, the 990/10 delivers the reliability you expect from TI. And all the off-the-shelf support you need for user applications. You get standard software languages, a broad choice of peripherals and nationwide service.

Built for more processing power.

The 990/10 is the most powerful member of the 990 computer family. Its architecture provides features that give you maximum processing power for your money. Like hardware multiply and divide. A 16-level hardware



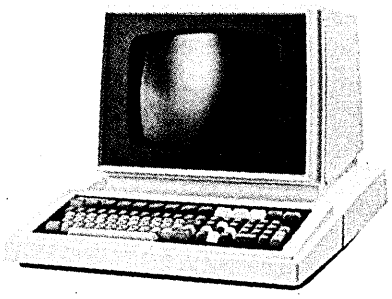
Peripheral Interface Modules

interrupt structure. 16 registers arranged in a workspace concept. I/O that's directly programmable through the Communications Register Unit (CRU) and autonomously through a high-speed data bus. And bit, byte and word addressing of memory.

Built for system flexibility.

In small or large configurations, the 990/10 design provides surprising flexibility for a small investment.

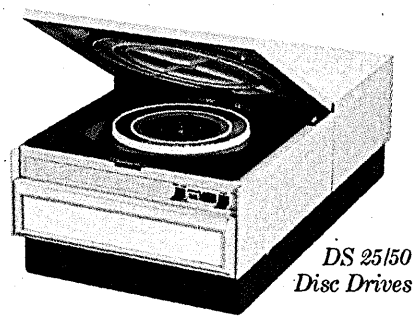
The CRU, with up to 4096 I/O lines, reduces interfacing costs by keeping controller complexity to a minimum. The TILINE* asynchronous high-



Model 913 Video Display Terminal

speed data bus can support both high- and low-speed devices and takes advantage of design simplicity for simultaneous data transfer between peripherals, the CPU and memory.

With the 990/10, you get a powerful instruction set with an extended operating feature that allows hardware to take over operations that software would normally execute. An optional mapping feature provides memory protection and memory expansion to 1 million words. And, optional error-correcting memory corrects single-bit errors for increased system reliability.



DS 25/50 Disc Drives

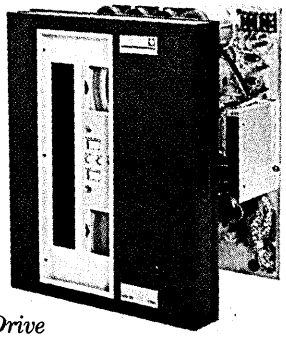
Full peripheral support.

As well as a range of standard peripherals, disc storage to 90 million 16-bit words and magnetic tape with 800 and 1600 bpi options are available for low-cost mass storage and back-up.

A choice of software.

With common higher level languages, FORTRAN IV, COBOL and Multiuser BASIC, plus the 990/10 assembly language, you have all the tools you need for an efficient application program.

Both the disc-based and memory resident operating systems give you modularity and flexibility for system generation to meet application de-



Model 979 Tape Drive

mands. We offer program development aids for creating and testing software, and communications software to support synchronous or asynchronous data transmission.

Backed with nationwide service.

Our responsibility to you doesn't end with the sale. We follow through with complete system training, plus a nationwide factory service network.

The TI 990/10 minicomputer. We build it, back it and price it the way you and your customers want it. You can start configuring a system now with our 990 Computer Systems Handbook on the upward-compatible family of the TMS 9900 microprocessor, 990/4 microcomputer and 990/10 minicomputer. For your free copy, send a letterhead request to Texas Instruments Incorporated, P.O. Box 1444, M/S 784, Houston, Texas 77001.

TEXAS INSTRUMENTS
INCORPORATED

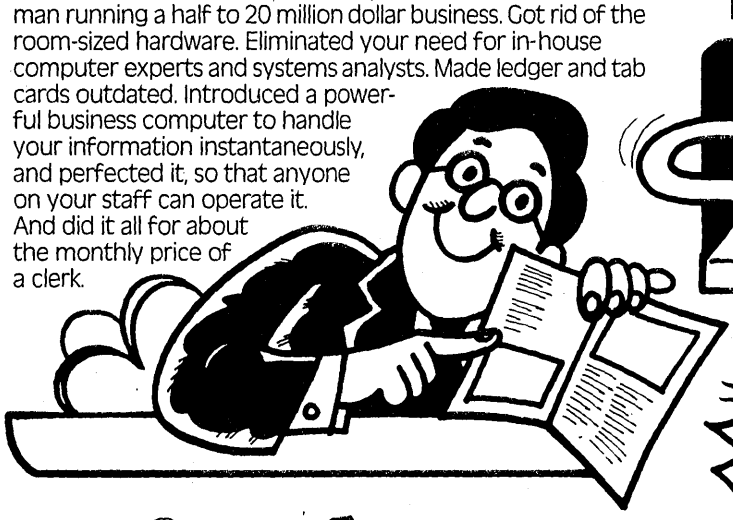
*Trademark of Texas Instruments

CIRCLE 39 ON READER CARD

It pays to know all about business computers.

A new idea in computers.

Basic/Four pioneered in redefining the computer. Trimmed off the fat to make it profitable for the business-man running a half to 20 million dollar business. Got rid of the room-sized hardware. Eliminated your need for in-house computer experts and systems analysts. Made ledger and tab cards outdated. Introduced a powerful business computer to handle your information instantaneously, and perfected it, so that anyone on your staff can operate it. And did it all for about the monthly price of a clerk.



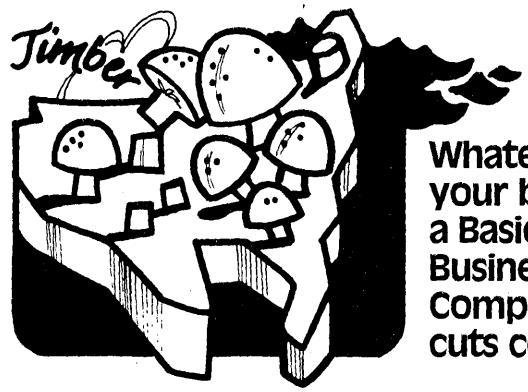
Accounting is just the beginning.

However you're doing it now–accounting machines, service bureaus, or simply by hand–the Basic/Four way can be faster and less expensive.

All that bookkeeping paperwork–order entry, invoicing, inventory control, purchase order processing, general ledger, payroll and sales analysis–is now child's play. In production, there's no limit to what a Basic/Four business computer can do. Job costing, labor distribution, bill of material, requirements planning, shop scheduling, forecasting, master shipping schedules, etc.

And the list of special applications is as all-encompassing as the metropolitan yellow pages. Property management. Insurance agency, appropriation, royalty, route and municipal accounting. And travel packaging, moving and storage and construction.

There's more to the story. Write for the complete facts about the Basic/Four business computer.



Whatever your business a Basic/Four® Business Computer cuts cost.

Over 2,000 of our business computers are now cutting costs for companies all over the world. In manufacturing, distribution, services, schools, retail and the government. In banking, trucking, insurance and publishing. And just about every other small to medium-sized business you can think of. Even some you can't.

Basic/Four Corporation, Dept. D2
18552 MacArthur Boulevard
Irvine, Calif. 92714

Please send me your easy-to-read, fact-filled free color brochure on the Basic/Four Business Computer.

NAME _____

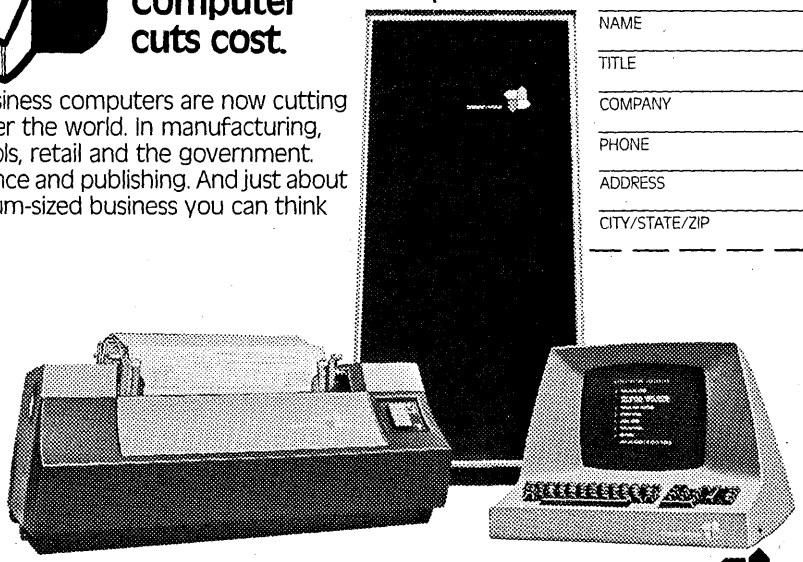
TITLE _____

COMPANY _____

PHONE _____

ADDRESS _____

CITY/STATE/ZIP _____



basic / four corporation®

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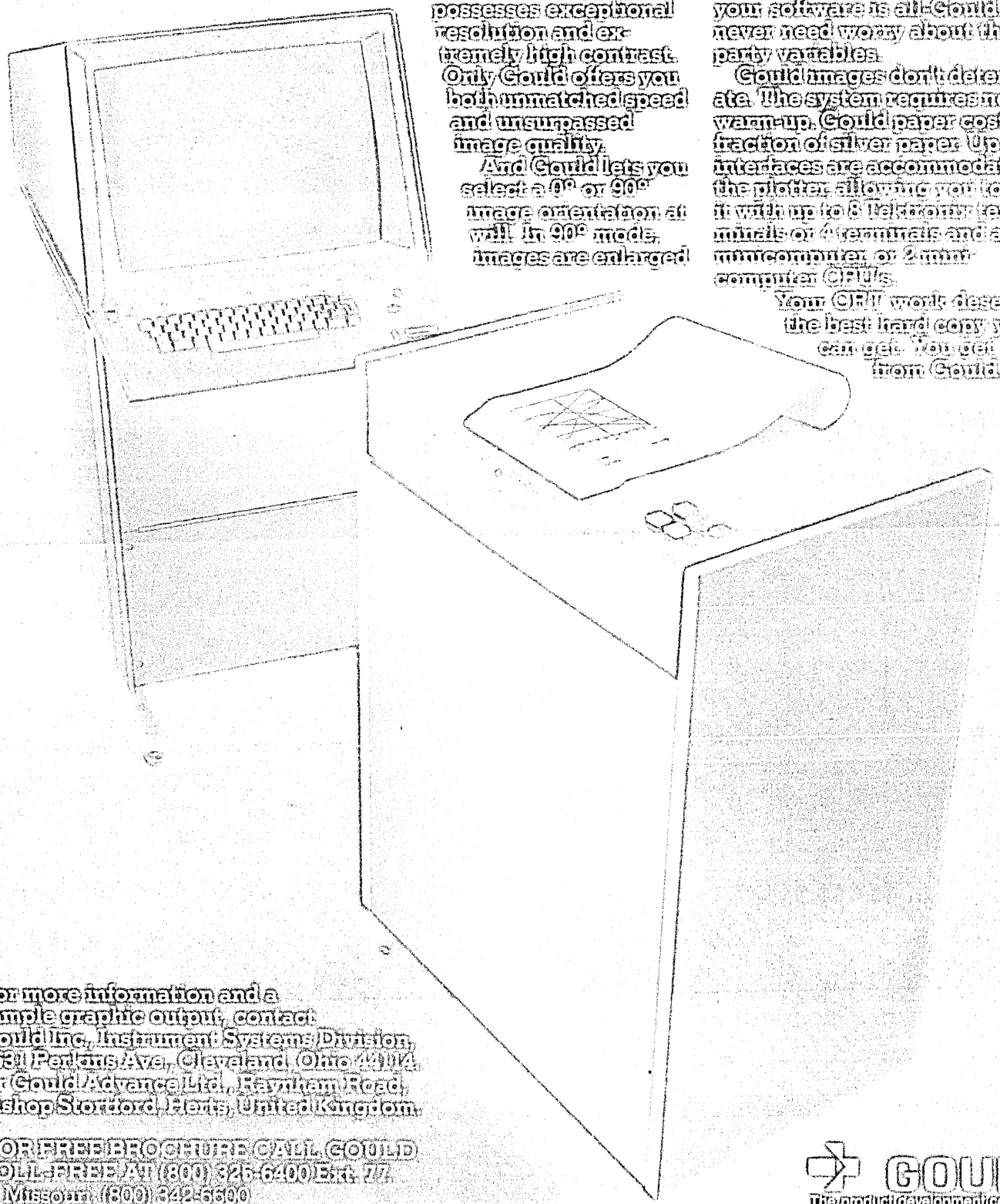

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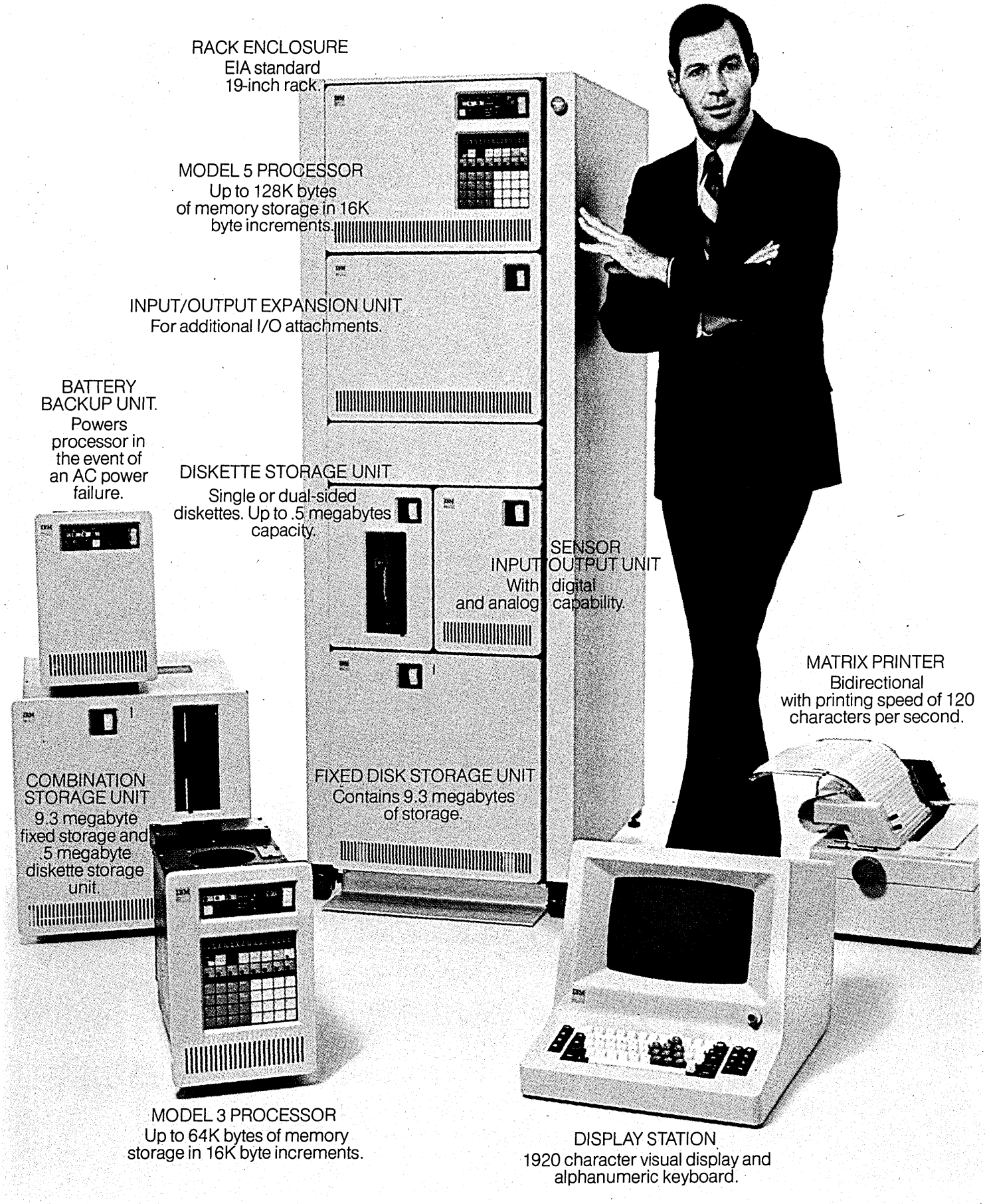
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Editor's Readout

John L. Kirkley, Editor

The Bell Bill - Is It Inevitable?

Among AT&T's not inconsiderable assets ($85.9 billion), there's one you will not find listed on any balance sheet: an overwhelming amount of chutzpah.

This fine old Jewish word translates roughly as incredible gall, a monumental arrogance that permits those who possess it to attempt things that ordinary folk would find inconceivable.

Like, for instance, asking the Congress of the United States to turn its back on our free enterprise system of competitive business and endorse monopoly instead.

Ma Bell's Consumer Communications Reform Act, the now notorious Bell bill, proposes precisely this. It is a bold attempt by AT&T to kill off present and potential competitors in the domestic private line and terminal equipment marketplace, a move designed to reaffirm Bell's total communications monopoly now and for all time. As added insurance, the legislation also would set up a thicket of regulatory barriers to any potential rivals, large or small. A key provision would turn interconnection regulatory powers over to the states, a move that will fragment jurisdictions, frustrate users from establishing networks that use services other than Bell's, and encourage the development of different interconnect standards from state to state.

If the Bell bill is passed the best the communications-oriented dp manager can hope for is more expense, more headaches, and an abrupt slackening in technical innovation—a characteristic not only of AT&T but all monopolies. He will be forced to accept Bell's solutions to his problems all in Bell's good time. (For example, Bell's Data Under Voice digital transmission service over its existing lines surfaced only after Datran began offering digital transmission over special microwave lines.)

Because the states will have jurisdiction over interconnect, the dp manager's and the data communications manager's dream of a transparent interstate network will die aborning. Instead, interstate communications on anything other than Bell sanctioned equipment may be like shipping goods on the old railroad lines in Europe where different gauge tracks met in misaligned chaos at each country's borders.

A chill will be cast over the entire data communications marketplace, freezing out Bell's competitors and bringing a glacial slowness to the rate of technical innovation.

Like the glacier, AT&T prefers slow, massive movements, grinding everything in its path. If the skirmishes at the Federal level—in Congress and in the Justice Dept.—wear on over the next five to ten years, it's all to Bell's advantage. In the meantime, they will have achieved their objectives de facto, quietly establishing a data communications stranglehold in each of the 50 states, an end run spearheaded by the Dataspeed 40/4 and the new Transaction Network Service.

But unlike the glacier, AT&T's maneuvers are not inevitable.

Specific legislation to counter the Bell bill is needed now. Those in Congress who wish to reaffirm competition must move from the defensive to the offensive and propose legislation that protects and fosters a free and open marketplace.

The bill should define classes of regulation and clarify just what is meant by a common carrier. The total communications marketplace should be defined and the unregulated portions of that marketplace must be clearly delineated. And this means a fresh look at the Federal Communications Commission and the extent of its authority and responsibility.

Our crazy-quilt approach to federal and state jurisdictions also needs a good airing with federal supremacy being cleanly established.

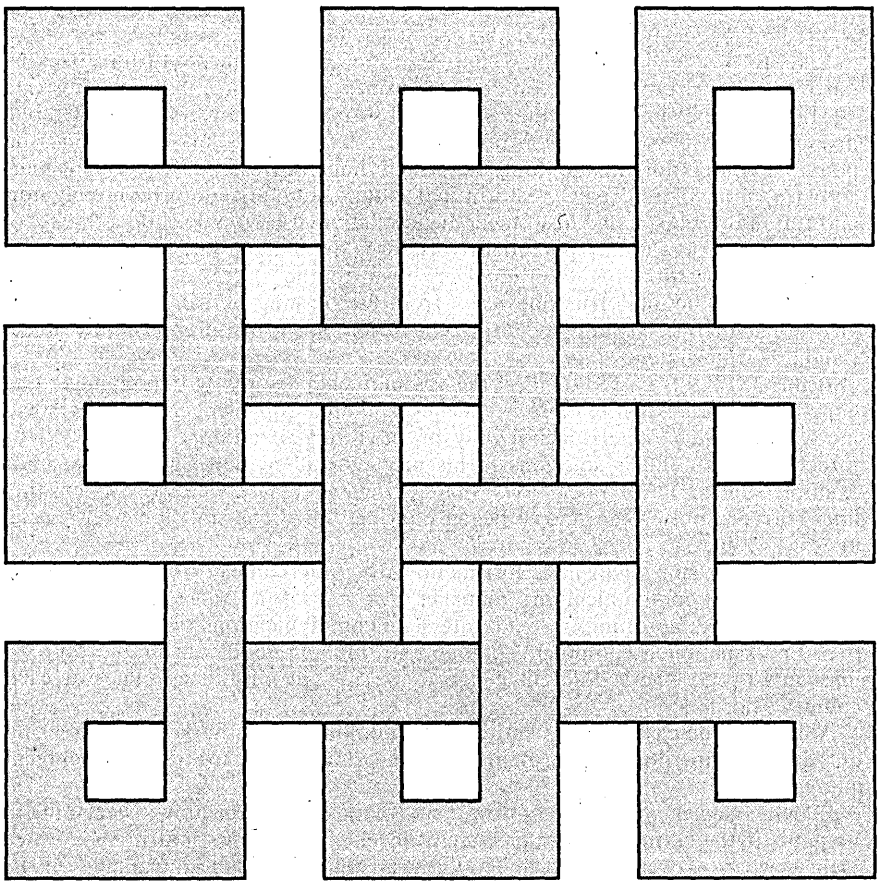
The FCC should be directed to determine which unregulated markets Bell can enter, and to be sure that Bell enters them only under the strictures of maximum separation—an arm's length arrangement preventing any cross subsidization and cross tying between the monopolistic parent and Bell's unregulated offspring.

Without an immediate push for landmark legislation of this kind, Bell will undoubtedly win this war of attrition as the press' and the general public's interest wears thin . . . and the Justice Dept., the FCC and the data communications industry slowly capitulate under the inexorable pressure. ❋

Comparing Architectures

by William E. Burr and William R. Smith

The method and metrics were first used in comparing military and commercial architectures—with surprising results. They could be used anywhere.



There is no insurmountable problem in evaluating specific computer systems for use in specific applications. We know how to do that. For example, if one wants to choose between a Burroughs B6700 and an IBM 370/168, one usually codes a set of appropriate benchmark programs and measures how well those systems run them, generally in terms of time. We collect information on costs and software availability, then rely on our own experience or that of other users in determining how well the manufacturer supports his machine.

But there has been a substantial problem in evaluating or comparing computer architectures for use on a general class of applications. The difference is that the thing we call an architecture is a concept which is independent of any specific implementation in hardware. It is much more difficult to project how efficient systems using that architecture will be, in terms of costs and performance, before they are built.

A joint Army/Navy project has recently developed a method for comparing architectures. We used it, and it seems to work. The actual results we obtained may be of immediate value to users and developers of commercial oem computers or military computers. The methods and metrics developed, on the other hand, should be of interest to *anyone* who wishes to compare or evaluate computer architectures for *any* application.

The Department of Defense is spending over $6 billion yearly for dp systems. A large portion of this sum goes for acquisition of militarized computers and associated software used in tactical and strategic applications. Traditionally, these computers have been specified by the individual organizations (military project managers or commercial contractors) responsible for the development of each system. More often than not, computer selections have been based upon local schedule, funding, or profit considerations, rather than on the impact that the selection would have on long range hardware/software logistics costs. The result has been that the large number of types of computers used in Army and Navy systems are contributing to serious problems in the development and maintenance of software.

Military vs. commercial: no contest

Military computers are ruggedized machines which are constructed to operate in severe environments such as tactical aircraft, ships, and land battle fields. Such military computers are normally employed in much the same manner as are commercial oem computers. That is, they are built into some larger system, such as a fire control system or a radar system, and are just one component of that system. They do not differ from civilian oem computers in the type of data processing operations they perform, only in where they perform them.

In military applications, the hardware issues are usually more apparent than the logistics of the software, and in consequence military cpu's normally have only the most primitive sort of support software. On top of that, development cycles for weapons systems are generally long enough (5 to 10 years) that the military computers in these systems are often obsolete before they are ever delivered to the Field Army or Fleet. To reduce the problem of obsolete hardware, software development is sometimes attempted before the computer design is frozen, usually with unfortunate results. One way or another, the Army and the Navy pay far too much for computer software and hardware that frequently falls far short of performance expectations.

This can be contrasted with the situ-

ation in the commercial oem marketplace. Here processors are produced for a much larger market by the thousands or even the tens of thousands. A number of manufacturers such as Digital Equip Corp., Data General, and Interdata, have software compatible product lines covering a wide range of processors of varying capabilities. Also, due to fierce competitive market pressures, either system deficiencies are corrected or the systems disappear. New products are developed much more quickly, and full advantage is taken of technological advances, such as in semiconductor device technology. Finally, due to the much larger user bases of commercial computers, and again, the competitive pressures of the marketplace, the support software bases of successful commercial computers are usually far superior to their military equivalents.

A solution to many of the software problems with contemporary military computers would be to produce a family of software-compatible ruggedized computers. Moreover, if such a family were based upon a proven commercial instruction set architecture, then it would be possible to capture a good support software base, and to be certain that any architectural shortcomings were known and recognized. As the commercial system evolved, and the architecture was extended to meet the commercial competition, the military computer family could also take advantage of the extensions. Adhering to an established family in this way would avoid the architectural mavericks that limited production military computers are prone to be.

Since early 1975 the Center for Tactical Computer Sciences of the U.S. Army Electronics Command and the Naval Air Systems Command have been supporting a cooperative Army/Navy effort to define such a family of processors, based upon a common instruction set architecture. The project has been informally known as "military computer family," and the architecture to be selected as the "computer family architecture."

The fundamental premise of the project is that software compatibility should be achieved by the adoption of an existing, proven computer architecture for the family, thereby minimizing the risks inherent in the design of a new computer architecture and permitting the "capture" of an existing and evolving software base.

In this context, computer "architecture" is distinguished from implementation considerations, and is defined as the structure of the computer which a machine level programmer needs to know in order to write all programs which will run correctly on the computer.

The "architecture" of a computer thus defined includes the instruction set, the address space, and those registers (program status register, accumulator registers, index registers, etc.), which are "seen" by a machine language programmer. Implementation features, such as bus width, pipelines, cache memories, etc., are not considered part of the architecture. In general, nothing which is time dependent is considered a part of the architecture.

For example, the architecture of the IBM S/370 is defined in a "Principles of Operations Manual." There are many implementations of the architecture, (the 115, 145, 168, etc.) but only one architecture, and every implementation will execute the same software at least in an upward compatible manner.

Another premise upon which the Army/Navy cooperative effort is based is the goal of software transportability from prior generation military computers to the new family, most probably through emulation. In other words, the Army and Navy cannot abandon their investment in existing software. There is a strong analogy here with IBM's continued support of such machines as the 1401 and the 7090 through emulation when the 360 family was introduced.

Candidates and criteria

The mechanism for selecting the computer family architecture was a joint Army/Navy selection committee, composed of representatives of 10 Army and 17 Navy organizations. To decide which architectures should be considered, the committee asked Army and Navy organizations to nominate candidates. This led to the examination of the following architectures:

- Burroughs B6700
- DEC PDP-11 (as typified by the model 70)
- IBM S/370
- Interdata 8/32
- Litton AN/GYK-12
- Rolm/Nova 1664 (a superset of the Data General architecture)
- Systems Engineering Laboratories SEL 32
- Univac AN/UYK-7
- Univac AN/UYK-20

(The AN/GYK-12, AN/UYK-7, and AN/UYK-20 are three of the most widely used military processors.)

Time and resources limited the depth to which all nine architectures could be investigated, so an initial screening process was devised to select several "best final candidates" for more detailed study.

After the initial screening, three final candidates were more intensively evaluated using a set of benchmark test programs. Also, the support software bases for the three were studied, and life cycle cost models were constructed to determine if one of the three had a decisive economic advantage. Finally, the manufacturers were contacted to determine the conditions under which they would be willing to license their architectures for military applications.

Two kinds of criteria were used in the initial screening and final evaluation. The initial screening used "absolute" criteria, which served as pass/fail tests of architectural adequacy. Absolute criteria included: the ability to support virtual memory, program protection, floating-point, interrupt and trap handling, subsetability (some features of the architecture could be omitted on small cpu's), multiprocessor support, cpu controllability of I/O, extendibility of instruction set, and read only memory.

Six of the candidates failed these criteria. DEC, IBM, and Interdata were further examined.

The second kind of criteria were called "quantitative" criteria. These were intended to provide a relative ranking of the architectures in terms of characteristics which are believed to be important measures of a computer architecture.

Quantitative criteria included: virtual address "space" (the size of the virtual address space in bits, and the number of addressable units in it), physical address space, the fraction of the instruction space which is not yet assigned (a measure of the number of possible new instructions), the size of the central processor state (the amount of information that must be stored upon interrupt or trapping), virtualizability, usage base (the number of computers delivered as of June 1, 1976, plus their total value), I/O initiation (measured as the number of bits which must be transferred between main memory and any processor in order to output one 8-bit byte), direct memory addressability, and maximum interrupt latency (the number of bits which must be transferred between memory and any processor before an interrupt is processed).

Three of the quantitative measures defined were to gauge the efficiency of the architectures independently of hardware implementation features such as cycle times. These were:

S—The static storage requirement for the program in 8-bit bytes.

M—The number of 8-bit bytes of program and data which were transferred between the processor and main memory during execution of a program. The *M* measure is intended to be an index of the memory bandwidth requirements of an architecture.

R—The number of 8-bit bytes of program and data which were transferred among the internal processor

registers during execution of a program. *R* is intended to be an index of the processor speed and complexity demanded by an architecture.

Benchmarking

To find the values of these indexes for the final candidate architectures, 12 benchmark programs were devised. These programs were believed to be representative of the operations performed in military applications. Each was a small, kernel type program. Most were subroutines, and most were defined as "structured" programs specified in a program definition language (PDL) which was an informal half-English, half-PL/1 mix.

Several programmers were then asked to "hand-compile" the same programs into the assembly languages of the respective machines from their PDL descriptions. (This procedure was followed to minimize the effects of differences in the efficiencies of the programmers and the compilers.) No large scale programs from "real" military systems were coded because of the excessive expense involved in coding and testing a statistically significant set of such programs. High level language programs were not tested, because there is no practical way to separate the effects of compiler efficiency from the effects of the architecture efficiency which the experiment was intended to measure.

Slightly over 100 test program samples were coded by 16 programmers at participating organizations. The programming assignments were designed so that the subsequent analysis of variance procedure could give the best estimates of the relative efficiency of the three architectures.

The results were averaged to obtain the final normalized *S*, *M*, and *R* measures shown below. These measures reflect the relative performance of each final candidate architecture. In this comparison, the lower the score the better the architecture. The results show that the IBM S/370 needs 21% more memory to store the test programs than the average architecture studied, the Interdata 8/32 needs only 83% as much as average, and the PDP-11 is nearly average in its use of memory. The differences between the IBM S/370 and the average of the other two architectures were statistically significant, but the differences between the Interdata 8/32 and the PDP-11 were not. (The differences between the 8/32 and the S/370 were also statistically significant in the *M* and *R* Measures.)

Architecture	*S*	*M*	*R*
Interdata 8/32	.83	.85	.83
DEC PDP-11	1.00	.93	.94
IBM S/370	1.21	1.27	1.29

As expected, we saw a large variation in programmer performance. It was not uncommon to see a factor of

The Simulation Process

Of the processor manuals for the various candidate architectures, only the S/370 "Principles of Operation" manual appeared sufficiently complete and precise to serve as an unambiguous specification of the architecture for use by different independent manufacturers in constructing software compatible versions of the architecture. A clear, complete, and unambiguous definition of the architecture is an absolute necessity for architecture comparisons too. The solution to this problem was to describe the three final candidate architectures in a formal register transfer language called Instruction Set Processor (ISP).

A Decsystem-10 hosted compiler and interpreter for ISP was developed at Carnegie Mellon Univ. and extended by the Naval Research Laboratory. Committee members at various locations were able to use the ISP compiler and interpreter there through the ARPANET, to develop and validate ISP architecture descriptions.

By compiling the ISP descriptions, and then running the object code on the ISP interpreter, it was possible to simulate the three candidate architectures on the Decsystem-10. Since the interpreter possessed facilities for collecting runtime statistics, the ISP simulations were used to execute the bulk of the test programs, and to gather the necessary data for the test program experiment. This process is depicted in Fig. 1. The procedure also serves to validate the correctness of the ISP descriptions.

To the authors' knowledge, this is the first time that nontrivial computer architectures have been described in a formal language, and those descriptions then used to simulate the architectures and to extract comparative data on their performance.

When the ISP description of the PDP-11 architecture is completely tested and validated, we will have a good, accurate, complete, and unambiguous definition of the architecture. This will provide a precise architectural standard for the military computer family. In addition, we will have a good tool for modeling and measuring the performance of implementation features, as well the performance of proposed architectural extensions and enhancements. ❋

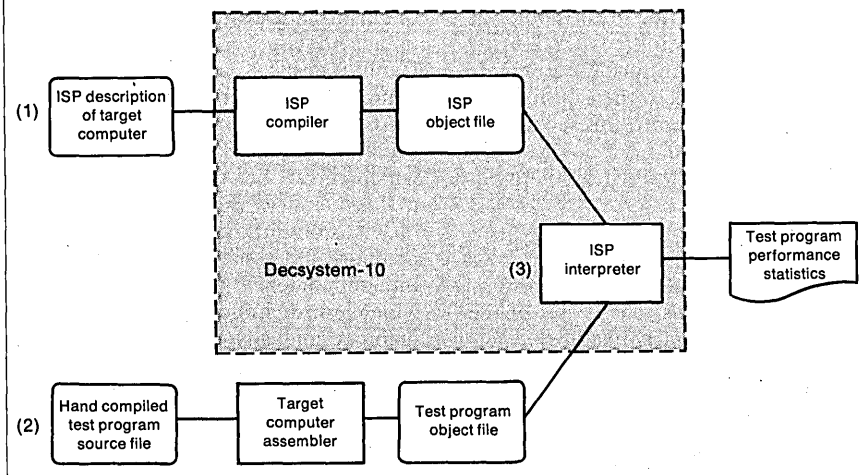


Fig. 1. Simulation of three final candidate architectures went as follows: (1) the architecture of each target computer was described in the ISP language, and the description compiled to produce object code for describing a nonexistent cpu; (2) in parallel with that, a series of test programs were specified in another language called PDL, hand compiled, and assembled on the real target machines; (3) three ISP interpreters, one for each target machine, were run on the Decsystem-10, simulating the target machines' processing of the test programs.

In short, the Decsystem-10 simulated a non-existent computer which was pretending to be the target machine.

The goal of the process was the detailed listing of statistics generated by the ISP interpreter, statistics covering the resources consumed by each target architecture in processing the test programs. The simulation process was thought to be easier than altering the real target computers' software to gather the statistics, and it had the added advantage of yielding a precise ISP-language specification of each target architecture.

two to four difference between the best and the worst examples of a test program on the same architecture. Hence, the careful design of the test programmer assignments, and the subsequent analysis of variance, was essential to both minimize and quantify the effects of programmer variation on the final architecture comparisons.

Persons who are familiar with the IBM S/370 and the Interdata 8/32 may wonder at the difference between the scores on these two architectures, since they are usually considered to be quite similar. The 8/32, however, has an interrupt structure which is tailored to providing very fast response to interrupts, while the 370 structure does not. Two of the programs were specifically intended to test interrupt response, which, as one might guess, can be critical in some military applications.

The 8/32 also has a variety of short format (16 bit) instructions, a program counter relative addressing mode, and 16- and 32-bit literal operands, which all represented savings over equivalent S/370 instructions or instruction sequences. In the selected set of test programs, relatively little weight was accorded to the kind of character manipulation, output formatting, and decimal arithmetic for which the S/370 has an excellent instruction set. If the experiment were performed with a business data processing mix of test programs, then the S/370 might well prove to be the "better" of the two architectures.

Evaluating support software

A support software evaluation subcommittee was appointed to study the support software bases of the three final candidate architectures. This subcommittee began by defining an extensive menu of support software tools which might be useful in military system development. Committee member organizations were then asked to rate each tool by its utility in developing software for military weapon systems. The 28 most important support software tools were selected from this rating:

- Compilers
- Macro assemblers
- Interactive source language editors
- Interactive symbolic debuggers
- Extended overlay linker
- Test case design advisors
- Integrated library
- Text processing system
- DBMS
- General purpose system simulator
- Time-sharing os with virtual memory management
- Language independent monitors
- Test data generator
- Non-interactive symbolic debugger
- Computer system simulator
- Batch source language editors
- Language dependent monitors
- Multiprogramming os with time-sharing and virtual memory management
- Basic assembler
- Real-time os with time-sharing
- Test instrumenters & analyzers
- Automatic sw production & test
- Basic link editor
- Standards enforcers
- Reformatters
- Test data auditor
- Simple overlay linker
- Data base design aid

The manufacturers of the three final candidate architectures were asked which of the 28 tools were available and supported by them. In addition, other commercial sources of support software were examined. Estimates were made of the cost to develop the missing tools for each of the three final candidate architectures and found to be as follows:

Architecture	*Estimated cost to eliminate deficiency*
Interdata 8/32	$25.9M
PDP-11	19.1M
IBM S/370	9.6M

Life cycle costs

A final "selection methodology" subcommittee pursued a methodology for combining the results of the full committee's evaluations into a single criterion which would be realistic and meaningful to DOD management. This subcommittee proposed a method of converting the architecture evaluation results to life cycle costs so that a final selection could be aided by data based on the comparative economics of using each of the candidate architectures in military computer systems.

Two separate life cycle models were used for the cost analyses. Both used the data gathered in the test program experiment and the support software base evaluation described previously.

The first model was a "top-down" model which represented total life cycle requirements for DOD computers from 1978-1990, using each of the three final candidate architectures. It was based upon available data on DOD expenditures and requirements for military computer hardware and software. Factors taken into account included the existing support software base and the relative efficiency of the three architectures as established by the test program experiment.

The second model was a "bottom-up" life cycle cost model, which was based upon data gathered on 15 existing or developmental Army tactical data systems. This model represented the life cycle cost for these 15 systems, using each of the three final candidate architectures. The costs to develop these systems both in 1976 and in 1985 were estimated.

A limited sensitivity analysis was performed with each model. If lower estimates are made for software development costs (relative to hardware costs), and/or if faster development of the support software base is projected (so that all three architectures rapidly acquire a complete support software base), then the Interdata 8/32 eventually becomes the least expensive architecture, because of its efficiency as indicated by the test program results.

If very high software development cost estimates are made, and/or if very slow support software development is projected, then the S/370 becomes the least expensive architecture due to its advantage in support software. The PDP-11, however, looked like a good choice in the middle range of assumptions, and neither worst not best in the extremes.

Licensing

Another consideration which had a significant effect on the final selection was the proposed licensing agreement with DEC, Interdata, and IBM. Although the legal issue of what rights a computer manufacturer has to a computer architecture is not fully resolved, a cooperative arrangement with the manufacturer of the selected architecture was desired. This, it was felt, necessitated a non-exclusive licensing agreement. Proposed agreements were received from the three manufacturers. Due to the confidential nature of the agreements, they cannot be described here, but licensing was a major factor in the final selection.

The results

The results of the absolute and quantitative criteria evaluations are summarized in Table 1. The PDP-11 and the IBM S/370 were the only two architectures which clearly passed all the absolute criteria, and they also were among the top three in the quantitative criteria evaluation. The Inter-

Architecture	Quantitative criteria score	Absolute criteria
Interdata 8/32	1.68 (best)	possible problem with interrupts and traps
PDP-11	1.43	passed all
IBM S/370	1.36	passed all
AN/GYK-12	0.94	failed floating-point
Rolm-Nova	0.92	failed virtual memory mapping
B6700	0.91	failed protection
SEL-32	0.86	failed virtual memory mapping
AN/UYK-7	0.46	failed floating point
AN/UYK-20	0.44 (worst)	failed protection

Table 1

data 8/32 was also selected as a finalist on the basis of its very strong showing on the quantitative criteria, despite a nagging technical uncertainty concerning the state of the machine after interrupts, which the committee was never able to resolve to its satisfaction. The respective strengths and weaknesses of each architecture can be summarized as follows:

INTERDATA 8/32. The 8/32 was the highest rated architecture on the quantitative criteria, and the test program results. It has a good interrupt structure for real-time processing, but its software base is relatively weak, which consequently compromised its performance in the life cycle cost evaluations. There was also a nagging question about how well the state of the machine was preserved after interrupts.

IBM S/370. The strongest virtue of the S/370 is its large support software base. The architecture performed well on the life-cycle cost analyses under assumptions of maximum relative cost of software development, and it is the only architecture demonstrated as an easily virtualized computer in a standard product line. On the other hand, its interrupt structure was considered cumbersome for real-time control applications. The test program results indicate that the architecture is significantly less efficient than the 8/32 and the PDP-11. There was also concern that small subset versions might not prove cost-effective for low-end applications, and that there was insufficient experience with the S/370 in oem applications.

PDP-11. The PDP-11 (as represented by the Model 70) enjoys a good support software base, performed relatively well on the test programs, and has a good interrupt structure for real-time control applications. It enjoys a slight advantage on the cost models for a range of reasonable assumptions. Small scale (microprocessor) implementations are practical and have been built. On the negative side, the 16 bit virtual address space is a limitation and it may be expensive to add a virtual machine capability to the architecture.

The committee made four final findings:

(1.) The DEC PDP-11 was determined to be the most advantageous architecture for the military computer family. The IBM S/370 was ranked second. The Interdata 8/32 third.

(2.) The committee unanimously agreed that a single instruction set architecture should be selected for the family, that the selection of only one architecture is more important than which one of the candidates is selected, and that any one of the three final candidate architectures could provide a satisfactory base.

(3.) The committee agreed that an effort (as yet undefined) should be made to relieve the limitations of the selected architecture. As mentioned, in the case of the PDP-11 the major limitation is the small (16-bit) virtual address space.

(4.) A single organizational structure must be established to control the architecture, or major incompatibilities between different implementations will surely result.

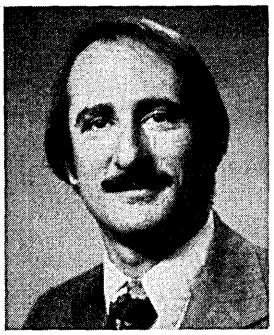
The "winner," the PDP-11, is one of the most successful architectures, in terms of user acceptance, in the history of the computer industry. It has been manufactured in the tens of thousands, and is widely used in almost every sort of oem application. An extensive support software base exists for it, and DEC will continue to develop and support the architecture for the foreseeable future. It is clearly a satisfactory choice for the military computer family. With that family intelligently defined and implemented, it will make available a series of militarized processors with excellent software development tools, and the capability to develop and maintain software on less expensive commercial equipment. This in turn will result in substantial cost and quality benefits in the application of computers to military systems.

It is not important to the results of the project that Digital Equipment Corp. is not presently a manufacturer of militarized computers nor that it has no present plans to become one. The purpose of the project was to define a detailed definition of a desirable architecture so that *various* manufacturers (in general, not the manufacturer of the commercial version of the series) will be able to independently develop processors to meet the form, fit, and function requirements of the family, and run the chosen instruction set.

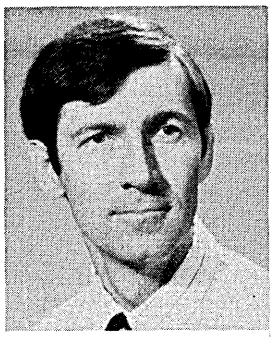
It is sometimes asserted that military systems have unique requirements which preclude the use of a general purpose commercial instruction set. Developers of computer based weapons systems often assert that they alone have such severe real-time constraints that they compel the use of a particular processor. It is worth noting that we compared three of the most widely used military architectures with six of the most widely used commercial architectures, and found that the military architectures compared quite poorly to the commercial architectures in terms of those architectural characteristics believed to be most important in tactical military applications.

It is also worth noting also that none of the military architectures had any particularly useful unique features which proved advantageous in military applications, while all three were found to have architectural shortcomings. Moreover, the support software available for the three military architectures is relatively weak. Considering how easily modern militarized microprogrammable processors may be adopted to a given instruction set, there appears to be little reason to continue to use obscure or immature architectures in future military developments.

The conclusions reached in this project, if adopted, should be of great benefit to the military. More than that, the methods and metrics developed in reaching those conclusions could, if adopted, be of use to many other dp professionals. It may even be that in the near future commercial computer customers may be able to specify computer architectures fitting their applications as the military is now capable of doing, perhaps opening up new areas of competition and standardization for the industry as a whole. ❁



Presently an electronics engineer with the Army Electronics Command, Mr. Burr has been a systems programmer (for the Army and for Ohio State Univ. Hospital) and a consultant specializing in data base systems (for Performance Development Corp.). He has been involved in the development of two major Army computer systems, one for command and control, the other for fire control.



Mr. Smith, a section head in the Information Processing Systems Branch of the Naval Research Laboratory, Washington, D.C., has been working on the development of standards for military signal and data processing systems.

Univac's Financial Model for Computer Development

by George A. Champine

Here's how one computer manufacturer figures out what the users will pay for their next model, and what they will receive for the price.

The modern large scale computer system is a very complex machine indeed. The start-up cost (development, tooling, and training) for the manufacturer and for the user community for systems like these range from a few tens of millions to a few hundreds of millions of dollars, with a development time of several years. Because of their cost, the total market for each product is only a few hundred systems. And yet, also because of their large cost, it is very important that the system design be optimized from a total financial (life cycle cost and revenue) standpoint.

The normal method for the manufacturer to optimize a large scale system design is to start with an initial "guesstimate" of what the design should be. This initial guesstimate can come from Marketing or even from a potential customer, but the usual source is Engineering because large scale products tend to be technology-driven. Once the initial definition is available, a series of iterations involving Engineering, Marketing, Maintenance and Controller personnel is used to reach the final business plan.

Although this methodology has produced the large scale systems that we all enjoy today, it has a number of drawbacks. Some of these are as follows:

- It is slow.

Each iteration requires the involvement of several functional organizations, each making detailed estimates whether the detail is required or not—and time is money. Also, the slowness limits the number of iterations and the degree to which the best solution can be approached.

- It is subject to bias.

The department that has the best "salesman" may bias the design in favor of the objectives of that department at the expense of global optimization.

- It lacks visible cost estimation techniques.

The functional departments often furnish only bottom line results on cost, schedule and performance, thus hiding the available trade-offs. Also, the lack of visibility allows guessing at costs rather than using supportable cost estimation techniques.

- It lacks a communications vehicle.

When each department supplies only cost, schedule, and performance information, there is often no common communications vehicle to allow inter-department discussions leading to trade-offs and optimization.

In view of the enormous complexity of the technical and financial considerations of modern large scale systems, it is a tribute to the personnel involved that designs are completed and profits can be made with the cumbersome tools employed.

The principles and techniques are applicable to a broad range of high cost, low volume systems —including airplanes, weapon systems, ships, and custom machine tools.

The advantages of a computerized financial model of a large scale system can be summarized as follows:

1. The overall design process is sped up so there can be many iterations.
2. Objectivity can be achieved because the possibility of "salesmanship" is eliminated.
3. Comprehensiveness can be achieved because all aspects of the estimation process are explicit and in one place.
4. Global optimization is possible because the trade-offs are explicit and comprehensive.
5. Historical data becomes explicit because it must be used as the basis for estimations.
6. A communications vehicle is almost an automatic by-product because the various departments are given a common language and common ground for communicating. Quantities and procedures are, for the first time, defined explicitly.
7. The key variables which have the largest leverage in the viability of the product are automatically exposed as the model is developed.

The design and development of a modern computer system is a very complex process, involving a number of detailed design trade-offs between hardware technology, architecture, functional partitioning, and software. As the complexity of the design process has increased, reliance on the "human interaction" procedure alone has become more and more difficult, and the need has become increasingly apparent for the help of a computerized financial model that would perform trade-offs at a global level. Once the system is optimized at the global level, design parameters can be provided to the individual design organizations so that they can further optimize at a local level, usually with the help of very detailed simulations.

The design of such a financial model for a large scale computer system was initiated at Sperry Univac in early 1974, and the computer program implementing the model became operational in early 1975.

To validate the model, the parameters of a new system then in development were provided to the model, and the model results were compared to the results obtained through the normal design process. The results of the model generally compared with the actual parameters to within 15-20%, but the model's results were obtained in a few weeks rather than the 8-10 months required by the normal methods. That machine has since been released. Engineering data has further verified portions of the model, but it is still too early to be certain about sales predictions. Subsequently, with this encouragement, the model is being used for a different computer system which is very early in the design process.

In the case of the new product—which is several years from introduction—the model has been able to answer three specific questions of considerable interest to management. These were:

1. A key component in the system was projected to be considerably over the cost goal. What would be the impact on profitability of the total prod-

uct program if this key component could not be reduced in cost?

2. What price should be charged for the product to provide maximum profit?

3. What would be the effect on total program profitability if the market were 20% larger than the marketing forecast?

With regard to the key component that was over cost goals, the model showed that system performance (and revenue) depended critically on this component but that total profit was not very sensitive to its cost. Total profit would be reduced by only a few percent even if no cost reduction of the key component occurred.

For the question on the optimum price for the product, the model showed that profitability is extremely sensitive to price. (The functional form of the data provided by the model is shown in Fig. 1.) As the price is increased above the break-even point (zero profit), the profit rises sharply. This is because the profit per system is rising sharply although market share is decreasing only slightly. As price is raised further, market share drops with increasing speed until it balances the increased profit per system. This is the optimum price point; it not only gives the maximum profit but it also is least sensitive to errors in estimates of competition and market share because of the broad plateau in the price/profit function. The model showed that there was much less risk in pricing the product too high than pricing it too low because of the limited price sensitivity of this market.

In the case of the market expanding beyond plan, the model showed that economies of scale had been fully realized with the existing forecast, and that profit was linear with the additional market revenue. The sensitivity of profit to market size was much smaller than the sensitivity to product price.

What the model can provide

In addition to the price/profit output of the model described above, a variety of other financial and technical data is obtained. The complete output of the model requires several pages of computer listing and includes the following:

Financial

- cost revenue, and profit for product
- cost, revenue, profit per month
- break-even point
- maximum investment
- present value of profit
- optimum price
- cost breakdown by performing department
- cost breakdown by system component
- market share

Technical

- total system performance
- performance of each system component
- amount of each system component (storage, processors, etc.)

Perhaps the most basic information output is a presentation of revenue, cost, and profit as a function of time as shown in Fig. 2. This presentation of data provides the most basic framework for financial analysis.

The next level of analysis is illustrated by break-even analysis. Fig. 3 shows a typical break-even analysis that may be performed with the aid of the model. The break-even point is the number of systems that must be sold to recover cost. Above this, the next point of interest is the number of systems that must be sold to meet the minimum profitability objective. However, products often have an expected profit which is greater than the minimum acceptable profit, and it is the expected number of systems that should be used as the basis for planning.

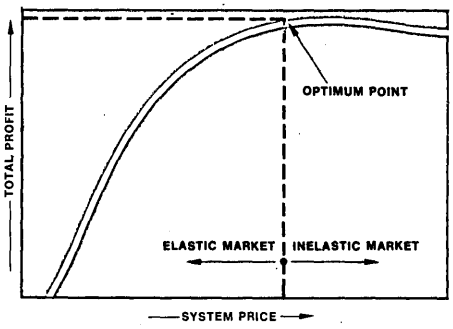


Fig. 1. The whole idea is to set the price to maximize profit, not to maximize the number of systems sold.

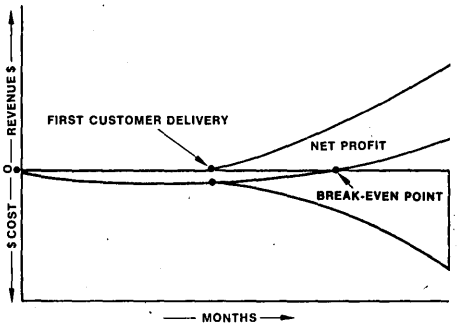


Fig. 2. The model's most basic output shows how great a net profit can be expected and, equally important, when.

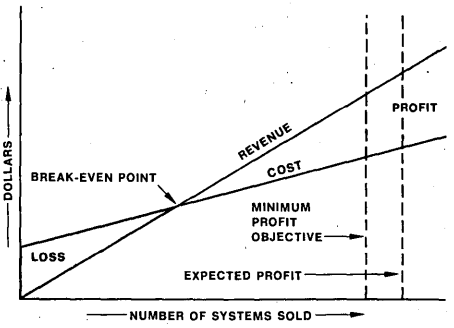


Fig. 3. Though deceptively simple to illustrate, finding the break-even point requires modeling market share, expected improvements in competitive products, etc.

In addition to these and other specific results, a sensitivity analysis was performed on all of the cost and revenue inputs to the model to determine which of these had the greatest impact on profitability. Each of the nearly 100 inputs was varied by 10% for one run, while all other factors were held constant. The results were quite surprising.

Although one might expect hardware cost parameters such as the cost of memory or the cost of logic to be important in determining profitability, the model shows that in fact they are not; no hardware cost factor is even in the top 15 of the most important cost/revenue factors. The seven most important factors in determining profit of a large scale computer system as shown by the model are, in decreasing order of importance:

1. interest rate
2. system price
3. development schedule
4. total market revenue
5. number of competitors
6. competitors' prices
7. product life.

Interest Rate for Present Value (Rank One)

To put costs and values incurred at different times on the same basis, the present value of such costs and values is used. With a 2% per month interest rate, a dollar of expense (or value) realized at month 24 has 0.62 of the impact on present value of a dollar of expense (or value) realized at month zero. This means that the cost and value realized early in the product life are magnified in effect relative to cost and value realized late in the product life. In the context of computer systems, the development cost and schedule assume a much more important role than they would if money had no time value. Thus, the large sensitivity of present value is also extended to development schedule (rank number 3).

The interest rate used in present value is normally the opportunity cost of the firm for alternative products. The opportunity cost is determined by the general profitability of the business in which the company is engaged.

System Price (Rank Two)

The price set by the manufacturers for the computer system influences the net profit through profit per system and market share. The higher the price, the higher the profit per system,

the lower the market share, and the fewer systems that are sold. The high ranking of price indicates the sensitivity of market share to price. Two other variables in the first seven also pertain to market share revenue. These are total market revenue (Rank 4), and number of competitors (Rank 5). As the price is increased above the break-even point, the profit per system increases faster initially than the loss of market share. However, as this is continued, the loss of market share accelerates, total profit reaches a maximum (where the market turns from elastic to inelastic), and profit declines.

Manufacturer Development Schedule (Rank Three)

The nominal development schedule determines when revenue from product systems begins. Earlier delivery of systems increases present value even if the total number of systems produced does not change. With a high interest rate (over 1% per month) it is possible to spend extra development money to shorten the schedule and still increase present value. It is also possible to capture additional early sales that otherwise would be lost.

Total Market Revenue/Month (Rank Four)

The total market revenue is defined as the market (in dollars per month) for all products of this type, including the product under study and all of its competitors. The number of systems delivered is increased if the total market for such systems is increased while all other factors are held constant. Increasing total market revenue/month is another, much less sensitive, way to accomplish the same objective as increasing the price. The total market revenue can be increased by, for example, adding features or making the product more universal.

Number of Competitors (Rank Five)

Increasing the number of competitors decreases the market share for the product, all other factors being constant. In the case of large scale computers, the number of competitors in the study is a one digit number, and even a small change in this number affects market share significantly.

Competitor Prices (Rank Six)

As the average competitor price increases, the market share of this product increases and the number of systems sold increases.

Product Life (Rank Seven)

The product life determines the time from development initiation to the time the product no longer generates profit. Generally, deliveries terminate before the end of product life due to non-competitiveness of the product, although revenue continues from systems on rent. Increasing the product life can generate significant additional profit because the development and manufacture costs are "sunk" costs, and the incremental cost consists only of operations and maintenance.

Pieces of the model

The model is a relatively straightforward FORTRAN program of conventional design, with subroutines for the various submodels included. It is about 1150 statements in size and required two people working for six months each to produce. (However, a sizeable part of their effort was in gathering data for input to the model and validating the output, not just in program preparation.)

Computation proceeds in a straight line basis, with iteration used to compute values such as revenue which are needed on a per month basis. Printout is under the control of a parameter card; four levels of detail may be requested, ranging from summary information only to relatively complete data after each iteration.

Although the optimization method used is rather slow, computation usually requires only about five minutes.

The same version of the program can be used in either a batch or interactive mode. All of the summary printouts have been formatted to fit in an 80-character line format on three pages. Although early experimentation with the system was done in batch, the concise nature of the input and output lends itself to interactive usage in a very natural way. This has led to a great deal of experimentation with the effect of system parameters on financial results.

The system financial model considers four major classes of economic factors: (1.) user cost, (2.) user value (benefit) from use of the computer, (3.) manufacturer cost, and (4.) manufacturer revenue (part of user cost).

The scope of the economic model is to include all costs and revenues for a single computer product from a single manufacturer, and all customers who buy one or more of that type of product. For example, assume company X were to develop a computer system called "System Nine," and to sell 1,000 of these systems over the lifetime of the product. The economic model would include the cost and revenue to company X for its development and sale of System Nine, and would also include the costs and benefits incurred by the 1,000 customers who bought and used a System Nine.

Other manufacturers are considered with respect to determination of market share based on the relative competitiveness of the products. Prior products (of company X) are considered only to the extent that they affect conversion cost.

The economic model is a generalized model which can be tailored to a variety of specific applications by simply providing the appropriate input parameters and functions.

The model is generally oriented towards large scale systems (Univac 1100/10 or larger) although it is also applicable to medium and small scale systems to the extent that their benefit and attractiveness depends on the rate of executing instructions.

It is assumed that a performance level has been established that is to be met by the computer system, and that the model is to meet this performance level at minimum combined cost for the users and manufacturer. A linear cost of storage (both main and mass) is assumed, although the user of the model can substitute his own functional relationship by changing the appropriate subroutine.

The performance model for the system assumes that a constant number of jobs exist in the system at any time, and that the jobs exist in queues for the various system resources. It is further assumed that the service times of the servers of these queues are all exponentially distributed.

The basic focus of the model is to meet a specified system performance objective at maximum total profit. The inputs to the model are the fundamental technology cost functions (cost per bit of storage as a function of performance, for example), environment conditions (total market and cost/performance of competitors, for example), and other cost estimating relationships such as labor rates. The output of the model is both a detailed and summarized tabulation of costs and revenues for the optimized system to meet the desired system performance goal.

The System Financial Model calculates both the life cycle cost and life cycle revenue of the total number of systems delivered for the product of interest.

The definition of life cycle cost used here is "all costs that influence the choices between competing design concepts or specifications, between possible procurement procedures, or between competing proposals for production." In particular it includes the development, manufacture, marketing, maintenance, management, and user cost of a computer system.

The overall System Financial Model is divided into the submodels as shown in Fig. 4. The principal submodels are: Computer System Performance Model, User Community Cost/Benefit Model, System Revenue Model, and Manufacturer Cost Model.

Computer System Performance Model

The Computer System Performance Model assumes that the useful system performance is the product of three

factors: (1) processor average instruction rate, (2) probability that the system is operational, and (3) probability that the processor is busy. The "processor average instruction rate" is a variable that is optimized to obtain the desired performance at minimum life cycle cost. The probability that the system is operational is calculated from the mean time to repair and mean time between failure values for each system component; these values are inputs to the model. The probability that the processor is busy uses an approach for closed queuing networks with exponential servers. A diagram of this approach is shown in Fig. 4a.

In operation it is assumed that the system consists of a processor and several mass storage devices of various service times. Each of these system components has an associated queue. A number of jobs equal to the multiprogramming level exist in the system, with each job residing in one of the queues. In operation, each job is processed alternately by the processor and then by one of the mass storage devices (on a probabilistic basis). The average number of instructions executed between mass storage accesses is a function of the multiprogramming level and main storage size.

User Community Cost/Benefit Model

The user cost model is divided, as shown in Fig. 4b, into one-time costs and repetitive costs. The one-time costs are further divided into: installation cost, training cost, and conversion cost.

These cost estimates are all inputs to the model, and must reflect the average cost expected to be experienced by the user community for the product of interest. These costs will depend heavily on the target market for the system.

The repetitive costs are further divided into: new programming, continuation programming, operations, and computer system rental plus maintenance.

The new programming cost is treated as a function of the number of lines of code generated (each month) by the user, and the language level of the coding. Provision is made in the model for both compiler level and assembly level languages. Continuation programming is assumed to be a function

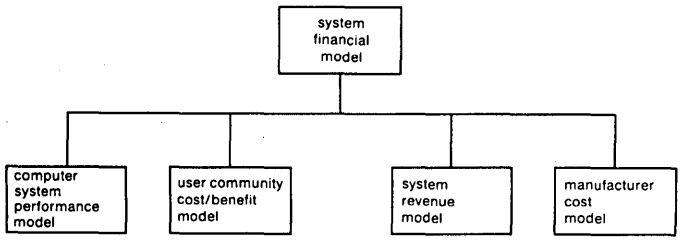


Fig. 4

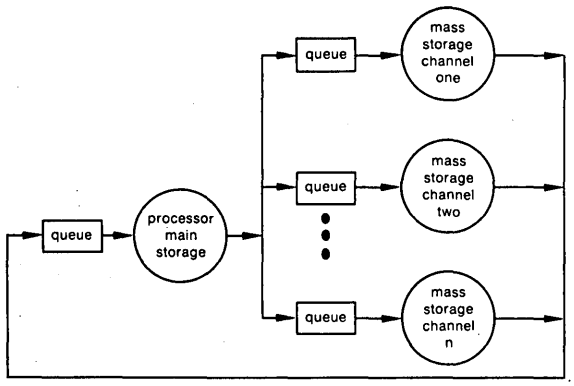


Fig. 4a

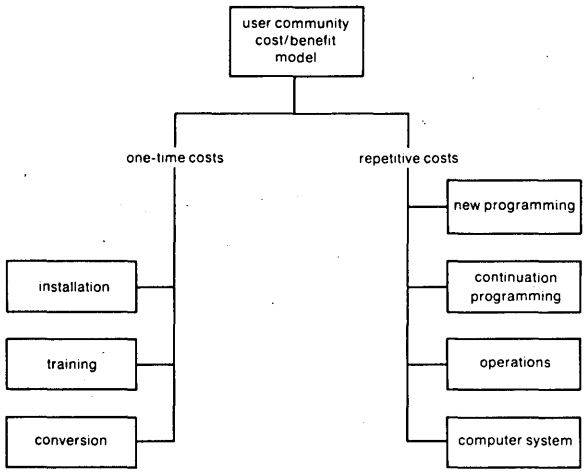


Fig. 4b

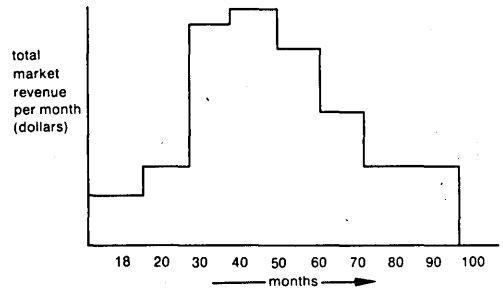


Fig. 4c

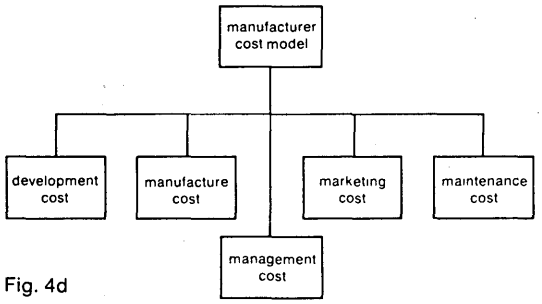


Fig. 4d

Fig. 4: Basic structure of the System Financial Model. Fig. 4a: Computer System Performance Model detail. Fig. 4b: User Community Cost/Benefit Model detail. Fig. 4c: Input for System Revenue Model (market share × total market = manufacturer's revenues). Fig. 4d: Manufacturer Cost Model detail.

of the number of lines of code supported.

Operations cost is composed of two parts: a fixed component, and a variable component proportional to the number of hours of operation per month. The cost per hour of operation in the model includes premium costs for non-prime shift, and for Saturday and Sunday operation.

System Revenue Model

The System Revenue Model is composed of two basic parts: the total market for the system as a function of time, and the market share for the system as a function of time.

The total market for the product of interest is an input to the model, and is assumed to be independent of any action by the manufacturer. A typical total market *input* is shown in Fig. 4c.

As adapted to the computer industry, the market share model of the product of interest is equal to the performance/price of this system, divided by the performance/price of all competitive systems on the market. Further, it is assumed that the competitive systems are improving exponentially in performance/price over time.

The revenue (per month) to the manufacturer is the product of the market share and total market, each of which changes every month.

Manufacturer Cost Model

The Manufacturer Cost Model, as shown in Fig. 4d, is divided into the categories of: development, manufacturing, marketing, maintenance, and management.

Separate development costs are calculated for each of the major areas of: processor, main storage, mass storage, peripherals, software, and "system" (how well the components are balanced).

The hardware design cost model uses a nominal development cost (input) which is modified by factors reflecting goals for performance, schedule, availability, and Value Engineering (spending more on engineering to find ways to cut manufacturing costs). The software development cost is modeled as the product of a cost per instruction times the number of instructions for four categories of software. The total development cost is simply the sum of the individual development costs.

Separate manufacturing costs are calculated for each system component, using an approach similar to the model for development. The total manufacturing cost for the system is the sum of the manufacturing cost of the components. A manufacturing start-up cost and Continuation Engineering cost is also included.

The marketing cost is divided into the major categories of pre-sales cost and post-sales cost. The pre-sales cost is modeled as a function of the number of proposals generated per month, and the cost per proposal. The post sales cost includes both sales support and technical support. Provision is made for two general categories of customers: sophisticated customers who: require extensive pre-sales activity for elaborate proposals and benchmarks, but little post sale support (like the U.S. Government); and less sophisticated customers who require simple proposals but extensive post-sale support.

Maintenance costs are divided into one-time cost, one-time cost per system (installation), and repetitive cost (per month) for each system (including emergency maintenance, preventative maintenance, and spares usage).

The emergency maintenance cost is derived from the mean time between failure and mean time to repair of each system component, along with the labor cost per hour. All other factors are inputs. The cumulative maintenance cost based on the number of systems in the field at any one time is calculated.

Finally, the management cost (including general management, personnel, controller, research, and legal) is modeled as a fixed percentage of the total product cost.

Inputs

The System Financial Model has a total of 91 scalar inputs and 37 inputs which are functions of other variables to be defined by the user of the model. Some typical scalar input parameters are shown below. A typical functional input is shown in Fig. 5, where the functional relationship of storage cost to performance is given. Where more than one technology or approach exists for a given function, the most efficient one (called the "efficient frontier") is selected.

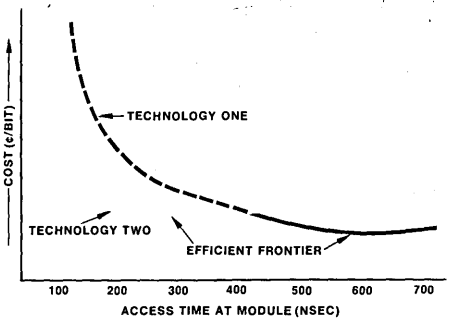


Fig. 5. Some 37 inputs to the model are non-scalar, including the relation of memory cost to performance (which is fed to the model as a function, and which assumes the use of the most efficient technology).

- User Parameters (per system), including installation cost, training cost, conversion cost, and operations (fixed and variable) cost.
- Manufacturer Parameters, including: pre-sale marketing cost per proposal, post-sale technical support cost per system, manufacturing start-up, cost, initial spares cost, and interest rate.
- Environment Parameters, including: cost/performance of competitive products, number of competitors, and rate of competitor improvement.

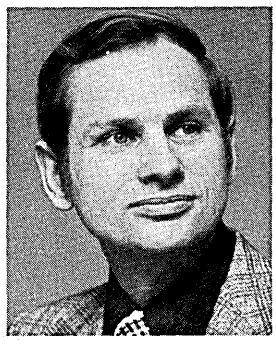
Applications in the outside world

The specific application described is a large scale computer system, but the principles and techniques of financial modeling are applicable to a broad range of high cost/low volume systems, including airplanes, weapon systems, ships, and custom machine tools.

The long development and cost recovery times for these complex systems make financial planning very important for profitable operation, and the use of a computerized planning model such as the one described here can provide very detailed, highly accurate answers to specific questions in a matter of minutes to hours at a cost of typically $5 to $10 per computer run.

Like all models, the financial model of a large scale system has very definite limitations which must be kept in mind in interpreting the results. In the case of the financial model of a large scale computer system, specific limitations include: add-on peripherals after first installation, salvage value, mid-life product enhancements, competitor reaction, and intra-product competition.

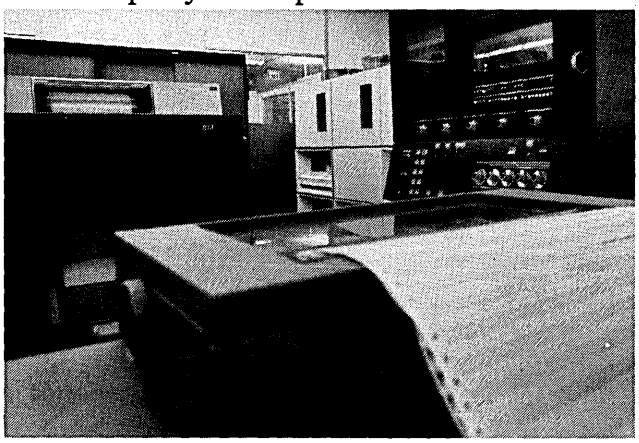
The model is not a substitute for technical and managerial judgment, but instead is a tool to provide additional information in a timely manner to be used in the decision making process. ❋



Dr. Champine is senior staff consultant at Sperry Univac, where he is responsible for managing the advanced technology program, and for technology planning of future large scale commercial computer systems. In his 19 years with the company he has held several technical and managerial positions in software and systems design, the most recent of which was as director of advanced systems design for large scale systems.

HOW THE FENWAL FIRE SUPPRESSION SYSTEM IN THIS AUTOMOTIVE COMPANY PAID FOR ITSELF IN ONLY 2 WEEKS.

At 9:03 on a Wednesday night, an electrical malfunction caused overheating, and smoke began rising in the west end of this company's computer room.



At 9:06, while the fire was still in the smoldering stage, the Fenwal Fire Supression System automatically sensed this smoke and discharged its extinguishing agent (Halon 1301).

By 9:30 that same night, the smoke had cleared, employees had arrived and with the appropriate Fire Department clearance entered the computer room. Traces of Halon were present but there was no discomfort.

Close examination of the problem area revealed scorched and discolored internal wiring. Some relays would have to be replaced. But no other damage had occurred.

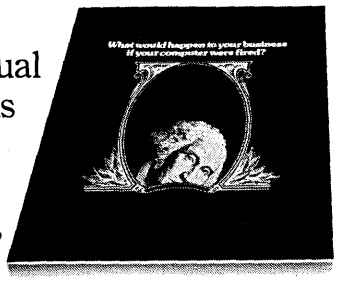
Even though the fire was inside the consoles, at the farthest point from the Fenwal discharge nozzles, the flames were snuffed out *dry* and major damage or personnel injury was completely averted.

At 10:45 P.M. the Fenwal distributor who had installed the modular suppression system was called. By 5:30 A.M. it was re-charged and back in service.

This protection system had been installed just two weeks prior to the true incident described above.

It actually made the difference between a few hours of downtime and several weeks of expensive business interruption. The kind of interruption from which some businesses never really recover.

Fenwal has designed and installed more of these Fire Suppression Systems than any other manufacturer. And we make a full line of thermal, smoke and ultraviolet Detection Devices and Control Panels.



We have visual proof our Systems work in a variety of environments. Send for our film, "The Fireaters." Or for a copy of our booklet on fire suppression. Write Fenwal Incorporated, Ashland, Mass. 01721. A division of Walter Kidde & Co., Inc., or call (617) 881-2000.

For installation and around-the-clock service, see our local distributors listed in the Yellow Pages under "Fire Protection."

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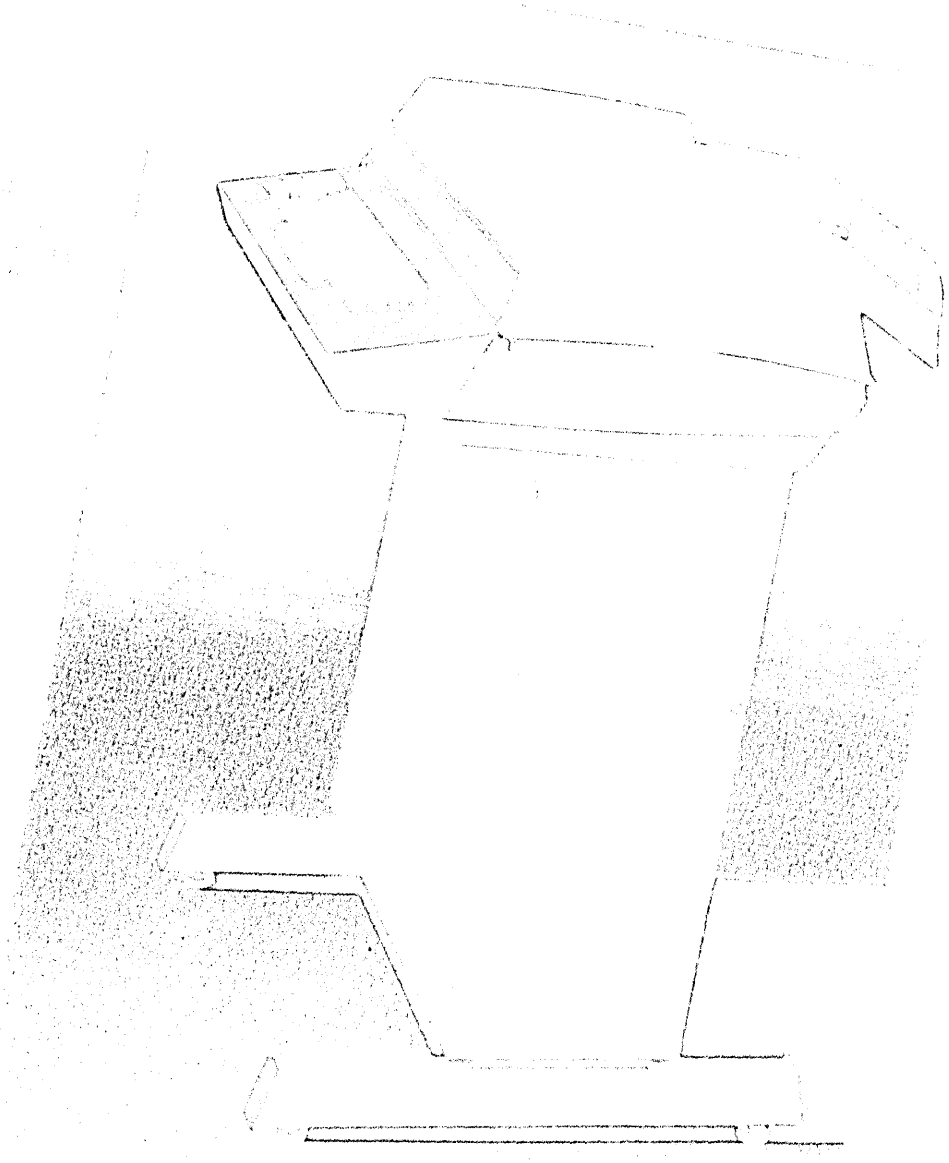

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DISK MANAGEMENT SYSTEM: UCC THREE/ADAM solves the problem of disk fragmentation and inefficient DASD space usage. Based on user specifications, it automatically scratches unneeded, unused and invalid data sets. Or it

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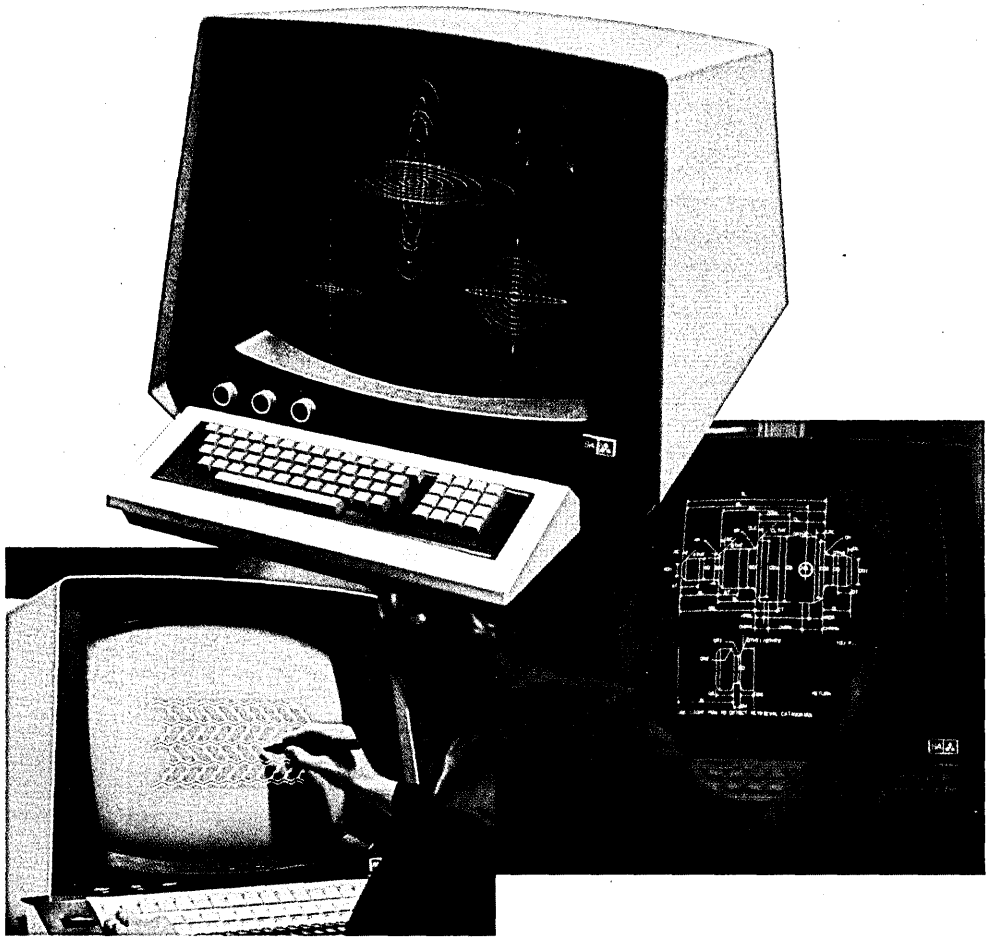

You'll draw a graphic conclusion.

Sanders' new Graphic 7 is an intelligent terminal with all necessary hardware and software as standard —not cost-you-extra—features.

But the Graphic 7 doesn't just save you money when you buy it. It also saves you money after you buy it.

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Six Future Strategies for IBM

by Marvin L. Silverman

IBM is faced with pressures from domestic and foreign mainframers, ambitious plug-compatible manufacturers, the courts, and the government. It will undoubtedly find a way to handle the situation. Here are its most likely responses.

IBM is now being tested in several courts and in the arena of public opinion. The outcome of that testing may be years in getting to us. But we cannot wait for the results of the contests to anticipate what IBM's future strategy will be and how it will concern others of us in the industry. If we believe that IBM's past holds the key to its future, we can best begin that anticipation and some preparation now. I've tried that, and it leads me to suggest six strategies for IBM's near term future, and to speculate on the forces the company will be responding to as much as ten years from now. The exercise requires some care in doing, but I think it's reasonably easy to follow.

In the 1960s firms such as Memorex, CalComp, Ampex, and others emerged to offer IBM head-on competition in what has come to be known as the "plug-compatible peripherals" arena. They offered the user disc and tape drives, memories, and printers, at prices below IBM's, and the computer giant lost market share and revenues as the independents built up healthy businesses. In the early '70s this healthy foundation began to collapse, and many independents were either forced out of business or were made to realign. ISS was absorbed by Univac, Telex and Ampex withdrew from the oem tape replacement market, and CDC emerged as a leading plug-compatible supplier along with Itel.

To many, these events became a cause celebre to claim unfair competition by the "giant," and a raft of lawsuits against IBM (many still under way) hit the courts. Of course the coin has another side, for the independent oem's forced IBM to compete in the marketplace to recapture lost revenues and share. In the succession of events during the early '70s, the user community was the unequivocal beneficiary. IBM reacted to market share intrusion with upgrades to existing peripherals subsystems with resulting improvements in price/performance and new sets of "alternatives" for the user. System peripherals that had been designed in the early '60s were replaced with equipment of better performance, higher reliability, and improved function.

IBM made several moves. One, the switch from 2314s to the 2319 direct across storage facility product line—termed by many a "face-lift" or repackaging—set a precedent for direct cpu hook-up of peripherals through an Integrated Storage Adapter when introduced on the 370/145. This permitted IBM to align pricing strategies to better compete with the plug-compatible manufacturers, as well as to offer 2319s to its own System/360 customer base.

Less controversially, but not less dramatically, IBM reacted to the pinch of suppliers such as Four-Phase, Telex and STC, and Varian, in the graphic terminal, tape drive, and communications markets respectively. The near-ancient 2260 terminal (and its 2848 control unit) was replaced by the 3270. The 2400 series tape subsystem evolved into the 2420, and then was superceded by the 3400 subsystem which offered advanced technology at a better price/performance ratio. And the 270X teleprocessing controller gave way to the 370X programmable controller.

The assortment of peripheral devices introduced on the 370 opened another round between IBM and the independents.

Disc access times and recording densities could be optimized at less cost, as well as could tape rewind and handling methods. Cost/performance were the selling points and IBM countered assaults by Itel, STC, and CalComp with newer, better "industry standards." Several versions of the 3330 disc subsystems and three new models of the 3420 tape subsystem led the way for IBM.

Another iteration by the independents during the last two years, leaves us today with a host of peripheral enhancements that represent (in many cases) quantum jumps in lower storage and data retrieval costs per character. Also, the "intelligent terminal" market for distributed processing is still actively competed for by Sycor, Four-Phase, Datapoint, Incoterm and others.

In 1976, no less than the cpu itself became the target of ambitious plug-compatible vendors. Amdahl, Itel/National Semiconductor, and probably Control Data (with a Cambridge Memories 145 emulator) look to replace IBM mainframes themselves!

Considered at least partial responses to this new form of competition, IBM introduced its 168 Attached Processor System (APS), and followed it with purchase price cuts on memory after the Amdahl 470/V6 introduction. With currently 30 machines installed, Amdahl's near 7% intrusion into the large-scale 168 market leaves speculation open as to a 178 in the wings.

And just as threatening to IBM's mid-range cpu base was Itel Corporation's October announcement of plug-compatible models in the 148 and 158 range. Itel believes its AS/4 and AS/5 systems have a potential share of 2% to 5% of what they see as 6,000 to 7,000 potential IBM 360 and 370 users. Again IBM met this announcement head-on two weeks later in its announcement of a 158 APS system, more power than Itel's AS/5-3MP. Similarly, IBM's anticipation of dp industry events was witnessed this past summer when speculation of CDC-funded Cambridge Memories 370/145 replacement was hinted. The code-named system "Colt/45" was met by a *new* IBM entry, the 370/148. Simultaneously, a 138 system to replace the 135 was announced, I believe, as a hedge against a suspected (and still rumored) Japanese entry into the mainframe market by Hitachi. In any event, two machines five years along in their life cycle were replaced by what some believe to be two machines of FS (Future Systems) architecture.

And so in the real world of 1977, IBM is being pushed everywhere by specialists. Their response? Well, it almost seems that they can announce new products faster than ever before—at the amazing rate of one per month. And what this does is impact the competitive situation between IBM and its

traditional mainframe competitors, Univac, Burroughs and Honeywell. Basically, this is what makes the new plug-compatible competition significantly broader in consequence to IBM in the long run than the peripherals contest. Univac, Burroughs, and Honeywell now face two new rivals (Amdahl, and Itel) in trying to woo customers away from IBM, stiffening their competition and the pressure IBM feels in the press when these companies' managements cry "foul." Secondly, whatever action IBM takes to meet the new mainframe competitors, the traditional three rivals have a tougher target to aim at, and overtures of "antitrust blues" can be heard in the wings.

The evolution of the series

Clearly, IBM is caught in the middle of what are ambitious plug-compatible vendors on one side, and the Justice Department on the other side, each looking for blood. Over $5 billion dollars in cash and marketable securities attests to "reserves" in capital this giant has with which to enter any technology in dp and come out with nothing short of the spectacular! What limits IBM is how its actions are *perceived.*

I contend that the IBM Corporation's stated policy of "evolution rather than revolution" is to be taken literally. Revolution would most certainly, it seems in these times, bring the wrath of the Justice Department down on the giant in quite an arbitrary and industry-damaging manner. It seems defensible for IBM to resort to a planned, evolutionary approach in bridging the 370 systems to the "next" generation through selling better price/performance.

We have learned from the documents filed in the Justice Department suit what IBM was trying to achieve in its FS design, and that to launch FS, they needed customers to shift to a larger data base and to sharply increase the storage capacity of their systems. The attraction for the user would be that the Future System would be usable by ordinary people, as easily as a hand-held calculator; trained specialists would not be required. But the required software could not be created. After spending between $30 million and $50 million trying to develop the systems software, IBM abandoned the attempt. The result: a philosophy of systems evolution through microcode disciplines.

What the FS failure left as a lesson for IBM management, is currently only the tip of an iceberg: evolutionary systems. What remains below the surface, what we have seen and will continue to see emerge during the next five years, is the knowledge and expertise gathered in progressing along the FS Learning Curve. Software development was and continues to be a major effort for IBM. But a major breakthrough in technology is needed to enable IBM to move forward with the "ease of use" concepts planned for the 1980s. While they progress on this course they gather tremendous wealths of experience, data, and research that makes the quest more nearly realizable.

An $80 million budget for the Watson Research Laboratories provides IBM's development lab with the background research needed to design "next-generation" hardware products. Something close to $990 million is spent annually on development work at 26 different laboratories, and if we look hard enough we can see these and past investments surfacing in today's new machines.

How can IBM provide the cost and performance benefits of new technologies while maintaining the necessary interfaces with existing older software and hardware systems? To answer this question and gain insight to the next five years we must look at the architectural foundations of the System/360.

Models 30 through 65's instruction repertoire "simulated" the hardware instruction set of the 360/75 to make that externally appear identical across all of the series. This simulation was performed in a more "primitive" instruction set than the Assembler language instructions the programmer would write in. These primitives carried out very elementary operations, such as adding one byte to another, or moving a byte from one internal register to another. The repertoire of these elemental instructions constituted a microcode instruction set for a particular model, with each instruction termed a microinstruction. Thus, the Model 30 had microcode that differed from the Model 50, and this in turn differed from the Model 65.

Each microcode instruction set was employed to simulate the System/360 instruction set implemented in the *hardware* of the Model 75. All the other machines executed microprograms for instruction simulation of the 75. On the System/360, microcode was stored in read only storage which could not be altered, except mechanically. For instance, 80-column, punched mylar cards contained the microinstructions to simulate the 360/75 instruction set on the Model 30, and these were inserted in a particular location in the cpu. Thus the IBM 1401 and 7000 series could also be simulated on a 360 in the same fashion as the target model 360/75 was simulated.

As a later addition to the 360 family, the Model 25 differed from its sister machines in that its microcode was executed from an inaccessible portion of processor storage called Writeable Control Storage (WCS) that could be altered electronically. Additionally, writeable control store was used to simulate some of the functions of hardware disc drive adapters, channels, and communications attachments which had previously been programmed through those devices like the mylar cards. Alterations to the control store were made by reading the new microprograms, in card image form, through standard I/O devices.

The System/370 Models 135 and 145 that evolved from the Model 25 were microprogrammed computers using the writeable control storage principle. Here it was termed Reloadable Control Storage (RCS) and was available in larger sizes than on the 360/25. Additionally, the larger bandwidth of the individual 370s dictated implementation of different microinstruction repertoires on each machine. The 158 and 168 (155 and 165 also) used RCS for microcode storage. Each machine's microprograms were individual to that system and could not operate on any other model.

On 370s the microprograms were loaded into RCS through a new IBM facility, the "floppy disc." IBM's introduction of this reliable diskette technology, which stored and transferred data quickly, opened up a new storage medium for the dp industry as a whole. But more importantly for IBM, it provided a fixed medium for implementing control functions in random access memory for the cpu, channels, and I/O device adapters.

To date, major IBM subsystem control facilities employ a microprogrammed peripheral processor that can be easily upgraded or modified via floppy disc loading of RAM housed in RCS. In the cpu arena, Models 138 and 148 demonstrate IBM's propensity toward increasing RCS in order to house more operating system functions. For these two systems, the VSI Releases 6 and VM/370 microcode permit increased throughput levels over and above what could be attained with software simply by bypassing instruction decoding, translation, internal register loading, etc. These control functions, performed by the microcode to execute the 370 instruction repertoire, eliminate costly cpu cycles that IBM has seen fit to bypass for "certain" operating system functions.

Six strategies

But to see further along the road ahead, we must closely examine where we have already traveled. As the 360/25 pinpointed the framework architecture of the 370, today's hardware and software developments from Armonk depict the "next generation"

systems through the early 1980s. The signposts along the way read "Evolution" of hardware/software systems while competing fiercely for better price/performance. Proven technologies from continuing research and FS development integrated with hardware and software design point IBM on an overall path of shifting software into hardware/firmware.

I see six distinct strategies for systems architecture that IBM will employ during 1977 to 1981. First, a "*functional distribution*" of operating system components into firmware can be accomplished easily over a wide range of systems through microcode simulation. Current and future software upgrades to MVS systems will be made through Selectable Units (SU's) added to the base system. Beginning with VS1 Release 6, the 158-3 APS selectable unit is available. The distribution of hardware SU's suggests the simulation of software functions in firmware without service disruption to the user, yet providing the seemingly evolutionary characteristic in external interface he has grown accustomed to. But for the plug-compatible vendor, IBM could build an almost insurmountable roadblock!

Maintaining proprietary rights or patents to its microcode, IBM's adoption of what I term a "distributed function" philosophy in design, could spell trouble for oem's. As a long term strategy, plus-compatible peripherals as well as mainframes could be unsuccessful, unless large amounts of firmware development dollars were to be spent to keep pace with IBM. The plug-compatible manufacturers would have to constantly be guessing whether the function employed in operating system or hardware device support existed *inboard* or *outboard* of the cpu.

Second, the IMS/VS and CICS/VS software announcements are what I consider another long term strategy of IBM: "unbundling SCP software." By charging separately for the operating systems software and related applications processors, IBM would effectively revalue its inventory and pass the unbundled costs along to the user in the form of higher software bills, and lower hardware costs. For the oem's, this would spell shrinking of profit-margins to remain price competitive.

Third, I see "*a new 370*" in the form of either a new more fully microprogrammable 168-level cpu or a 370/178 announcement, to round out the current product line and carry it through 1981-1982, and to effectively compete with Amdahl. Two things will be required of such a cpu: flexibility more like that available through microprogramming in the lower end of the line, and greater speed internally.

But more important is the ability to continue on established paths and provide the evolutionary enhancements to the *outboard* subsystems via microcode. Linked directly with this would be the expansion of multiprocessing to more than two cpu's and even to include networking architectures. The logical outgrowth of the virtual storage hardware and software design would be the incorporation of virtual channel logic within these device interfaces (something Fujitsu currently has on the M-190!) Last, bubble memory itself will be tested by IBM and win entry to software and microcode program storage both inboard and outboard of the central processor.

Fourth, look for refinement and enhancement of support for distributed processing systems and further application of terminal-minicomputer based distributed data bases employing the technologies developed for the larger host systems.

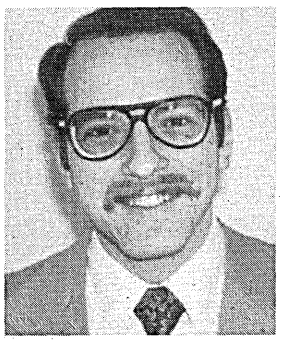
Hand in hand with these developments, IBM's future strategies in word processing, the fifth area, will be directly related to its current penetration of the business office market through the Office Products Division, providing opportunities for further expansion there. Coupled with a "distribution of functions" into more intelligent controllers feeding host computer networks, the present capability to transmit letters and data in paperless form foretell a time when even the postal service may be hard-pressed to compete.

Last, and key to the latter of my two "predictions," IBM must first establish its System Network Architecture to provide high speed, high quality, cost effective data transmission for its large scale systems interface. Developments such as their joint venture into Satellite Business Systems, Inc. seem to leverage these strategies, with ultimate success hinging on government regulatory agencies as well as computer technology.

It is noteworthy that Japan is the *only* country outside of the U.S. where domestic manufacturers hold a majority share of the computer market: 56.9% on a value basis, 63.6% on an installed basis as of March of last year. As of the same date, IBM holds only a 25% share on a value basis, and is a prime target of the Japanese computer manufacturers. Japan continues to build its native computer capabilities, with massive infusions of government aid being supplied, and cooperative approaches to hardware/software systems development being made legally binding. Fujitsu has its own version of SVS and MVS running on its M-Series systems, and is working on a new version of the MVS system. Too, the Fujitsu-backing of the Amdahl Corporation is important to Japan's success in the industry—especially to its ability to compete with IBM.

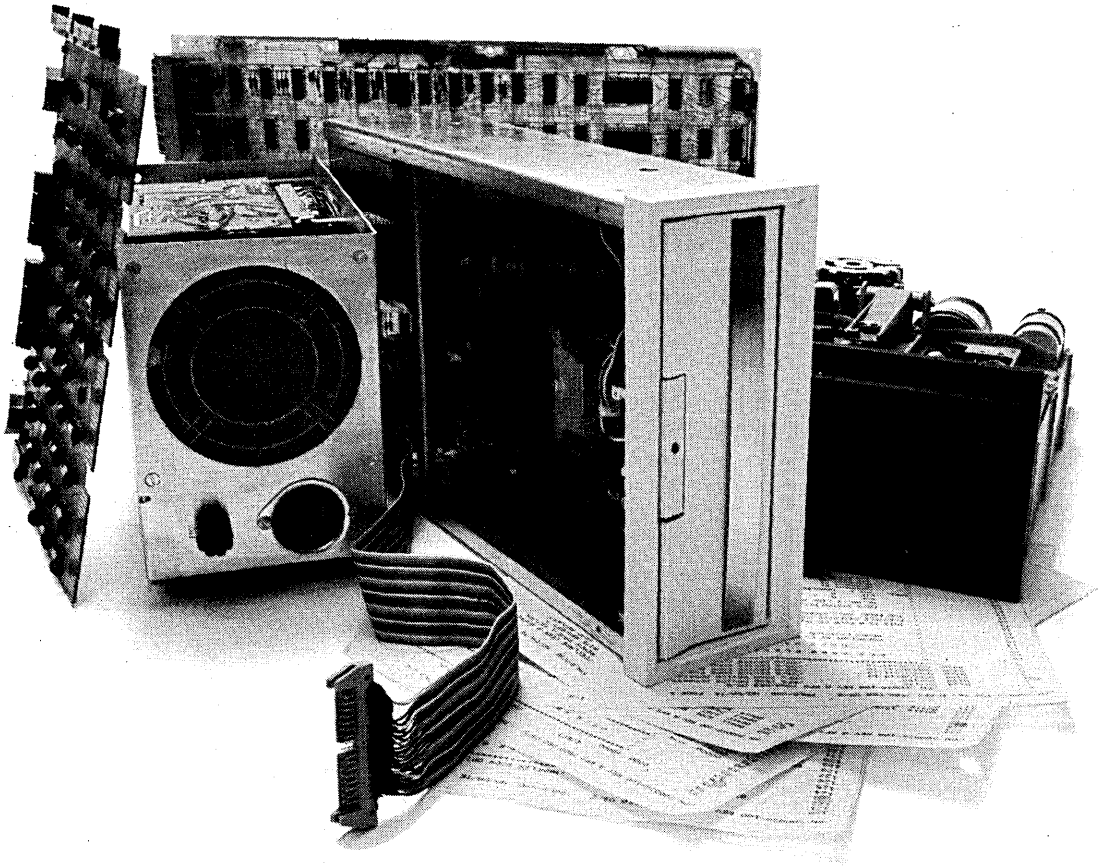
The Japanese pose a highly competitive threat to the United States computer industry during the 1980s given their technology, their government support, their cooperative approach, their intensity, and the example of what they did to the U.S. home entertainment business. To IBM in particular, the importance of Japan as a competitor cannot be underestimated, and the effect they have in the years ahead may well change and shape the course that IBM adopts in its marketing and development strategies!

By the mid to late 1980s it is very possible that only Americans and Japanese will have the technological skills required to compete effectively in dp markets. But possibly the key indicator of how the events of the next ten years will turn out for the U.S. dp industry, should be gauged by the fact that the Nippon Electric Company has participated in the construction of more than half of the 130 ground stations in the Intelsat System—and in 20% of the cases supplied the entire station. The Japanese penetration of the global satellite communications market could spell competitive troubles for IBM if, as all these strategies suggest, the company is betting heavily on the SBS venture in the decade ahead. The big competition—that which will force the adoption of IBM's next six strategies—may be not the plug-compatibles, not the U.S. mainframers, not even the plug-compatible cpu makers, but those firms whose labels read "made in Japan." ❋



Presently the manager of technical support within American Express' systems planning office, Mr. Silverman began his dp career as a systems programmer working for IBM on the CP/67 executive and working on the GE-420 time-sharing system while employed by various service bureaus. More recently, he was the manager of computer planning for the Chase Manhattan Bank, and worked for Whitlow Computer Systems Inc., in the production of IBM-compatible proprietary software. He is also currently the president of the OS Eastern Region Systems Group, an organization of 120 New York area IBM installations.

THEIR PARTS



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☐ expands data capacity through implementation of IBM3740 format or a user selectable 1, 2, 4, 8, 16, 26 or 32

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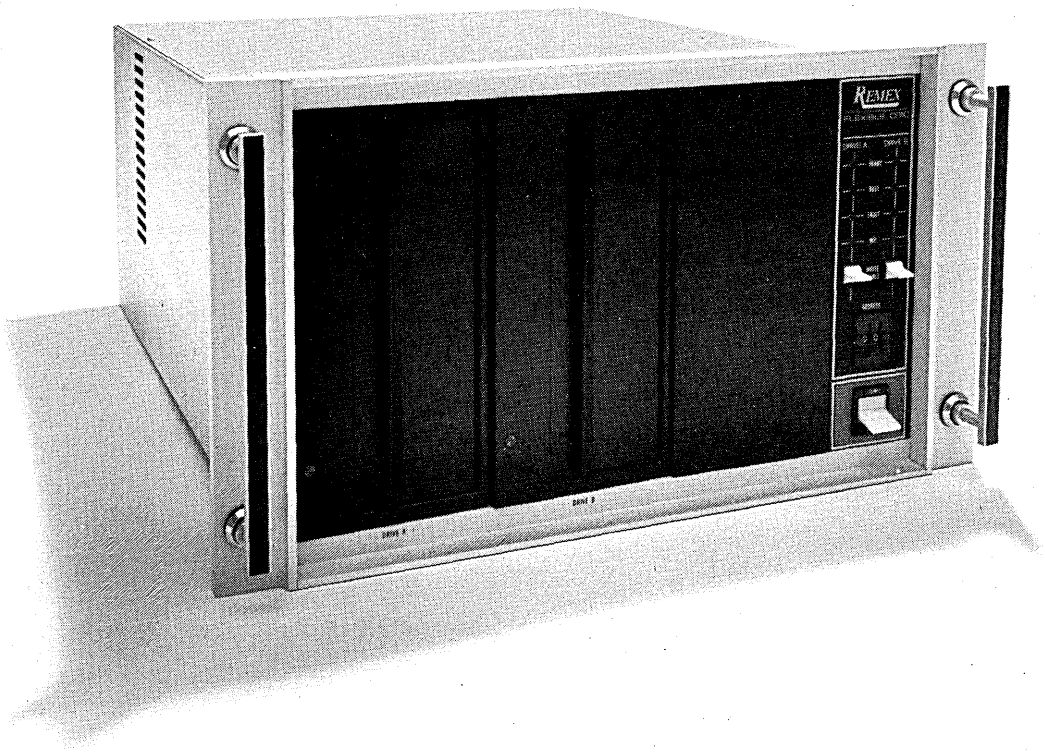

sector format. ☐ saves computer time by data block transfer of from one to 65K 2-byte words on a single command from the host. ☐ reduces core memory requirements due to automatic track and sector search and auto-initializing without software. ☐ simplifies operation and system integration by 8-command structure. ☐ saves space by housing interface card in the system chassis in some configurations. ☐ speeds access through 6 ms track to track speed plus unit select.

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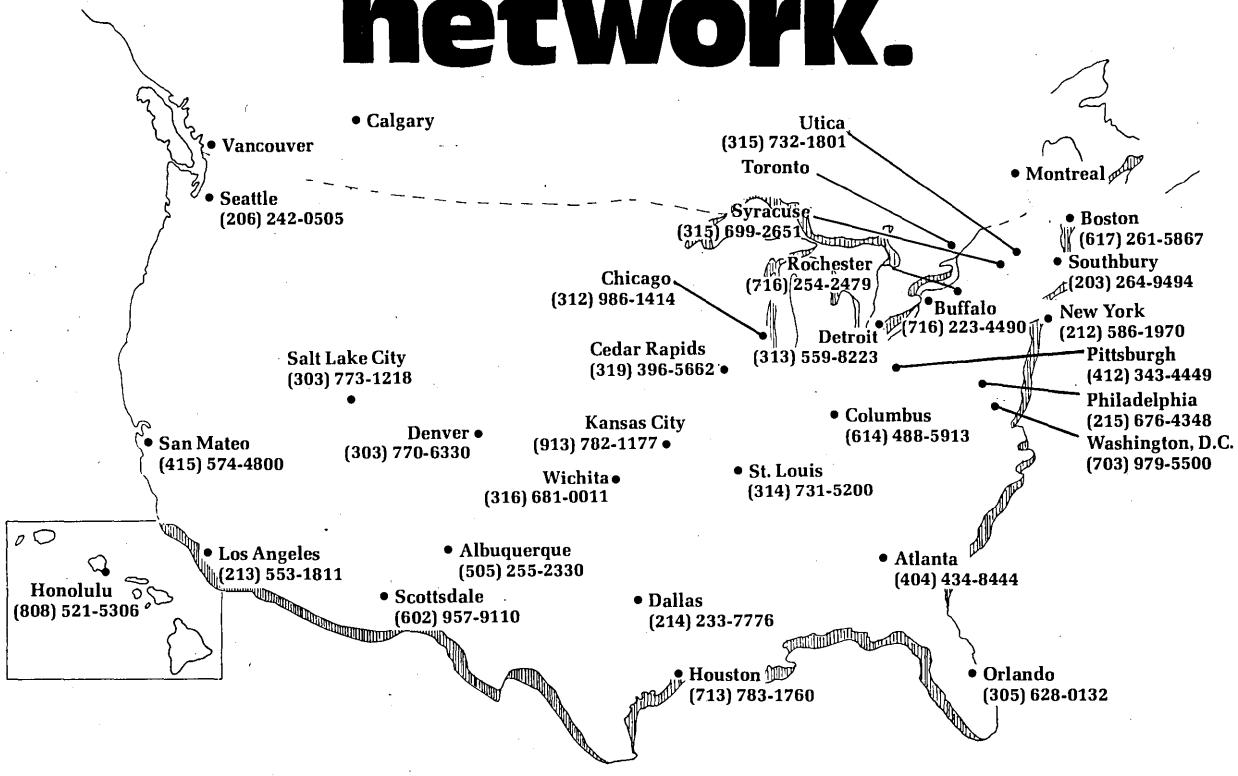

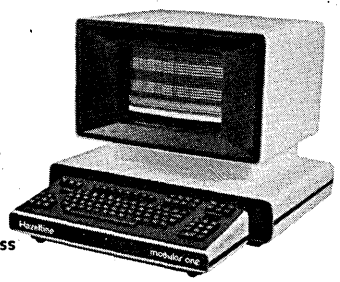

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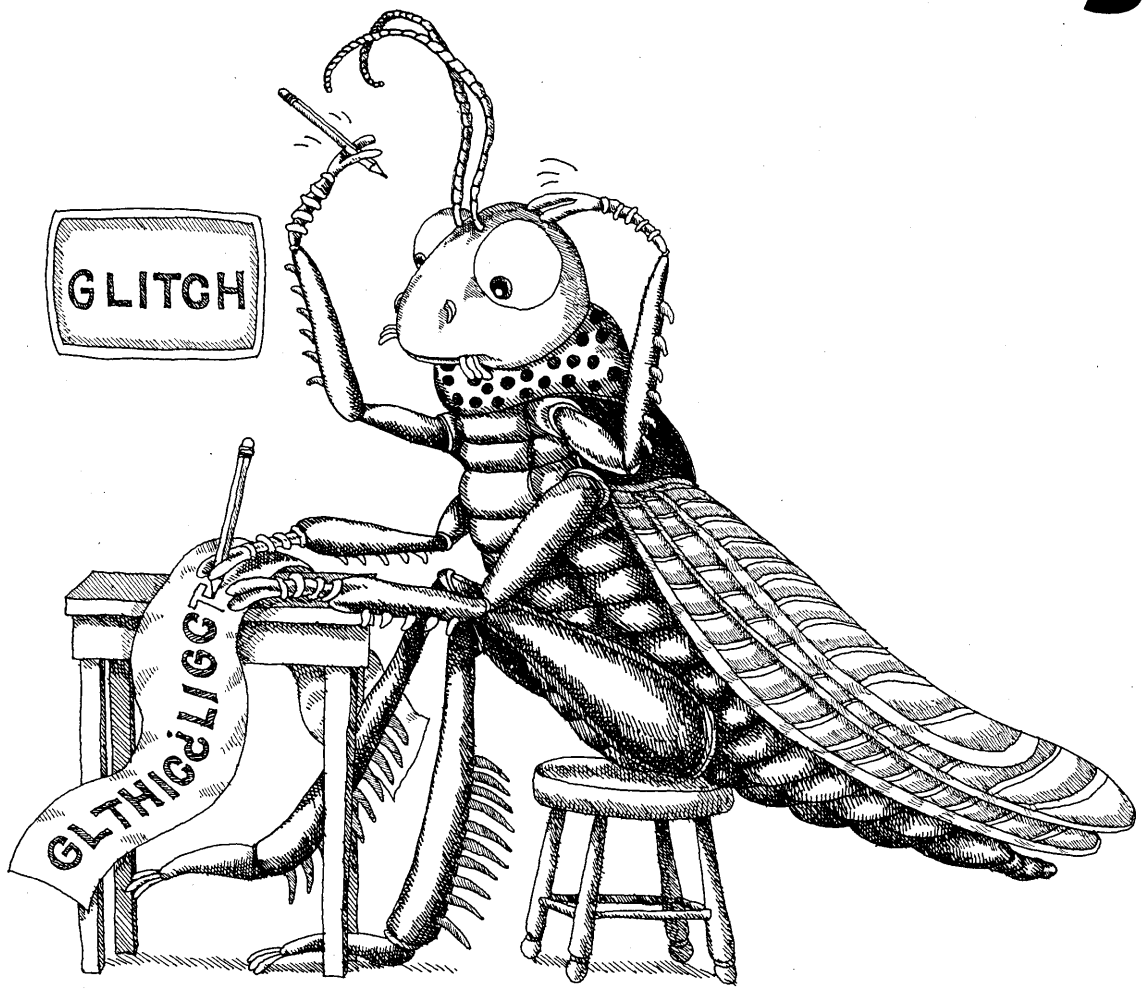
The Read/Write Error Bug.

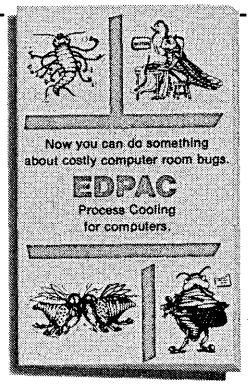


If the environment's not right, this bug won't let your computer read/write right.

An unstable environment results in the appearance of the Read/Write Error Bug. Sudden temperature changes, dirty air, static electricity, high or low humidity can nurture this costly pest.

EDPAC Process Cooling Systems are specifically engineered to achieve an exact, totally regulated environment that will prevent such occurrences. So you can rely on EDPAC to protect your computer like no regular air conditioning system can.

Before the Read/Write Error Bug plagues you with another costly error, contact EDPAC today! SEND FOR OUR BOOKLET. HOW TO GET THE BUGS OUT.



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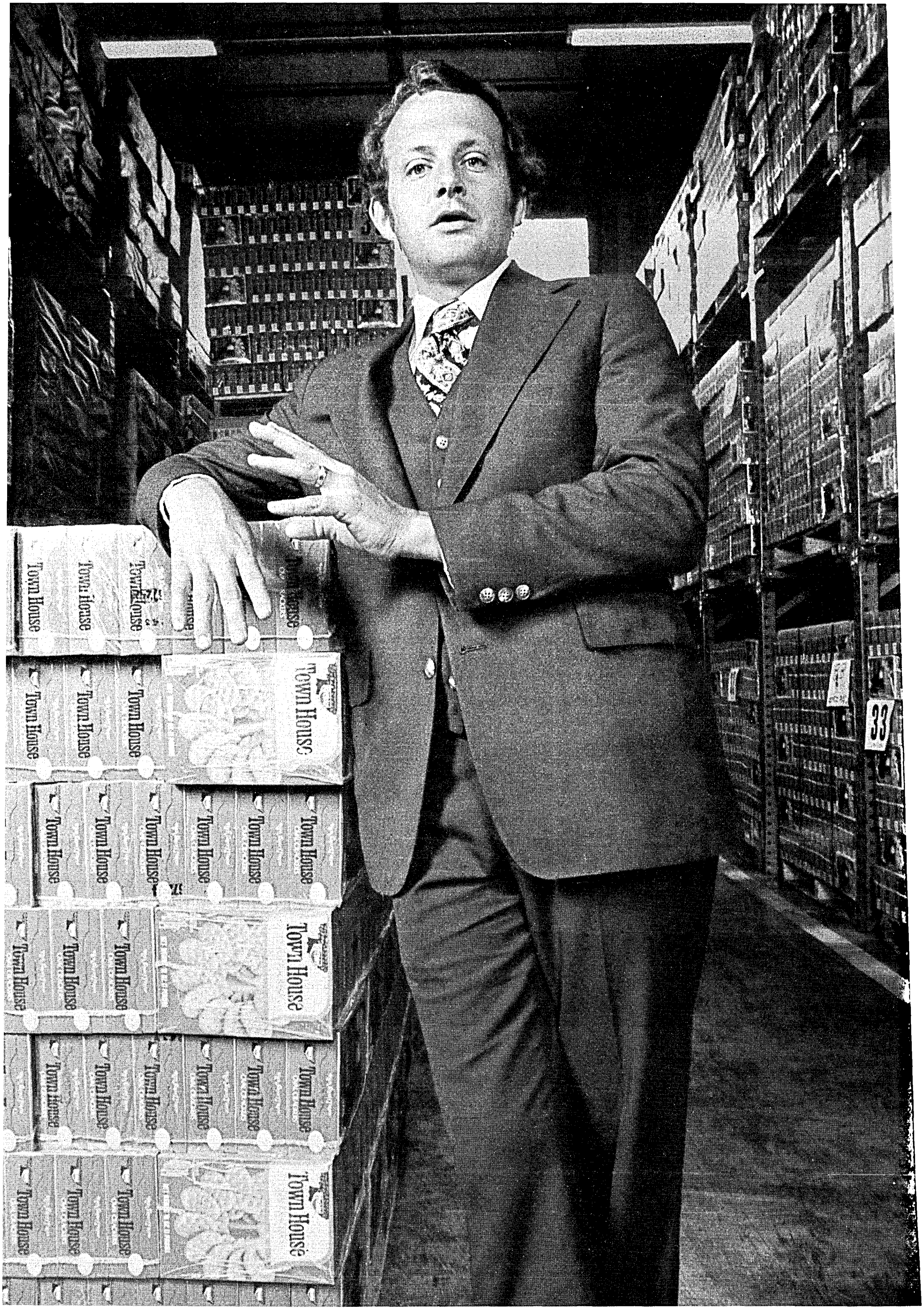
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33

"Sycor service keeps my network uptime to 98.5%."

Bill Dierkes, VP Information Systems, The Keebler Company.

The Keebler Company, second largest producer of cookies and crackers in the U.S., has six bakeries and 63 distribution centers serving 90,000 retail outlets. Keebler's sales force of more than 1200 used to mail 40,000 orders per week to the 63 distribution sites, where processing and invoicing were done manually. The problem was, these orders weren't getting processed fast enough.

The installation of Sycor intelligent terminals changed all that. And established a new set of order processing standards. Operating at peak efficiency, invoices are now transmitted from the CPU back to the branch locations the same day orders are received. Keeping up this level of performance demands terminal and service reliability.

Keebler puts Sycor to the test.

After a year of operation, Information Systems VP Bill Dierkes wanted to know how reliable Sycor terminals and service were.

"I conducted a survey of 61 of our Sycor terminals from December, 1975 through May, 1976. Some of the terminals were in out-of-the-way places like Minot and Fargo, North Dakota; Billings, Montana; and Pocatello, Idaho. Places where service might be a problem.

"What I found out really amazed me. Naturally I expected the terminals to be reliable, and I expected Sycor to back them up with good service. But even I was surprised to find that, when a station went down, *80%* of the time it was back up again in four hours or less. And *95%* of the time in eight hours or less.

"When you consider that each location uses the terminal an average of eight hours per day and that there are 127 working days in the six-month period surveyed, the total system was up 98.5% of the time."

A Sycor intelligent terminal is a management tool.

Beyond fast maintenance and reliability, Bill Dierkes has found many other benefits from his network of Sycor intelligent terminals.

"Price, ease of installation and the Sycor terminal's ease of operation were other factors I considered. But the real benefits emerged when the system was installed. As soon as it was up and running we were able to reduce order processing labor by 75%, inventory by 15%, and process 40,000 accurate invoices per week. My Sycor system is a real management tool.

"We're extremely satisfied at Keebler with the overall performance of Sycor terminals. And the people responsible for maintaining them."

Put Sycor to work for you.

To find out how much Sycor intelligent terminals and responsive service can mean to your network's efficiency, contact Bill Newell, our national sales manager, at Sycor, Inc. Corporate Offices, Ann Arbor, MI 48104.

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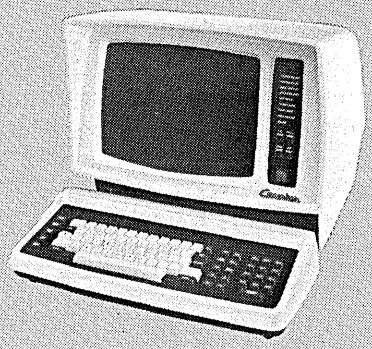

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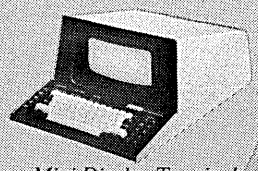
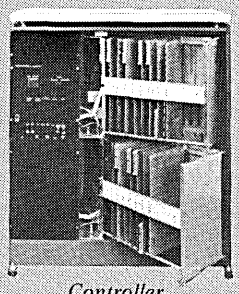
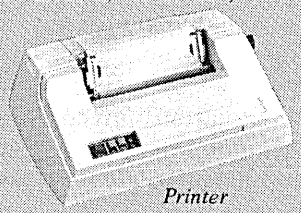


Mini-Display Terminal



Controller



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The Midicomputer

by Douglas J. Theis

For small scale users with growing pains, or for large scale users wishing to decentralize, this "forgotten" class of machines can be a perfect fit.

As minicomputers strike out for new records in computing per dollar, and large scale systems push the limits of how much figuring they can do without taking a breath, one class of machines is being largely ignored. This is the "midicomputer" group, the machines whose mid-length word sizes and less than midsize price tags position them just right in the hardware spectrum to be attractive to small scale hardware users with expanding workloads and to large scale users seeking to decentralize.

It's a mistake to ignore them, possibly a big mistake. Midis can often offer the best of two worlds. First, they are far less expensive than large scale computers. Second, they can frequently beat the minicomputers at their own price/performance game by delivering much higher throughput at comparable prices.

Once there might have been reason to ignore the group when considering general purpose applications. Midis were typecast as being for real-time use only, or for specialized applications only. It is time to reconsider any such conceptions. Midis now offer interactive BASIC, RPG, and COBOL, as well as FORTRAN. They also provide multiprogramming operating systems, data base managers, terminal-based data edit and data entry, remote job entry, and other niceties.

The group is not large, as we define it. It is composed of products with 24- or 32-bit words sizes and price tags under $100,000. Included are systems from Harris Computer Systems, Interdata, and Systems Engineering Laboratories.

True, some computers from other manufacturers also compete in this marketplace. But although "larger" machines, such as the low end of the IBM 370 line or the Digital Equipment Decsystem-10, can do the work, they don't fit under the price ceiling. In most cases they don't come close. "Smaller" systems, such as the million-byte minicomputers, miss the cut the other way. When fully configured, their prices are comparable, but due to their shorter word lengths and narrower data paths they may offer only half the performance for some applications.

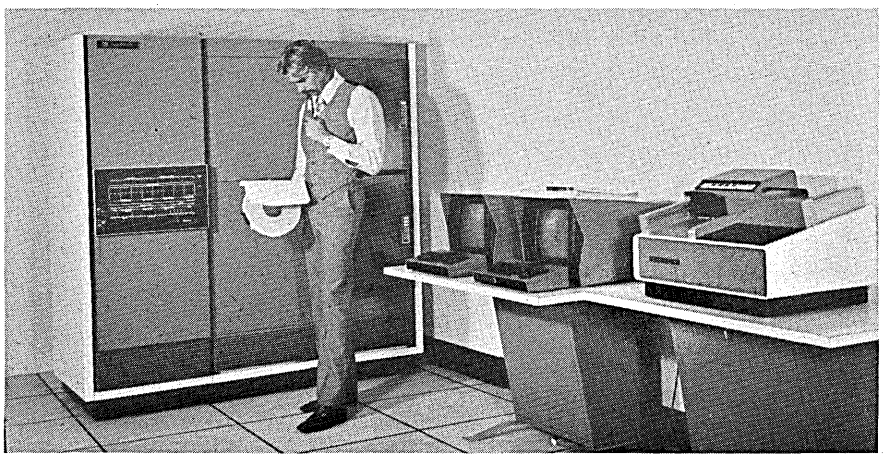
Minis use words of 18 bits or less. That means their memories, memory buses, and I/O buses are all 18 bits wide or less. To perform a 32-bit operation or the equivalent amount of work, they must do two loads, two stores, and use two cpu registers. All of this drags down their effective throughput. Their disadvantage also shows up when they attempt to provide large volumes of high numerical precision answers.

Table 1. shows several name brand computers of the "maxi-mini" class. Each was considered but eventually excluded from the midicomputer classification we use due to its data path widths. Even DEC's PDP-11/70 must be classed as a mini in spite of its 32-bit Massbus I/O and cache memory connection; its 16-bit cpu, memory, and Unibus clearly limit it.

One machine, the Interdata 8/32, went through that evaluation and was classed as a midicomputer in spite of one limitation. Although it has 16-bit I/O, its cpu, registers, and main memory path widths are wide, giving it most of the features of a larger-than-mini machine. (The firm's obvious reasoning for falling back to 16-bit I/O was that it already had 16-bit I/O controllers, and the costs of developing double-wide ones is very high. Still, we would expect them to do it in the near future.)

Operating systems

As suggested earlier, these computers all got their start in real-time applica-



Harris Computer System's line of midicomputers began life as Datacraft models. Shown here is the S220 cpu. The Harris line is unusual in that it uses a 24-bit word rather than one of 32 bits, and that it is optimized for double-precision floating point arithmetic (in fact, single-precision results are obtained by discarding the least significant 24 bits from double-precision results).

tions. They worked at jobs in process control or other event-driven uses, where the results of their processing had to be produced quickly enough to influence external processes in a timely way. This was the real kind of "real-time," not just "interactive" applications, as the word has come to be used.

It's no surprise then, that these computers all have advanced real-time operating systems. In fact, their executives have evolved over the past 10 years or so to where the user need only specify parameters for assigning service routines to interrupts and timings, or for priorities for various event scenarios. All that remains for the user beyond that is to code driver routines for new or unique equipment, and to code computational algorithms.

All of the real-time versions of the operating systems use a disc and are designed to minimize the use of core for operating system residence in spite of the machines' relatively large memory capacities. Compilers and support software are made disc resident too, as are user routines when not being executed, and the file manager—which is integral to the operating system.

To provide the capabilities for program development and remote job entry concurrent with other operations, significant additions have been made to the base real-time operating systems. For example, when real-time executives are to be extended to support multi-tasking, the disc file formats for real-time and batch mode jobs should be compatible, and file protection should be provided. Furthermore, one would want batch programs to be able to read real-time files after they had been updated by a real-time job. Potential customers should check for these features.

The true challenge was to expand the real-time operating systems without degrading the machines' overall performance on any one task. The basic approach used by all vendors is context switching. Something about how the vendors claim to have handled this is suggested in the comparison tables included in this article, where the number of concurrent tasks supported and the scheduling method are listed. Some partition of memory between foreground and background operations, either concurrently, or one job at a time, is utilized by all three suppliers.

Also, each vendor has extended its FORTRAN for real-time applications with assembly language subroutines which allow FORTRAN programs to control real-time processes. These routines are used for initiating foreground programs at specified times, for holding execution for a specific delay, and for providing special low overhead I/O operations, among other tasks.

Other real-time routines issue I/O commands to external equipment, such as an analog to digital converter for example, by using modified FORTRAN Read and Write statements. (Another example is the subroutine used to load a value into and read out the interval timer.) These subroutines have parameters for arguments such as the number of channels, scaling factors, and variable names. High overhead functions, on the other hand, such as the FORTRAN Format statement, are usually done outside the real-time operation.

All of the FORTRAN compilers mentioned here can accommodate in-line assembly language code entered by the programmer. This feature provides a convenience and flexibility of extra value to the real-time programmer. Of even more importance is the ability to generate reentrant code, so that one program can resume execution exactly where it left off when interrupted by a higher priority routine. When used in service routines, reentrant code enables several user programs to access the same copy of a routine, cutting storage requirements.

Other support software offered with these systems includes a loader, which is generally small because features such as linking are handled by what is called a cataloger or establisher program

MINICOMPUTER VS. MIDICOMPUTER THROUGHPUT CHARACTERISTICS

Manufacturer/ Model No.	32 Bit Instruction Formats (Yes or No)	Cpu Register Bus Organization (16 or 32 bit)	Memory Bus Width (16 or 32 bit)	Input/Output Bus Width (16 or 32 bit)
Data General C/330, S/230	Yes	16	16	16
Digital Equipment PDP 11/70	Yes	16	16/32* (both)	16/32** (both)
Hewlett Packard 3000	No	16	16	16
Interdata 7/32	Yes	32	16	16
Modular Computer Systems Modcomp IV	Yes	16	16	16
Prime P300, P400, P500	Yes	16, 32, 32	16	16
Varian V77-600	Yes	16	16	16
Harris S100, S200, Slash 6	24 bit	24	24	24
Interdata 8/32	Yes	32	32	16
Systems Engr. Labs 32/35, 32/55, 32/XX	Yes	32	32	32

* Memory to cache is 32 bits and cache to cpu is 16 bits.
**Memory to disc or tape controller is 32 bits.

Table 1.

The Interdata 8/32 is the only computer in this class which currently supports user-programmable writeable control store. The machine also has four specialized instructions which allow the user to set up any number of circular lists in memory for stack or queuing operations.

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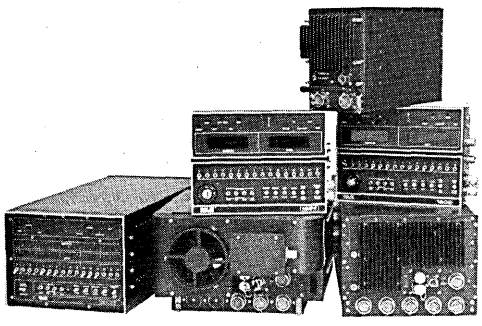

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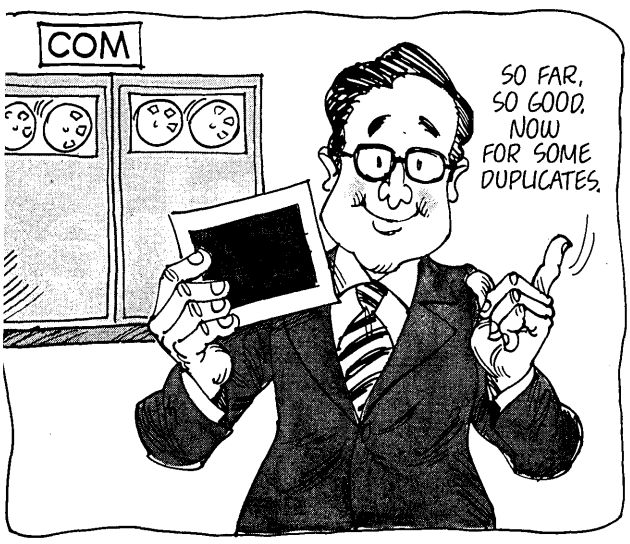

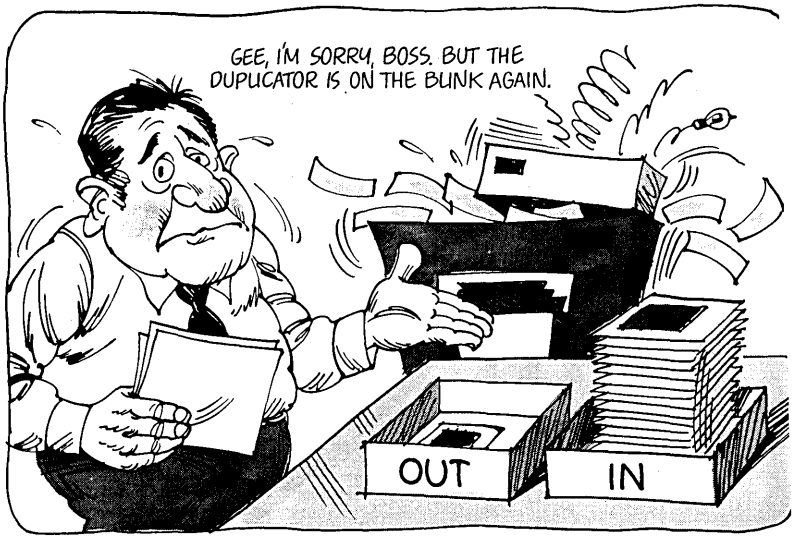

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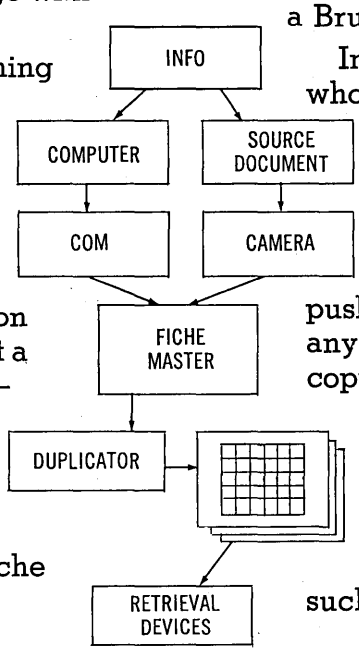

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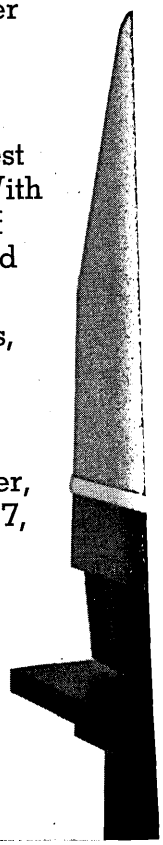

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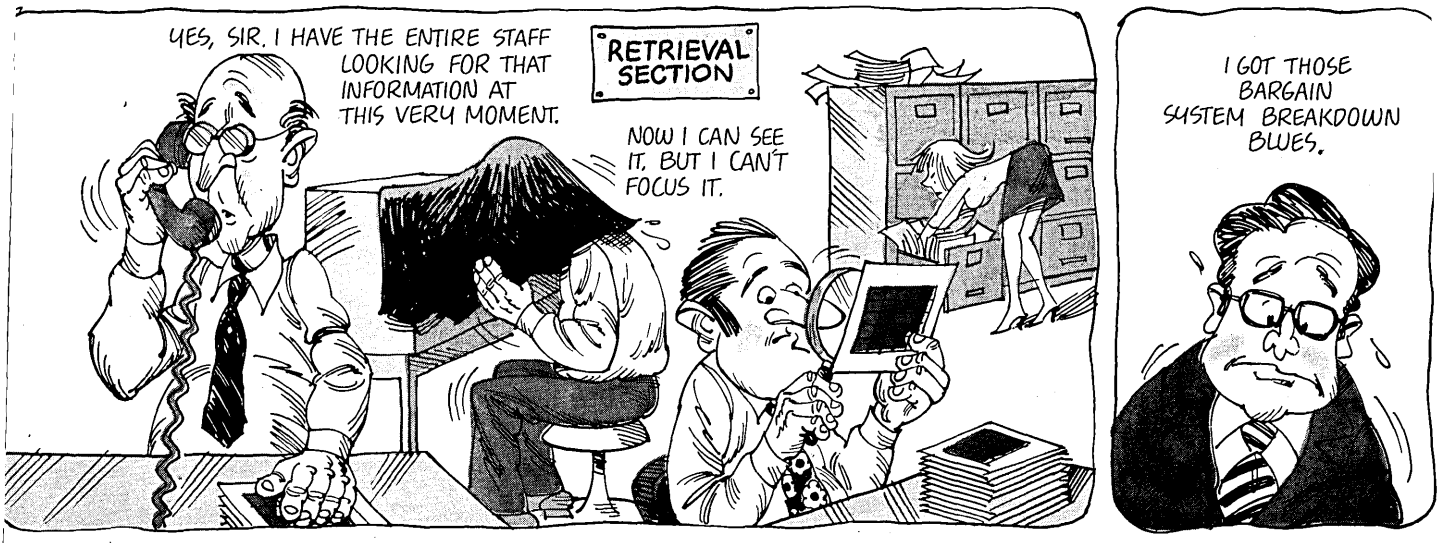

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MIDICOMPUTERS

MODEL HIGHLIGHTS	Harris	Harris	Harris
Designation	Model S100	Model S200	Slash 6
Date 1st installed	09/73	11/75	12/76
Word length	24 bits	24 bits	24 bits
Memory cycle time	750nsec core	675nsec core	450nsec semiconductor
Dbl.-precision Flt. Pt.	2.25usec add/5.25usec mult	1.8usec add/5.90usec mult	2.03usec add/11.88usec mult
Languages	FORTRAN, COBOL, BASIC, SNOBOL IV, RPG II, and FORGO	FORTRAN, COBOL, BASIC, SNOBOL IV, RPG II, and FORGO	FORTRAN, COBOL, BASIC, SNOBOL IV, RPG II, FORGO, and ACONIM
OPERATING SYSTEMS			
Designations	VULCAN	same as S100	DMS Disc Monitor System
Types	multi-user, t-s, batch, r-t		multi-user, batch, t-s, r-t
Maturity	2 years old, 55 sites		5 years old, 100 sites
Main memory required	20K-45K words core req'd		12K-18K words memory req'd
Disc memory required	1.5MB disc required		1MB disc memory required
Foreground/background	1024 tasks (inc terminals)		128 tasks (inc terminals)
Scheduler	time-slicing/priority		time-slicing/priority
Special features	dynamic memory allocation, interactive debug, spooling, memory protect, sort/merge, disc compression, RJE		dynamic memory allocation, interactive debug, spooling, file security, common, file compression, indexed seq files, sort/merge, RJE
SUPPORT SOFTWARE			
Assembler	2-pass macroassembler	same as S100	same as S100
Loader	linking loader with overlay		
Data base manager	TOTAL ($10,000)		
FORTRAN	extended ANSI FIV		
COBOL	X3.23-1974 ANSI		
BASIC	compiler		
Others	SNOBOL IV interpreter, RPG II, and FORGO (load and go FORTRAN with extensive diagnostics)		
PROCESSING			
Instructions	120, hardwired	120, hardwired	120, microprogrammed
Arithmetic	2's-complement	2's-complement	2's-complement
Bit/byte manipulation	43 bit/byte instructions	43 bit/byte instructions	43 bit/byte instructions
General timings:			
load and store	750nsec	540nsec	1.2usec
test and branch	750nsec	540nsec	900nsec
logical (Boolean)	750nsec	540nsec	1.2usec
Single-precision Flt. Pt.	24-bit mantissa (fixed pt)	24-bit mantissa (fixed pt)	24-bit mantissa (fixed pt)
add	1.5usec (inc memory ref)	1.12usec (inc memory ref)	1.2usec (inc memory ref)
multiply	6.0usec	2.32usec	6.3usec
divide	11.25usec	6.32usec	12.9usec
Dbl-precision Flt. Pt.	39-bit mantissa	39-bit mantissa	39-bit mantissa
add	2.25usec (inc memory ref)	1.8usec (inc memory ref)	2.03usec (inc memory ref)
multiply	5.25usec	5.90usec	6.18usec
divide	12.0usec	11.16usec	11.88usec
Special instructions	multi-reg save and restore, PI entry and exit, 10usec hardware square root, compare	multi-reg save and restore, PI entry and exit, 10usec hardware square root, compare	multi-reg save and restore, PI entry and exit, enable/ disable, square and square root, fixed to floating, etc.
MEMORY			
Main memory data path	24 bits	24 bits	24 bits
Interleaving	none	2- or 4-way interleaving	none (2-word access, though)
Memory size	96KB-384KB	96KB-768KB	48KB-144KB
"Virtual" memory size	768KB	768KB	768KB
INPUT/OUTPUT			
I/O data path	24 bits	same as S100	24 bits
Aggregate transfer rate	1.33M words/sec		4.4M words/sec
I/O processors/subchannels	0 to 12 (4 subchannels each)		1 to 8 (2 subchannels each)
Direct memory access	optional		optional
PRICING			
Typical system price	$119,000	$179,000	$70,500
Configuration priced	S120 cpu with 64K words	64K S210 cpu	64K Slash 6-1 cpu ($38,500)
	10MB disc	40MB disc	5.4MB disc ($11,500)
	300lpm printer	300lpm printer	300lpm printer ($14,000)
	300cpm reader	300cpm reader	300cpm reader ($4,000)
	Model 2310 console	2310 console	ASR-33 console ($2,500)
	9-track mag tape	9-track tape	
	DMA	floating-point hardware	
MAINTENANCE			
Monthly fee	0.75% of price	same as S100	same as S100
Guaranteed response	24 hours (80% @ 4 hours)		
Service centers or reps	28		

MIDICOMPUTERS

Interdata Model 8/32 06/75 32 bits 750nsec core 2.5usec-5.3usec multiply FORTRAN, COBOL, BASIC, CORAL 66 (simulation)	Systems Engineering Model 32/35 12/76 32 bits 900nsec core 6.3usec add/24.9usec mult FORTRAN, COBOL, BASIC, GASP (simulation), and PCX (process control)	Systems Engineering Model 32/55 08/75 32 bits 600nsec core 2.6usec add/5.6usec mult FORTRAN, COBOL, BASIC, GASP (simulation), and PCX (process control)	Systems Engineering Model 32/XX new product* 32 bits 900nsec or 600nsec core 2.6usec add/5.6usec mult FORTRAN, COBOL, BASIC, GASP (simulation), and PCX (process control)
OS/32MT multi-task, real-time, batch 2 years old, sites not given 15K-32K words core required optionally, 10MB disc 256 tasks (with terminals) priority with time-slicing dynamic memory allocation, interactive debug, spooling (to be released), file mgmt, inter-task communication, task-level interrupts	RTM (disc) & PDX (core) multi-user, real-time 7 years old, 200 sites 11.K-32K words core req'd 1MB 256 tasks (inc terminals) priority/timer dynamic memory allocation, interact debug TSS optional, spooling, soft/hard priority, security, global common, multiple overlay, HASP, etc.	same as 32/35	same as 32/35
2-pass macroassembler linking loader with overlay from several independents superset of extended FORTRAN compiler interactive Level II interp CORAL 66 (simulation, esp U.K.)	2-pass macroassembler linking loader with overlay optional DBMS ($8,000) interact extended ANSI FIV interpreter (to be released) interact interpreter or cplr GASP (simulation) PCX (process control) struct FORTRAN preprocessor	same as 32/35	same as 32/35
to 178, microprogrammed	154, microprogrammed	156, microprogrammed/ hardwired	same as 32/55
2's-complement 10 bit/byte instructions 0.4-1.25usec load/2.0 store 0.4-2.0usec 0.4-1.95usec 24-bit mantissa 1.0-1.82usec (inc mem ref) 1.75-2.50usec 3.6-4.45usec 56-bit mantissa 1.04-3.75usec (inc mem ref) 2.5-5.3usec 6.7-9.65usec writeable control store instr, load/store multiple reg, PSW manipulation, branch and link, circular list instructions	hexadecimal/2's-complement 26 bit/byte instructions 900nsec 900nsec 900nsec 24-bit mantissa 2.7usec (inc memory ref) 7.3usec 9.3usec 56-bit mantissa 6.3usec (inc memory ref) 24.9usec 43.1usec load/store file, call monitor and wait, and double word instructions	hexadecimal/2's-complement 26 bit/byte instructions 600nsec 600nsec 600nsec 24-bit mantissa 2.4usec/1.95usec (inc refs) 7.0usec/3.95usec 9.0usec/4.10usec 56-bit mantissa 5.4usec/2.6usec (inc refs) 24.5usec/5.6usec 42.5usec/6.85usec load/store file, call monitor and wait, and double word instructions (plus wcs instr for 32/75)	
34 bits (2 bits parity) 2-way interleaving 128KB-1MB does not apply	36 bits (4 bits parity) none 64KB-512KB 512KB	36 bits (4 bits parity) 0 to 4-way interleaving 32KB-1MB 1MB	36 bits (4 bits parity) 0 to 4-way interleaving 32KB-512KB 16MB
16 bits (plus 1 parity) 1.5M words/sec 7 selector (16 subchannels ea) optional	32 bits 6.7M words/sec 4096 (256 subchannels each) standard	same as 32/35	same as 32/35
$75,000 64K word cpu 10MB disc 30cps console printer	$64,100 64K cpu ($43,500) 5MB disc ($6,000) 300lpm printer ($10,000) 300cpm reader ($3,000) KSR-33 console ($1,600)	$88,600 64K cpu ($68,000) 5MB disc ($6,000) 300lpm printer ($10,000) 300cpm reader ($3,000) KSR-33 console ($1,600)	$90,600 64K cpu ($70,000) 5MB disc ($6,000) 300lpm printer ($10,000) 300cpm reader ($3,000) KSR-33 console ($1,600)
1% of price 8 hour 30	0.8% of sale price 4 hours in major city 36	same as 32/35	same as 32/35

*specifications subject to change before announcement

which can reside on disc. Spooling is supported (with higher priority I/O also supported for real-time operations which require it), and interactive debugging is available either as a standard feature or as an option. Full-fledged data base management systems are not usually offered as standard equipment, but they too are available as options.

Processing

Midicomputers provide a comprehensive instruction set consisting of some mix of full word (32 bit), half word, byte, bit, and double-precision instructions. The addressing modes include direct addressing plus various combinations of indirect, indexed, indirect indexed, immediate, and extended addressing.

The instruction set itself is usually implemented in microprogrammed hardware rather than hardwired combinatorial logic. The microprogrammed implementation has a cost advantage and some degree of flexibility. It also facilitates software compatibility in new machine models. However, microprogramming changes are not practical for the user to make except on the Interdata 8/32, because modifying or adding to the instruction set impacts the off-the-shelf software significantly. (The Interdata 8/32 facilitates user microprogramming with four instructions for its optional Writeable Control Store memory; these are Read, Write, Enter, and Branch to Control Store.)

Of particular significance is the fact that these machines have double-precision floating-point arithmetic representation. (And since their execution times are significantly slower when they are implemented in microprogrammed hardware, sometimes both microprogrammed and hardwired instruction implementations are available.) All these machines use a 2's-complement fixed point notation for negative number representations, and all make standard integer arithmetic available for those applications where it is needed.

And each of these machines has some unique cpu instruction capabilities. The Interdata 8/32 has four circular list instructions (remove from top, add to bottom, remove from bottom, add to top) which allow the user to set up any number of circular lists in memory for stack or queuing operations. It also has a special instruction for data communication operations to do a cyclic redundancy check on a modulo-12 or modulo-16 basis as specified by the programmer. The Harris Slash 6 has a unique hardwired floating-point square root instruction and instructions for conversion between fixed and floating-point. The SEL 32 series has special instructions for interrupt control and priority level designation, and also 26 instructions for bit-manipulation.

Memory

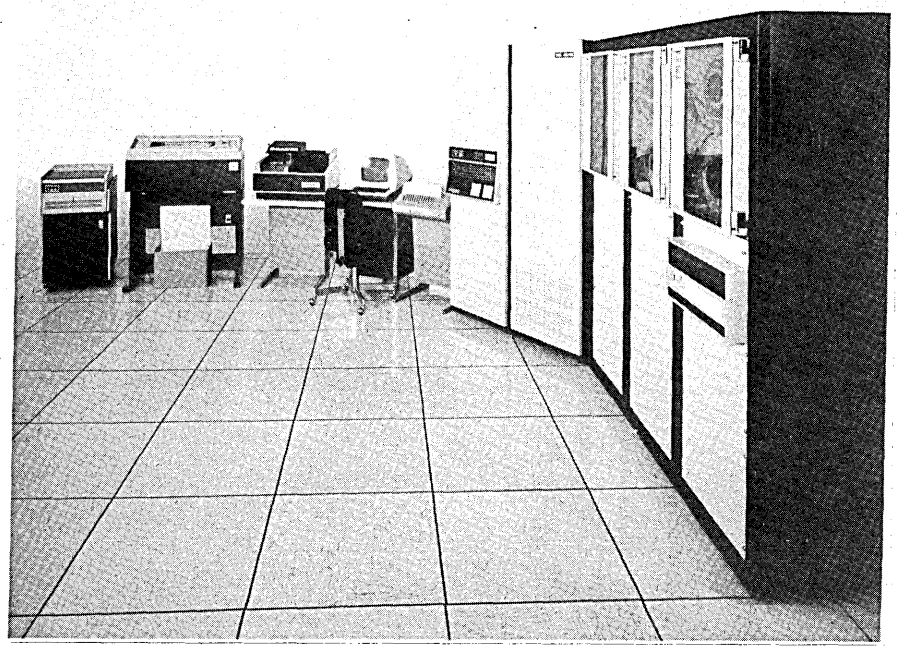
In order to enhance performance, most of these machine architectures have gone to interleaving memory banks to achieve a higher effective cpu to memory bandwidth (transfer rate). This allows some degree of overlap for increasing the number of words accessed per memory cycle, and is accommodated by a wider bus between cpu and memory. The Harris Slash 6 and Interdata 8/32 also both use a mini-cache technique with two double-word registers to increase machine throughput.

This class of machines predominantly uses core memories. The only *delivered* semiconductor machine in this survey is the Harris Slash 6, but falling semiconductor costs along with cycle time improvements will surely cause more changeovers in the near future.

Without error correction, reliability of RAM's today is about the same as cores. This, along with other factors such as proven design and availability of core explains why RAM's were not used sooner in these kinds of machines. In addition, there are applications where core is preferred because of its nonvolatility. Many industrial or harsh environments require core because it is less sensitive to these conditions, for instance. However, users can put batteries on their semiconductor memory systems to make them a viable alternative under conditions of sudden power loss.

Built-in memory error detection and correction circuitry can be added to either memory technology. Typically, error detection and correction methods will handle two error detections and one correction before maintenance personnel must take action. (Usually light displays or other indicators show the up-to-date status.)

Now, with single-bit error correction techniques and the densities of today's RAM devices, (easily 4K per chip), several minicomputer manufacturers have achieved an overall RAM memory system reliability which is significantly better than core systems deliver (5 to 10 times more reliability than core or early semiconductor systems without error correction). The goal for RAM devices in a system is 0.001 failures per 1,000 hours, which is equivalent to a meantime between failure (MTBF) of one error in 10^6 hours (only one error in over 100 years). So far, as mentioned, Harris is the only vendor in the midicomputer group to have delivered semiconductor (RAM) memory. That firm's reliability engineers expect a memory system MTBF of 40,000 hours (over four years) with their single bit error correction techniques using 4K RAM's. The point is that semiconductor memories are certain to eventually force core out, even for the worst of environments.



Systems Engineering Laboartories Model 32/55, shown above, is the firm's top machine until next month, when the 32/XX will be announced. One basic difference between the two models is the incorporation of user programmable writeable control store for the channels on the new machine.

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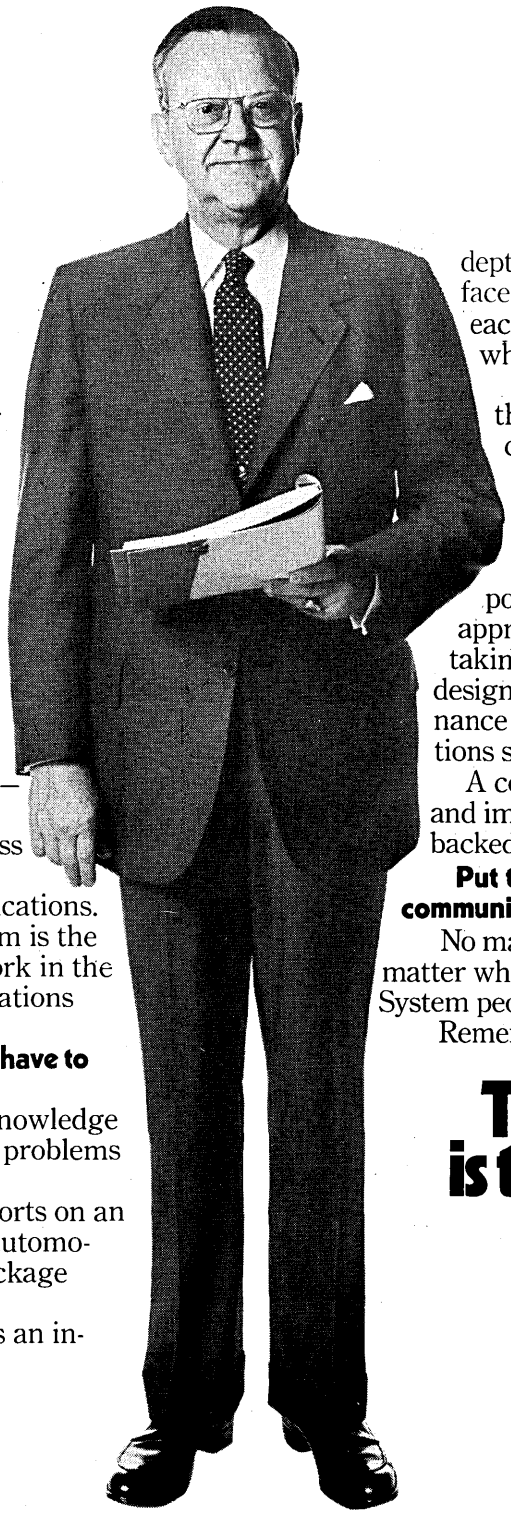
John D. deButts, Chairman of the Board, AT&T



You'll be seeing the phrase: "The system is the solution." It's more than a slogan. It's a basic expression of the Bell System's marketing philosophy.

The single fastest growing part of any business today is communications.

The flow of information.

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Communications can solve business problems.

At the Bell System, we believe we can be of enormous value to business—any business—by applying our expertise in communications to your business problems.

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We take total responsibility.

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Put the resources of the world's largest communications company to work for you.

No matter what business you're in. No matter where you're located. There are Bell System people ready to meet your needs.

Remember, if you have a problem:

The system is the solution.

Bell System

THE MIDI-COMPUTER

In memory size, that is, in their ability to make efficient use of large memories, midi's have an obvious advantage over minis. A midi typically has 16 to 18 bits of address space in an instruction—versus only 8 to 9 for a mini—and can theoretically directly address up to 256K words (1MB). Only Interdata chooses to do this, however; the other vendors use some form of base address register to address a megabyte memory.

The typical memory capacity for this class of machine is presently 64K words to 128K words. Our tables show the possible range from minimum *useful* memory (a meaningful application program can be executed) to maximum *delivered* memory. So far, although larger memories are offered, none of the vendors has delivered a system of over 256K words.

In fact, very few machines have ever been delivered with as much as 256K words of main memory. This leads one to wonder how much genuine demand there can be for extended or memory map systems offered by these manufacturers (which provide a facility something like virtual storage). Certainly the world is going to need larger memory capacity, but the costs and the competition of distributed systems have kept this area relatively quiet in terms of growth and user demand. Also, the cost advantages of disc overlays continues to be dominant.

Things will change if RAM memory costs continue to drop 20% a year through 1980 as we expect, and users overcome their past ways and order larger (512K word and 1M word) systems in a big way. (Memory system costs to the user for this class of computer is approaching one cent per bit. It is projected to be two-tenths of a cent per bit by 1980.) We can only guess exactly when this trend to bigger memories will take hold, but 1978 seems like a good bet.

Input/output

Although one big advantage of a midi is its big 24- to 32-bit I/O pipe, sometimes only an 8-bit path is used, depending on the peripheral or external device attached. The controller connecting the peripheral to the computer channel bus connector is designed to balance or match timing and minimize overhead to effect the transfer. Controller capabilities are taken for granted, but as I/O channels increase in number and type, the versatility requires more controller complexity.

Midicomputers have several types of channels which often include I/O processors to off-load the cpu of the host computer. The implementation of these is similar to those used on several large scale class machines. One of the primary functions of such an I/O processor is to free the host from sequencing through a group of many slow speed devices, and for that reason the I/O processor is organized with subchannels to handle just this kind of configuration. In most of these units, the processor has direct access to a memory port as well as to the cpu bus. There are also special configurations that use a direct memory access channel for large data block, high speed transfers.

These machines have an evergrowing variety of types of I/O channels to support external equipment. Each manufacturer has many variations on its basic approach but they are all designed to maximize throughput and to effectively off-load the operating system. For instance, the Interdata 8/32 does not have I/O processors as such, but its "Auto Driver" channels provide an interface that is programmable to the extent that it can do such things as recognize a device address, respond to a direct memory access service request, and raise an interrupt. The Auto Driver channel contains a microcoded controller that does the functions typically performed in I/O driver routines. The newest variation in channel implementation is used on the SEL 32/75 announced last month. SEL has made its Input-Output Microprocessor Channel completely user microprogrammable (with a RAM) in a manner similar to Writeable Control Store would be for the cpu.

Just as the transfer rate for an individual transaction is determined by the peripheral, total transfer rate is also strongly influenced by the situation in which the processor is used. Note that in the tables, "Aggregate transfer rate" is meant to indicate the maximum bandwidth of I/O traffic that can be accommodated. Typically a significant portion of the overall data transfer time associated with I/O activity overhead is for set-up, device handshake, and proper termination. The transfer rate shown for the different machines in this survey varies depending on how the manufacturer decided to establish it. The very high SEL transfer rate is derived arithmetically from the bus clocking rate, for example. For other machines effective or average rates are given; these are smaller because of overhead bus functions such as addresses, bus protocols, software overheads, bus contention, and interrupts.

Our conclusions

Yes, there are some situations where a super-mini works fine; but, on the other hand, there should be no case where a midi would perform less well than a mini. Furthermore, in situations where growth is expected, the midi is definitely the better alternative.

For more information

The machines discussed here are certainly worthy of careful consideration, and the accompanying tables are intended to make that consideration easier. All of the data presented was carefully screened, but the vendors of the systems are the ultimate sources of the information and should be contacted for clarification or expansion. They may be contacted directly at the addresses below, or reached by circling the appropriate number on the reader service card bound into this issue.

Harris Computer Systems Div.
Subs. of Harris Corporation
1200 Gateway Drive
Ft. Lauderdale, FL 33309
Est. as Datacraft Corp. 1968
610 employees, 17 U.S. offices
European headquarters in U.K.
Vendor would not release sales
David Soule, mgr marketing
communications (305) 974-1700
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Interdata, Incorporated
Subs. of Perkin-Elmer Corp.
2 Crescent Place
Oceanport, NJ 07757
Est. 1966, over 1,200 employees
30 U.S. offices, 19 foreign
$45 million in sales last FY
C. J. Hoppin, pr mgr (201) 229-4040
CIRCLE 402 ON READER CARD

Systems Engineering Laboratories
6901 West Sunrise Blvd.
Ft. Lauderdale, FL 33313
Est. 1961, 650 employees
16 U.S. offices, 6 foreign
$20 million sales last FY
Abe Glatzer, dir product mktg
(305) 587-2900
CIRCLE 403 READER CARD ❋

Mr. Theis is the manager of the computer applications section at Aerospace Corp., where his responsibilities include hardware and software evaluation, especially for real-time systems. He has been a senior associate for Hobbs Associates, a senior engineer with North American on the Apollo project, and a frequent contributor to Datamation.

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Sorry, Burroughs.

ADDS CONSUL 980B

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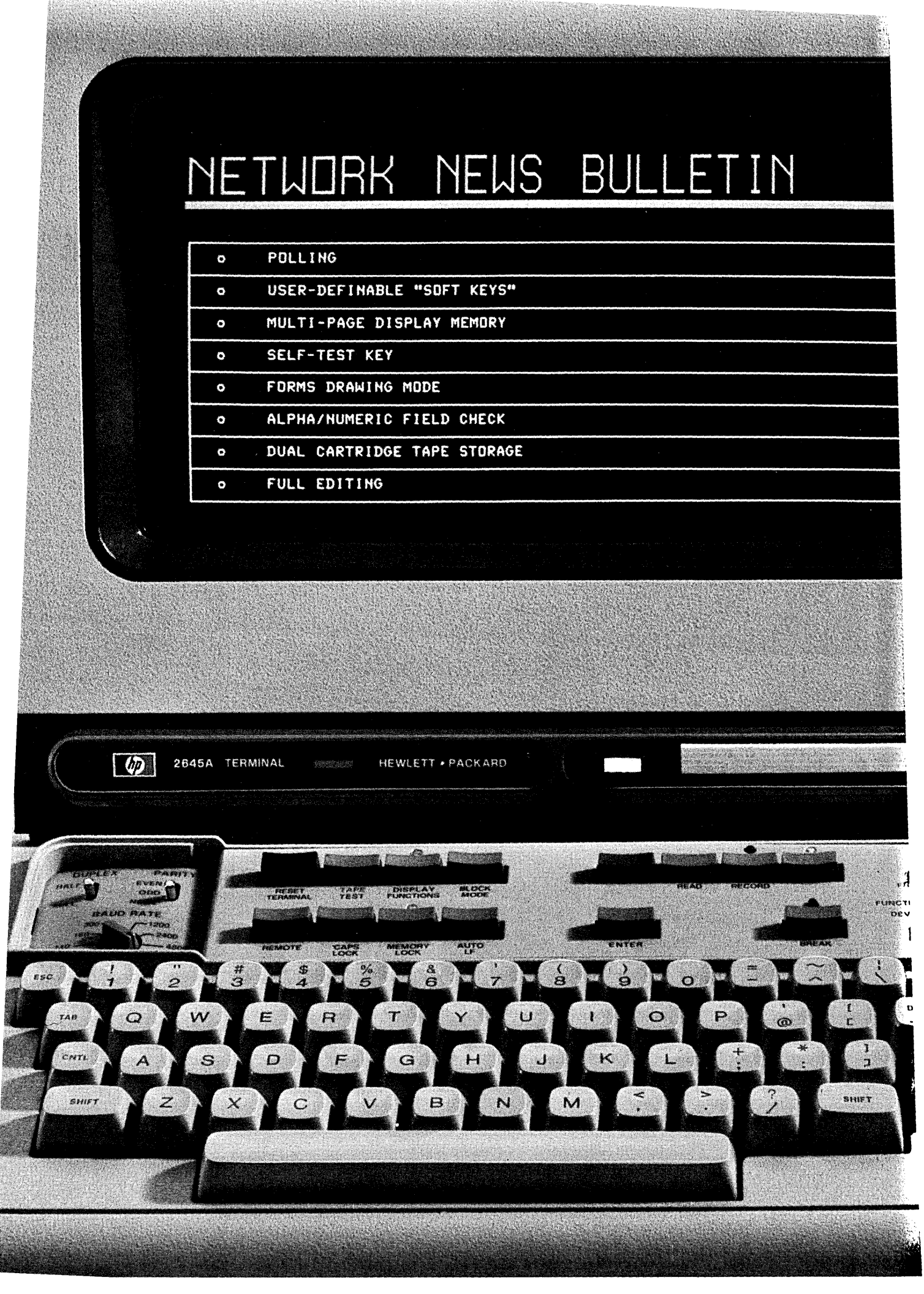
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CNTL
SHIFT
SHIFT

The HP2645A Display Station is welcome news for your information network. For a very reasonable price, it provides the speed and versatility you need for network data entry.

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The eight "soft keys" let you personalize the HP2645A to specific job functions. For instance, you could assign one key to generate a computer log-on sequence and another to call up an order entry form. These "soft keys" are simple to program with each of them capable of storing up to 80 characters.

Even when the computer or data lines are unavailable, the extensive off-line data storage allows you to keep on inputting data. Each of two tape cartridges will store up to 110,000 characters of data, forms, and programs. These optional dual-tape units are integrated right in the terminal itself and can be specified initially or added at any time you desire.

The line drawing set is another useful option that lets you generate and store basic business forms so that you have only to call up the one you need and simply type in your new data.

This kind of convenience extends to the many editing features such as the character or line insert/delete. Accuracy is enhanced by the alpha/numeric field check, which signals with a tone if you have improperly entered an alpha in a pre-assigned numeric field or vice versa.

Another time saver is the self-test key. Press it and you will receive a tone indicating that the terminal is ready to operate. If a fault should exist, the 2645A helps you determine if the problem is in the terminal, communication line, modem, or computer by displaying a coded sequence.

The HP2645A has several other features worth considering when you're choosing a terminal. They include the easy-on-the-eye high-resolution display; plug-in modularity to ease and speed maintenance; and the inherent flexibility of the 2645A in interfacing with your network.

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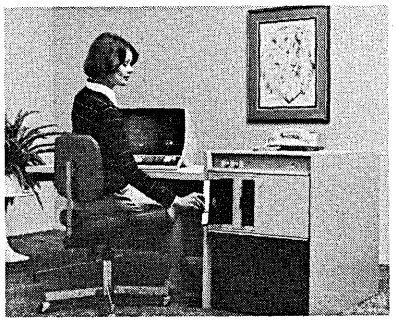
Series 21 represents a long-term growth path. It begins with two models, one for data entry and one for application processing. They are called System 21/20 and System 21/40 respectively and with what we've got planned, Series 21 is all you'll ever need for your distributed information systems.



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Just Enough Queuing Theory

by Joe M. Wiley

The systems analyst and operations manager—among others—need to know it, but more often than not the Greek symbols frighten them away.

Doctors deny its existence, x-rays don't show it, dissection reveals nothing. In spite of all this evidence to the contrary, I know there is a steel shutter in many people's heads between their eyes and brain. In my case I can hear it snap shut whenever I look at a complicated math formula. The shutter prevents my brain from comprehending what the eyes see.

A few months ago I got into a terrible problem: I *had* to make a queuing analysis. Flipping through a handy book on the subject, page after page of complex formulas leaped out at me. Since resignation and extended sick leave were out as escape routes, there was no choice but the tortuous path of pushing the formulas past the shutter by sheer force of will.

After a few days of study, I made a wonderful discovery: a queuing analysis can be easy! Applying many of the ready-made formulas is at about the same level of difficulty as basic statistics or college freshman algebra. In fact, after my first analysis was finished, I went looking for more. It was turning out to be fun.

My purpose now is to share the fun with others. In the paragraphs to follow are the simple formulas for queuing analysis—the ones I was able to understand. Of course this doesn't cover the whole field, but it is enough to use to obtain some interesting findings.

Is it worth the time for a computer analyst? You bet. For example, an analyst in the communications area who does not know queuing is as ineffective as the proverbial one-armed paperhanger. What happens to terminal response time as line utilization goes up? What is the impact on polling time as cluster controllers are added to a multidrop line and the number of terminals is unchanged? Does response time change if both line speed and the number of drops on a line are doubled? How many lines should a time-sharing system have on a dial-in rotary?

Interested in computer performance evaluation? Queuing can tell the effect of file contention on processing time, or the effect of varying the number of job streams in a multi-partition operating system.

These kinds of questions are endless, and can be answered with fairly simple queuing knowledge. My original problem—the one which forced me into the subject involved—determining how many terminals were needed in an on-line inquiry center and how much idle time the operators would have. ("Fitting in That Extra Workload," July 1976, p. 65.)

Before going any further, three things should be mentioned. First, the ability to make a queuing analysis is an essential tool for the well rounded analyst, so don't let *your* shutter snap shut at the first formula. They are all easy, Second, a knowledge of arithmetic means and standard deviations is a prerequisite. If you don't know basic statistics, go learn that first and catch up with us later. Third, if at all possible acquire a copy of James Martin's book *System Analysis for Data Transmission,* Prentice-Hall, Englewood Cliffs, N.J., 1972. He has a unique collection of tables and graphs of queuing functions. Many of the formulas to be given below can be looked up, making an analysis even quicker and easier. Frequent reference will be made to this.

But even without the book—maybe even without the prerequisites—you can get something out of what follows.

So let's get our feet wet. Below are the parts of a study in the approximate order of the steps to be taken.

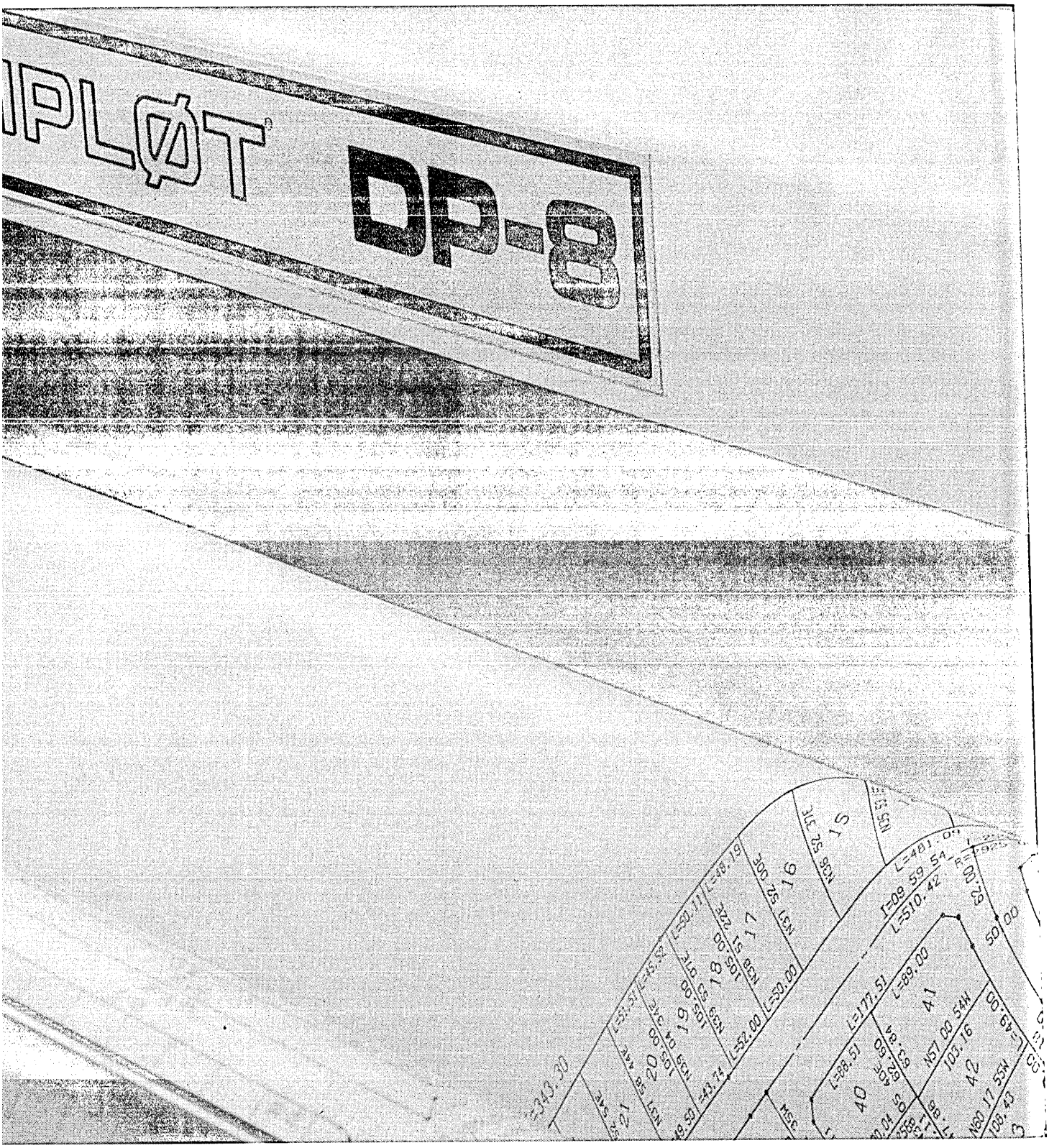
1. Study the task to be analyzed. There are some conditions that must be met before a queuing analysis can begin, plus some understanding by the analyst.

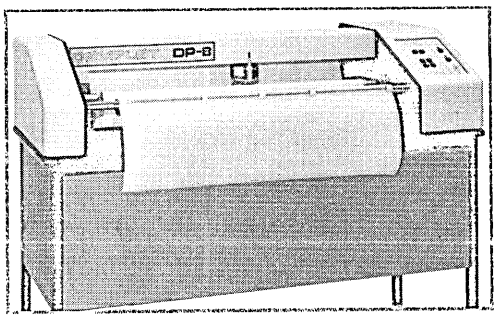
a. *Is the problem really a queue?* It makes a person feel foolish to perform queuing math on a problem that turns out not to be a queue. An essential ingredient for the formulas here is that of completely random arrivals (of messages, people, etc.) More formal ways of describing it are "exponential interarrival times" and "Poisson distribution." If the arrivals are not completely random, then a simulation model is suggested. For example, output from a production line is usually not random, nor are arrivals at a movie theatre.

b. *Is it a multiserver queue?* Be careful to distinguish between a multiserver queue and several single-server queues. The requirements for a multiserver queue are that the next customer to get service be handled by the next available server, and that all servers be equally loaded. An example is the barbershop that cut my hair when I was inducted into the Army; the guy at the head of the line got the next available barber. Examples of single-server queues are grocery store check-out lines where the customer picks a line and a bank where the customer gets in what he hopes is the fastest line.

c. *What is the dispatching discipline?* Once a queue has formed, there are many procedures for the order in which those in the line get serviced, such as first in/first out, last in/first out, shortest first, input before output, and vice-presidents to the head of the line. Any ordering is permissible with one exception. The priority must not be correlated with service time. If input has priority over output, and input message lengths are shorter and faster, then my list of formulas does not apply. There are formulas for this in Martin and elsewhere, so additional study will be necessary.

2. Raw Data Required. The most time-consuming part of any study is gather-





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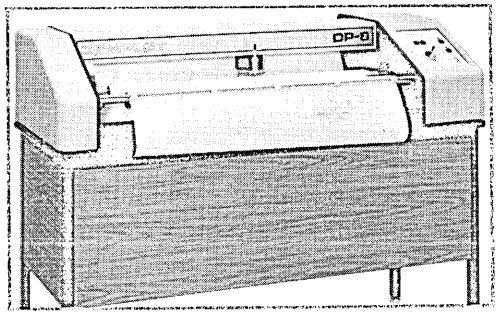

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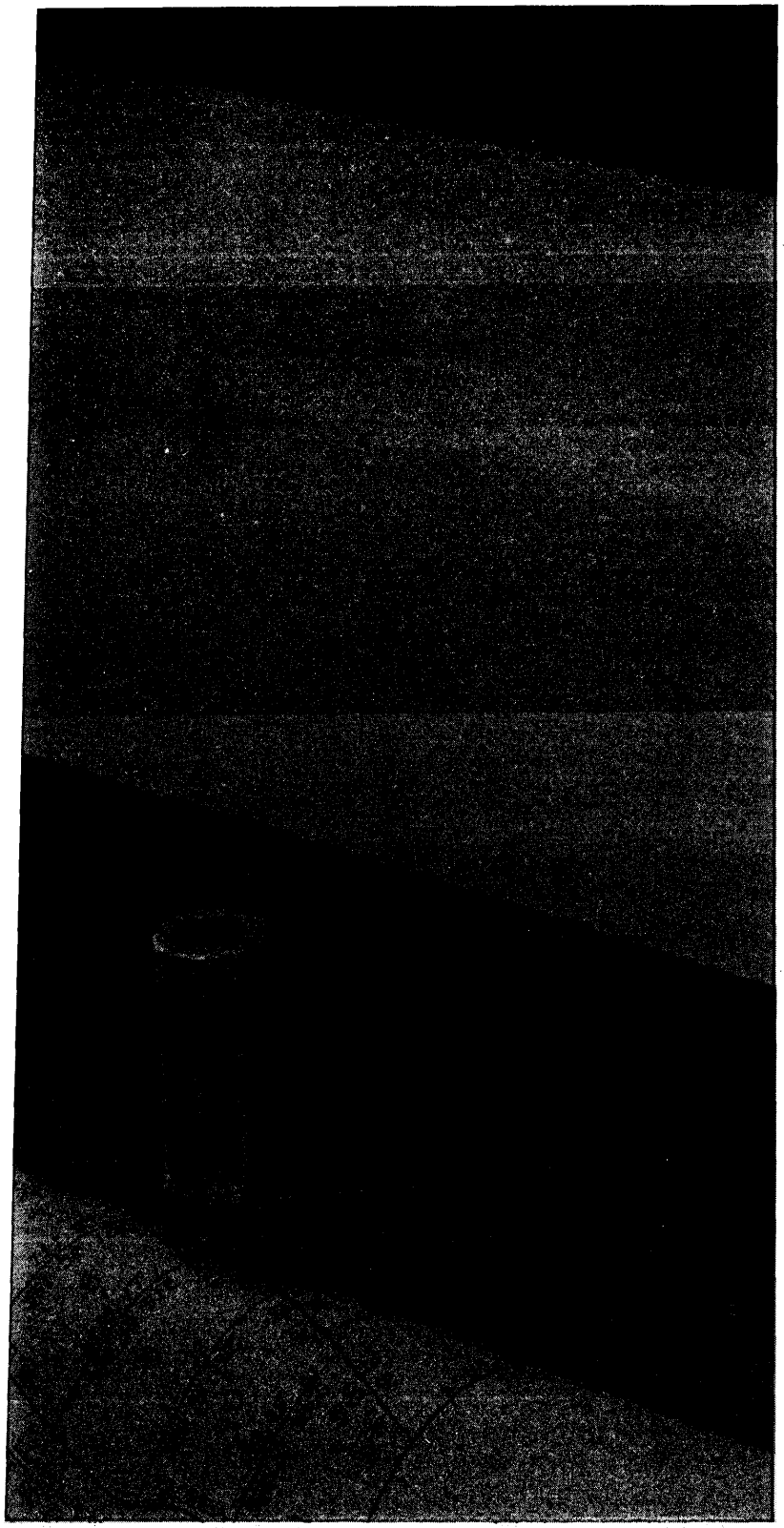

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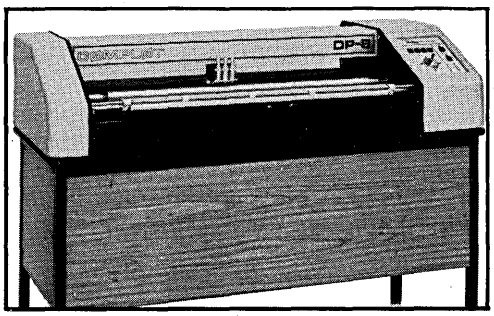

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ing the raw data. Two basics are needed for substituting into the equations.

a. Average service time, $E(t_s)$. Whenever the form $E(\ )$ is used hereafter, the E signifies "average." Similarly, $\sigma(\ )$ signifies "standard deviation," sigma. The analyst must collect enough data to get an accurate mean and a good estimated standard deviation of the time required to service the arrivals.

If service times vary a good bit, with some readings up as high as three times the average, then bypass the computation of sigma and use the mean as the sigma value also. This will normally not influence the results significantly.

b. Average arrival rates, E(n). Collecting and using these data require a liberal application of common sense. The problem is in finding the right balance between too short or too long study intervals. What is needed is the precise rate of arrivals for the interval to be studied.

Guidance can be best obtained from examples. If peak loads on a communications front-end processor are to be studied, an average arrival rate derived from counts made from 8:00AM to 5:00PM wouldn't tell much about a peak load. In contrast, using just one 5-minute interval could be just as bad. Plotting is always a good idea. There are no rules nor guides on getting the best arrival rate, and most books avoid the subject altogether. The only available tool is the exercise of good judgment.

3. Facility Utilization. One book made a very profound sounding observation: the higher the facility utilization, the busier are the servers. This does seem logical since what facility utilization means is how busy are the servers. Since Martin uses the Greek letter "rho" to represent facility utilization, let's adopt it also. (We'll also use, M for "the number of servers.")

$$\rho = \frac{\text{time spent working}}{\text{hours put in}}$$

or

$$\rho = \frac{\text{capacity being used}}{\text{maximum capacity}}$$

or

$$\rho = \frac{\dfrac{\text{(number of arrivals)}}{\text{(time of service)}}}{\text{(number of servers)}}$$

$$= \frac{E(n)E(t_s)}{M} \quad (1)$$

With this much information and Martin's book, the important values can be looked up with no further calculations. The values available are the average queue length E(q), the average number waiting to be served E(w), the average time spent in the queue including waiting for service and being served $E(t_q)$, and the average time waiting to be served $E(t_w)$. The queuing "analysis" becomes the queuing "look-up."

4. Analyze the Standard Deviation. This step is not all math as might be expected. Start out by getting the ratio of the standard deviation (σ or "sigma") to the mean service time, $\sigma(t_s)/E(t_s)$. The ratio is important in evaluating the answers to be obtained from the computations. Let's consider the possible ranges of the ratio.

a. *Sigma equals zero.* This is a rare case, and means service times are constant. The greatest likelihood of seeing it would be associated with a mechanical device or computer. Transmitted messages, if all alike, would fit this case. If sigma is zero, then queue sizes and times are one-half those given in charts or tables for exponential service times, the most common ones.

b. *Ratio Less Than 1.* This ratio is better than worst case. Since the look-up tables for multiserver queues have only worst case, a sigma smaller than 1 indicates queues slightly smaller than those given. Using the tables would give answers on the safe side. A sample case is data entry or keypunching from one particular form.

c. *Ratio Close to 1.* This is the most common occurrence, and is described as "exponential service times." What it means is that service times are random, but form a normal distribution about a mean or average. Consider message lengths to computer terminals: a full screen is maybe 1,920 characters, with message sizes varying the full range. In grocery stores the check-out time is near random but within limits. Airline reservations, utility turn-on's, file look-up's on inquiries, bank tellers, and so on fit this category.

d. *Ratio Greater Than 1.* If you have this, you have a problem. This means there's no consistency at all to the service times. The suggested procedure is to forget a queuing analysis and go study your queue for how to improve it. It means there are some excessively long items—mavericks like "100" in list of 4's, 5's, 6's and 7's.

Remember, queue sizes for service times like 5, 5, 5, 5 are one-half those with a random service time. Just the opposite happens for sigmas greater than one, the queue sizes get longer. If your queue with a ratio greater than 1 cannot be improved, and an analysis is made, the results will be increasingly unreliable as the ratio goes above 1.

e. *Adjustment Factor.* In the formulas to be given in the following sections, an adjustment factor is shown as a suffix on many of them. This estimating adjustment is the term A.

$$A = \frac{1}{2}\left\{1+\left[\frac{\sigma(t_s)}{E(t_s)}\right]^2\right\} \quad (2)$$

Note that for a ratio of 1 the term equals 1 and drops out. For a sigma of zero the term equals ½. For those cases with a ratio in-between, the adjustment should be computed.

5. Single-Server Queue Calculations. A queue is made up of those waiting to be served plus those being served.

$$q = w+s. \quad (3)$$

Again, using an E with any symbol indicates the mean or average.

$$E(q) = E(w) + E(s) \quad (4)$$

The average *number* in the queue equals average number waiting plus average number being served.

$$E(t_q) = E(t_w) + E(t_s) \quad (5)$$

The average queue *time* equals average time to wait plus average time to be served.

With facility utilization from step 3 and average service time, $E(t_s)$, from step 2, queue size and time can be obtained. The easiest way is to look it up. If a book isn't handy, then they will have to be computed from these formulas:

$$\text{queue size} = E(q) = \rho + \frac{\rho^2 A}{(1-\rho)} \quad (6)$$

$$\text{queue time} = E(t_q) = E(t_s) + \frac{\rho E(t_s)A}{(1-\rho)} \quad (7)$$

Don't let the shutter behind the eyes bang shut. These equations are simple to substitute into and solve.

6. Multiserver Queue Calculations. These are a little tougher mathematically, but are certainly worth the effort. Let's consider a couple of cases. Suppose you have a multipartition operating system, several remote batch terminals, plus on-line terminals using several partitions. You have reached 75% system utilization, and predict turnaround times with load growth as shown in Fig. 1. Such a projection would look reasonable, but may be very inaccurate. Having learned about multiserver queues, an operations manager would know that turnaround times actually behave as shown in Fig.

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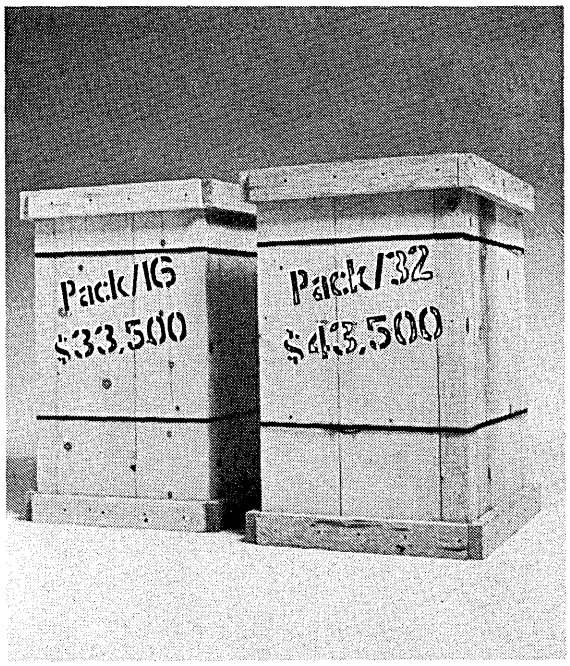

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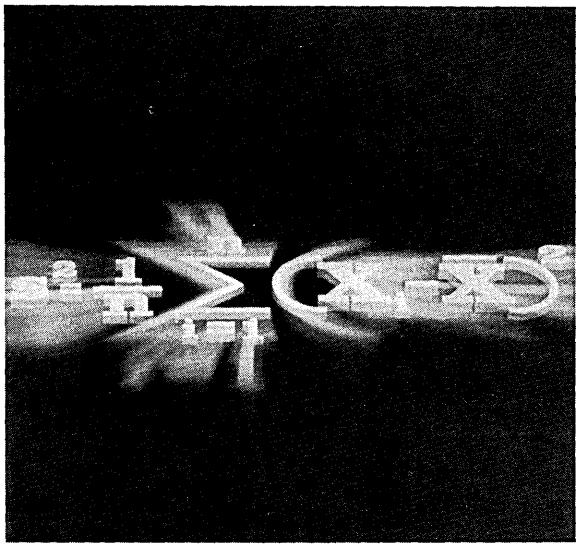

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2, and that the last 5% of increase can really kill you. He would know what to expect as computer loading reached full capacity.

Or consider another case. You are using logical channel designations versus physical channels for file access, have more logical channels than physical ones, and have multiple paths to each physical channel. As file access loads increase, is processing being delayed, and to what degree by waits for a physical channel?

Actually, the only difficulty with multiserver queue math versus single-server is that multiservers have a factor *B* added to the formulas. *B* is the probability that some server is *not* busy for a given value of facility utilization. (Martin has the values in both a table and graphs.) Computing *B* by hand is not so bad up to 6-8 servers if a book is not available to you, but beyond that level it might be advisable to program it.

Probability that some server is free:

$$B = \frac{1 - \left[\dfrac{\sum_{N=0}^{M-1} \frac{(M\rho)^N}{N!}}{\sum_{N=0}^{M} \frac{(M\rho)^N}{N!}}\right]}{1 - \rho\left[\dfrac{\sum_{N=0}^{M-1} \frac{(M\rho)^N}{N!}}{\sum_{N=0}^{M-1} \frac{(M\rho)^N}{N!}}\right]} \qquad (8)$$

where *M* is the number of servers and *P*, again, is facility utilization.

Once *B* has been looked up or solved, the other calculations are straightforward.

Average numbers being served:

$$E(s) = \frac{E(n)}{M} \qquad (9)$$

facility utilization:

$$\rho = \frac{E(n)E(t_s)}{M} \qquad (10)$$

average number waiting to be served:

$$E(w) = \frac{\rho B\, A}{1-\rho} \qquad (11)$$

average wait time:

$$E(t_w) = \frac{B\, E(t_s)\, A}{M\,(1-\rho)} \qquad (12)$$

7. Delay Time. This is a goody that is easy to calculate once the other values have been found. It is the time of delay only if an arrival has to wait. This may seem like the same thing as average wait time, but average wait time $E(t_w)$ is the average of all arrivals whether they have to wait or not. In contrast $E(t_d)$ is the delay time of only those that had to wait.

$$E(t_d) = \frac{E(t_s)}{M(1-\rho)} \qquad (13)$$

and can be used for both single and multiple server queues.

Terminal queuing

Consider the case where a computer has one leased telephone line with 10 remote terminals on the line. The average transmission time of messages on the line is 6 seconds, and the standard deviation is estimated to equal the mean. At peak times the message rate over the line reaches 2 per minute. The problem is to find: (1) the average response time ignoring line overhead. (2) If a 15 second response is considered the maximum acceptable, what per cent growth in message load can occur before the maximum is reached? (3) If 20% more utilization is experienced, will response time increase more or less than 20%?

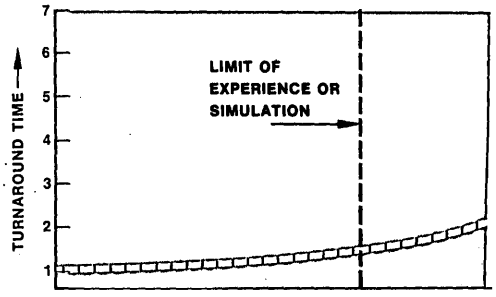


Fig. 1. A "reasonable" projection of turnaround time versus input load.

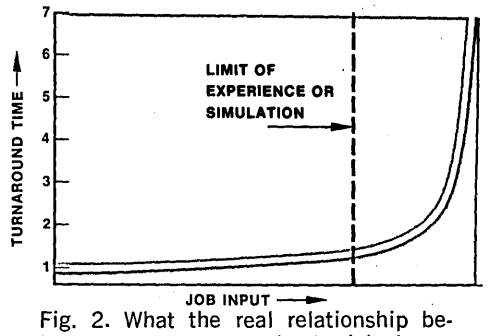


Fig. 2. What the real relationship between turnaround and load might be.

Solution: Since it is the telephone line that is the server, this is a single server case. The first thing to do is compute facility utilization. Substituting into formula (1) we get

$$\rho = \frac{(2 \text{ arrivals per minute})\ (6 \text{ seconds})}{(60 \text{ sec/min})\ (1 \text{ server})}$$

$$\rho = 0.2 = 20\%$$

The first part asks for response time, which is composed of the time for service to start (the wait for the poll) plus the time to transmit the message. The overhead to turnaround the line and for the response to begin is assumed to be zero. So what is wanted is $E(t_q)$, and we should substitute into formula (7).

$$E(t_q) = 6 + \frac{(0.2)\ (6)A}{1-0.2} = 6 + 1.5A$$

$$\text{where } A = \frac{1}{2}\left\{1 + \left[\frac{6}{6}\right]^2\right\}$$

$$= 1/2(1+1) = 1, \text{ so}$$

$$E(t_q) = 7.5 \text{ seconds} = \text{average response time.}$$

Part 2 asks for the facility utilization with a response time of 15 seconds. This is easy with a book. Fifteen divided by 6 seconds equals a factor of 2.5. The intersection of 2.5 and published curves appears to be at 0.6 (60%) facility utilization. Let's compute it and find out. Again we will use formula (7) to solve for ρ and ignore the factor *A*.

$$15 = 6 + \frac{6\rho}{1-\rho}$$

$\rho = 9/15 = 0.6$, which is the same as from the graph.

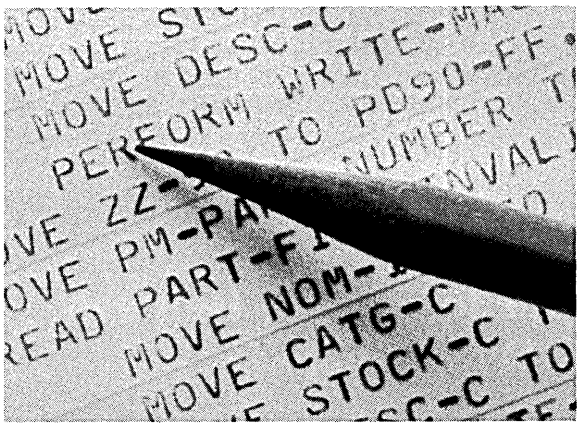
What this means is that facility utilization can increase to 60% before *average* queue time reaches 15 seconds. Remember, though, that half the response times will be greater than 15 seconds. With facility utilization as low as only 0.2 (20%), a 15 second response is at the 1.25 sigma level, and 15 second or longer response times *can be expected* for 21% of responses. What is needed is a smaller sigma to keep times below 15 seconds.

Part 3 of the problem is to find the relationship between increases in load versus response time. Since a facility utilization of 0.2 is down in the flat part of the curve, it is expected that response time is increasing slower. Let's confirm this. If facility utilization increases from 20% to 40%, this is a 100% increase. Computing $E(t_q)$ for 40% we get 10 seconds, for an increase of 33%, not 100%. In answer to the question, a doubling in facility utilization, from 20% to 40%, would indicate an increase in response time from 7.5 seconds to 10 seconds, 33%.

Multi-server queues are better

A savings and loan association has 5 drive-up tellers. Service times average 2 minutes, and sigma is 0.8 minutes. Note this sigma is 40% of the mean. During peak load times cars arrive at the rate of 120/hour. The present procedure is for the driver to get in any of the 5 lines he chooses, taking a chance

PERFORM



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as to whether it is a fast moving line or not.

As an analyst you get curious as to the effect on customer queue times if the procedure is revised. The revision to the procedure would be to set up a stop point back from the windows so that the first car in line waiting can go to the next empty window. What is the time differences in the two procedures?

Solution: The present procedure is five single-server queues. Each teller has 1/5 the load, so $E(n) = 120/5 = 24$. Since $E(t_s) = 2$, from formula (1)

$$\rho = E(n)E(t_s) = \frac{(24)\ (2)}{60\ \text{min/hr}}$$

$$= 0.8 = 80\%$$

Looking this up on the graphs we get a factor of 3.3, which is multiplied by service time of 2 minutes for a queue time of 6.6 minutes.

In calculating this by hand let's first compute A using formula (2).

$$A = \frac{1}{2}\left\{1 + \left[\frac{\sigma(t_s)}{E(t_s)}\right]^2\right\} = \frac{1}{2}$$

$$\left\{1+(0.8/2)^2\right\} = 0.58.$$

Substituting in formula (7),

$$E(t_q) = 2\ \text{min} + \frac{(0.8)\ (2\ \text{min})\ (A)}{(0.2)}$$

$$= 2 + (8)\ (0.58) = 6.64\ \text{min.}$$

By subtracting service time we find the average waiting time, $E(t_w)$, equals 4.6 minutes. What, though, is the time delay for those who do have to wait in a line?

$$E(t_d) = \frac{E(t_s)}{M(1-\rho)} = \frac{2}{1\ (0.2)}$$

$$= 10\ \text{minutes delay.}$$

Why was M=1 instead of 5? Because this is a single-server queue, and M is always equal to 1 in these cases.

How does the present procedure compare with the proposed? The first step is to get the factors A and B. A is known from the previous step as 0.58. To get B we look it up in the book under a facility utilization of 80% for 5 servers and get $B = 0.554$. Substituting into formula (12), we get

$$E(t_w) = \frac{(0.554)\ (2)\ (0.58)}{5(1-0.8)}$$

$= 0.64$ minutes average wait time.

How about average delay time? We use the same formula, except M now becomes 5 instead of 1, so average delay time is one-fifth, or 2 minutes.

In summary, the revised procedure would reduce average wait time from 4.6 minutes down to 0.64 minutes. Those having to wait would have their delay time for service to begin reduced from 10 minutes to 2 minutes!

Although you may not be expert in queuing theory, you now know enough to get irritated just as I do every time I wait in line at multiple single-server queues. ❋

A computer communications specialist, Mr. Wiley also specializes in equipment selection. He has had 19 years experience in the computer profession, most of which was spent in the design and programming of real-time systems. He has worked as a data communications analyst for the Texas Dept. of Public Welfare, and at one time headed his own firm in developing and marketing minicomputer based turnkey systems.

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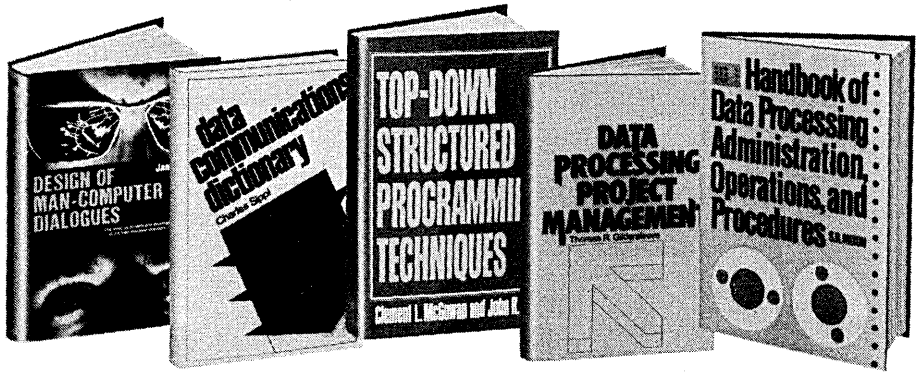

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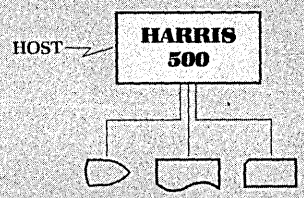

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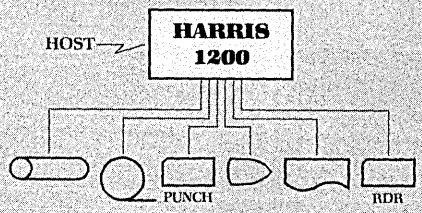

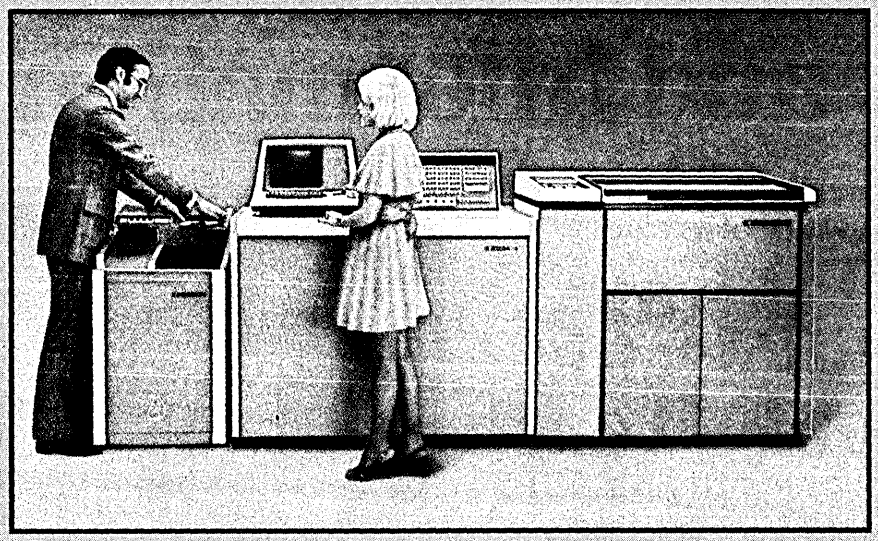

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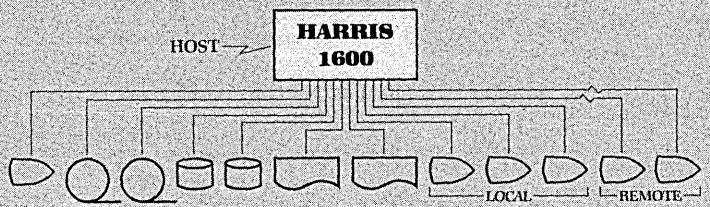

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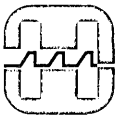

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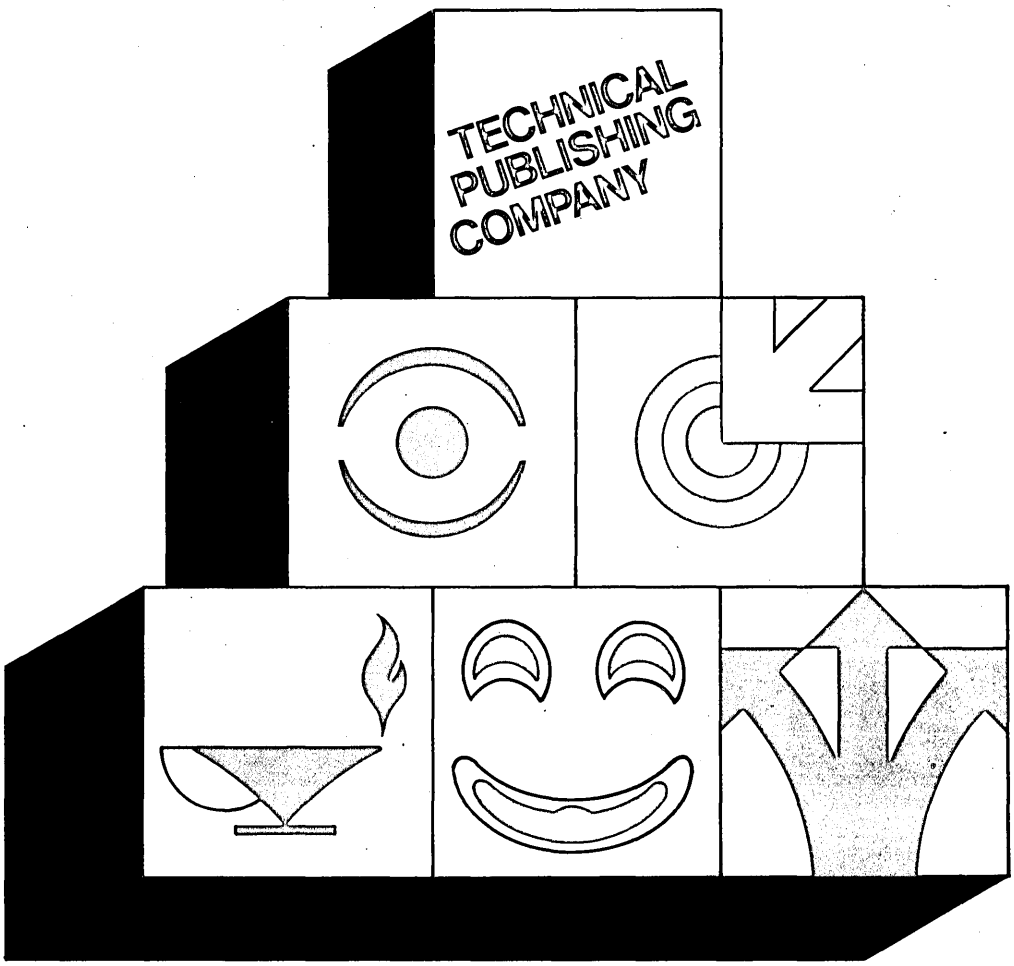

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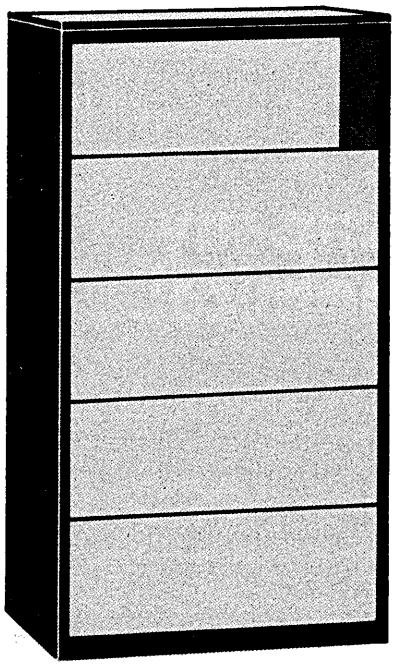

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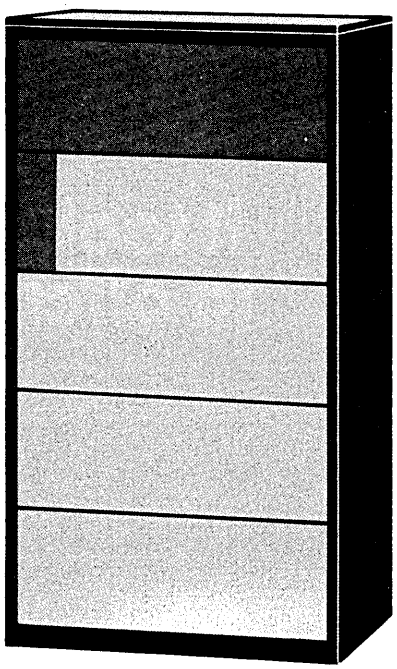

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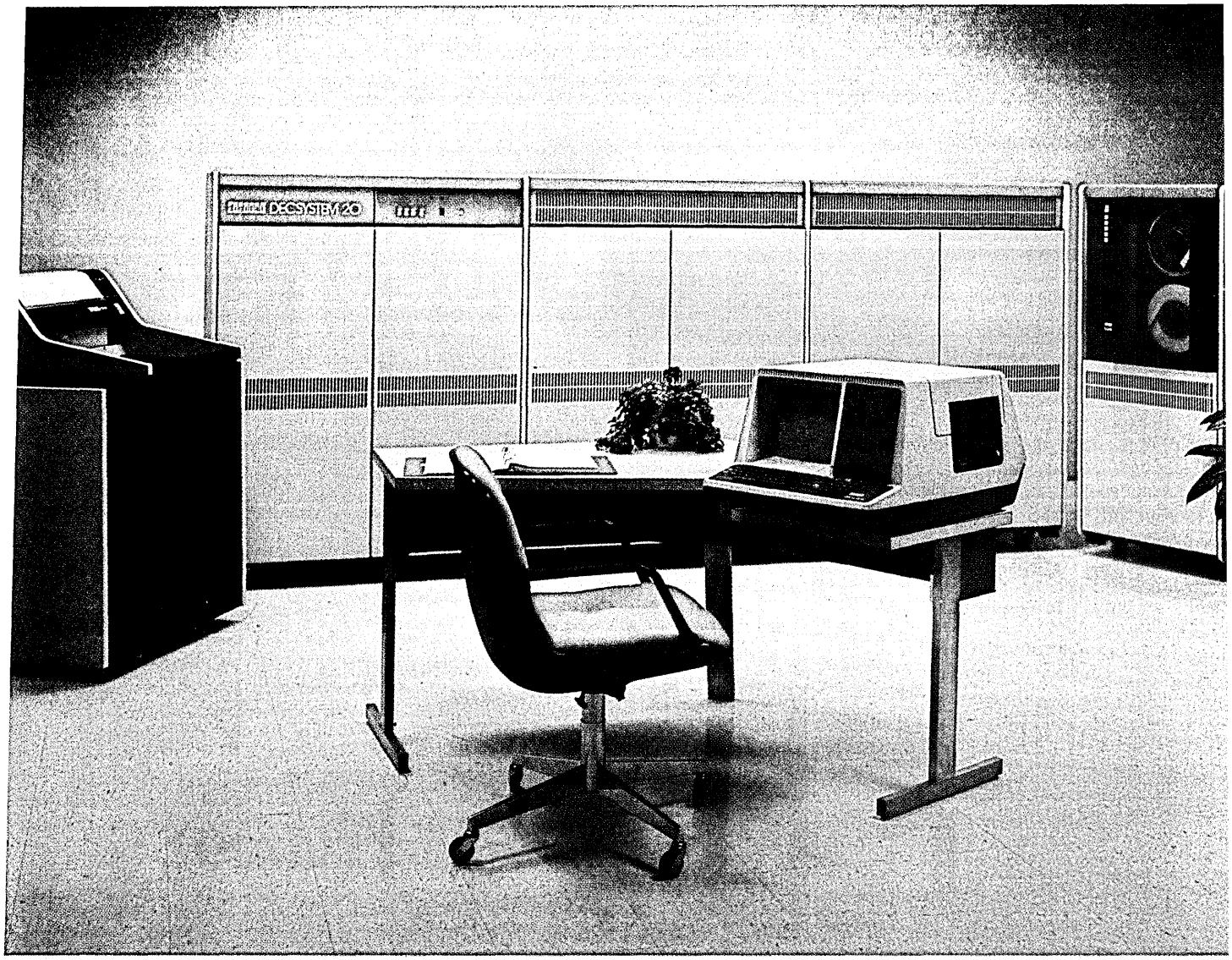

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A Working Measure of Productivity

by James R. Johnson

"Lines of code" is the only usable measure of program development productivity available. And it can be made to work fairly well.

As experienced managers acknowledge, productivity is a function of selecting qualified people, establishing an adequate working environment, motivating personnel, and providing the proper management direction. When a group of individuals achieves high productivity, a positive atmosphere exists. Even though productivity may not be measured, those associated with the project know productivity is high. Optimal productivity is a result of dedicated, involved individuals working on "their" system. The adage "Put your heart in your work" still applies in the computer age. Management's responsibility is to provide individuals this opportunity. Thus, it is concluded that managing is a motivating process not a productivity measuring activity, right?

Wrong. In this scientific world, productivity is only productivity if it is measurable. Knowing, feeling, or believing productivity is high is not, or soon will not be, acceptable in a programming environment. Faith is no longer an attribute of higher management. Proof of performance is a central issue. As maintenance and overhead increase, justification of the growing data processing budget becomes more difficult. First and second level managers are comfortable with existing management techniques, but higher level management is making the message clear: show us your productivity increases.

Granted, there is logic behind this philosophy; after all, the programming profession is still relatively unscientific.

Yet the "success" of a software project, today, remains a subjective issue since the performance of a programming project involves evaluating a composite of subjective factors: the "quality" of people, the exactness of the requirement definition, the complexity of the hardware, the degree of innovation, etc. Quantitative measures do not exist for these factors. In the future, it may be possible to standardize functions (generalized requirements) so that meaningful comparisons can be made among software products, but progress in this area has not thus far been significant.

There does exist one piece of information which is an integral part of all programming projects. It is not subjective, it is measurable, and *by default* it is the best data available. The measure is "lines of code." Opinions on the value of Lines of Code ("LOC," for convenience) as an estimating standard are divergent. Some groups are ignoring LOC while others are utilizing self-developed standards.

Definitions are the keys

Before presenting a recent study of LOC rates, it is appropriate to address definitions.

References to LOC rates can be found, but the range of reported productivities varies from less than 1 LOC/-hour to 30 or more. Is it possible that one group of individuals can out perform another by a factor of over 30? Why is there such a variance? More precise definitions of programs, man-days, and LOC clarify the situation.

1. *Systems Programming Product*

There are programs and there are programs. Depending on the definition of "program," the cost of one may be nine times the cost of another. As Fred Brooks explains in his book *Mythical Man-Month*, (Addison-Wesley, 1975, Reading, Mass.) portions of which appeared under the same title in these pages (Dec. 1974, p. 44), programs exist at four levels of complexity:

Level	Type of Program	Cost Factor
1.	program	1
2.	programming system	3X
3.	programming product	6X
4.	programming system product	9X

According to his definitions, a "program" is run only by its author for a specific purpose. A "programming system" is differentiated from a program in two ways: (1) it is generalized, and (2) it is documented. Going from Level 1 to Level 2 increases the cost by a factor of three.

A "programming product" is a component which must be integrated, along with other components, into a system. Having to resolve interfaces increases the development cost over the cost to develop a "program" by an additional factor of three.

In the commercial data processing environment, the fourth level of complexity is the normal product. It has the attributes of both a programming system and a programming product. A "programming system product requires nine times more resources than a 'program' of similar size. The system is

Problems of LOC Productivity Reporting

	Project A	Project B
Program	—	yes
Programming Systems Product	yes	—
Design Time	500	55.5
Programming Time	500	55.5
Total Statements	10,000	10,000
Verbs	3,000	3,000
Productive Time Factor	1.0	0.5

$$LOC_A = \frac{\text{Number of verbs for programming system product}}{\text{Total man-days} \times \text{productivity factor}}$$

$$= \frac{3000}{1000 \times 1.0} = 3.0 \text{ Lines/Day} = 0.375 \text{ LOC/hour}$$

$$LOC_B = \frac{\text{Number of statements for program}}{\text{Program time} \times \text{man-days} \times \text{productivity factor}}$$

$$= \frac{10{,}000}{55.5 \times 0.5} = 360 \text{ Lines/Day} = 45 \text{ LOC/hour}$$

$$\frac{LOC_B}{LOC_A} = \frac{45}{0.375} = \text{a factor of 120.}$$

Table 1. In the past, lines of code has not proved to be a useful measure of program development productivity, largely due to definitional problems. Here, for example, two projects might report LOC rates differing by a factor of 120 due to differences in definitions.

generalized, documented, integrated, and independent of its writers.

Implied in the term "cost" is a programming rate of production based on LOC. In other words, if 9 LOC per hour are generated writing "programs" (the first level), than a productivity for a programming system product of 1 per hour would be expected.

When discussing rates of production, it is essential to define the level of complexity involved.

2. *Man-days*

There are two clarifications required when quoting man-days. The first involves productive and nonproductive time. Generally, individuals are considered available for productive time somewhere between 50% and 80% of the total time. Vacations, illness, training, meetings, breaks, etc. account for the loss in productive time. Five man-days of productive time could equal ten total man-days based on that lower productivity factor of 50%. Thus, LOC rates may vary by a factor of two based on this distinction.

Another item requiring clarification is related to project phases: definition, design, programming, testing, and conversion. Programming and testing generally comprise one-half of the total project. It is important to identify the phases included when addressing productivity rates. Is definition and design time included or just programming and testing time? If LOC rates are computed using programming time only, the result is two times higher than it would be if time from all phases of the project were included.

Thus, man-day definitions may account for a total variance factor of four: a difference of two based on productive/nonproductive time and a difference of two based on program/design time. In the extreme, 3 LOC per hour could equate to 12 per hour based on man-day definitions.

3. *LOC*

What then is an LOC? The simplest definition for an LOC is as follows:

> "An LOC is a source statement. It corresponds to any line on a coding sheet including internal comments and job control statements. It is installed, operational, and debugged to an acceptable level."

This all-inclusive definition facilitates *collecting* LOC data since most installations utilize automated librarian systems to store and modify programs. Note that it does not include external documentation production.

There exist other less general definitions which are worth discussing. In a COBOL program for example, the following statements are LOC candidates:

Procedure division (which approximates the number of verbs),
Other divisions,
Comments, and
Compiler control statements.

The COBOL compile lsiting outputs the following statistics:

	Example
1. Number of total source records	1,733
2. Number of data division statements	936
3. Number of procedure division statements	525

"The last output equates to the count of COBOL verbs, possibly the most revealing statistic about the complexity of a program. It is a much more refined measure of a program's complexity than the total number of source records. The ratio of verbs to total records is approximately 3.3 to 1 in this example.

The variance among programming rates is closely related to the definition of an LOC. Using the total number of source records is recommended since it facilitates collecting and comparing programming rates among corporations.

Inconsistent definitions can account for dramatic differences in LOC rates. In a worst case situation, definitions could account for a factor of 120! The assumptions have a multiplicative effect when the extremes are used; i.e.,

	Factor
Program definition	9
Man-days	2
Productivity factor	2
LOC (source vs. verbs)	3.3

Result (9x2x2x3.3) ≈ 120

As the example in Table 1 shows, identical "productivities" could be reported as 0.375 LOC/hour or 45.0 LOC/hour. As usual, a meaningful comparison is only possible when assumptions are stated.

It is almost impossible to obtain comparative data on LOC, since very few quoted figures include mention of the assumptions. Historically, LOC data was not considered relevant in project development or the maintenance environment. Thus, it is not surprising to obtain incomplete information when searching for LOC rates.

Taking the measure

In order to establish a data base for comparisons using LOC, a total of 16 in-house projects were audited. Project completion dates ranged from 1970 to the next six calendar months (as noted in Table 2).

Definitions are as follows:

1. All projects produced systems programming products.

2. Man-day figures include both productive and non-productive time. They were obtained on a macro level; i.e., by multiplying the number of people assigned to projects times the duration of assignment. The man-days in-

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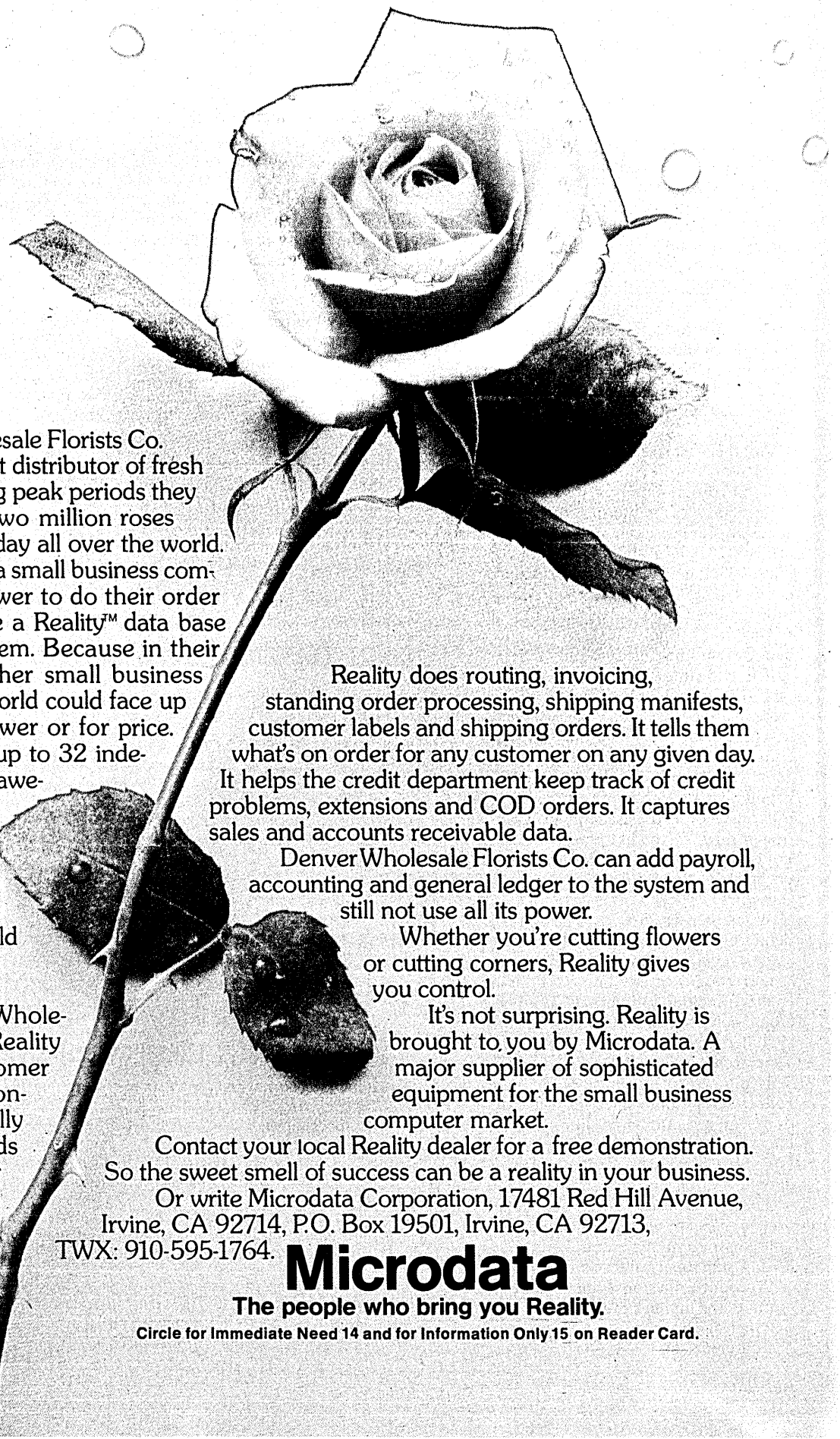

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clude time spent on all phases of the project. Also, since users were assigned as analysts in many cases, their time while on the project is part of the total. The man-day totals may vary by ± 15% due to historical inaccuracies. However, an average figure taken from this data should negate compensating errors and thus improve accuracy.

3. LOC was obtained from automatic librarian counts on implemented systems and from current estimates on soon to be implemented systems. Thus, comments and all other statements counted as LOC. For older systems, adjustments were made for the code added since implementation.

Also, since common record layout definitions were used extensively in different projects, and since these common definitions are coded only once (even though called by many programs) they were counted one time only.

Based on the techniques used to gather data, error rates for LOC could be as high as ± 10%. The averaged result would be more accurate.

Table 2 lists the projects in descending order of man-days expended. The first observation is that a strong relationship does exist when LOC/hours are compared for small and large projects (large projects are defined as two-plus man-years).

LOC averages are listed below:

Projects	*small*	*large*
LOC/hour	8.7	2.9
Range	6.7-12.5	1.2-5.1

On the average, small projects produced over three times more coding per hour than large projects. This is what would be expected based on increasing numbers of both interfaces and communication links.

The LOC rates did reflect, in a general way, management's subjective opinion of the "productivity" of the various projects.

Factors such as design difficulty (innovation), level of technology, and quality of staff are considered in the subjective opinion. On Project "B" (12.5 LOC/hour), all the factors which tend to impair progress were absent. The team was highly motivated and working with known technology. One of the large projects, Project 'J' had one of the highest rates (5.1 LOC/hour). The project was an Employee Information System which included Payroll, Benefits, and Personnel subsystems. The extent of innovation was limited as well as the amount of new technology involved. Thus, a high level of productivity could be anticipated. Project "O" had the lowest LOC rate. Since it was the first system of its type in the industry, a lower "productivity" resulted.

It is concluded that LOC can be used at a gross level for project estimating. In other words, knowing that the average LOC rate for large projects is 2.9, is useful information. If new technology and large scale innovation are inherent in the project, the LOC rate will be less.

The projects in the study were restricted to the commercial data processing environment. This implies a high level language and does not include developing operating systems and compilers. As Fred Brooks stated:

> "My guideline in the morass of estimating complexity is that compilers are three times as bad as normal batch application programs, and operating systems are three times as bad as compilers."

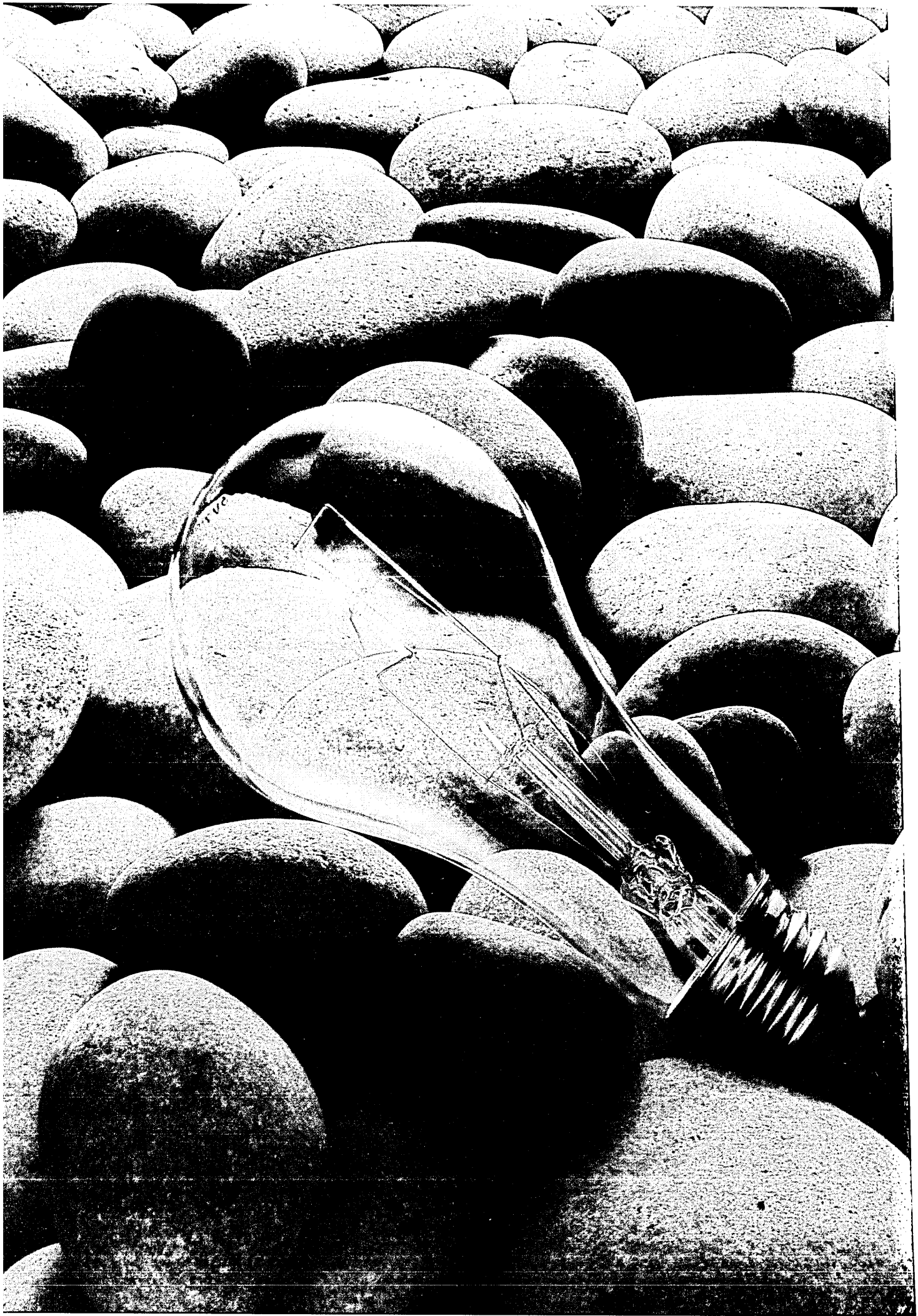
Using this concept and converting the study rate for large projects (approximately 3 LOC/hour) to operating

Recorded Statistics for Commercial Projects

Project	Man-Days Total	Lines of Code (×1000) Batch	On-Line	Total	Lines/Man-Day	Lines/Hour
A	40	3.1	0.0	3.1	77.5	9.7
B	56	5.6	0.0	5.6	100.0	12.5
C	70	4.0	0.0	4.0	57.1	7.2
D	110	2.7	3.2	5.9	53.6	6.7
E*	240	2.0	12.0	14.0	58.0	7.5
					Subtotal =	43.6
F*	528	10.0	0.0	10.0	18.9	2.4
G*	924	36.0	5.0	41.0	44.4	5.6
H[1]	924	33.0	1.0	34.0	36.8	4.6
I	3432	60.0	0.0	60.0	17.5	2.2
J	3432	140.0	0.0	140.0	40.8	5.1
K	3960	46.0	29.0	75.0	18.9	2.4
L*	4752	80.0	0.0	80.0	16.8	2.1
M	8712	190.0	0.0	190.0	21.8	2.7
N	10,560	133.0	7.0	140.0	13.6	1.7
O[1]	14,784	130.0	0.0	130.0	8.8	1.1
P	79,200	784.0	126.0	910.0	11.5	1.4
					Subtotal =	31.5
					Total =	75.1

*Projects nearing completion. (All others are completed projects.)
[1]Coded in PL/1 (Others COBOL)

Table 2. Clearly small projects have, according to the lines of code measure, better productivity rates than do large ones. These figures support an average LOC measure for small projects of 8.72 lines of code per hour, and only 2.86 for large projects.



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systems and compiler rates produces consistent results. (See Table 3.)

What next?

It is appropriate to discuss action items relating LOC to definitions and project estimating. The first task is to complete a data base of historical LOC information. Hopefully, this article has provided guidelines and project data to augment other data. As the worst case example illustrated, assumptions must be defined prior to discussing LOC rates. Implementing a post audit procedure to capture the information immediately after a project is completed is suggested. The following data should be included (as their non-COBOL equivalents):

- Type of product (level: program, program product, etc.)
- Design time
- Programming language
- Programming time/type program (validate, update, report, etc.)
- Total statements/type program
- Data division statements/program
- Number verbs/type program
- Productive time factor

Having this data will allow meaningful comparisons among departments, divisions, and corporations.

After we've collected the data, we can begin using the measure on a macro or project level. Based on this study and others, a relationship has been established between LOC rates and the size of a data processing system. Thus, if LOC are known, it is possible to estimate the man-days required for a project. It could be argued that knowing LOC implies knowing the scope of the project, and if the scope is known, man-days can be estimated directly.

The only argument which establishes LOC as a legitimate estimating tool is experience with the technique. After initially challenging the concept, the author has found it useful and is now a supporter of the technique.

Assume a marketing system planned to be replaced. The existing system has 60,000 LOC. Using the principle of analogy and the best judgment of the people involved, the new system is estimated at 120,000 LOC. Assuming a 3 LOC/hour productivity rate, the project requires 40,000 hours or 5,000 man-days, or 18.9 man-years. If six individuals are assigned, the elapsed time is over three years. It would not be feasible to plan a two-year implementation based on this knowledge.

In a pure maintenance environment (staff performing minor enhancements and resolving production problems vs. development projects), lines of code could be an excellent tool for measuring responsibility. For example, a cursory study has shown that one full-time support analyst can maintain between 50,000 and 100,000 LOC. Of course, other factors are equally relevant in a pure maintenance environment, for example, frequency of runs, number of interfaces, and volume of coding changes.

We haven't done the research necessary in regard to LOC in the maintenance environment, but the obvious use of this data there would be in projecting continuing support resources.

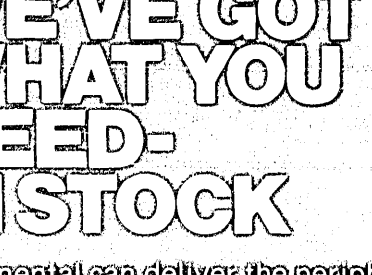
In either the development or maintenance environment, LOC estimates can be included in the work plan. When defining programming tasks, an estimate of LOC should be included along with the man-day estimate. Also, on enhancements or user requests, one of the required fields should be LOC.

If adopted, at least as a default measure, LOC could answer some of management's questions on productivity. And that's worth doing. ✲

These Results Vs. Brooks' Results

Product Complexity	This Study Hourly	This Study Yearly	Brooks' Estimate
Batch Programs	3 LOC/hour	6,336	6-9,000
Translators	1 LOC/hour	2,112	2-3,000
Operating System	0.3 LOC/hour	704	600-800

Table 3. One encouraging result of having gone through the exercise is how closely the lines of code figures compare with those published by Fred Brooks, the "father" of IBM's OS/360, in "The Mythical Man-Month," (Dec. 1974, p. 44).



Employed by Hallmark Cards as a dp section manager, Mr. Johnson is responsible for managing the design, programming, and implementation of all major dp projects for the company. His prior experience includes a three-year stint as a systems analyst in the U.S. Navy.

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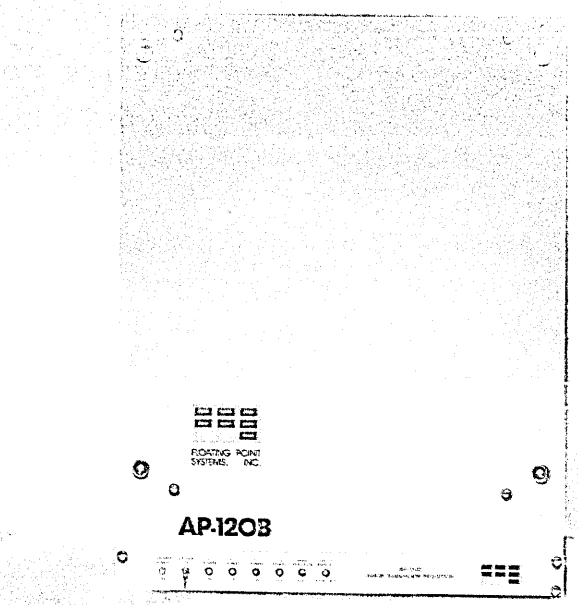

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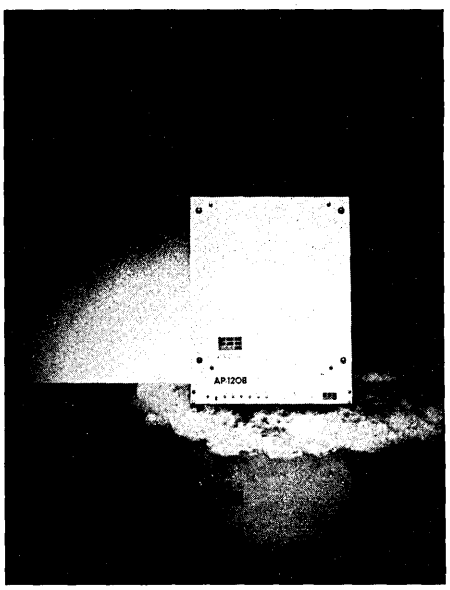

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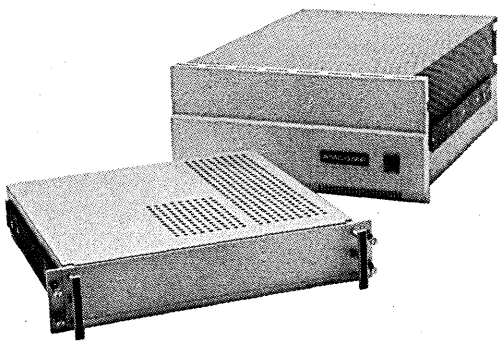

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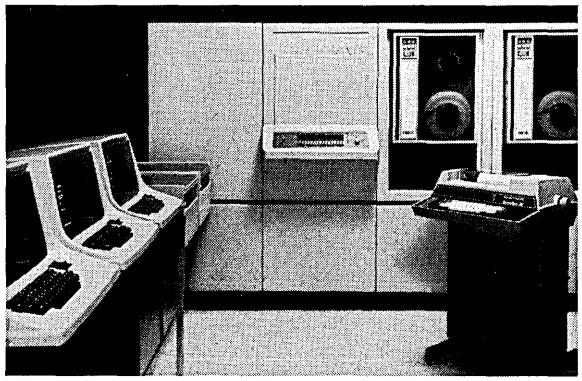

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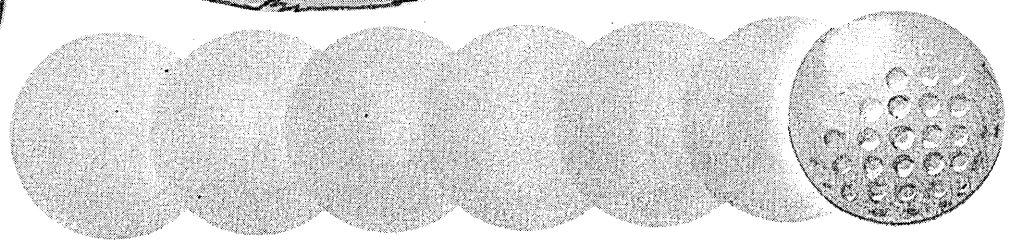

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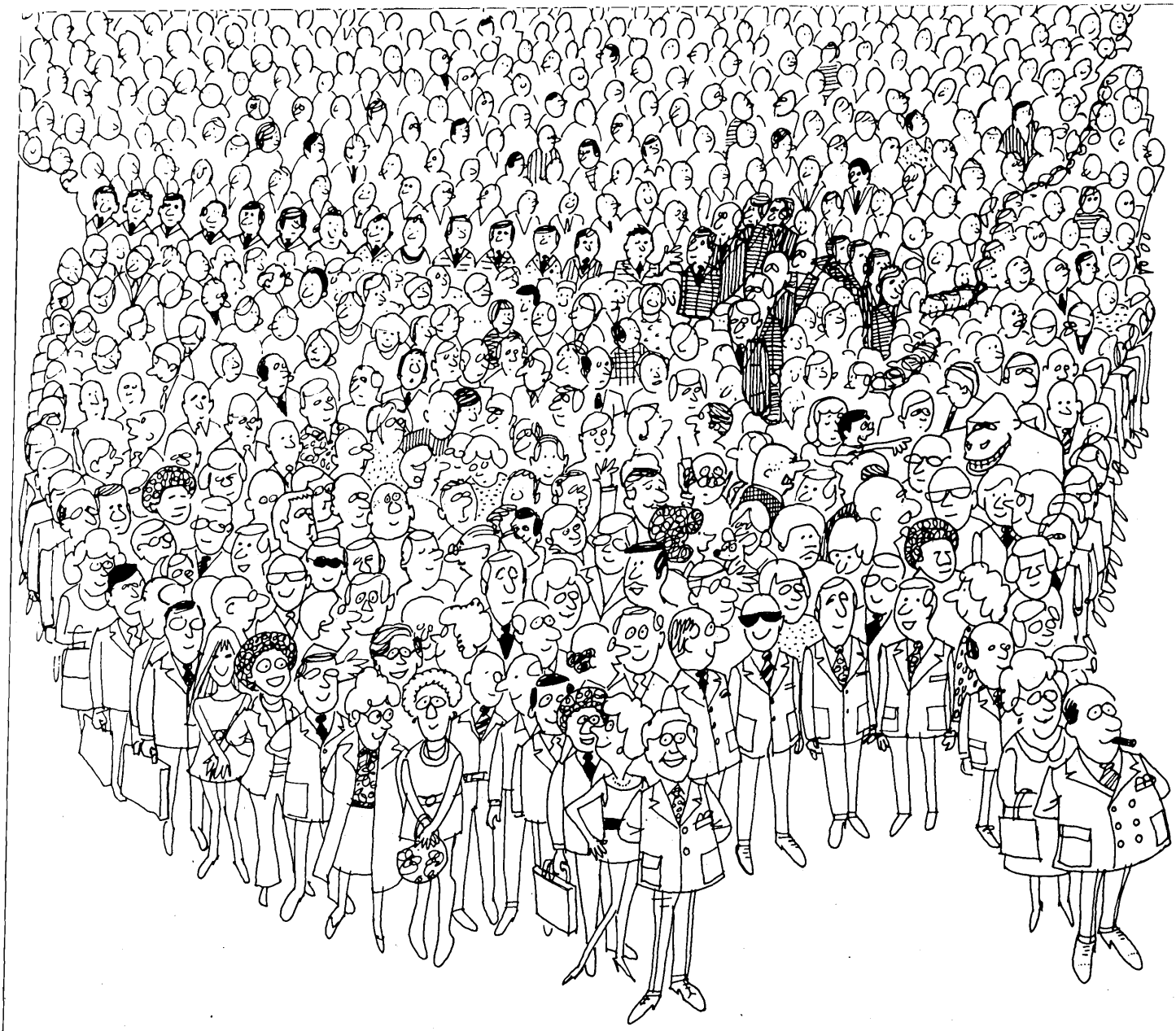

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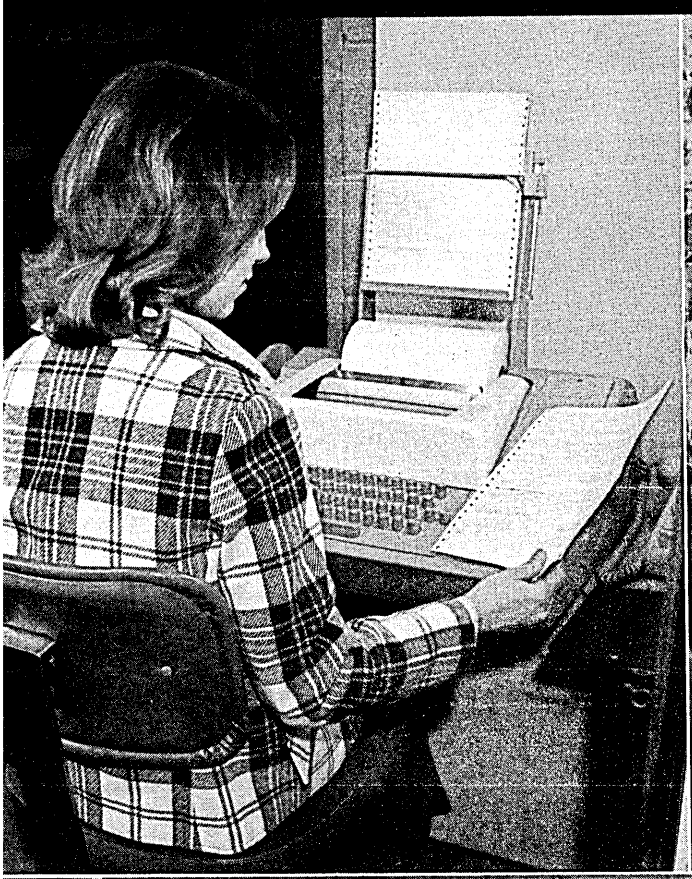

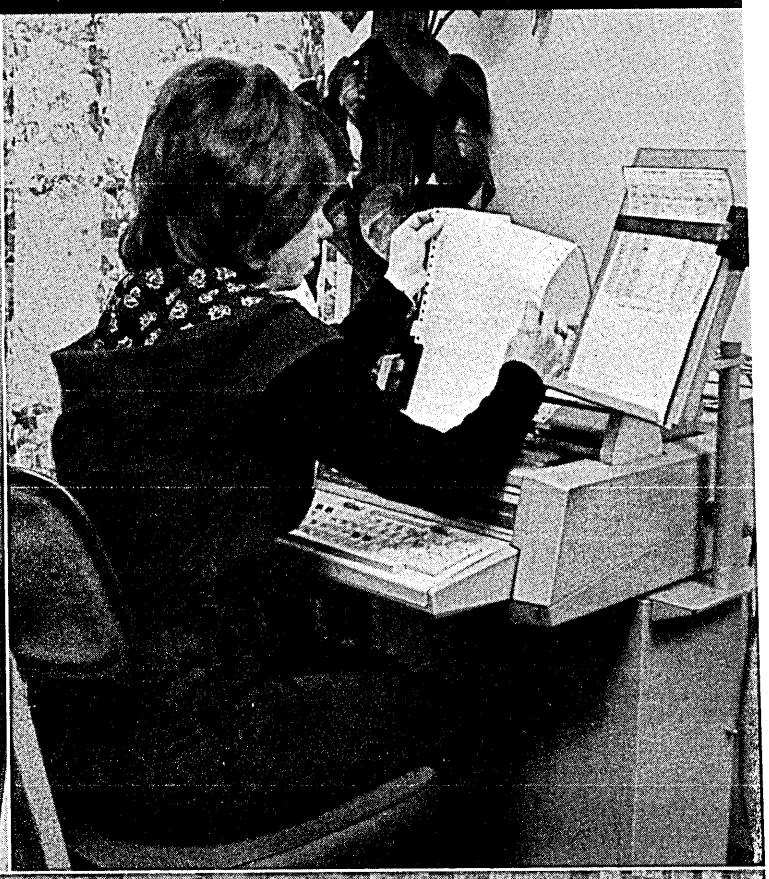

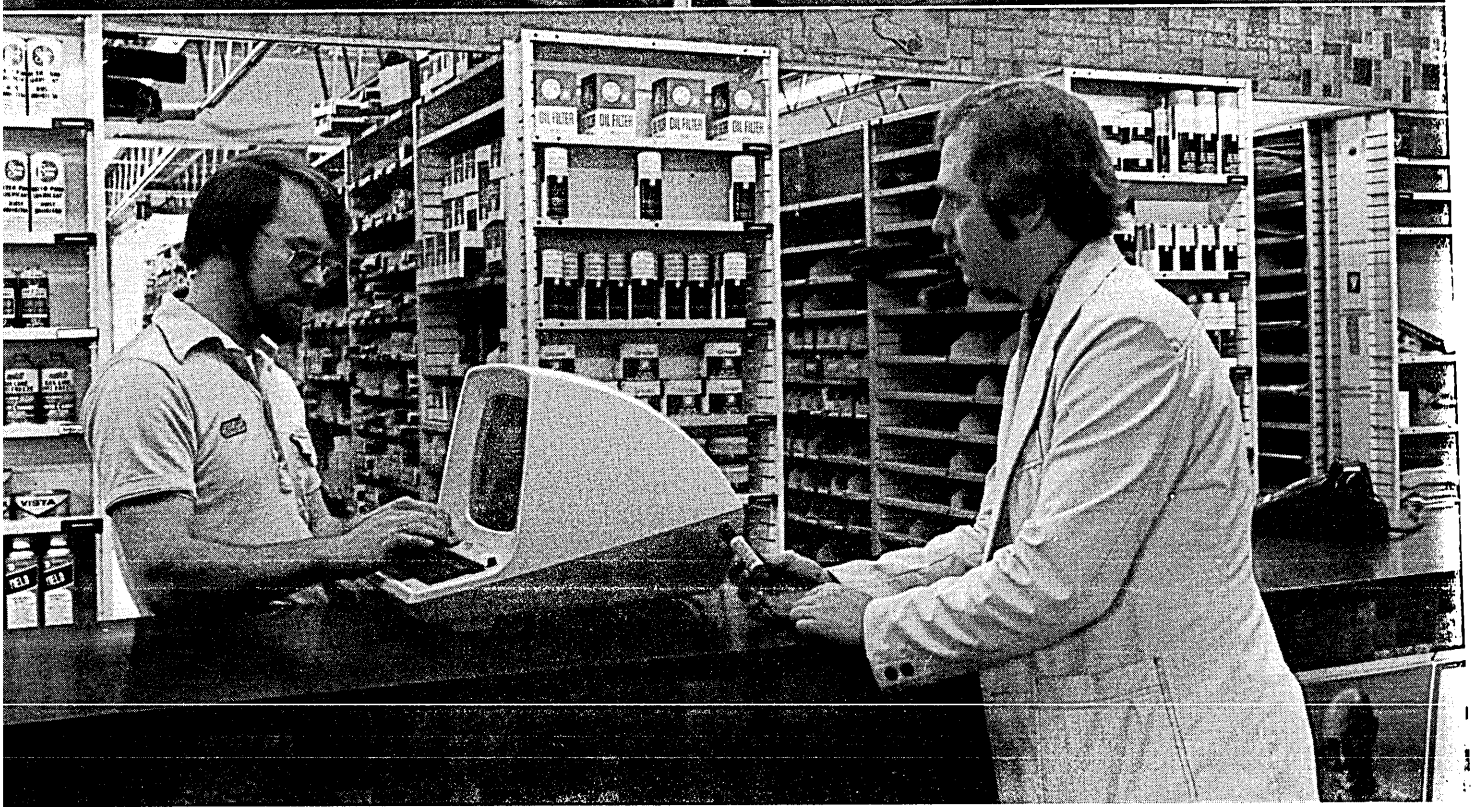

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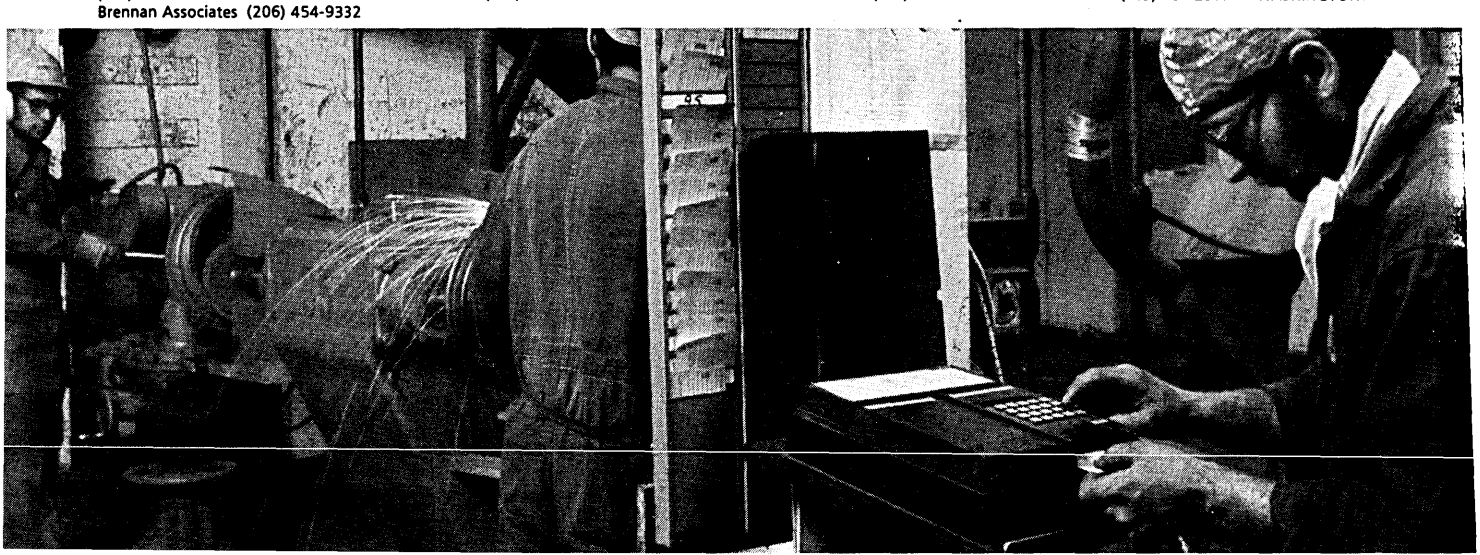

Converting to MVS

by Kevin P. Farrell

A large performance improvement could not be proved for it, and it was not perfectly compatible, but MVS still seemed the best alternative.

IBM's OS/VS2 operating system, MVS, is not a stranger to Aetna Life and Casualty, but it is not presently a welcomed friend nor permanent resident either. While our implementation efforts are gradually yielding results, some of which we can now share with others considering going to that system, much remains to establish the latter conditions.

Aetna Life and Casualty gained its first exposure to MVS in March of 1973, when, with 20 other installations, we participated in a preview presentation of the concepts, facilities, logic, and structure of MVS. This activity consisted of:

1. a detail documentation of our hardware, software, applications, and operations;
2. an intensive week of explanation from IBM;
3. a two-week in-house follow-up analysis of MVS with key personnel in our operations, support, and user areas;
4. a three-day feed back session with IBM to relate our impressions of what impact an MVS conversion would have on our installations, and what our implementation schedules would be.

The summary of the results of that effort was:

1. that the MVS concept was a significant change, and although IBM made significant efforts to maintain compatibility with MVT, implementation would not be easy.
2. while a few installations would move almost immediately to MVS, most would take a conservative, get more experience, wait until needed, approach.
3. that comprehensive, affordable user education would be needed early in the cycle.
4. that well-trained Field Engineering and Systems Engineering support would be required from IBM at the start.

Our reactions were consistent with the summary; we anticipated: a significant learning effort, a need for education and competent service personnel, the critical aspect of compatibility with what we were doing under MVT and, obviously, well defined benefits which would justify our committing to an implementation.

Since we perceived MVS to be an almost totally new environment, it was desirable to know as much as we could, as soon as we could, about its potential impact. As a step to achieving this and as a follow-on to the preview, we agreed to participate in field testing Release 2 of MVS.

IBM provided the MVS components, full-time Systems and Field Engineering support, and education for our systems programming staff. Aetna provided six systems programmers and machine time.

Conversion was not to be a simple task. Aetna runs six IBM 370/168's, housed in two buildings in Hartford. Each machine operates independently and, for the most part, is dedicated to a single application. At the start of the conversion project, each was a 4MB machine; one has since been upgraded.

One building houses one cpu for processing policies for the Casualty Insurance Division. This system supports 450 terminals located in 77 offices across the country. Along side it, a second 168 supports program development work and acts as a backup.

Of the four cpu's in the other nearby building, one is for on-line claims processing for the Group Insurance Division, one performs a mix of corporate tp and Life Insurance policy processing, one supports time-sharing (under VM/CMS), and the last is for development and backup.

At night all six are given over to production work.

Approximately 7,000 jobs were being run on these systems. Coded primarily in ANS COBOL Version 2, they were being processed under OS/MVT when we began learning about MVS.

We established a plan, extending over four months, designed to provide us information on the aspects of function (did it do what they said it would?), compatibility (could we run what we were currently running on MVT), performance, and new features, and also to identify as many conversion considerations as we could.

474 man-days just to look

Four months, 474 man-days and 270 dedicated machine hours later, we concluded:

1. MVS did function as defined.
2. We could expect MVS to be compatible with current MVT processing.
3. We were unable to adequately assess the new features but anticipated they would have long term benefit to Aetna; however, the use of any new features should be restricted until MVS was installed on all Aetna computer systems.
4. Performance for batch processing was quite good, with as much as a 23% throughput improvement. However, we were unable to reasonably establish field test procedures for our teleprocessing systems and thus had no basis for projecting their performance.
5. The field test did not discover near term benefits which would justify implementation. No immediate problems existed which MVS would solve and the need and potential benefits of future facilities (Systems Network Architecture (SNA), the 3850 Mass Storage System (MSS), etc.) had not yet been determined.

A number of conversion considerations were identified and documented for future inclusion in an implementation plan. We felt that although immediate benefits were not evident, it would be advisable to consider what the potential for the future was and consider implementing MVS in mid-to-late 1975, to get it in and settled prior to needing it.

On the assumption that tangible benefits would be identified in several studies of the new facilities (multiprocessing, MSS, SNA) being conducted in late 1974 and early 1975, a detailed implementation plan was developed. At this point, it was expected that the "window" chosen would not conflict with any major application or hardware implementations and also that the user divisions were in agreement with our plan and could provide the necessary manpower to participate. A systems programming team of ten persons was formed, interfaces to user divisions and other support areas defined, machine schedules were developed, and we began to execute our plan.

For several reasons the studies of the new facilities either were not completed as originally planned or were completed with no tangible benefits defined. The impetus to continue on the planned schedule began to decline. When a conflict developed with the implementation schedule of our Life Insurance Division on-line information

system, we decided to defer implementation until late 1975 or early 1976. Then our scheduling conflict would be eliminated and more studies would be completed. Our MVS systems programming team was reduced to four and the major portion of the scheduled machine time was cancelled. The skeleton team would maintain a base of knowledge in MVS, keeping abreast of changes, maintaining an Aetna modified version of the latest release levels, and assisting in the evaluation of MVS-related facilities. This approach was intended to protect our investment to date and to prevent our having to play catch-up ball when we did return to an implementation plan.

As we approached the latter part of 1975, successful implementation of the life insurance on-line system resolved our scheduling conflict; however, the completion of additional MVS facilities evaluations and the deferral of others, again left us without identified tangible benefits associated with MVS. At this point, the implementation window was moved to mid-to-late 1977.

Moving into 1976, several major factors emerged which resulted in our *again* moving our implementation window, this time forward into late 1976-early 1977 (November 1976 through May 1977). These were:

1. The pending implementation of a new on-line Group Insurance Claims system presented a conflict in 1977 between MVS implementation and the production installation of the several hundred-terminal Claims system.

2. IBM announced that it would drop all MVT support to a "Class-C" basis (to be supported only on a time-available charged basis) by November, 1977. Support for our MVT Release 21.6 system and TCAM level 5C would become Class-C in May 1977 and February 1977 respectively.

3. The Life Insurance Division identified a window of late 1976-early 1977 (October-March) during which they would be between major applications efforts and would be able to invest the manpower in MVS implementation.

4. Evaluation studies identified significant cost reductions associated with the use of the native mode capabilities of 3350 direct access storage device (in particular, a 40% reduction in the number of drives, on average, compared to the 3330 Mod 11's). These cost reductions could be realized as early as May 1977 if software support were available. MVS provided the only known support for these facilities.

5. The Casualty Division identified their implementation window as November 1976 through February 1977.

6. The Group Insurance Division indicated a need to be installed on MVS at least four to six weeks prior to entering the conversion of their major offices to the on-line group claims system (primarily for health insurance claims) in March 1977. This meant that the latest we could install for that division's processing was the end of January 1977.

One concern about the installation of MVS relative to the group insurance claims system was that we were not confident (nor was IBM) that TCAM 5C could support a network of several hundred 3270-type terminals. This concern, and the tight conversion schedule, impacted our considerations for implementation alternatives.

The determination of implementation dates was not quite as simple as the previous paragraph might imply. Having recognized the major factors involved in the conversion, it was necessary to expand these in more detail, then determine what aspects of MVS made it the appropriate solution for these concerns and what aspects made it a less appropriate solution. We added to this the pros and cons of continuing with our current MVT system, of moving to the last MVT Release (OS/MVT Release 21.8 with TCAM 5E), or choosing some mix of those.

$2.4 million to play

Finally, the recommendation to go to MVS was accepted; we were to pursue installation of MVS for all processing on our six 370/168 systems. The time frame was as described above and a "cost" of $2.4 million was projected. The cost is derived: from the man-day cost for our systems programming, operators, corporate dp services, and user division personnel involved in the plan; from our cost allocation rates for machine time; and from monies we would have to spend for outside services such as IBM education, etc. The outside costs turned out to be minimal, amounting to about $35,000.

At this point, detail planning was initiated to define exactly how we would convert the processing on six 168's located in two computer centers and supporting two existing nationwide teleprocessing applications, one rapidly emerging national teleprocessing system, two in-house RJE networks, a test environment supporting all divisions, an in-house TP system and, of course, our large batch processing workload.

Two other major conditions were imposed: (1.) Today's processing environments must not be allowed to degrade while conversion proceeded, and (2.) The Group Insurance Division required that Release 21.8 be held in the wings as a fall-back option. If MVS did not work for the Group TP system, the requirement to get off TCAM 5C had to be met by TCAM 5E and Release 21.8.

The planning process was the responsibility of our systems programming unit and was carried out over a period of six months. Intensive interaction was required with the user divisions, operations and support groups to assure all aspects of their processing requirements were considered and that they knew precisely what they must commit to doing. All interim dates for various steps of the plans were agreed to by all involved areas.

Because our systems are located in two computer centers, and because we were converting major teleprocessing systems from three corporate divisions, one all-encompassing plan was not appropriate. Instead, we developed three related plans.

1. One plan covered the two machine centers including our Casualty Division's SAFARI on-line system (the 450-terminal, 77-office network for "personal" lines of insurance like automobile insurance), one RJE network, and the portions of our batch production and testing supported on those two systems.

2. A second plan was designed specifically for the conversion of the Group Division's on-line claims system and related Group batch processing; it involved one 370/168 which would be supporting this environment.

3. The third plan centered on the Life Insurance Division's on-line system and the corporate testing environment, and included the second RJE network, our in-house terminal system and the remainder of the batch processing. Three 168's are involved in this plan.

Activities are now progressing on all three plans. Thus far, all are on schedule and in the case of our first plan, we have accelerated the activities to the point where one machine was fully converted to MVS six weeks earlier than the planned five months time. The environment now running on MVS includes RJE, a test version of the SAFARI on-line policy system (which uses TCAM, MCP, application code, and in-house lines and terminals) batch production, and some general user application testing.

So far, so good

Referring to the areas addressed by our field test effort (function, compatibility, performance, new features, and conversion considerations) plus adding reliability, our experiences to date can be summarized as follows:

1. *Function*—MVS continues to function as described by IBM. We have not yet found a facility of the base systems (we do not use TSO, IMS or CICS) which does not do what IBM said it would, in the way IBM said it would.

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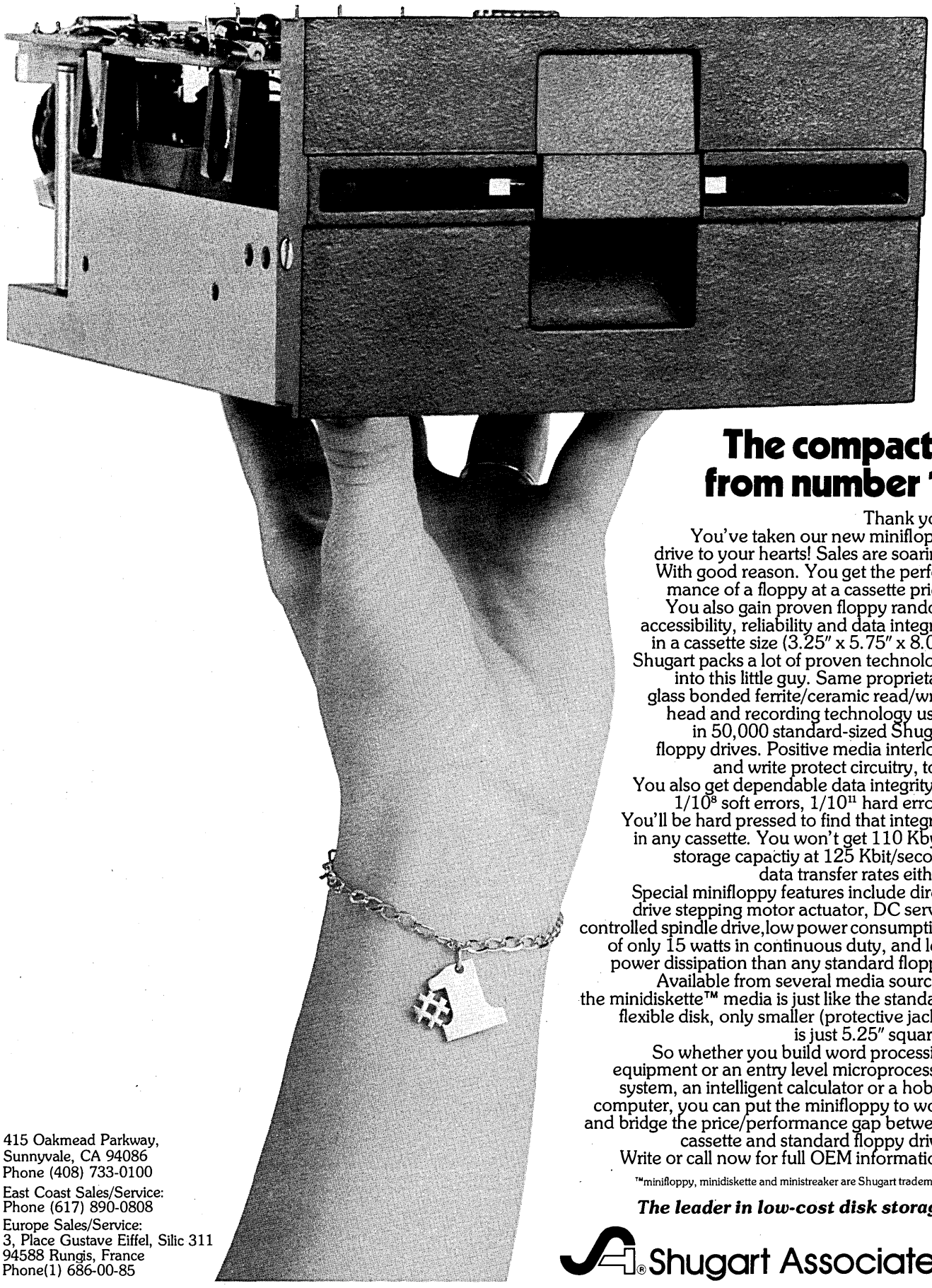

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CONVERTING

Aetna has extensively modified MVT to enhance and extend its function for our applications. MVS eliminates the need for about 40% of these modifications and we have installed the remaining 60% in MVS. Thus, in the area of function, we have proven the "vanilla" system, modified it, and also proven the modified system.

Under MVT, our accounting and utilization data gathering has been based on the ACCOUNTPAK facility which we obtained from SDL International of Canada. Under MVS, we chose to switch to IBM's SMF for data gathering. We have found that the MVS/SMF is vastly improved in its capabilities over MVT/SMF and that it also functions as advertised. Here again, we have also successfully modified the system to provide additional function.

At this point, our modified MVS is providing the functions we require.

2. *Compatibility* with our existing applications programs and with several software packages which we have installed, has generally existed with the exception of some programs compiled under ANS COBOL Version 2. MVS supports only Version 4.

The COBOL incompatibilities have been the result of both invalid application program logic (which MVT allowed to run) and of compiler-generated code which was not compatible with MVS.

We have found that we cannot predict which jobs will fail, and we have not yet recognized even general classes of jobs which we ought to suspect will fail.

Nor have we yet attempted to run all of our 7,000 or so COBOL programs under MVS (perhaps 35%-40% have been run so far), thus the full extent of the incompatibility is not known. Of those of which we are aware, we estimate about three man-months of time to convert. Since we are primarily a COBOL shop and all our COBOL is ANS Version 2, the successful implementation of MVS could very well hinge on COBOL compatibility.

In addition to the COBOL situations, there is one other area where application program changes have been required. Any programming which accessed MVT systems control blocks, etc., had to be reviewed to determine what systems data was changed or unavailable to user programs under MVS. To date, this has not had a major impact.

We have successfully tested the following major software facilities: INTERCOM Version 7, TOTAL, SHRINK, ANS Version 2 COBOL Compiler, ASSEMBLER-H, ADPAC, ASI-ST, COTUNE, CUE, FDR, PANVALET, plus about 45 Aetna-written utilities and macros.

3. *Performance* is still the major unknown for us. And, as with the field test, it is the area of on-line systems where the question mark remains most pronounced. We have done more work with test versions of our on-line environments, but they are drastically stripped down packages which do not provide an accurate projection of the full systems running live.

What performance work we have done has been relative to our Casualty Division's SAFARI system. With our batch driven test vehicle, we initially were able to attain only 80% of the transaction per minute rate under MVS that we had under MVT. In looking at both MVS and our applications, we concluded that MVS was adding significant overhead, but that the only way we at Aetna could reduce it was to make changes to our applications. For its part, IBM has offered the recent supervisor and scheduler Selectable Units as partial solutions to the overhead situation. Our application changes consist of converting much of our code to re-entrancy and making some logic changes in the applications. Additionally, we had to add a megabyte of storage to our test and back-up system to gain the improvements of the re-entrant code. We feel this is due to the large number of jobs being run on that system at one time, and that we will not be forced to similarly upgrade our other four 168's.

The above changes improved our test facility performance about 10%. The results of this test cannot be directly translated relative to the full on-line system, but we suspect that with additional overhead from TCAM and our MCP's, on-line performance under MVS is initially going to be less than under MVT.

Batch processing has shown no decrease in throughput under MVS, but we have not pushed the system to determine if any of the 23% improvement found in our field test exists in real life.

Substantial work from our people and from IBM will be required to improve on-line and batch performance and to properly balance those systems running both environments. We are just entering this phase and anticipate that, into the foreseeable future, tuning will be an on-going task requiring the efforts of top technical personnel.

4. *New features* (such as using the 3350 storage system in its native mode) will not be tried until after we have installed MVS on all systems. This restriction is to assure our ability to fall back to MVT in the event MVS does not perform. Our 1977 and subsequent years' plans will include work on evaluating and implementing those new MVS facilities which have proven cost effective and have relevance to our processing.

5. *Conversion considerations* as defined for the field test consisted of identifying those areas that would have to be addressed by our system applications and operations personnel if we were to implement MVS.

Now that we are actively implementing MVS, the lists of our conversion considerations are in the form of three manuals we have developed for our applications and operations personnel:

"MVT-MVS TRANSITION GUIDE." This manual identifies and explains the Aetna modifications which have been made to MVS; documents all Aetna generated systems messages (using the same format as IBM's message manual); and identifies compatibility situations such as those COBOL conditions discussed earlier, changes in macro expansions, changes in control blocks, linkage conventions changes and many others too numerous to list here.

"JES2 RJE OPERATIONS GUIDE." This manual is composed of instructions and standards relative to Aetna's use of the JES2 RJE Facility. It is intended for systems operators and can be useful to remote station operators. It supplements the standard IBM publications.

"MVS OPERATOR'S GUIDE." This is a generalized document containing information unique to Aetna (the effects of Aetna modifications and operating standards). Included are the Aetna messages and RJE operator's documents mentioned earlier.

None of these documents are intended to be training manuals or sole references. However, they do consolidate the major conversion considerations to provide effective reference points for our applications and operations personnel.

6. *Reliability* presents a two pronged concern: How good is it? How do you maintain it?

As indicated earlier, reliability has thus far been very good from both the systems availability standpoint and the proper functioning of the components. We have run almost 1600 hours of production work with only two unscheduled IPL's. While we have identified about 120 known or suspected MVS problems, no one component has been singled out as being a major problem source. Too, with a few exceptions, IBM fixes have been defined in a timely manner, and found to be effective on first try.

We undoubtedly will encounter more problems as we bring our major systems on-line. However, we are encouraged and optimistic that MVS indeed has high availability and general reliability. Maintaining that reliability and availability will be contingent on staying as current as possible with IBM

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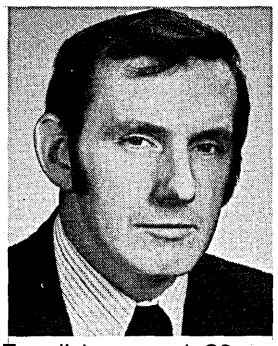
OS maintenance. (The SMP, PUT TAPE and IPO options individually and in combination, for example, will require significant manpower to carry out and must be used in conjunction with a specific maintenance plan.)

To date, our maintenance has consisted of applying all updates and temporary fixes for software (PTF's) to insure that our base is as current as possible from the beginning. As we make production commitments, we will be setting up maintenance plans to allow us to react to immediate problems and to apply preventive maintenance on a timely basis.

View from the bridge

At this time we expect that we will meet our implementation schedule dates and that this June will see Aetna fully converted to MVS. We feel that a key ingredient in the success of our conversion has been the full involvement of all concerned persons. At the onset, everyone understood what the benefits of MVS would be to him, and what resources would be required of him. He saw an alternative which was not perfect in all respects, but which included and met his concerns and requirements.

Those installations that have already implemented MVS should empathize somewhat with us. Those that are planning to convert should learn a bit from our experience. However, as we have found for our systems, that old IBM standby statement is true: every installation is different. So forewarned and forearmed, each installation must go it alone just as we did. Perhaps our having been there ahead of them will make it easier for those who follow. ❋



Mr. Farrell has spent 20 years in Aetna's data processing operations. Currently the manager of systems programming in the corporate dp center, he began his career in EAM operations and progressed through computer operations supervision, applications programming, and systems programming slots, gaining expertise on the IBM 1401, 7074, 360, and 370 along the way.

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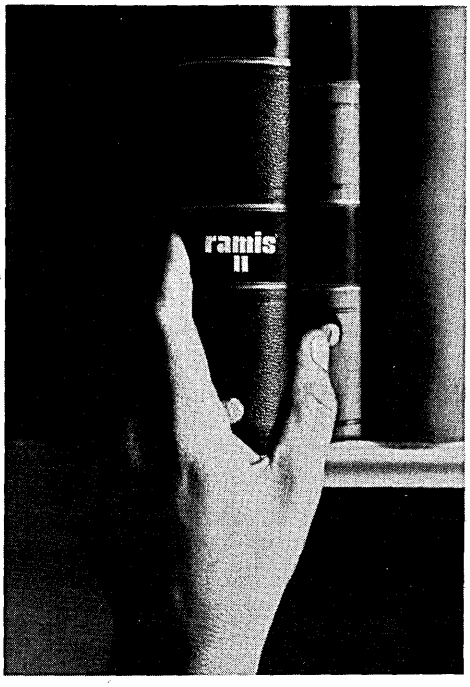

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Data Communications in March

Two conferences in Washington and Atlanta each devote three days to presentations on all aspects of data communications. A trade show and a school for the uninitiated.

One sponsor calls it "The Critical Event." The other invites us to "Be Where the Action Is." With these slogans, two organizations next month will stage conferences on the subject of data communications—conferences that are very similar in many respects: They are two weeks apart. They're similar in format and content (some of the speakers are on both programs). They're aimed at the same audience. They charge the same registration fees. The sponsors are both located in the Boston area. Each is three days long and each has a trade show.

DataComm 77 is being held March 9-11 at the Sheraton Park hotel in Washington, D.C. Data Communications Interface 77 is being held March 28-30 in the Georgia World Congress Center in Atlanta, Ga.

DataComm 77 is being staged by Data Communications User, a magazine for the data communications using industry based in Newtonville, Mass. It coincides with a meeting in Washington of the Association of Data Communications Users, which also is sponsoring one of the sessions at the conference. Data Communications Interface 77 is put on by an organization of the same name in Framingham, Mass., headed by Sheldon G. Adelson. It is co-sponsored by DATAMATION magazine.

Following are highlights of the two conferences:

DataComm 77 March 9–11 Sheraton Park Hotel, Washington, D.C.

In its three-day program, DataComm will address applications, networks, issues, and government. It also will hold sessions on data communications basics for newcomers and management generalists. Its keynote session will feature a slide presentation produced by the Computer and Communications Industry Assn., entitled "Fate, Fiat, or Fait Accompli," about the integration of computers and communications. On March 10, the Association of Data Communications Users will hold what it calls an "FCC Town Meeting" at which users will have a chance to air their views on topics the FCC is considering in its second Computer Inquiry.

The chairman of that session is Harvey S. Hershkowitz, vice president of Chase Manhattan Bank. The sponsors said the give and take session also will provide attendees with a status report on tariffs and other matters under review by the commission.

Applications

Nine sessions will discuss applications for data communications in manufacturing, insurance, service industries, banking, law enforcement, retailing, hospitals, computer services, and energy industries. In a March 9 session on service industries, speakers will detail the steps involved in developing networks for such service applications as charging travel and entertainment expenses and reserving hotel rooms, rental cars, and airline seats. Chairman of that session is W. Thomas Dixon, who is a communications analyst and designer with General Electric Credit Corp.

Chairman of a session on manufacturing is William F. McKenna, manager of Ford Motor Co.'s systems department. Speakers will discuss data communications systems that aid inventory and production control, sales order processing, and finished goods distribution.

Networks

A 10-session program will discuss the optimization of today's networks and the planning for tomorrow's networks. Sessions addressing tomorrow's networks will focus on diagnostics for distributed networks, putting data bases on-line, network standards and protocols, the impact of semiconductor technology, and the expanding realm of data communications. In this last session, chaired by Ken G. Bosomworth, president of International Resource Development, Inc., speakers will review advances in high-speed facsimile units, communicating word processors, and network-oriented small business machines. They'll give advice on integrating them into existing data communications networks.

The discussion on today's networks cover domestic and international networks, minicomputer based networks, and terminal based networks. A fifth session, chaired by Washington consultant, Richard L. Deal, is billed as a "rap" session at which attendees are invited to discuss networking problems or questions on distributed processing with the speakers.

Workshops

Six workshop sessions will cover data communications products and three will discuss networks. Dr. Howard Frank, president of Network Analysis will lead a session on *Network Analysis,* giving a rundown on the different network types and the tools for performing cost and throughput/response time analyses with each. Robert R. Cooney, a data communications analyst with Pratt & Whitney, will head a session on *Network Implementation,* and Ira W. Cotton will tell how network managers must expand their arsenal of diagnostic tools to allow for distributed processing and the sharing and integration of teleprocessing facilities in a session, *Network Management.* The product workshops will cover cpu's and datacomm software; communications processors and multiplexers; remote batch and data entry terminals; interactive terminals; modems and couplers; and data transmission services.

Government

Four sessions will be held to review how military and civilian agencies plan, implement and maintain data communications networks within the government. Session chairmen are: Valerio R. Hunt, chief systems development group, Office of Data Processing, CIA; Roxanne R. Williams, director of plans and policies, U.S. Dept. of Agriculture; Edi Franceschini, a senior scientist with ERDA's computing laboratory at Courant Institute of Mathematical Sciences; and Maj. Gordon W. Arbogast, directorate of telecom and command and control systems, Dept. of the Army.

Issues

A group of five sessions will examine such topical issues as procurement, regulatory policies, Electronic Funds Transfer systems, security, and privacy throughout the three-day conference. For instance, a session on privacy, according to the sponsors, will look into the questions of extending present federal privacy regulations to the private sector. There are technological as well as philosophical implications to such a move.

Exhibits, Attendance

The turnout for this three-day conference is estimated at from 2,000 to 3,000 persons, but it could go higher because

of its Washington location. Dr. William A. Saxton, conference chairman and publisher of *Data Communications User* magazine, believes that anything beyond 4,000 persons would have to include what he calls "casual" visitors, those with a curiosity, but with minimal buying power (buying power is a big factor in attracting exhibitors to a conference). Saxton explains that studies by International Data Corp. show that 1,100 computer sites account for 80% of total spending for data communications products and services.

DataComm 77 expects to have about 30-35 exhibitors at an accompanying trade show, also to be held in the hotel. This figure doesn't include about ten trade magazines and associations upon whom the two fledgling shows rely for publicity, and in turn offer them exhibit space at no charge. Among the paying exhibitors at DataComm 77 will be International Business Machines, American Telephone and Telegraph Corp., Datapoint Corp., General Electric, General Automation, Data General Corp., Entrex Corp., and Telenet, the packet switched network.

Says Saxton of the similarity: "Let's face it, we organized the program for the first three conferences of Interface and they've never wavered from it in the two conferences following:" (Saxton and Morris Edwards, editor of *Data Communications User,* organized the programs for Interface when it was part of their magazine. After the magazine changed hands two years ago, Interface continued into its fourth and fifth conferences and Saxton and Edwards launched another conference).

Data Communications Interface '77
March 28–30, Georgia World Congress Center, Atlanta

BELL BILL DEBATERS: John M. Eger, former acting director of Office of Telecommunications Policy, (left), Bernard Strassburg, former head of FCC's Common Carrier bureau; and Rep. Timothy E. Wirth (D-Col) will take part in series of debates on controversial Consumer Communications Reform Act.

In its three-day conference in Atlanta, Data Communications Interface will stage its Data Communications School, together with sessions entitled: Product Updates, Service Updates, Network, Technology Management and Applications Workshops, Highlight Sessions, and a Consultants' Corner. A highlight of the conference is a series of "Bell bill" debates—sessions covering implications of the AT&T-inspired Consumer Communications Reform Act.

First of the Bell bill debates will be launched the evening before the conference starts. Entitled, "Effects on the Consumer of Competition in Communications," it will feature talks by lawyer John M. Eger, former acting director of the White House Office of Telecommunications Policy and Rep. Timothy E. Wirth (D-Col.), both opponents of the legislation.

Other sessions on the legislation: Pro's and Con's of Competition in Transmission Service; Considerations for Interconnect Competition; View on FCC Effectiveness; Present and Future Implications of Satellite Business Systems; and How Users Can Impact on Communications Legislation. Among the speakers are Bernard Straussburg, former head of the FCC's Common Carrier Bureau; Herbert Marks, attorney for the Independent Data Communications Manufacturers Assn.; Prof. Manley Irwin, professor of economics at Whittemore School of Economics; Donald Dittberner, a consultant; and Herbert Jasper, executive v.p. of the Ad Hoc Committee for Competitive Telecommunications.

Workshops

Twenty-one workshop sessions are planned for the conference—seven on technology subjects, four on networks, four on management subjects, and six on applications.

Applications workshops cover electronic mail, data communications in a communications utility, time-shared services and systems, EFTS, point of transaction systems, and distributed computing. Chairman of the distributed processing session is William A. Sommerfield, vice president and editorial director for Auerbach editorial activities. A thorough airing of the potentials and procedures in implementing a distributed computing approach is promised in this session. Einar Stefferud, president of Network Management Associates, will chair the session on electronic mail in which the experience of users of electronic mail, message systems, and teleconferencing will be explained.

A workshop designed for management will include talks on plans for growth, data communications department organization, hiring and training of people, and contractual policies for vendor relations.

A four-session series, *Network Workshops,* begins with a session headed by consultants Howard Frank and Dixon Doll in which they offer a tutorial exposure that includes guidance on setting objectives for implementing data communications networks. Other sessions are on network design optimization, network operating systems, and remote software and network operations productivity.

Seven technology workshops cover

(Continued on page 158)

Back to School

Sponsors of DataComm 77 and Data Communications Interface 77 will both stage sessions for the uninitiated, an apparent recognition that it's still a new field with many new entrants.

DataComm 77 will hold a five-session series entitled *DataComm Basics* for newcomers and management generalists. Data Communications Interface 77 also will stage a school covering fundamentals of data communications as well as applications. Nineteen sessions are offered.

Information on the schools and advance copies of the programs for each event are available from the sponsors: DataComm 77, 60 Austin St., Newtonville, Mass. 02160, 1-800-225-3232 and Data Communications Interface 77, 160 Speen St., Framington, Mass. 07101. 800-225-4620.

Budgets

DP Budgets Seen Growing At Slower Rate Than '76

Investment in personnel at dp sites shows no changes as trend towards outside services rises sharply

Data processing budgets will grow this year by almost 10% over last year, appreciably less than the 12% jump that actually occurred last year over the year before. In 1977 there will be a 16% increase in expenditures for outside services, an 11.6% increase for equipment, but only a 6.5% increment for personnel. This is despite a 6.5% rate of inflation that economists are predicting. Those are the findings of Input, the Menlo Park, Calif., research firm, in a study being released this month.

The largest growth in dp budgets this year are being reported by the banking, process manufacturing, and utilities industries, all looking for a 12% jump. The transportation sector, it is being predicted, will experience a 10% increase, followed by diversified financial and discrete manufacturing firms (9%), and insurance companies, the federal government, and state and local governments (8%). Retail firms trail with only a 6% increase.

Telephone study

Input's study consisted of telephone interviews of 113 dp managers and top financial executives of those 10 "industries," all but the governmental units being very large corporations. The responses are not representative of those that might be obtained from small users, but the group surveyed is said to control more than 60% of all expenditures for dp.

They tend to be "at the 'leading edge' in the utilization of new products, systems, and technologies," and to be less affected by short-term economic changes than smaller firms. In addition, the study is a follow-on to a similar survey conducted a year ago, and so Input was able to compare the 1976 dp budget estimate with actual spending.

The table accompanying this story shows the percentage increases being projected this year for equipment expenditures, personnel, and outside services. In eight out of ten cases, a larger percentage increase is being forecast for secondary processors than for main processors, the former including satellite processors, minis, and turnkey systems. The two exceptions are in process manufacturing and in the utilities industry.

Communications: 10% to 35% boosts

Also in the "equipment" category, increases in the budgets for data communications gear range from a low of 10% in discrete manufacturing to a high of 35% in banking and utilities. Budgeting for data entry equipment ranges from a minus 20% (retail) to a plus 5% (process manufacturing); the only other minus figure is a 10% drop in expenditures for peripherals (again in retailing), which contrasts with an 18% increase in spending for peripherals by process manufacturing firms. The numerically largest changes are for terminal equipment; here we see retailers anticipating a 70% increase, utilities a 60% jump, and banks up 50%.

In the category of "outside services," where a 16% jump is seen, spending for software products is apparently catching on. The lowest budgetary increase for packages is registered by retail firms (up 10%) and the highest by discrete manufacturing (24%), with most of the respondees in the 16% to 19% level.

It is when we get to spending for remote computing services that the two governmental sectors show up. Federal agencies see a 33% increase for these services, versus 7% for batch services, and state/local governmental units (selected from among the 15 largest states and 20 largest cities) look for a 25% increase for time-sharing and a 12% increase for batch. In both banking circles and diversified financial firms, there's also a 25% increase in the budget for remote computing services, where spending by process manufacturers will be up by 19%: it'll be up by 17% at discrete manufacturing firms and at life insurance companies.

Spending for education will be up by 20% at utilities firms, by 17% at banks, and by 12% at insurers; both governmental sectors see this rising by 10%.

—Edward K. Yasaki

Percentage Increases in DP Budgets, 1976–1977

Industry Sector	*Equipment*	*In-House Personnel*	*Outside Services*
Insurance	11.3	3.0	11.5
Diversified Financial	6.5	6.1	21.7
Banking	18.3	0	20.6
Retail	14.0	3.5	7.0
Discrete Manufacturing	9.2	7.2	14.4
Process Manufacturing	15.6	8.6	15.7
Transportation	11.5	10.1	10.5
Utilities	19.1	7.0	10.9
Federal Government	5.8	5.1	18.1
State/Local Government	9.6	3.0	17.6
Total, All Sectors	11.6	6.5	16.0

Source: Input, Menlo Park, Calif.

A Change in Pace?

1st West Coast Case Finds Jury Attentive But Hardly Animated

Can a farm boy from Oklahoma take on and conquer the grey giant of Armonk?

As the first of the so-called "West Coast cases," in which IBM is charged with antitrust violations by a number of competitors, moved into its third month, this question was read subliminally into the scenario, adding something of a soap opera note to a trial which, up to that point, had seemed more like a haggle in a board room with tutorials on marketing strategies and data processing hardware thrown in.

Maxwell Blecher, lead counsel for California Computer Products Corp., which is asking $300 million treble damages in its antitrust suit against IBM, led CalComp chairman Lester Kilpatrick through a brief recitation of his early days as CalComp neared the end of its presentation in the case.

". . . born on a farm in Oklahoma 53 years ago . . . mother was a school teacher . . . moved to Texas at the age of seven when his father died . . ."

Just possibly one or more members of the eight woman; four man jury was born on a farm in Oklahoma, or at least on a farm, and maybe one or more of them had a mother who was a school teacher. If so, Kilpatrick personally could be something they could relate to, and giving the jury something to which to relate is the name of the game in this case.

First sight

Prior to a court-ordered field trip just before opening statements, none of the jurors had ever even seen a computer. But they're getting an education. The field trip was to Los Angeles' Biltmore hotel where both sides demonstrated and explained various pieces of data processing equipment which would be talked about during the trial.

Kilpatrick was a good witness. As Blecher led him through his professional career, he would turn to the jury from time to time with well thought-out explanations when technical terms came up.

The trial is considered something of a personal crusade for the CalComp chairman. Since he relinquished his other title of president of the company to George Canova last June, he has been spending all of his time on the litigation.

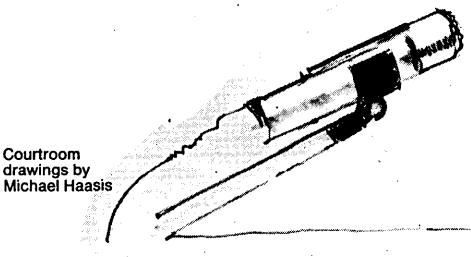
IBM is expected to dwell on last June's management changes in its defense. The giant's lawyers hinted strongly during opening statements that the changes were a result of management incompetence. In taking depositions from CalComp directors it's understood IBM zeroed in on the changes and the reasons behind them. It is expected that IBM will read some or all of these depositions in presenting its case.

Blecher made a strong case for Kilpatrick's technical competence as he led him through the later parts of his life. The CalComp chairman said he'd grown up and gone through high school and college in Texas, receiving a BS in electrical engineering from Texas Tech Univ. in 1946. Prior to graduation, he spent two years in the Navy at the end of World War II. He received an MS in electrical engineering from MIT in 1948. While at MIT he worked 36 hours a week in the research labs there doing engineering work on telemetry systems.

To North American

He took his masters, got married, and moved to the West Coast all at the same time. His first full time job was with the Autonetics Div. of North American Aviation. He was with NAA for eleven years.

LESTER KILPATRICK: born on a farm in Oklahoma.



Courtroom drawings by Michael Haasis

DAVID BOIES: hopes the jury understands.

His first responsibilities at North American were in engineering work on developing inertial navigation systems for the Navajo missile. The company was using analog computers. "I was told to think about digital computers."

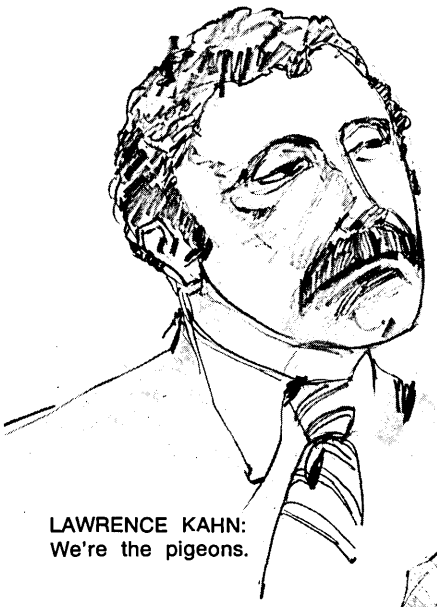
While at North American, Kilpatrick said, he was involved in the development of six different digital computers. The jury was shown pictures of all of them and it was carefully noted that all had disc memories, head per track disc files, establishing Kilpatrick's early familiarity with the industry in which he alleges IBM has hurt CalComp.

He was asked about the formation of CalComp. He said it was originally formed in the "1953-55 time frame" by Eugene Side, "who worked for me at

MAXWELL BLECHER: adding a soap opera note.

news in perspective

North American," and Robert Morton. The two tried to bid on a digital plotter contract from Alwac Computer, Kilpatrick said. "They were laughed out of the company. Alwac awarded two contracts. Side and Morton developed a plotter without a contract. Theirs worked and the others didn't and they had a sale." Nothing followed, however, and Side returned to North American. "Morton was left with a one man company and a small shop on Jefferson Blvd."



LAWRENCE KAHN: We're the pigeons.

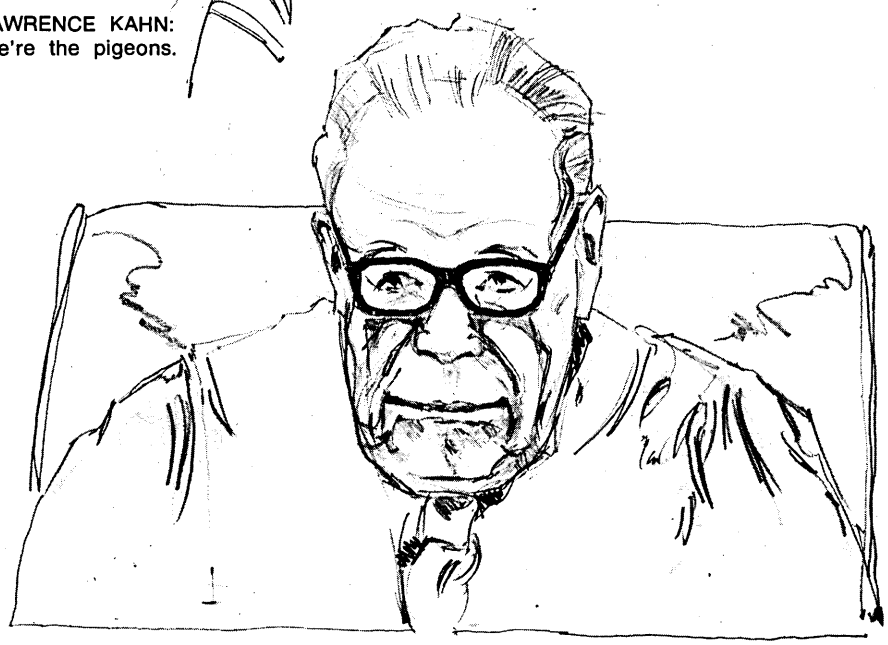
Those green halls

Next, Kilpatrick explained, he, Side, and another North American employee, Don Cone, became unhappy with some organizational changes taking place at North American. Then a friend of his from MIT, John Chism, "came into my office at North American and asked me 'how can you stand all these green walls' and that did it."

Kilpatrick, Side, and Cone began doing engineering work for Chism after hours in Morton's garage. This was profitable, he said, because there was practically no overhead. It went on for about a year and one-half.

"Then my wife got tired of the neighbor women smirking about my being out so many nights." Kilpatrick, Cone, and Side resigned from North American and formed a four man partnership with Morton. They started with some $20-$30,000 from their moonlighting operation and Morton's equipment. That was in 1959, Kilpatrick said, and was the real start of CalComp.

Should CalComp win its case against IBM it could get a new start. But it's IBM's turn now. IBM lawyers had said they would ask the judge for a directed verdict when CalComp finished its case but such a verdict seemed unlikely in the final days of the CalComp case. In fact, Federal Judge Ray McNichols, in telling the jury that they would have the week of Jan. 24-28 off (with jury pay of $25 per day but no traveling expenses), commented that they would probably need it to get through "the next three and one-half months or so."



JUDGE RAY MC NICHOLS: gave the jury a week off.

Listening

In the first three months the jury was attentive but hardly animated as it listened to deposition after deposition (mostly from the Justice Dept.'s case against IBM) and viewed literally hundreds of blow-ups of documents entered into evidence.

There were occasional smiles such as when Lawrence Kahn, CalComp's Los Angeles branch manager, talked under cross examination of a man eating from a big bag of popcorn. "He occasionally throws a handful to the pigeons. We're (the plug compatible peripheral manufacturers) the pigeons. The man with the popcorn is IBM."

IBM may be glad the jury had that week-long rest as it presents its defense, which its lawyers estimated would take four months. Lead lawyer David Boies said he hopes the jury recognizes that the case treats complex products in industry.

If the jury's attention does lag from time to time in coming months, it is certain that of another group, watching the trial just as closely, will not. They are the participants in the other upcoming West Coast cases—suits brought against IBM by Memorex and Transamerica Computer Corp. Both are slated for jury trials.

—Edith Myers

Amdahl in '76: From Oblivion to a Comer

By any measure, 1976 was a very good year for Amdahl Corp. The company finished the year with an installed base of 33 systems, having a sales value of more than $140 million, and 27 of them were shipped during that 12-month period. Its last installation at year-end, a 3-megabyte system at the Library of Congress, was also the first in which the vendor is carrying the lease papers. And the firm has already held the first meeting of the Amdahl Users Group.

Impressive as these accomplishments are, exhibiting the vendor's ability to produce, install, and service an IBM-compatible mainframe in direct competition with you-know-who, the firm last year was also successful in its public stock offering. That move wiped out a $31-million debt load and added some $25 million to the corporate coffers. According to Cliff Madden, v.p. of finance, the firm's interest expenses before the public offering was about $2.6 million in 1976, but in '77 they'll be earning interest income of at least $1.5 million. Thus the Sunnyvale, Calif., firm, which president Eugene R. White estimates will have recorded revenues of more than $92 million during its first full year in the market, emerges out of oblivion to rank somewhere in the middle of DATAMATION's Top 50 as calculated last year (June 1976).

In its analysis of Amdahl Corp.'s ability to survive in the market against IBM, the research firm of Input looks at several things IBM could do to remain competitive, such as upgrading the 370/168. It says, "The user who buys the (Amdahl) 470V/6 is not exposing himself to a major risk if his payoff period is four years or less because the likely price/performance of the short term upgrades of the 158 and 168 systems will not provide significant price/performance advantages ... Amdahl management is aware of IBM's options and is ready with its own countermoves. The net effect may be to slow down Amdahl's growth and to gradually change Amdahl from an IBM plug compatible mainframe manufacturer to a supplier of a variety of functional mainframes."

No slack in shipments

The backlog of orders for the 168, Input says, means shipments this year for that machine will continue at about the same rate. To keep from impacting this schedule, it is believed, IBM is not expected soon to announce an upgrade for the 168. But the effect on Amdahl, should this upgrade occur in the near future, is expected to be minimal. "Amdahl would continue to be viable, although its future market potential would be severely limited. Amdahl, in the short run, would probably be capable of responding to most upgrades likely to be announced by IBM."

Amdahl's Madden, asked what they foresee in the way of IBM announcements that could impact them, says only that potential customers for the 470 and 168 represent "a damned big market and it shows little sign of slackening." He didn't think there was much IBM could do to seriously impact his firm.

The brokerage firm of Arnhold and S. Bleichroeder Inc., in its analysis of the plug-compatible mainframers, projects 44 shipments by Amdahl during 1977, which contrasts with some estimates that IBM will be shipping from 12 to 20/month of its 168s. Madden also sees Amdahl shipping between three and four per month "until we see how the market goes." He and others at the firm allude to the need for "controlled growth" so that shipments and new installations don't exceed the vendor's ability to support those machines.

EUGENE R. WHITE
Amdahl revenues will top $92 million during first full year in the market

Back in 1975 the early users were provided with 60-day acceptance test periods; it dropped to 30 days in 1976, and is now down to 15 days. Thus, it is said, there are no plans to increase the four/month shipment rate maintained through the fourth quarter of '76. Late last October, at a gathering of securities analysts, Madden reported on the firm's financial results. At that time, he said, "Our break even point is slightly less than one system per month."

Strong strategic position

Since that time, the company has taken on the manufacture of an additional portion of the mainframe, the memory system. It has begun using 4K chips in place of the 1K memories of the past. Under the current set-up Amdahl makes the power supply, power distribution units, and the memory, while Fujitsu in Japan continues to make the cpu and channels. Not only does this mean economy for Amdahl, but it also places them in a stronger strategic position if IBM were to lower main memory prices further on the 168.

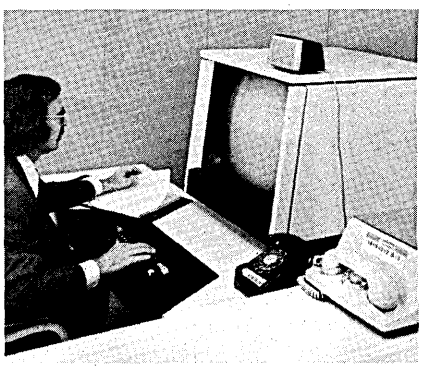
The financial health of the organization, evident in its ability to undertake more of the manufacturing activity and the inventories that result, also shows in its willingness to lease some systems as that becomes necessary. "We think we'll do some selective 3- to 5-year leases in 1977," Madden says, "because we think there is a certain part of the marketplace that not only demands it but requires it." The Library of Congress was such an installation.

As this story was being prepared, the company had not released preliminary earnings for the year. But in the final quarter it recorded revenues in excess of $40 million, compared with the third quarter's $26 million. Indeed the fourth quarter gross came close to the total for the first nine months, which was $52.3 million, at which point the net earnings were almost $10 million.

Fourth quarter domestic shipments were made to General Motors, AT&T Datasystems, Reynolds Metals, Outboard Marine Corp., AT&T Long Lines, Williams Co., Data-Sys-Tance, Southern New England Telephone, Sundstrand, and Library of Congress.

Three to Europe

In addition, the firm last year established a joint international marketing organization with Fujitsu Ltd. and shipped three systems to Europe in rapid order. "Our game plan all along had been to do three quickly, and we did," says Madden. In three weeks' time, from late December to early January, 470s were delivered to the Max Planck Institute and to the DFVLR, the West German



DIAL A DIAGNOSIS: From this minicomputer based console at Amdahl headquarters, computer engineers give instant maintenance back-up to firm's field engineers. It is used to scan out latches, examine machine status, run diagnostics, and even operates system using phone to link the customer's console with the Amdahl diagnostic assistance center.

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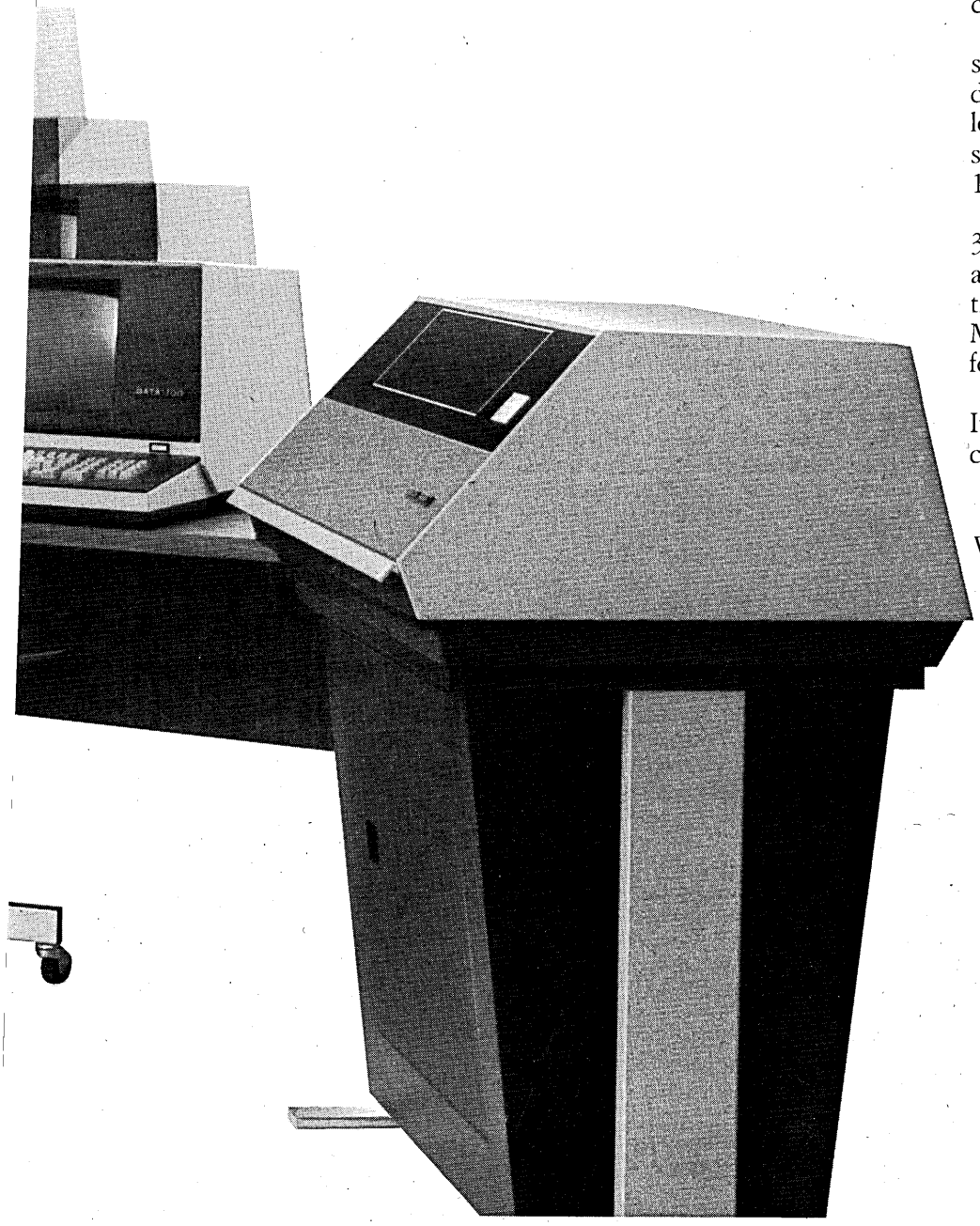

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space agency, both in Munich, and to A/S Elektronisk Databehandling, a wholly owned subsidiary in Oslo, Norway, of a large insurance company.

"I think Europe has shown an even stronger interest (in the 470) than have users in the States," says Madden, who sees from four to eight systems being shipped there in 1977. But it was 1976 when they turned the corner at Amdahl Corp. That was a very good year.

—E.K.Y.

Plug Compatible Manufacturers

Ippolito's 145-Like Cobra 45: It's Just His First Product

It was not, nor will it ever be, "Control Data's bid to break IBM's grip"—although that was the headline over the *Business Week* article last May that verified rumors of a Control Data/Cambridge Memories Inc. 370/145 plug compatible mainframe. Since summer, half an ocean has flowed under the proverbial bridge: IBM's price cut upgrade 370/138 and 148 entries girthed the 135-145 market; the simultaneous IBM shift from bipolar to cheaper MOSFET incremental memory ripped the uneasy truce in the add-on memory market where CMI and others were only sluggishly recovering from the core to semiconductor shift in memory technology; then CMI's lending banks called in their loans, temporarily closing down the company and forcing it to default on its agreement with Control Data.

It has had an awkward, confusing history, but the 145 plug compatible processor—now named the Cobra 45—now is in limited production at a Bedford, Mass., CMI plant; although CMI is now no more than a contract manufacturer. The rights to the processor were held from the beginning by the virtually unknown IPL Systems, Inc., an independent corporation formed in 1973, in which CMI had a substantial minority holding (reportedly 49% before the debacle), and although the original production contract between CMI and Control Data was voided soon after the banks pulled out, IPL and Control Data signed a new agreement in late December.

The potential for the Cobra 45 seems unclear, and the two partner firms hold markedly different views of its prospects. Control Data senior v.p. Gordon Brown says that his company "obviously plans to market the Cobra"—but he bluntly terms it a "limited product offering."

"I don't foresee any marketing effort that goes beyond the entry of the 138 and 148," said Brown. Control Data has a "nearly conventional" oem agreement with IPL, he explained: it has no loss exposure and will market the unit only through outright purchase or pay-out leases arranged by its Commercial Credit subsidiary. There will be no operating leases. Brown said that Control Data "sees this basically as a limited market in which we can capitalize on the financial services of Commercial Credit."

Going slowly

With the first IBM 138's installed, and the first 370/148 being shipped this quarter, Control Data seems to be hedging IBM's 18 month lead time on the machine. The Control Data-IPL contract sets the Cobra lead time "in the six to seven month time frame," said Brown. Yet Control Data seems to ill-equivocate on their marketing plans; although it has had a Cobra prototype under evaluation in Minneapolis since last spring, Brown said it planned another evaluation program for IPL's Cobra production models that will not be completed until April. Only then, said Brown, will Control Data "make the final decisions as to investment and marketing commitment—we're not going to commit ourselves until we're convinced that (the production model) is reliable, compatible, etc."

The financial and organizational chaos that accompanies its birth has largely obscured the technological achievement of the Cobra design. Although neither Control Data nor IPL executives will comment on the specs of the machine itself, other sources familiar with the prototype design suggest that the Cobra will get high design marks for what many expect to be its brief half-life on the market. Using a parallel, microprogramming architecture, said one source, the Cobra designers came up with a product that was "basically a hardwired 145—they didn't worry about the secondary levels of the 145 design. They were just building a machine that would act like a 145."

As such, the Cobra will be cheaper, much easier to build, "but much harder to change." IBM, with its "softer" design approach, can upgrade the systems design fairly easily, but IPL's approach means they will have to redesign most of the system to produce another model comparable, for example, to the 370/148.

An original

IPL president Stephen Ippolito, architect of the Cobra design, said the new machine is an original—"in no way a copy of an IBM System/370, Model 145, although the two machines are identical at the software level." The Cobra, he said, "can do better than stand behind the 145. Obviously, to sell against IBM you have to offer better price/performance than they do and we intend to sell this thing!"

Ippolito, in contrast to Control Data marketing executives, does not concede the field to be 370/148; he said he expects the Cobra to exploit openings in the market even after the new IBM offering is in the field, and, he added, "Even now IPL is working on more than this current machine. We intend to be around; this is only our first product."

Another source familiar with the Cobra prototype described it as "IBM's 145 with a five-year design upgrade: better circuitry, packed a little better; with a power supply considerably better than IBM's." But even with its claimed price/performance benefit, the Cobra will have to go up against the recently undercut 370/145 used computer market. But both Ippolito and CD v.p. of business planning Harry Ashbridge claim the Cobra can sell against 145's marked down to 50% of original cost.

The IBM 138/148 announcement impacted the used computer market heavily. Prices on the 145 dropped from $600,000 to $400,000 within a day, according to William Grinker, executive v.p. at American Used Computer, Boston. "But that was an emotional reaction," he explained. "The market started to come back when people realized that the 148 wasn't going to be out in the field very quickly." Now, he said, the 370/145's have stabilized mid-range, between 40% to 45% of cost: $450,000 to $400,000. "The 145 will be in a viable, strong, and supported market for the foreseeable future," Grinker predicted. Could a new plug-compatible 145-like mainframe find a market? "Sure," he said. "If they can get the price down."

One interesting market for the Cobra may be Control Data's own CD Service Bureau Corp. which is still IBM based. Wall Street analysts following Control Data suggest service bureau replacement might be the real logic behind the Control Data/IPL agreement—although both CD and IPL insist they plan to bring the Cobra into the marketplace. The Control Data Service Bureau maintains eight IBM 370/158's for their time-sharing operation, but they also have between 35 and 40 smaller and older IBM systems in their batch centers around the country—"quite a mix of equipment, including 370/135's and even the old

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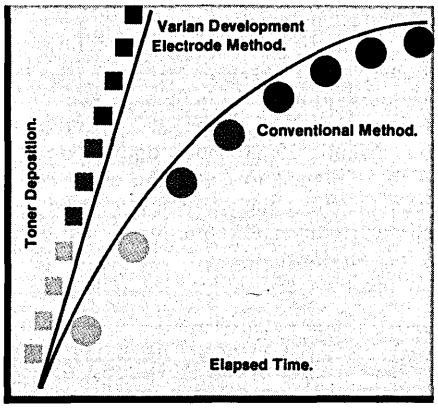

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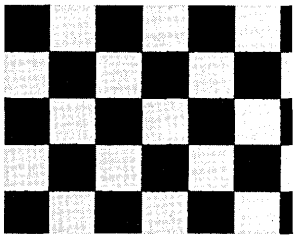

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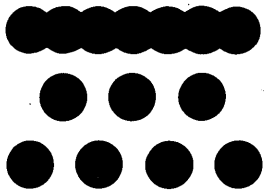

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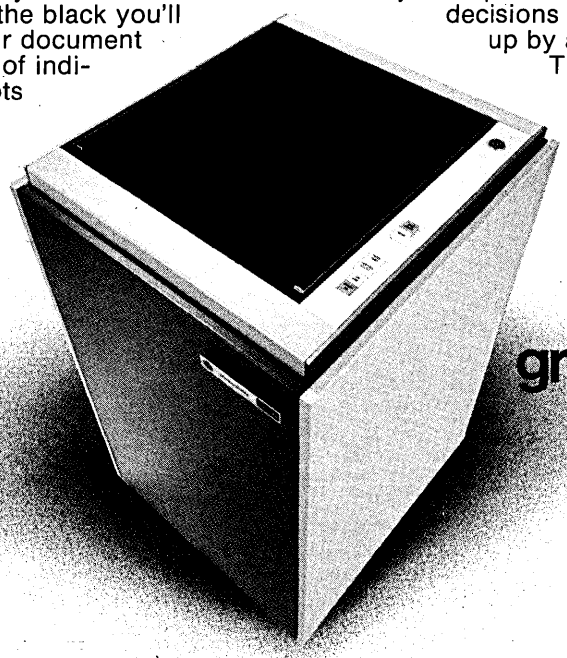

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model 40." The possibility of moving Cobra 45's in as replacement units, said Control Data's Brown, "was certainly one of the areas for the potential evaluation in our plan—but it would also certainly be correct to say that we are not yet committed to that replacement."

Control Data seems committed to avoiding commitments on the Cobra 45 at this stage. Even the mysterious clauses in the CD/IPL oem agreement that both parties refuse to discuss apparently do not involve any commitment to purchase; and according to Brown, Control Data has not taken any warrants nor made any investment in IPL. "There was none of that," he said.

Brown stressed that the possibilities of Cobra installations in the service bureaus, and the number and utility of any such installation, are still subject to debates at CD headquarters—"but theoretically, we could possibly use one at each of the 35 batch centers," he said. "But that's the high maximum, and that's only theoretical."

For all the theoretical uncertainties, the Cobra lives. IPL is still in business, and "about 100 employees"—50 from IPL and 50 from Cambridge Memories—are busy in Bedford on Cobra production, and IPL's future offerings. There are no heavy bets being placed on Cobra's market penetration, but a project that appeared dead six months ago has been resurrected. "We're working hard over here," said IPL's Ippolito. "We never stopped."

And Steve Ippolito, the CMI product engineer who talked his boss into backing his dream, his own computer design, still insists that the Cobra 45 is only his first design. Only his first product.

—Vin McLellan

National Aiming at IBM With Top-to-Bottom Mainframe Line

A line of plug-compatible mainframes bracketing the IBM line from System/32 to the 370/168 is being designed by National Semiconductor Corp. The company that is manufacturing the Itel AS/4 and AS/5 IBM-compatible computers, not content with being merely a semiconductor manufacturer, has established a Computer Products Group with an eye on new and larger markets.

"We're attempting to come out with a top to bottom IBM-compatible mainframe product line," says the group's general manager David N. Martin. He says the company wants to accomplish that with a minimum number of products. "And we see that basically falling into four, two of which we've announced and two of which we're working on."

The Santa Clara, Calif., firm is reported to have started the design activity last fall, and has scheduled availability of the two additional mainframes in the first half of 1978. "It will be our objective at this time next year to be in a position of having products that go all the way from the low end to the high end," Martin adds. "The high end will be enhancements to our AS/5-type of product, as opposed to a brand new product."

At the bottom end, there is to be one computer that bridges the s/32 with the 370/115 and 125. An additional model will be designed to cover the gap between this machine and the AS/4 that Itel is currently marketing, or aimed at the 145 on down.

While the AS/4 and AS/5 are being

made in San Diego, Calif., by what is now called the Large Systems group, the new mainframes are being developed up north in Santa Clara by General Systems, which also produces add-on memory systems for the IBM 135 through 168. According to Martin, National is now the largest add-on memory maker in terms of bytes shipped or dollar volume, purportedly having passed Intel and Advanced Memory Systems in the latter half of 1976; it is a claim that does not go unchallenged by the competitors.

Microcomputer segment

The third segment of the Computer Products Group, called Microcomputer Systems, enters the oem minicomputer marketplace against established mini makers. It implements National's microprocessor technology at the system level—the card level on up—producing the processor, memories, interface electronics, and cabinet. "We want to come up with system-level building blocks that allow a much broader customer base to apply the capability of microcomputers sooner," says Martin. One part of this audience will be those who have never before used a computer; the other is the mini user.

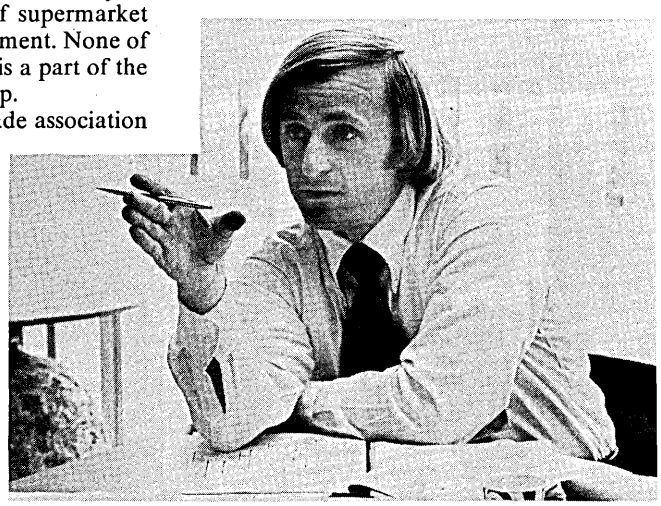
"Secondly, there'll be a very clear overlap and, over the next few years, a complete loss of identity between the microcomputer market and the oem minicomputer market," Martin remarks. He sees National's products having the same capabilities as today's low end PDP-11s from Digital Equipment and the Data General Novas and the like.

The fourth part of the newly formed group, also directed at the oem market, is into custom memory systems, minicomputer add-ins, and bulk memory as for test systems. It is said to be a business that's doubling each year.

National Semiconductor, which during calendar year 1976 had sales of approximately $375 million, earlier had diversified its product line to include calculators, watches, and video games. And it is thought to be second only to NCR in the installation of supermarket electronic checkout equipment. None of these activities, however, is a part of the Computer Products Group.

According to WEMA, trade association for the electronics industries, total worldwide sales of all semiconductor devices is expected to reach $6.2 billion this year. With the lineup of products being anticipated by the new group, it also places the company squarely in the larger data processing market, a daring move characteristic of National's president Charles E. Sporck.

In discussing the potential for the AS/4 and 5, Itel v.p. Richard Lussier said the domestic installed base of 360s and 370s would exceed an estimated 16,000. "We view approximately 7,000 to 8,000 of the current cpu's as a potential market for Itel's Advanced System," he said at that time. **—E.K.Y.**

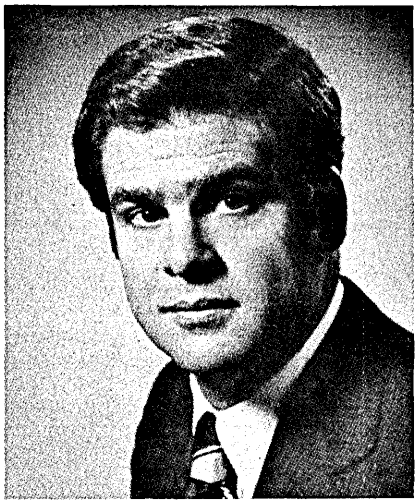


DAVID N. MARTIN
Working on two products at low and high end

news in perspective

Price Advantage No Problem to Itel

The introduction by Itel Corp. of National's mainframes late last year (November, p. 136) followed the success of Amdahl Corp. in the IBM-compatible business. In its study, the brokerage firm of Arnhold and S. Bleichroeder recently analyzed the seeming ease with which Amdahl has been installing its large scale 470V/6 where 370/168s were meant to go. "Customers have been impressed with the quality and credentials



RICHARD LUSSIER
"I wish we had five more of those (pricing) problems"

of Amdahl's management," the study says, "particularly with its marketing philosophy which emphasized advantages in performance rather than price."

But it is less bullish about Itel/National's effort "because their primary thrust is based upon a price advantage, which is easier to counter than Amdahl's performance advantage." The report also notes that a 370/148 user, to whom the AS/4 would be directed, requires more support than the user of an Amdahl machine, "and with only a minimal price/performance advantage, the customer may be reluctant to abandon the security of IBM service."

Thanks for this problem

But Itel's Richard H. Lussier, president of the Data Products Group, says he fails to see how a 148 user in that respect should differ from a 158 user or even a 138 user. He cites corporations such as AT&T, to whom Itel supplies memories, as having many 145s and 155s, and says the same for General Motors. "A lot of large corporations that have 145s and 155s also happen to have 158s and 168s," he notes. Asked whether he considers it a problem to be stressing lower price rather than higher performance, he answers, "It's a real problem, I'll tell you. I wish we have five more of those problems."

Lussier adds there's "absolutely no question" but that Itel will be able to ship whatever number of mainframes National can manufacture this year. "We've been holding a number of orders, frankly, to pick the ones we think are best for us because we'll be limited as to how many we'll be able to ship this year." He says the company currently cannot accept an order, even for internal use, for shipment before the fourth quarter, and along about the end of February will no longer be able to accept an order for shipment this year.

The first shipment, to Pacific Mutual Insurance in Newport Beach, Calif., originally had been announced as scheduled for the second quarter of this year. "I'd say now the chances of the first customer getting the machine before the end of the first quarter are better than 95%," Lussier says.

He would not say how many they will be shipping this year, commenting only that they now have more than 15 signed contracts. Two are from Europe. The emphasis initially is on sales of the larger AS/5, he adds.

Although interest is being expressed by single system shops, most of the customers are those with multiple systems. "We've got two or three 2-machine orders . . . the one in Brussels is for two machines." He adds, ". . . There are more people willing to make this commitment from a wider band of potentials than we had thought . . . The user surprises you with his sophistication and independence. And I'm sure IBM is getting that message."

Surprises in Europe

As expressed also by a spokesman for Amdahl Corp., Itel's Lussier says they continue to be surprised by the reception from among users in Europe. In percentage terms, there are more users of computers in the 135 to 148 range. "If I had 10 more machines to give to Europe, they could sell them all this year," he says. As it is, the first shipment there will follow by about six months the first domestic installation.

As for National Semiconductor's two new mainframes, still in the early design stages, Lussier says, "They've talked to us about it, and we're interested." ❋

Cities

New York City's Frantic Effort To Build a Financial System

New York City's fiscal future may well depend on the efforts of a special task force struggling frantically to complete a massive $16 million plus financial system within the next few months.

A combined effort by the Mayor and City Comptroller's offices and five outside firms, Integrated Financial Management System (IFMS), as the system has been dubbed, is slated to go into operation July 1 when the city's new fiscal year begins. Its success is critical to New York's regaining control of its chaotic financial affairs and reestablishing some kind of credibility in the money markets, city officials say.

Important as it is, IFMS is being put together under extraordinarily difficult conditions. "The Mayor (Abraham D. Beame) and the Comptroller (Harrison J. Goldin) aren't even speaking to each other after all the political squabbling that's gone on during the financial crisis," one city official involved with IFMS explains. "On top of that we've been given 19 months to do something that would take at least three years in the private sector, and we've got everybody from Congress to the Treasury Dept. looking over our shoulder."

IFMS originated at the height of New York's fiscal crisis in 1975. "The near financial collapse of the city riveted a number of peoples' eyes on the inadequacies of the old system and underscored the need for an IFMS," says Steven Clifford, special deputy comptroller and one of the principal architects of IFMS.

Ancient accounting procedures

Prior to IFMS, Clifford explains, New York had been using accounting procedures that hadn't changed since 1920. Various city departments worked with their own computer, their own version of the budget, and even their own approach to coding. The results were disastrous, particularly when it came to billing for the state and federal aid from which New York derives about half its income.

"There was no central system for tracking what was owed," explains Harvey I. Susswein, a group v.p. with American Management Systems, Inc., the Arlington, Va. based firm responsible for designing, programming, and providing much of the IFMS software. "That was New York's real problem—collecting revenue sources. A lot fell between the cracks."

Exactly how much? No one seems to know for sure, but Clifford estimates the city has written off a whopping $780 million in uncollectibles over the past six years—money it might have gotten from the state and federal governments if it had billed properly, or at all.

Once IFMS got the go-ahead, the city brought in American Management Systems which had developed big systems for companies like Burlington Northern and had been involved in earlier city projects. Bradford National Corp. (formerly Bradford Computer & Systems) was contracted to develop a payroll subsystem and set up the data center that would serve as the hub of the IFMS network. Touche Ross & Co. and Ernst & Ernst, two big accounting firms, were also signed up to provide accounting policies and standards, and work with the user agencies respectively. The job of training the system's estimated 7,500 to 10,000 users was turned over to the Urban Academy, an institution that's a joint venture of the City and City University of New York. Finally, the Financial Information Service Agency was established to manage the system, and the city named a board of systems executives from major corporations to provide additional technical guidance.

"May Day" environment

Given this apparent patchwork approach and the critical time element involved—New York pledged to balance its budget by 1978 in exchange for federal loans, and IFMS is a cornerstone of this effort—it's a wonder that the system ever got off the ground at all. But participants claim the "May Day" environment that surrounds development has actually proven beneficial. "Without the crisis you'd have tremendous resistence to this type of thing from the old guard who'd been doing things their own way for years," Jan M. Lodal, an executive v.p. with AMS, says. "But now everyone realizes the urgency of the situation, and we've had complete cooperation."

"Also, in an emergency situation like this we're able to use a 'top-down' approach, meaning a very small group can make decisions that go all the way down the line," adds David G. Woodbridge, a Chase Manhattan Bank officer on loan to the city for the IFMS project as special assistant to the deputy mayor for finance. "This is entirely different from a corporate environment where you work from the bottom up and are continually tied up in negotiations between one department and another."

Technically, IFMS is relying on an IBM 370/158 backed up by a 370/145 and will use load-leveling under IMS and DB/DC. Between 150 and 200 crt's will be tied into the network once IFMS evolves from a batch mode to real time. The 145 has been in operation for some time now while the 158 was recently installed in an annex of New York's Fire Department Communications Center where the IFMS data center is housed. Boiled down to its essence, this is a data base management system with on-line audit capabilities.

Massive training effort

What remains between now and "D-Day" July 1? Many of the city's workers have still not been acclimated to the new system. "We've already trained several thousand," says Dr. Warren Walker of the Urban Academy, which soon may utilize computer aided programs as part of its approach. "But this is probably one of the most massive training efforts of this sort ever undertaken, and we still have much more to do. The most difficult thing is to put together training manuals and a curriculum while the system is still being developed. We continually encounter changes, unresolved issues, and unrefined procedures."

And serious questions remain about the software. "We're like the man who falls off the World Trade Center and says 'so far, so good' as he passes each floor," says Clifford. "We've had insufficient time to test our applications software, and with our deadline we won't even be able to run a parallel."

"I'm kept awake at night thinking of the enormous programming and debugging effort still ahead of us," adds

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Woodbridge. "We've also had problems finding technical people to staff the data center, but now dp pay scales have been boosted to be competitive with the private sector which should help alleviate that bottleneck."

Woodbridge estimates that if IFMS is successful, it will pay for itself two or three times over the first year in added collections. It will also enable the city to comply with federal and state accounting procedures and perhaps put its financial house in order.

If it fails or falls significantly behind schedule, the consequences are self-evident. "From day one everybody involved recognized the extremely high risk inherent in this project," says Clifford.

—Laton McCartney

Companies

Mohawk Data: Trim And in the Black

Quick now, whatever became of Mohawk Data Sciences Corp.?

If you can't come up with the answer right away, you're probably not alone, because the once high-flying miniconglomerate has been maintaining an extremely low profile over the past few years. But now, after a major restructuring and some severe losses, MDS has emerged with a new management team, new products in the distributed processing area, and a renewed commitment to some of the fundamentals that originally made it successful.

"We have returned to a more stable operational and financial footing," MDS chairman and president Ralph H. O'Brien says of the turnaround. "And we're now much better positioned for growth in the years ahead."

Not long ago MDS' footing was anything but stable. In the late 1960s when its stock was up over 100, Mohawk decided to become "the company that could surround the computer" with a wide array of plug to plug compatible peripherals. Previously it had concentrated on the data entry market, and in order to expand its horizons the firm acquired a number of companies in the peripherals field.

MDS was biting off far more than it could possibly chew, as it turned out. "It was a classic case of what can go wrong when management spreads its attention too thin and moves into markets it doesn't know well," observed MDS sr. v.p. Douglas A. Davidson.

The consequences of playing miniconglomerate soon began to show up in the balance sheet. In 1973, MDS registered a net loss of more than $3 million. The figure jumped to $16.5 million in '74 and $21.6 million in 1975.

Enter Ralph O'Brien

1975 was also the year that Ralph O'Brien came over to Mohawk from Litton Industries where he was executive v.p. responsible for business systems and equipment. In his 21 years at Litton, the 48 year old O'Brien had witnessed first hand the problems in operating

RALPH H. O'BRIEN
He lopped off unprofitable businesses while managing to keep banks at bay

conglomerates and immediately began cutting MDS back down to manageable size.

"Ralph simply lopped off whatever business wasn't profitable while managing to keep the banks at bay long enough for us to get back on our feet," an associate explains.

Specifically, under O'Brien Mohawk has shut down plants in Pennsylvania and Long Island; consolidated what had been far-flung manufacturing operations into central facilities at Herkimer, N.Y. (corporate headquarters are in Parsippany, N.J.); reduced bank debt to $45 million from about $102 million; and shown a net income gain of $13.6 million for the last fiscal year—the first profit on Mohawk's books since 1970.

O'Brien also managed to bring aboard a high caliber of managerial talent. Davidson came over from Honeywell where he had been v.p., Information Systems, North American Operations. R. Watson Bell, MDS chief financial officer, had been with Lennox, Inc. and logged 13 years at GE. Other came over from Singer, Univac, and Control Data.

What attracted this group as well as

O'Brien himself was the fact that despite its problems, MDS' inherent strengths were impressive. "The company has a base of 6,500 customers and produces a steady income stream since 68% of its revenues come through leases rather than through sales," says Davidson. "There was obviously tremendous potential."

Even during the lean years, the size of the MDS revenue stream was impressive, and today it's about $160 million annually; more than twice that of Datapoint, and three times that of either Four Phase or Sycor. Moreover, in the international market, from which the company derives nearly half its revenues, MDS has its own strong marketing and distributing organization while many of its competitors have to rely on outside firms—a dependency that sharply dilutes their profits abroad. "If we have anything to thank the old MDS management for today," Davidson explains, "it's that they entered Europe and retained a strong organization over there."

And though admittedly incomplete, the basic line of data entry and communications equipment and systems that remained after O'Brien's cuts—Systems 2400, 2300, and 1200—was strong, particularly after some recent enhancements. For example, the 2410, an upgrade of the 2400 which can be expanded to twice the 2400's memory capacity, is moving well, O'Brien claims, and now represents the bulk of 2400 line sales.

Rounding out the line

The overall product line has now been rounded out, Mohawk believes, with the new Series 21, a product Davidson describes as aimed "towards the low end of the intelligent terminal/distributed processing market."

Series 21 encompasses two models, the 21/20—programmed for formatted data entry and upgradable on site—and the 21/40 which is fully programmable and uses a variation of Cobol. Aimed at multiple unit sales in large corporate network situations, the 21 Series starts at $190/mo. for a single unit lease and features a 15-inch crt, memory capacity of up to 64K, and functions with up to four operator stations on each controller. "Series 21 fills a gap in our line," says Davidson. "And there are more products of this sort coming. We don't have to tell our customers to call Sycor or Datapoint anymore when they ask for this kind of a product."

As yet MDS' rivals don't seem concerned. "They've got the hardware, no doubt about it," a v.p. with one rival firm asserts. "But they don't have the software capabilities, particularly if they're going to move into distributed processing."

"That might have been a valid criticism a few years ago," counters O'Brien. "But we've dramatically revamped our entire efforts in these areas. There's a new advanced software development laboratory in New Jersey and we've put on a new engineering team. For a company our size I'd say we have as good a software and engineering capability as anyone in the country."

A further assessment of MDS from another competitor: "They don't really seem to be aggressive in a marketing sense. We rarely come up against them in a competitive situation." That will change drastically if O'Brien, Davidson, and the new team at Mohawk have their way. And to date, they've had just that. **—L.M.**

Small Business Systems

And My Dog, Spot . . .

Will there come a time when computer systems are sold like automobiles?

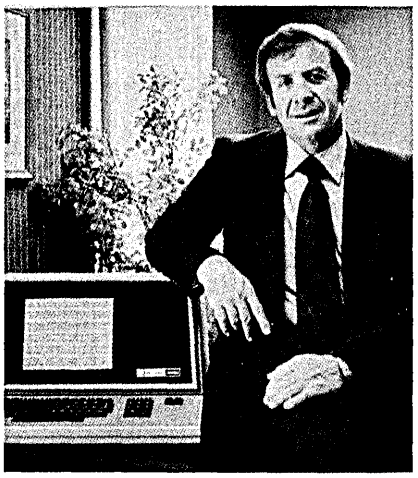
Al Cosentino, president of Business Systems Products, thinks so, at least with respect to small business systems. So does Don Fuller, president of Microdata. Both companies are located in Irvine, Calif. Both sell small business systems.

Business Systems Products was formed last July and, in mid-January, had installed one of its Adviser systems and had orders for four more. "We're the new kid on the block," says Cosentino. Microdata has been around a bit longer. Founded in 1969, it got into the small business systems market in mid-1973. By the end of January it had installed some 700 of its Reality systems.

AL COSENTINO
New kid on the block

The two presidents agree on another point—that California's Orange County is the minicomputer capital of the world. They could be right. Not in terms of numbers of minicomputers produced and shipped. That record belongs in the East. But, in terms of the numbers of mini makers and companies who supply mini-peripherals, it would be difficult to find as many in close proximity to each other as there are in Orange County.

It's an incestuous group. Cosentino and four of his co-founders of Business Systems Products came out of Basic Four, a small business systems front runner also located in Irvine. Cosentino had been president and chairman of the board of Basic Four.



DON FULLER
One new dealer per month

Microdata, which already describes its Reality marketing efforts as being like that of the auto companies, went that route largely as a result of the ideas of another Basic Four alum, John Keogh. Keogh is president of Southern California Data Products, Inc., a Microdata Reality dealer in the Los Angeles area. Microdata sells Reality through a network of 26 independent dealers in the U.S. and six overseas. Fuller says they are adding dealers at the rate of one per month.

Much like the auto companies

He explained that Microdata's contractual arrangements with its dealers are much like the auto companies have with theirs. Microdata agrees to provide the dealer the exclusive right to represent himself as the Authorized Reality Dealer. The dealer agrees to a multi-year quota and also to pay Microdata promptly, averaging 45 days. The dealer agrees not to sell any computer system other than Microdata's. Microdata agrees not to sell Reality systems through any other distribution channel, other than the dealer network. Typical-

ly, a dealer is capitalized at around $250,000, Fuller said.

Microdata's dealers have an organization which has officers and holds regular meetings. They do all the applications software for the systems they sell. Fuller said they share some of this and sometimes sell to one another.

Last month the dealers were given a second family of products to sell, Microdata's Express systems which it has been selling oem since its introduction last June at the National Computer Conference. Express is based on a stack processor computer and is offered in two configurations. Express I has memory expansion up to 128k bytes and disc capacity up to 50 million bytes, with expansion provisions for up to eight users. Express II has memory expansion up to one million bytes and disc storage up to one billion bytes and supports more than 32 users.

Software called English?

Software provided with Express includes Cobol, Fortran IV, and Basic. Software provided with Reality is called English, a name Microdata, surprisingly enough, was able to trademark. Reality users also can use Basic. Fuller said price range to end users of the two families of systems is about the same, from $30,000 to $250,000.

Cosentino is looking further into the future when he talks about selling systems like cars. "When the price of a system gets down to the price of a car, say $6,000, they'll be sold at dealer locations." A customer wouldn't be able to drive one away but supposedly he could go into a showroom and browse. And Cosentino thinks this could happen in as few as five years.

Business Systems Products' systems are Adviser II and Adviser III. Adviser I, which will be microprocessor based and will sell at $12,000 for a total system, is under development. Advisers II and III use Computer Automation cpu's, Pertec disc drives, Data Products and Tally Corp. printers, and Computer Automation video terminals. Cosentino said he eventually plans to manufacture his own hardware.

Microdata does and Fuller thinks this is the only way to survive in the burgeoning small business systems market which has an estimated 100 entrants. Microdata rounded out its manufacturing capability to include printers when it acquired Applied Computing Technology last year.

The Adviser system

Business Systems Product's Adviser II, with a base price of $38,400, includes 64K bytes of core memory, a 10 megabyte disc drive, a 100 cps, 80 column matrix printer, and a four port multiplexor. Its operating system is called Avos for Adviser Virtual Operating System. Programming language is Abol (Adviser Business Oriented Language), a derivative of Cobol.

Cosentino said Adviser II can be expanded to include eight crt's handled by the same 64K memory, and disc storage of 40 megabytes.

Adviser III has a base price of $65,800 and includes the same 64K of core memory. It has an 80 megabyte disc drive, an eight port multiplexor, a 165 cps matrix printer and one crt. Core memory can be expanded to 306K bytes, disc to 640 megabytes, and crt's to 24.

Currently Business Systems Products is selling only in Southern California. They opened a Santa Monica office in December and are planning offices in San Francisco and San Diego. Cosentino said he expects to have all of California covered by the middle of next year. Up to this point, he said, he expects the company to continue to be self-funding. Two years away he foresees national expansion which, he says, would require outside funding.

Business Systems Products has 12 employees. All, with the exception of chief financial officer, H. D. Thoreau, are alumni of Basic Four.

Cosentino thinks the small business systems market "is big enough for everybody. From current independent data processing industry statistics," he said, "it is known that the small business computer market, the installed base of small business systems, is expected to grow from just over $3 billion at year end 1975 to more than $7.5 billion at year end 1980. The portion of that base attributable to non IBM mainframes will approach $2 billion by then."

Says Microdata's Fuller: "Database management-oriented small business systems are going to become a vital part of our international markets in the decade ahead. This type of operational mode, the on-line transaction processing mode, will be in my opinion, the fastest growing functional use of computer systems of all sizes, but nowhere will the growth be more dramatic than for small business systems with a purchase price in the range of $25,000 to $150,000."

—E.M.

Health Care

That Tooth's Long Gone

Imagine a dentist charging for repairs to a tooth a patient had lost earlier, or a charge for a bottle of cologne rung up as a prescription drug charge.

Samuel X. Kaplan did and he did something about it. In so doing, he parlayed an idea into a 100 person firm handling multi-millions of dollars in administering employee benefit programs.

Some ten years ago, Kaplan, an engineer by training, moved to California after selling off an engineering firm he had run in the mid-west. He moved because "I like it here." He became interested in the administration of employee fringe benefits. "I naively assumed that hospital and medical programs were all tied up. At the time, (the late Senator Estes) Kefauver was sounding off about high drug prices. I decided to look into prescription drugs as a fringe benefit."

Photo by John Waterhouse

SAMUEL X. KAPLAN
Words of one syllable please

Kaplan decided he needed to know more about pharmaceuticals, so "I opened a pharmacy from scratch. I learned from a sharp pharmacist. I learned everything a pharmacist could do to cheat." In about a year he was enough of an expert to be asked to be the speaker on prescription drugs at a UCLA seminar on "Emerging Fringe Benefits." Shortly after that he negotiated his first contract to administer a prepaid prescription drugs plan for a company. He formed Pre-Paid Prescription Plans, Inc., a company name he retains today along with United States Administrators, which handles medical, dental, pension, and trust fund programs, and Fundumatic which does mutual funds accounting.

His idea went beyond the basic administration of prepaid prescription drug plans to the control of such basic abuses as a druggist selling a friend a bottle of cologne and ringing it up as a prescription drug charge; filling a prescription for one person and writing it up as if it were for a person covered by the plan; and short counting (fewer pills in the bottle than actually were called for).

Needed a computer

"They said it couldn't be done," says Kaplan, "and I knew it couldn't without

a computer." His idea was to establish patterns against which future claims could be judged.

He took his idea first to CEIR (which later became a subsidiary of Control Data Corp.) and then to (then) IBM's Service Bureau Corp. "They didn't know what I was talking about and I didn't know what they were talking about. They wouldn't talk in words of one syllable. They built up a mystique around their computer systems. Since then I've insisted that all my data processing people limit their vocabularies to words of one syllable so I'll know what they're talking about."

So Kaplan assembled a group of moonlighting data processing people who helped him develop his first system: they would rent raw time from companies with excess capacity.

In 1969, Kaplan got the idea of establishing a mutual funds service bureau. He approached John Parry and Don Foster, both data processing employees of American Express Investment Management Co., a mutual funds subsidiary of American Express, with the idea.

"The timing was all wrong," recalls Parry, "but to keep us, Sam brought us into U.S. Administrators." The two became the nucleus of Kaplan's data processing staff. Parry is vice president of data processing and Foster is vice president of computer systems.

Did everything

The firm continued to rent outside computer time. "We did everything," said Foster, "even running the machines."

From prescription drugs, Kaplan turned his attentions first to dental plans, then to medical plans, and subsequently to pension and trust fund programs. "It took us three and one-half years to develop our dental system, and more than that to develop the medical system," said Kaplan. The company today has six major computer systems. The mutual fund accounting system, its newest, is the only one not connected with fringe benefit programs.

With the dental program, claims for work exceeding $100 are fed to the system before the fact. Stored in the system are dental profiles of every insured person and their dependents. A quick look through Kaplan's voluminous stack of print-outs of rejected claims shows the most common reasons for rejection are for claiming for work on teeth no longer existent or for work that has been done before.

U.S. Administrators' health care program is probably its most ambitious. "We set about to conceptualize, design, and implement a quality assurance program that works effectively both to control costs and to improve the quality of delivered care. Other health care program administrators simply write checks. We're swinging a club. We have defined procedures that not only are responsive to the cooperative and capable doctor who practices according to established standards and guidelines, but also identify and deal effectively with the ones who are incompetent or dishonest."

An effective monitoring system, says Kaplan, means a proper balance between computer evaluation and human evaluation. "The computer of course, is essential. Without it there would be no means for both storing and making readily available the vast amount of health care data that is required to make the system work. In fact, it is accurate to say that without the advances in computer technology of the last ten years our system would not be feasible.

Only a tool

"But," he says, "the computer is only a tool. And as a tool it can be no better than the information you've stored in it, so we set out to create and store the most complete and equitable set of health care standards and guidelines available anywhere."

"When we began our research," Kaplan said, "we found that while considerable data exists on the hospitalized patient, such as average duration of stay, services rendered relative to diagnosis, and costs related to diagnosis, practically nothing was available on the ambulatory patient. What constituted usual or customary practices in the private physician's office also was an unknown quantity. So, we decided we would have to establish our own baseline profiles for claims review."

To accomplish this, U.S. Administrators set up a Council of Health Professionals composed of 20 "outstanding" physicians, dentists, and chiropractors. All specialties are represented. All council members not only are practicing professionals but also are on the faculties of major medical schools.

The council, working in conjunction with various professional societies, compiled and summarized all available health care data. The refined data, combined with the council's own expert knowledge, became U.S. Administrators' initial screening criteria.

"Our profiles," says Kaplan, "today represent only acceptable quality care, not optimum quality. As more and more claims are processed," he explained, "the baseline is not only being continuously updated, but the criteria for optimum care is being developed."

Basic document

The claims process begins when a doctor completes and submits the basic claims document. This is manually screened to assure that all pertinent data is included. The information is then entered into the computer for processing. For data input, U.S. Administrators has

news in perspective

12 key to disc entry stations from the CMC Div. of Pertec Computer Corp.

The computer system checks all aspects of the diagnosis and treatment against the appropriate standards and guidelines. If everything matches properly—and 68% of the medical claims usually do—a check is in the mail within 24 hours.

The remaining 32 percent, Kaplan said, are subjected to manual review by lay experts. Questionable claims are passed on to professional consultants who may approve the claim or, if necessary, refer it to a specialist in the field. If the specialist can't determine the proper course of action, he refers the claim to the Council of Health Professionals. Kaplan said only seven or eight percent of the claims reach this stage.

The system, he said, is "effective in uncovering those practitioners who are flagrantly incompetent or dishonest. Abuses are rarely isolated incidents; they tend to cluster and the system is quick to pick up the pattern. The chronic offender is not only pinpointed, he is subjected to two powerful deterrents: loss of fees and peer pressure."

With the dental claims which are reviewed before the fact, Kaplan said, "We reject 29% of everything we see." The rejection doesn't always mean a reduction of fee, it can mean an increase if the system determines the work to be done is not adequate in a given case. Kaplan said that 93% of the rejections result in reductions and seven percent result in increases. An increase might result, he said, when a patient who hasn't been to a dentist in a long time is having some pain, and goes to a dentist asking to have all of his teeth pulled and a plate put in. "This could leave him a dental cripple," said Kaplan. "Our system could determine that he has a number of saveable teeth and that a better, though more expensive solution would be a partial plate."

Have staff now

Kaplan's top dp men, Parry and Foster, are no longer doing everything. In addition to 12 data input operators, they have a staff of eight (including themselves) in systems and programming and four in computer operations.

And they no longer rent outside time. They got their first hardware, an IBM 370/135 with four tape drives and no terminals in 1973. They have since increased memory to 256K and have added four additional tape drives and 32 IBM 3270 crt's. The terminals are located in the various departments and are used primarily for display, although some input is done there. "Although the system has on-line capability, we do most of the updating in a batch mode at night," said Foster. "The operators sometimes think they're updating on-line, but we know better."

They currently are developing their first on-line system to use remote terminals. This will be for trust administration and they expect to have it up by July. Foster believes it won't be too long before they'll outgrow their 135 and have to go to a 148, "or maybe two 135's."

Kaplan has a different philosophy of hiring when it comes to data processing personnel than he does with the rest of his staff. For his dental and medical departments, he likes people who have had some dental or medical experience. "In data processing, we won't hire anybody who has ever worked anywhere else. We take top people right out of school and we train them."

A part of the training, no doubt, is talking in words of one syllable.

—E.M.

Privacy Safeguards Urged by Westin

"Basic citizen rights cannot be made a casualty of technology assisted health systems. To do so would be to betray the tradition of Hippocrates, and ultimately to dehumanize health care itself." This is the ominous warning sounded by Dr. Alan F. Westin in his latest privacy probe into the impact of computerized health and medical record systems.

Westin's 381-page study, sponsored by the National Bureau of Standards' Institute for Computer Sciences and Technology, culminates a two year, $37,000 effort to pinpoint the privacy threats posed by computerization of personal health and medical care data. While the bulk of privacy violations still stem from mismanagement of manual files, the report forecasts an increasing potential for privacy infringement from computerized medical systems.

"What makes such potential harm particularly serious for civil liberties," the report points out, "is the fact that these possibilities of misuse have not been taken into account and dealt with effectively by the managers of such computerized systems." Another problem, according to the Westin report, derives from the technology itself—the hardware and software "bugs" in every new generation of computer/communications equipment. "Until we are much farther down the road to a stable and disciplined technology than we are now," the report cautions, "we must constantly take it for granted that

automated systems have a propensity to go awry."

"Acute privacy problem"

But it's the "social uses" of medical data stored in these automated systems that particularly worries privacy proponents. At a press conference last month, Westin explained why the flow of this sensitive information into the hands of insurance companies, employers, and other social use institutions creates the most "acute privacy problem." Citing several examples of abuse in this area, he went on to assert that "Americans have lost control of the flow of medical information about them in our society." And to make matters worse, he complained, the present laws are "very bad in terms of privacy protection" of medical records.

Unlike the "days of Marcus Welby and Dr. Kildare," Westin noted, "medical care today is an impersonal system involving many specialists and institutions." And supporting all this impersonalization and institutionalization is computer technology which Westin claims shifts the privacy onus from doctors onto the builders of medical data banks. For it's these system planners and designers, he argued, who must deal

DR. ALAN F. WESTIN: An authority on privacy, he received three national awards for "Privacy and Freedom," a comprehensive study of the political and social function of privacy in a democratic society and of the dangers posed by technological advances in physical, psychological, and data surveillance. Other books: "The Anatomy of a Constitutional Law," "The Supreme Court: Views from Inside," "Freedom Now," and "Privacy and Freedom." He's a professor at Columbia Univ. and a member of the National Academy of Computer Sciences and Engineering Board where he was director of its project on computer data banks. The results were published in the 1972 study, "Data Banks in a Free Society." ❋

with the privacy realities of record access and distribution.

Westin also has his own opinions on how to safeguard computerized medical data. "Stripping personalized identifiers," he contended, "is the best way to ensure privacy." His other suggestions, bundled into his voluminous report, are modeled after many of the stipulations spelled out in the Federal Privacy Act of 1974. Garnered from "real world" information handling practices, Westin's 12 recommendations provide the standard privacy remedies: the right to see what goes into a medical file; the right of consent for release of that information; and the right to correct erroneous information.

Routine safeguards

More specifically, the report calls for routine privacy safeguards on all health data systems. All new systems, according to the recommendations, would be subject to review by an outside authority, such as a state health agency. This oversight review would also be augmented by public hearings. Existing systems, under these requirements, also would be periodically looked at for conformance with privacy principles.

Although these recommendations are not yet backed up by law, "managers of every health data system ought to follow them," Westin urged. Now is the time, he insisted, to plug up the privacy loopholes in these systems. Now is the time, as he points out in his report, to recognize that "given the more detailed, more centralized, more permanent, more easily transmissible quality of computerized medical records, the flawed procedures and policies currently employed with respect to manual records threaten to be seriously inadequate to the computer era."

—L.F.

International

ICL's U.S. Operation: Looking Beyond NYC

It's difficult to be impressed with a large foreign mainframer that spends more than two years in the U.S. and only manages to sell 21 small business computers. The British firm, International Computers Ltd., has posted that record with its American subsidiary, now called ICL Inc., but there are signs that finally they may be rolling.

Those 21 small systems they've sold have been purely in the New York City area, where ICL installed a staff and a customer support center in November 1974 to market its 2903 and 2904, competitive with various IBM System/3 models. Sales v.p. Eli Hiller claims ICL is number two in this territory with this size machine, having sold more than Univac has with its 90/30 and than Burroughs, with its B-1700 range machine.

Meanwhile, the firm has laid the foundation for expansion by buying up the manufacturing facilities of Singer Business Machines last summer. As of Jan. 3, it took over full ownership of the Singer/Cogar plant in Utica, N.Y., and the machinery out of its Albuquerque, New Mexico, plant (the facility itself was sold to Digital Equipment). It also is now establishing 12 sales offices around the country, manned by 36 marketeers, to sell enhancements and parts of the Singer products to the existing customer base and to strike out for new business for Cogar 1500 intelligent terminals and the successor products to the aging Singer System 10.

A worldwide supplier

TRW owns the existing Singer customer base in the U.S. and ICL owns it abroad. Thus the plant here will be a worldwide supplier for those products.

There are about 1,000 Cogar 1500s here and another 3,000 to 4,000 overseas. There are a few thousand 10s worldwide, and an "unknown" number of Singer point-of-sale devices. While initial new sales efforts here will be for the 1500 and 10 successors, ICL is still examining the point-of-sale market and the obviously entrenched competition.

Considering the more solid U.S. foundation for ICL, plus the fact that it is involved with Control Data and NCR in Computer Peripherals, Inc., one can see why ICL's new local executives are more optimistic than ever before. (ICL has casually entered the U.S. market several times with New York efforts to sell its earlier product lines. Its only notable achievement was a service bureau.)

R. J. "Spud" Taylor, new president of ICL Inc. and head of ICL's Americas operation; Frank Connors, president of the U.S. manufacturing operation, and Eli Hiller met with a DATAMATION reporter last month to discuss plans for the expansion of both the Singer and ICL product marketing effort.

Connors, flushed with "exciting" news from Utica, N.Y., where ICL was getting incredible play from the local tv stations because of its takeover of the Cogar facility, said, "I was on three channels last night."

Depressed town

Utica is a depressed town. Univac and Mohawk Data have virtually moved out of the area, and everyone expected more bad news when Singer announced its withdrawal from the computer business. The Cogar plant employed 360 persons who would have an impossible time finding jobs, without moving away. Connors moved in late July to manage the facility for Singer until the ICL full takeover last month. His staff examined the operation and decided to retain almost all employees and recently committed to add another 60 persons this year. ICL has also taken over 140,000 square feet of a nearly deserted shopping mall there, and says Connors, they hope to expand even more.

Taylor's financial projections are quite good compared to the past. An ICL management veteran of hard-fought wars who once oversaw the installations of the first big 2900 machines in the U.K., Taylor looks for a 400% increase in revenues in 1977. ICL Inc. will move from $2.5 million in 1976 to $10 million in 1977, mostly due to the Singer line. In 1978, Taylor hopes that will double to $20 million, with most of that increase coming from sales of 2900 products, including the 2903, 2904, and larger 2900s not yet introduced in this country.

ICL has been promising some expansion of 2900 sales outside New York for two years. Its staff has been hampered by the geographical restriction. Taylor said that the Singer buy was the simple reason this expansion has not come sooner. There was too much to do. But he expects about three new 2900 sales locations will be opened before year end, with at least two being in the Northeast. One user is already pushing for a Massachusetts installation.

Customer center concept

Taylor noted that the customer center concept, in which users travel to the center for training, debugging, and other support has been successful, although there has been some customer resistance. He allows that ICL will not necessarily stick to that concept in every location, varying its approach from on-site support to a joint user-vendor center.

Besides these current direct sales plans, the British executive stated that ICL is still looking to expand its involvement in the U.S. with joint ventures and/or acquisitions of companies with complementary product lines. "Sanders Data Systems, for example, would have been such an acquisition possibility if the timing had been right." (It's been acquired by Harris Corp. of Cleveland.)

Talks with a few of those users make one fact evident: they won't say it has all been trouble free, but they're happy with the kind of hand-holding support that invariably comes from a new company on the block. They know ICL's test will come as it expands and stretches its resources, although they're a bit more assured that ICL is committed to the U.S. (The first year was a sluggish, investment-poor one for the U.S. staff, which led to some management defections and unpleasant public criticisms of the defectors by ICL executives in the U.K. These resulted in public apology.)

If the British company is sometimes painfully aware that it is a foreign interloper, evidenced by its own advertising, its users seem unaffected by the fact. Ed Manello, president of Port Computer Services, said he was comfortable going with an established, large ($500 million) mainframe company. (ICL has well over 1,000 2903s installed worldwide.) Choosing a U.S. vendor is no guarantee of stability, he said, pointing out that his firm uses a Xerox Sigma 9. He considered going to a minicomputer manufacturer, but they wouldn't provide the software support and suggested he go to a systems house. "What would I do if that small systems house went out of business?"

Support and growth

Manello, whose firm provides medical billing and other services, notes that ICL offered not only much support (back-up time, applications, fast repair response time), but also upward-compatible avenues of growth. A 2904 is on order, and Port is a good prospect for medium-scale systems ICL may bring into the U.S.

—Angeline Pantages

such subjects as communications theory, advanced message switching, high speed communications, developing transmission concepts, technical control, and network simulation techniques. Speakers are: Howard Curtis, of Arthur D. Little, Inc.; D. P. Fulghum, program manager of speech programs at E. Systems, Inc., Garland, Tx.; Ted S. Britton, Information and Computer Services Div., State of Georgia; and Thomas F. Wyrick, of the Federal Computer Performance Evaluation and Simulation Center, Washington, D.C.

Product Updates

Eight sessions called *Product Updates* will bring attendees up to date on such products as hosts, front ends and communications processors, switching systems, data base and communications software, and diagnostic testing and technical control. Ronald Sander, senior computer specialist with the U.S. Senate, will chair a session on diagnostic testing and technical control in which it will be noted that the tech control center has become a new approach to improving productivity.

Other sessions in the product update section of the program include reports on modems, multiplexors and network processors, crt's and teleprinters, remote data, job and batch entry, and distributed computing systems. This last session, chaired by Richard L. Deal the Washington consultant, will present a review of major approaches being taken and the more advanced hardware/software tools leading the thrust towards distributed processing.

Service Updates

The proliferation of transmission services will be reviewed in a series of six sessions, entitled *Service Updates.* They'll cover low-speed transmission services, Bell's services, those of independent microwave and specialized carriers, international carriers, packet switched carriers, and value added services.

Highlight Sessions

Ten sessions, entitled *Highlight Sessions,* will address evolving products and policies. Dr. Stanley Cohen, senior scientist at Argonne National Laboratory, Argonne, Ill., will talk on graphic terminals, explaining how they'll find homes in the most remote locations to handle chores for businesses and sciences. There will be discussions on international standards and protocol transparency as well as on teleconferencing, word processing networks, and facsimile systems and services.

Consultant Paul Armer of San Francisco will talk on the privacy and security aspects of data communications. He'll ask: to what extent and at what cost should people implement secure systems procedures to ensure privacy?

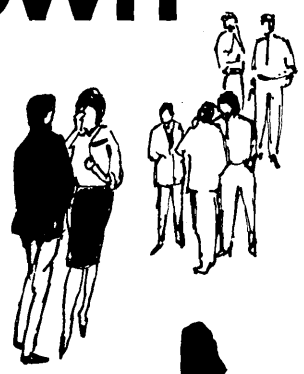
George Smith, director of telecommunication marketing for Avis Corp., will chair a session on Users Vend Excess Capacities. Many users are getting extra mileage from their data communication system by vending excess capacity to other users. Large dedicated networks spanning the country may offer cost-effective alternatives to users.

Exhibits

While both conferences are similar, Data Communications Interface 77 is turning out to be a large trade show as well. Some 120 exhibitors are listed by the sponsors who said the turnout, including magazines and trade associations, might rise to 150 by the time the show opens in late March. That, they say, should improve attendance which last year ranged around the 2,000 mark. This year they're expecting some 5,000 persons, and buoyed by that outlook have now launched a similar show in Los Angeles next November for West Coast data communications people.

Registration fees for the two conferences are $95 for all three days or $50 for one day. Companies sending more than two people will be charged $50 and $25 for the third and additional persons. ❋

How to get your own free ticket to COMPUTER EXPO 77



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Cleveland Convention Center—April 19–21
Minneapolis/St. Paul, St. Paul Civic Center —April 26–28
Chicago, McCormick Place—May 3–5
New York Coliseum—May 10–12
Philadelphia Convention Center—May 24–26
Washington, DC, Sheraton Park Hotel —May 31– June 2
Boston, Northeast Trade Center (Rte 128, exit 39) —June 7–9

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VISIT: *Free Exhibitor Seminars* covering the selection and use of these products and services. These free seminars will be held every day.

ENROLL: *Case Study User Forums** will be conducted in all nine cities by leading users and independent consultants. Topics are: Applying Minicomputers (Tuesday) • Managing Terminal Networks (Wednesday) • Improving Software Productivity (Thursday)

NOTE: *Computer Designer Forums** will also be available in San Francisco, Los Angeles, Chicago, New York and Boston. Topics include: Evaluating and Using Microprocessors • Evaluating Peripherals for Mini- and Microcomputers • Evaluating Memory and Storage Devices

*The Forums are held in conjunction with COMPUTER EXPO and require separate registration and fees. They are held each day from 9 AM to 1 PM. One day's admission fee is only $45; additional days are $35. Advance registration is recommended. Call (800) 225-3080 to reserve your space and get complete registration materials.

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BENCHMARKS

Telex Acquisitions: Telex Corp. has added to its product line through acquisition. Most recent was purchase of all assets of Gulliver Technology Corp., (Dec. '76, p. 174) Santa Monica, Calif. producer of a 6250 bpi tape drive. Terms of the cash agreement were not disclosed. Dan O'Neil, president of Gulliver, said all principal personnel of Gulliver will move to Tulsa. "It makes a good package," he said, "our drive and their controller." Earlier Telex moved into the IBM 3270-compatible crt terminal market with acquisition of Terminal Communications Inc., Raleigh, N.C., a subsidiary of United Technologies Corp. Terminal's operations remain in Raleigh.

Satellite Go-Ahead: Despite opposition from computer industry organizations, common carriers, and government agencies, the Federal Communications Commission in January gave Satellite Business Systems the go-ahead to develop its domestic satellite communications service. The joint venture of IBM, Communications Satellite Corp., and Aetna Casualty & Surety Co. will be built at a cost of $406.9 million over a ten year period. The company did not say when service would start, but in a five volume application for construction filed early last year, SBS said its network could be operational by 1979 if the FCC granted the application by the fall of 1976. The FCC may have solved some of the problems raised by opponents by prohibiting IBM from selling or promoting SBS services to its customers, and by prohibiting Satellite Business Systems from selling or promoting IBM dp equipment or other services. The agency said it will monitor the system to see that antitrust problems do not develop.

Opposition to AT&T: IBM and the Computer and Communications Industry Assn. (CCIA) have gone to court to protest the Federal Communications Commission's (FCC) order permitting interstate tariffing of AT&T's Dataspeed 40/4 data communications service. IBM submitted a notice of review with the Second Circuit Court of Appeals in New York, identifying the FCC decision and asking the court to review it. CCIA took its similar case to the appellate court in Washington, D.C. The New York court, first to receive a request, will handle the review and has set March 14 as deadline for appellant's brief. Replies are due by April 14 and oral argument has been tentatively set to begin April 25. CCIA also has filed a motion with the FCC asking for a stay of the Dataspeed 40/4 decision pending the outcome of the Commission's Computer Inquiry II, or alternatively, the appeal to the Federal Court. CCIA contends Dataspeed 40/4 performs data processing which requires the FCC "by its own rules, to determine whether the offering is a hybrid communications service or a hybrid data processing service which the FCC has failed to do."

Tymnet Expansion: Tymshare Inc.'s wholly owned communications network, Tymnet, has been authorized by the Federal Communications Commission (FCC) to expand its service from 61 to 105 U.S. cities by 1979 as a value-added common carrier. Telenet Communications Corp., to which Tymnet will be a head-on competitor as a result of the expansion, had argued to the FCC that it was subject to common carrier regulation, while Tymnet was unregulated and could violate the FCC's Computer Inquiry decision through subsidies from Tymshare, or by marketing data processing services rather than communications. The FCC said Tymnet has assured that it will maintain an organization and operations completely separate from Tymshare and that it will not engage in the sale of data processing services, on its own or on behalf of Tymshare.

ITT Network Approved: ITT Domestic Transmission Systems' plan to establish a nationwide, packet switching, store and forward network for communications between incompatible facsimile and digital data terminals has received Federal Communications Commission (FCC) approval. The network, called Com-Pak, will be operated on a resale basis, leasing long distance circuits from common carriers. The network will operate between 24 cities at 9.6 and 56 kilobits per second. ITT has awarded a $3.5 million order to Modular Computer Systems, Fort Lauderdale, Fla., to provide 30 small computer systems for the network.

Outright Purchases: Outright sales, vs. rentals, pushed IBM's 1976 profits to a high of $2.4 billion, compared with $1.99 billion a year ago—an increase of 21%. Its revenues were up nearly 13% to a record $16.3 billion, from $14.44 billion in 1975. Fourth quarter results—a record for any quarter in IBM's history—saw the company's income rise 15% to $674 million. Its revenues rose 11% to $4.52 billion. Breaking down its sales vs. rental revenue, the company reported revenue from rentals in 1976 at $10.34 billion, compared with $9.89 billion the year before—a relatively low increase of 4.6%. Its revenues from sales rose more than 31% to $5.69 billion, from $4.55 billion in 1975. On the outlook for a continuing high level of outright sales in 1977, an IBM spokesman wouldn't comment, but observers note that in most new product announcements IBM's pricing strategy seems to foster sales over rentals.

Burroughs Corp. had a good year, reporting revenues of $1.9 billion, compared with $1.7 billion in 1975 and a net income of $185.9 million, compared with $164 million in 1975. Sperry Rand Corp., preparing in late January to announce its first small business computer—the BC-7—also reported a gain of 4.8% in third quarter income to $36.7 million from $35 million a year ago. The "modest" gain was due to reverses in its non-computing operations.

For the Home and Hobbyist: A burgeoning market in computers for the home is forseen by Venture Development Corp., Wellesley, Mass. The firm completed a study which showed that purchases of computers and related products for home use will increase at an average 37.2% annually for the period 1976-1981. The study also showed that not all computers used in the home are so-called "hobby computers" but that some are industrial single board prototyping systems adapted to that purpose. This year, for example, VDC said, 22.5% of the 24,164 computers purchased for home use will be supplied by such established "non-hobby" manufacturers as Intel, National Semiconductor, Texas Instruments, Intersil, and MOS Technology. Copies of the complete study, "The Home Computer," including product descriptions, manufacturer listings, and addresses of hobby computer stores and organizations, are available for $950 each from VDC, One Washington St., Wellesley, Mass. 02181.

Memorex In System/3 Market: In a strong bid for a chunk of the lucrative System/3 user market, Memorex Corp. has agreed to acquire two Orange county, Calif. firms which sell big in that market. One is Lencor International, sole owner of CFI Memories, Inc., Anaheim producer of disc cartridges, flexible discs, tape, and System/3 semiconductor add-on memories. The other is Business Systems Technology, Inc., Santa Ana, which produces disc drives, memories, and printers for users of small systems, primarily in the System/3. Memorex agreed to pay Lencor shareholders $2.4 million in cash and 200,000 shares of Memorex common stock. The BST transaction involves exchange of 346,000 Memorex common shares for some 501,500 of BST common shares. Both BST and Lencor exceeded $10 million in sales in their last fiscal year. ✻

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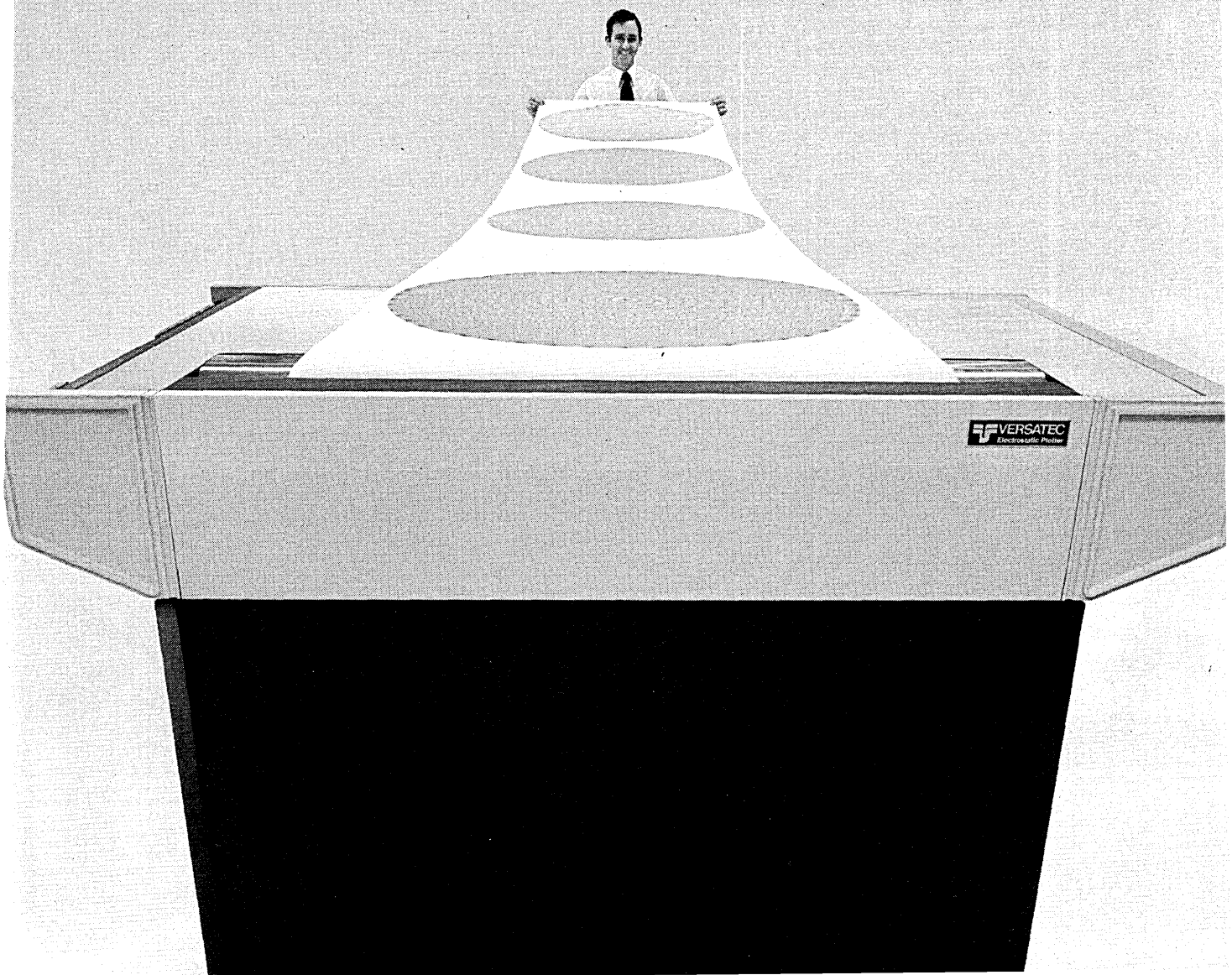


LOOK AHEAD

(Continued from Page 16)
problems with the hardware "are being addressed" by the New York bank.

Gould, a former Interdata v.p. of system engineering and software development, said the bank had to use larger disc drives than those originally supplied by Control Data through Interdata and it had problems with applications software--a package of programs provided by "about 10" different software vendors. He denies comments from other minicomputer vendors who blame the trouble on the bank's uncompromising determination to use Cobol for the several discrete securities functions.

The original $2 million contract with Interdata was signed in the fall of 1975. And the bank's schedule called for the on-line system to be running Jan. 1, 1976. Then, after delays, it was supposed to take over all stock transfer functions from a 370/165 mainframe by July 1. Six months later, says another Citibank source, the securities transfer division is still relying heavily on the IBM backup. Interdata has installed at least a dozen 8/32s, says a competitive source, and there is talk of another 32 being on order. Gould denies this, saying only that the bank now has "about five machines over what we had before" and that this is due to normal expansion. He calls the problems normal start-up problems on a new system in a new and complex application. Other sources familiar with the situation call it a "disaster, a continuing fiasco."

BANK TERMINALS SIT AND WAIT

Giant Citibank has quietly been installing and debugging a network of crt's and minicomputers designed to provide its branch banks with on-line account adjustment and loan approval capabilities. Called Citiscreen, the network is up and running in a number of downtown Manhattan banks but has run into implementation snags elsewhere. "We've had the terminal sitting here for two months and it hasn't even been programmed yet," the manager of one midtown branch says. "All we get is some sort of electronic burp every morning about 10."

Another delay: the bank planned to use both in-house and outside sources for on-line credit evaluation, but now foresees problems in the privacy area that may preclude this application.

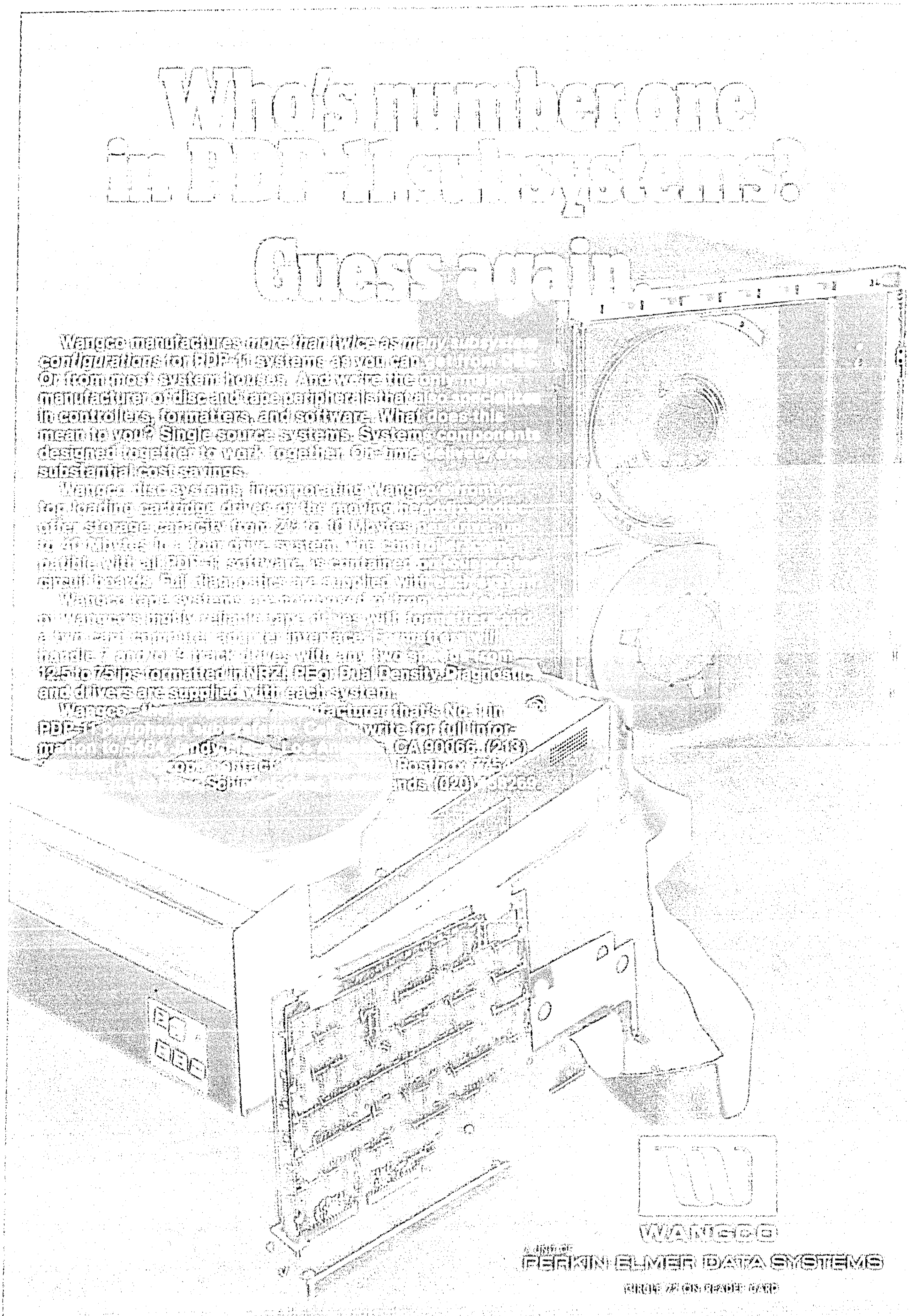
YEAR-END COMPUTER CAPER

Most bright young operators sometimes ponder the perfect computer crime. In January, Rodney Cox tried to act out what he had confided to colleagues was a lifetime ambition. Cox, in his mid-twenties, was an operations manager for Imperial Industries in Britain. One weekend he went to a subsidiary of the company in Rotterdam and made off with all copies of crucial year-end information. The security man on the door helped Cox load the heavy cartons of tape into his station wagon. He then stole the father and grandfather files and held them for ransom. Cox and an accomplice were apprehended when they tried to pick up the close to $500,000 ransom in Britain.

Correction: Last month Datamation reported erroneously in this column (p. 16) that Porter Paint Corp. of Louisville, Ky., had filed suit against Honeywell. No filing has been made with the Western District Court of Kentucky.

RUMORS AND RAW RANDOM DATA

A help wanted advertisement in the New York Times asks for "Sales representatives to market IBM Series/1 business computer systems" and gives a Rhode Island telephone number. The number is that of Span Management Systems, which sells business systems based on Digital Equipment minis, and a person answering the phone says the "IBM thing is confidential. Call back in three months"...The Bell Labs operating system UNIX, produced by the Labs for the PDP-11/45 and widely successful among universities and in research facilities, is about to migrate to the Interdata 8/32, despite heavy pressure from DEC to generate the system on the DECsystem 20. DEC, which once had a chance to secure the entire operating system for its commercial customers is miffed to say the least...IBM's new Office System 6 appears to be a step towards the fabled office of the future--supporting text processing, record processing with automatic recall of text records, and communication with other word processors or with computers, so that data and word processing can conceivably be intermixed. With that intermix, Office Products has now fully exposed itself to its siblings--Data Processing Div. and General Systems Div., whose cannibalistic tendencies it fears.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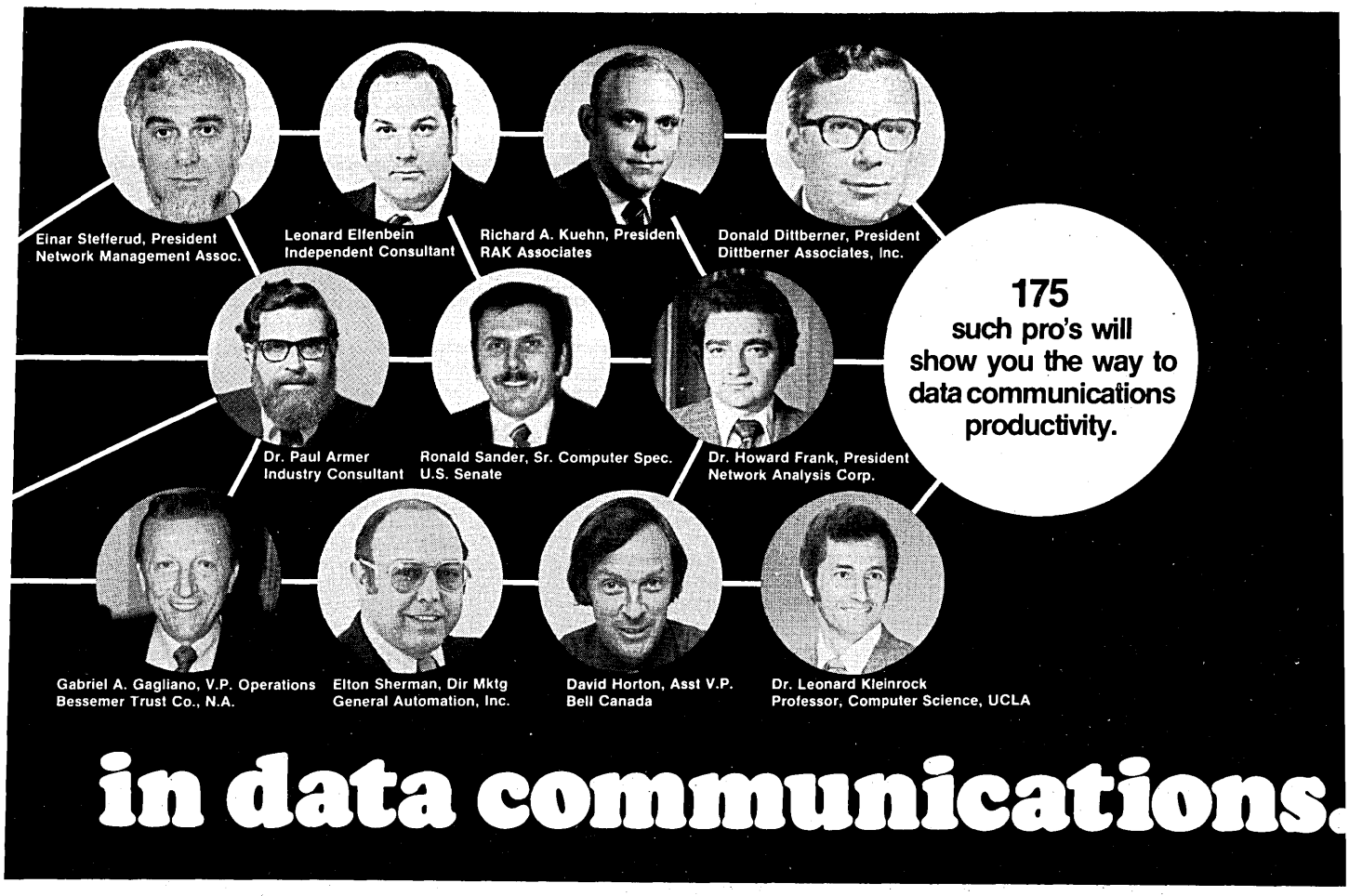

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hardware

Off-line

IBM continues research into faster, cheaper, more reliable memory technology. The latest announcement is of an experimental 64-bit dynamic random access memory array with spatial density approaching the conceptual limit of the intersection of two conductors. The new device structure, which uses a new form of surface charge storage, is fabricated using charge-coupled techniques and achieves a storage element size of approximately one ten millionth of a square inch. The storage cell differs from conventional field-effect transistor memory cells in that the charge storage capacitor is structurally merged with the bit line.

On the subject of memory, rumor has it that Hewlett-Packard is planning a drastic cut in the price of 8K memory boards, from $1,100 to $750. Good news for users and bad news for competitors.

Where will the ubiquitous mini show up next? The largest taxi company in Ottawa, Canada, is the first on the North American continent to install a computerized taxi dispatch system, complete with terminals in the taxis. The owner of the taxi company says the development is making customers happier since they don't have to wait so long for a cab, and it's saving the company money. With the standard voice dispatch system, taxis would be sent out for riders who could not be found--due to an incorrect street name, or the lack of an apartment number. Now, with the Data General mini, call takers at the Blue Line company are prompted to obtain apartment numbers. Information is then displayed in the cab's terminal. Digital Methods of Ottawa came up with the $1 million system.

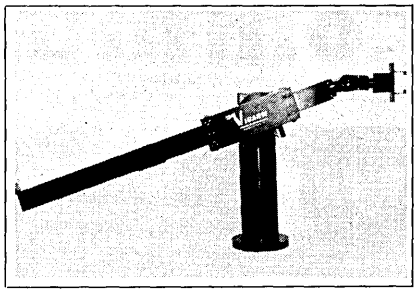
Meanwhile, arch-mini rival DEC was busy planning to install the largest computer it has ever developed, a DECsystem-1099 large-scale, dual processor configuration with 512K words of storage, or about the equivalent of 2 megabytes.

A 16-page analysis of the IBM System/32 is available for $10 from Management Information Corp., Cherry Hill, N.J. 08034

The Tab Products model 700 key-to-diskette product (December p. 179) places its data on IBM-compatible diskettes, and not on cassettes, as we stated.

Robot Arm

Robots are slowly pushing their way out of the research laboratory and into industrial use. This manufacturer claims to have pilot installations in at General Motors, the National Bureau of Standards, and "a large semiconductor house" where it is used to assemble calculator electronics. Called the Standard Manipulator System, the device consists of an access arm with two-fingered hand, a data acquisition and command interface unit with 32 channels of analog to digital conversion capacity, a DEC LSI-11 micro with 20K words of memory, and a key-board terminal. The arm is servo-controlled for position, velocity, and torque at all points. It features six degrees of freedom—not compass degrees, but rather



unique motions, or every motion you can make with your shoulder, arm, and wrist. The arm will work at speeds beyond those attainable by humans, and is designed to replace special-purpose assembly machinery, but could also obviously be used to scare the hell out of the more lethargic assembly line workers! The unit is programmed in a proprietary high-level language compatible with the PDP-11 series. The manipulator load capability is 4 kg (about 10 pounds) and the working volume is a 2-meter-diameter sphere. The SMS is priced at $48K, with installation handled under a separate contract. Delivery time on specialized items such as this one is somewhat longer than usual, requiring about four months. VICARM, INC., Mountain View, Calif.

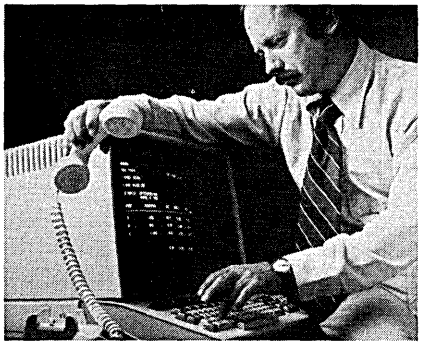
FOR DATA CIRCLE 226 ON READER CARD

Distributed Processing

The pitched battle being fought for the distributed processing market has a new, but established, supplier. Inforex has built a good reputation in the relatively small configuration data entry market and is now moving into competition with such established central site equipment suppliers as Sycor, Datapoint, and Four-Phase. Essentially the System 7000 provides the user with a means of doing data entry, data validation, and management of locally stored files wherever he or she is located in the company. The controller, which contains a 16-bit minicomputer and up to 128K of semiconductor memory, talks to a controlling crt terminal, itself equipped with a 16-bit microprocessor. The controlling terminal can support up to seven additional remote terminals, with plans afoot to upgrade this number to 16 or 32. Other components of the system might include up to 100 megabytes of disc storage, up to four diskette drives, and a choice of printers ranging from a 30 cps serial device up to a 600 lpm line printer.

What may prove key to the success of the 7000 is the choice of software for it: it's ANSI 74 COBOL, which has been enhanced to better serve the 7000's intended applications. The system, designed with the help of an extensive independent study of user wants and needs in such equipment, also sports three file access methods and four security features. Before the end of the year, Inforex plans to add RPG II capability to the system to make it easier for users knowing that language to obtain local reports.

A typical system, with 64K of memory, three satellite terminals, 10 mega-



bytes of cartridge disc storage, a 9-track tape drive, a 165 cps printer, and bi-synchronous communications capability, is priced at $68,100, or $1,715/month on a four-year lease, including maintenance. Basic systems are priced much lower, however, starting around $13,350. INFOREX, INC., Burlington, Mass.

FOR DATA CIRCLE 229 ON READER CARD

Disc Alternative

It should be interesting to see whether the Megastore catches on as a product concept. It is a large (512K to 4 megabytes) storage device having a relatively slow access time of 2.5 usec, but

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We think you'll be surprised to see some of the add-on memory suppliers who will slip into the past during the next few years. So in selecting an add-on memory supplier, ask not "What have you done for us lately?"

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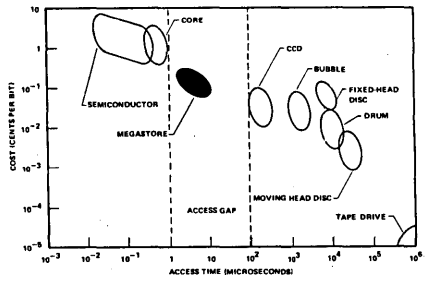
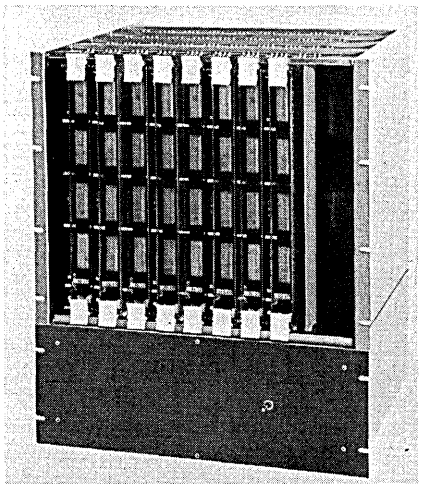
hardware

priced and targeted at the fixed-head disc system builder. The model 1223 is offered as a plug-compatible replacement for the Data General Novadisk; the Megastore 11 is directed to the Digital Equipment RJ S03/S04 discs used on PDP-11s, and the model 4666 is designed to provide the oem multiple



unit buyer with a product that will work with his interface controller. At around .3 cents per bit, however, price tags for the products still seem to escalate quickly: a 512K byte 1223 is priced at $12,670, which will buy quite a bit of add-on (or add-in) memory these days. On the other hand, if the user does opt for the new device, he's



been freed from the agony of head crashes on the disc. Maybe Ampex has indeed found a new market. The Data General version is available currently, and the other two are slated for second quarter production. AMPEX CORP., El Segundo, Calif.

FOR DATA CIRCLE 230 ON READER CARD

Computer-Aided Design

For all the efforts given to the computer-aided design (CAD) market, it's estimated that there exist a total of perhaps 600 systems in use at 100 companies in the U.S. This manufacturer has been a factor in the field with its IDIOM system since 1968 and claims roughly a third of the total number of CAD installations, but has come up with a product it thinks will vastly expand the market. For one thing, the System 150 is pitched directly at the draftsman and the drafting function, and not at the expensive, and smaller, designer market. The system is many times faster than manual drafting, and the use of refresh graphics might prove to be at least twice as fast, and more flexible, than current storage-tube-based equipment now dominating the field, claim the 150's developers.

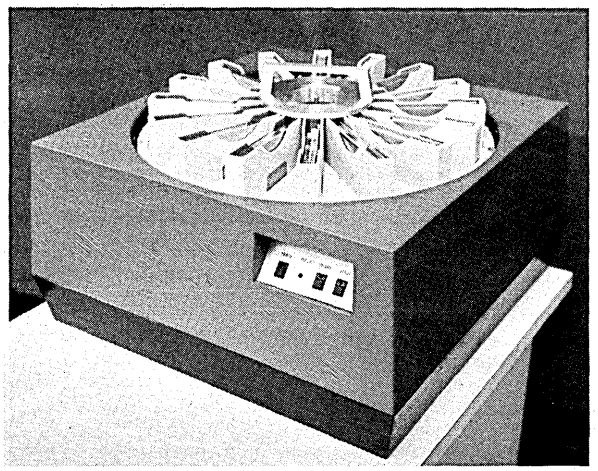
The equipment consists of a 32K 660 nsec controller with hardware multiply/divide, bootstrap loader, DMA, and operator console; 21-inch display console with light pen, keyboard, and 32 function keys; display controller containing a proportional vector generator, 128 symbol character generator with four size controls and character rotate/circle generate/intensity control/line structure/blink; a tty/controller; 1.17 megawords of disc storage; floppy disc; a two-pen plotter, digitizer and power supply. The software includes a time-sharing OS called HIGHER, and FORTRAN 2D and 3D packages. The configuration is priced at $150K, or $4,167/month on yearly rental. Larger models add more memory, magnetic tape, a floating-point processor, additional disc capacity, and additional memory of the graphic display processor. INFORMATION DISPLAYS, INC., Elmsford, N.Y.

FOR DATA CIRCLE 217 ON READER CARD

Multiprocessor Mini

This company has been very successful in the medical market with its PC-12 minicomputer, of which there are over 200 installations. The latest design, however, will probably attract attention from other markets too. It's a Lockheed SUE-based machine called the Modulex. It gets its name from a bus structure that gives the user almost complete freedom in attaching peripherals to it. Once attached, data transfers can be performed at rates as high as 10 megabytes per second. Data transfers between modules are monitored by a bus control unit that is responsible for resolving priorities and granting access to the bus. The processor includes seven general purpose registers, 98 instructions, and seven addressing modes. Memory is MOS, with cycles times of 480 nsec, and supplied

product spotlight

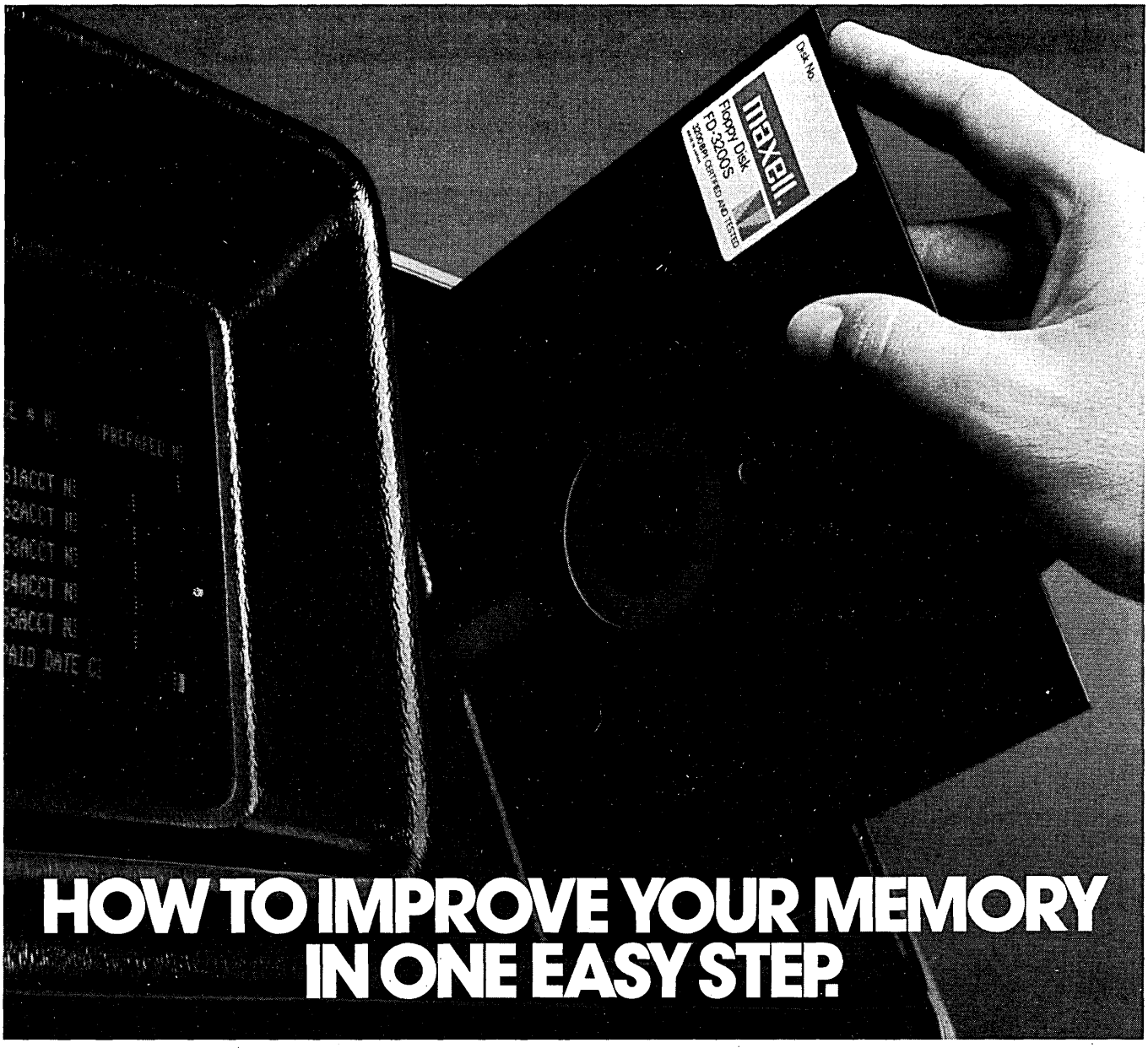


Low-cost Storage

Since the price of processing power has dropped so dramatically during the last few years, the heat is really on the engineers to come up with some lower-cost peripherals to match. The Carousel Tape System is one proposed solution, and it looks like a good one, especially for the exploding mini and micro markets. The system is based on the successful 3M DC300A data cartridge which is a proposed ANSI standard. Up to 16 of these cartridges can be inserted into CTS, providing 32 megabytes of storage. One read/write station is standard, with a maximum of four possible. Two microprocessors control operation, making it possible to perform two operations concurrently, such as looking ahead to select and position the next data cartridge. The cartridges are read and written at 40 ips, and searched at 120 ips. The recording density of 1600 bpi yields a transfer rate of 8000 cps. The average amount of time to access any tape block count or file mark count on the cartridge is 15 seconds, and the maximum is 30. That might seem slow, but it *must* be faster than anything else on the market for the price: as little as $3,125 each in orders of 50 or more per year for a single-read/write station model.

For now, the CTS is an oem item, but the developers are already talking in terms of (possibly) an RS-232 or other common interface. One of the nicer features of the system is that the controller, at $100-$150, is unusually cheap, which will help keep finished system costs down. Production units are slated for April delivery. DATA INPUT, INC., Minneapolis, Minn.

FOR DATA CIRCLE 224 ON READER CARD



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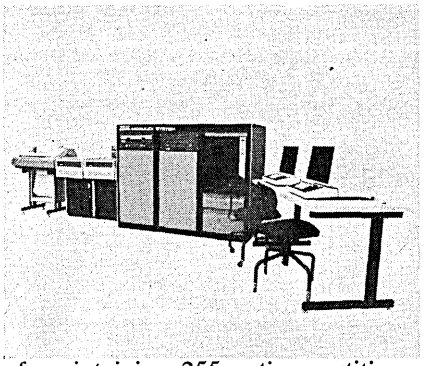
So if your computer has a problem remembering things, contact a Maxell sales representative and ask about the data products with the good memories.

But you better do it soon. Before you forget.

hardware

in 16K chunks. Up to 64K bytes are directly addressable on the bus, or up to 1 megabyte with each memory management controller.

Software consists of an operating system called MX/OS, which is divided into a set of semi-independent modules, each performing a class of functions. All or selected modules can be incorporated into a particular system. A multiterminal, multiprogramming environment is supported capable

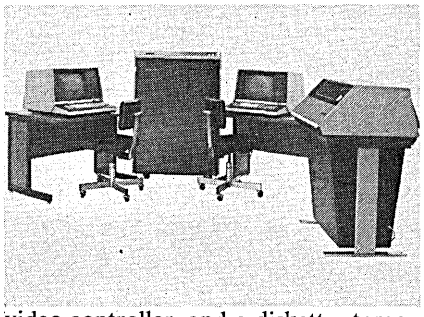


of maintaining 255 active partitions. Application languages include MUMPS and FORTRAN IV, plus some medical and business routines. A twin-cpu, 96K byte system with 160 megabytes of mass storage, line printer and 16 terminals is priced around $100K. The company maintains domestic direct sales offices and foreign distributors. ARTRONIX, INC., St. Louis, Mo.

FOR DATA CIRCLE 211 ON READER CARD

Distributed Processing

This manufacturer, with nearly 25 percent of the remote batch terminal market—and second only to IBM in it—is rapidly becoming a legitimate contender in the distributed processing market, a segment that dictated the capabilities of the model 82 remote display system. The system consists of a processor, a



video controller, and a diskette storage module for loading control programs and system diagnostics. Up to sixteen 1,920-character display stations can be located up to 2,000 feet from the controller. The system supports IBM 3271 emulation, making it possible to perform a variety of functions, such as data entry, remote batch transmission, and on-line inquiry, all concurrently. (This capability of emulating the 3271 is also being added to the firm's model 74 KEYBATCH and model 78 remote processing system, so those products become more flexible, too.) Later this year the manufacturer plans to add stand-alone processing capabilities through RPG II and disc based sort/merge capabilities. Next year, Data 100 plans to add off-line remote file management functions.

The operator stations operate interactively on a real-time basis with host-based programs and files. Data is added, modified, or deleted and sent back to the central site for further processing under control of host-resident application programs. A basic model 82 with four display stations and controller rents for $589/month on a five-year lease, including maintenance. DATA 100 CORP., Minneapolis, Minn.

FOR DATA CIRCLE 228 ON READER CARD

Portable Terminals

This company has been in the terminal field a long time, but even it has found some new features to add to its latest series, the Execuport 3000 series. For starters, the claim is made that the latest series is the first portable (22 lb. 8 oz.) terminal that provides 136-column capability—most such units are usually restricted to 80 columns. The print resolution of 240 points per inch makes it possible to use the 3000 for plotting in 24 dot (vertical) by 10 dot (horizontal) format. The paper is automatically positioned under the head as it moves during plotting. Other plot-

ting features include underscore, overscore, subscript and superscript, and ¼-line stepping.

The 3000 series has built-in acoustic couplers for operation over regular telephone lines at 10, 15, and 30 cps. Paper rolls are available in lengths of 100 and 180 feet.

There are three other interesting features about the 3000 series. An out-of-paper alarm not only signals the operator of the condition by audio alarm, but also sends a break signal back to the minicomputer to tell it not to send any more info over the line until the condition has been remedied. (Free!) A $100 bill will get you a 40-character buffer that will up the throughput of the 3000 to something over 33 cps. And an additional $25 will get a data logger capable of printing all 35 non-print character codes to assist communications debugging. Capable of fitting under an airplane seat, 3000 series terminals are priced at $3,495. COMPUTER TRANSCEIVER SYSTEMS, INC., Paramus, N.J.

FOR DATA CIRCLE 212 ON READER CARD

Remote Terminal

The model 5441 remote terminal can be attached to the manufacturer's 5400 KeyScan system to perform remote data entry. The terminal appears to the system and the user as an additional keystation on the system, though it can be located many miles from the KeyScan.

The 5441 is reasonably modular in design: the keyboard can be ordered in either a keypunch layout or typewriter style, and both configurations are

available with a numeric pad. Operators can enter, verify, correct, and update data, with communication to the host 5400 taking place in dial-up half- of full-duplex mode. A flashing cursor and audio/visual error indicator are additional features of the 5441, which displays information in 12 line by 40 character format. It leases for $95/month and sells for $3,735. CUMMINS-ALLISON CORP., Data Systems Div., Glenview, Ill.

FOR DATA CIRCLE 220 ON READER CARD

Floppy Disc

Variations are still being made to the original floppy disc design to make it an even more flexible device. A case in point is the model 78 Super Floppy which boasts track-to-track access times of only 3 msec, said to be more than twice as fast as any other floppy. Other features include an optional autoload feature providing completely automatic diskette loading, positioning, and clutching for gentle media handling, and up to 6.4 megabits of capacity using GCR mode encoding. Hard and soft sectoring can be accom-

Very little stands between your mini and the disk drives of your choice.

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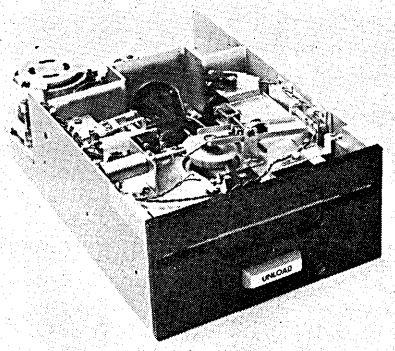
CIRCLE 93 ON READER CARD

hardware

plished on the same drive without additions or alterations, and up to eight drives can be daisy chained to provide 51.2 megabits of capacity. Prices get



down under $500 in small oem quantities depending upon specific customer requirements. WANGCO, INC., Los Angeles, Calif.

FOR DATA CIRCLE 216 ON READER CARD

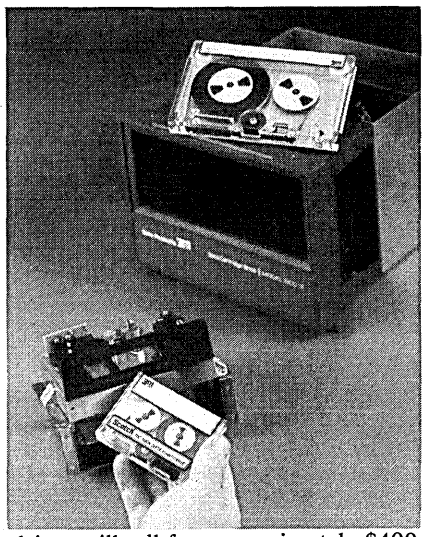
Univac Memory

Add another supplier to the add-on memory list for Univac users, of which there aren't that many. The T-7005, while this manufacturer's first product for the Univac 494, 1106, 1108, and 1110 computers, is already up and running at two customer locations. The principal advantages of the T-7005 compared to the original equipment manufacturer's ration, according to Telefile, are that it uses only one-third the floor space, 30 percent of the power, and costs less than half. Compatible with either single or dual-processor systems, capacity starts at 64K 40-bit words, augmented by 32K chunks. The standard cycle time is 750 nsec, but it can be optionally set to 875, 1 usec, or 1.5 usec. Pricing is just under $1 word, or $59,500 for a 64K unit. TELEFILE COMPUTER PRODUCTS, INC., Irvine, Calif.

FOR DATA CIRCLE 213 ON READER CARD

Cartridge Drive

Why 3M continues to announce media before announcing the machines they'll run on is beyond us, but chalk up a second time with the DCD-1. It's a drive for the small-scale version of the popular DC300 A cartridge that is taking the world by storm. The drive, which fits within a five-inch cube, is being targeted at point-of-sale, calculator, mircocomputer, and word processing markets. Of importance to oem's are the use of TTL circuitry, and the packaging of the electronic interface on two 5 x 12-inch pc boards. The



drives will sell for approximately $400, depending on quantities and specific customer requirements. 3M CO., St. Paul, Minn.

FOR DATA CIRCLE 215 ON READER CARD

Document Processing OCR

As if Burroughs' 1000 series of what it calls document management systems hasn't been versatile enough, OCR capability has been added to it. Now, the 1000 hardware can be used for data capture, document reading, data communications, microfilm recording, and OCR data entry. The processor out of

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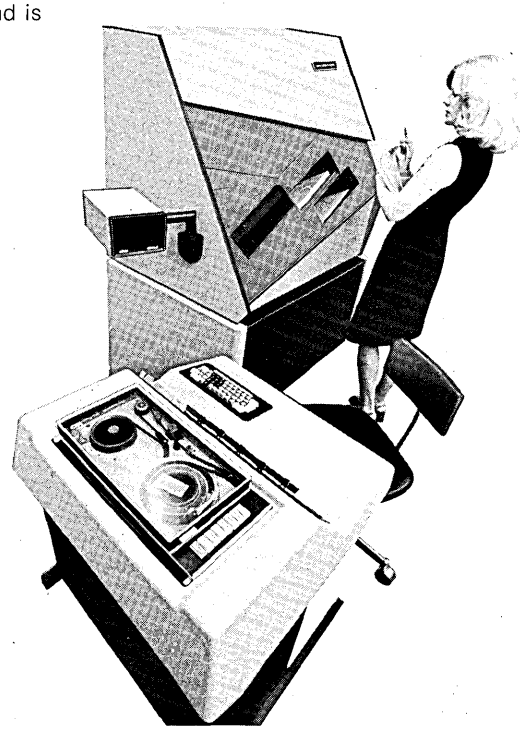

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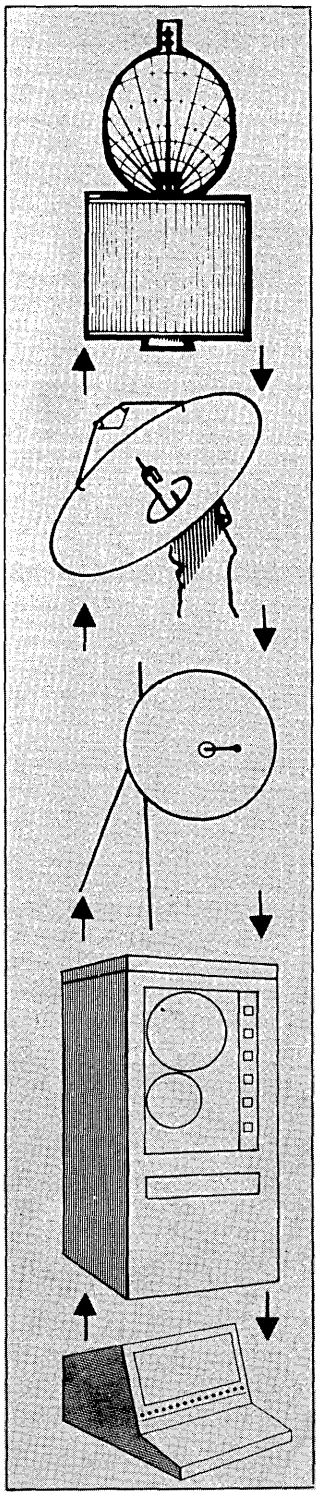

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Satellite Communications – W. L. Pritchard, Satellite Systems Engineering, Inc.

Data Communications – D. W. Davies, National Physical Laboratory, U.K.

Broadband and Narrow Band Services to the Home and Business – D. Gillette, Bell Laboratories and C. Brownstein, National Science Foundation.

International Telecommunications – A. Easton, ICM, Americon, Inc.

Economics of Telecommunications – D. March, ITT

International Telecommunications Policies – L. Day, – Bell, Canada

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Horizon House International is a subsidiary of Horizon House, publisher of Telecommunications, Microwave Journal and Artech House Books, as well as the organizers of INTELCOM 77, an International Telecommunications Exposition to be held in Atlanta, Georgia, 9-15 October 1977.

hardware

Burroughs' B80 small-scale mini is used as the controller on the models S 1700, S 1800, and S 1900. Among the documents that can be processed are remittance advices, utility bills, insurance premium notices, credit card

slips, and banking vouchers.

A clipped character feature in the series enables it in most cases to read and interpret partially printed OCR numeric characters as long as 80 percent of the character is present. Fonts recognized include OCR A/1428, OCR B/1403, and Farrington 7B, and any two of these fonts can be read in combinations. When a character cannot be read, an operator station displays the garbled data. Configurations range from an operator-attended two-pocket encoder to an operator monitored 20-pocket item processing system. The S 1700 has manual document feed, with the larger two models sorting documents at 120 and 240 documents per minute, respectively. Prices start at $45,400. BURROUGHS CORP., Detroit, Mich.

FOR DATA CIRCLE 219 ON READER CARD

Disc Storage

Data General has put the final piece of the memory puzzle into place and now manufactures all its own memory products, from memory cores to this product, 3330-type high-performance disc drives. The moving head disc pack designs are available in two capacities, the model 6060 with 96 megabytes, and the 6061 with 192 megabytes. Average access times are 43.4 msec, with track-to-track positioning accomplished in only 6 msec. The average head positioning time is 35 msec and the maximum is 60 msec. The data transfer rate is the standard 806 KB for devices of this type.

The discs will run with any NOVA or ECLIPSE minicomputer running DG's newest operating system, AOS, or the Real-time Disc Operating System, RDOS. The discs can be shared between two minis using an optional dual-port interface option. Drives can be mixed in any combination up to four, providing a maximum capacity of 768 megabytes.

The discs are attractively priced, so much so that it almost doesn't pay to buy the 96-megabyte model which lists for $24,950 including controller, adapter, and necessary cabling when you can get the 192-megabyte set-up for only $5K more. Five months delivery wait is being quoted on the larger model but you can get the smaller version in three. DATA GENERAL CORP., Southboro, Mass.

FOR DATA CIRCLE 227 ON READER CARD

Multiplexer

The 6116 is a 15-port time-division multiplexor designed to connect to a high-speed bisynchronous communication adapter on a host processor and then distribute outgoing data into 15 slower speed asynchronous ports. The 6116 can function either locally or remotely with respect to the host computer. In a remote environment, the unit usually serves as the communication support for a clustered crt configuration, thereby reducing the overhead

hardware

requirement in a multidropped crt configuration. In a local environment, the mux can support any mix of terminals or modems connected to it. The speed of each terminal device can be preselected from 110 to 9600 baud. A microcomputer oversees the 6116's performance, handling code conversions, backspace on the terminal device, parity checking, and other functions from 15 separate input buffers. When used with the manufacturer's Galaxy/5 business computer, the 6116 is priced at $6,250. Prices for software modules needed to support the 6116 on other cpu's are quoted separately, but usually cost an additional $2K. DIGITAL SYSTEMS CORP., Walkersville, Md.

FOR DATA CIRCLE 221 ON READER CARD

Interdata Memory

This small, new firm, whose name translates to lotus flower in a number of Eastern languages, is offering 32K (16-bit) memory cards for the Interdata models 50, 5/16, 6/16, 70, 74, 7/16 and 8/16. The 750 nsec cycle time core memories will be pitched to users contemplating a switch to the larger 32-bit series but holding off due to software considerations. The manufacturer can supply an address table for the minis that allows addressing of up to 256K words. Since most software doesn't tend to jump memory fences excessively, the only time lost is the occasional jump back to the table and back out to the new memory chunk, a jump of around 3 usec on this equipment. This capability is priced at $2K per memory block. If you wanted to bring a model 8/16 up to a full 256K words, the cost would be $25,600 for the hardware plus $16K for the software. PUSHPA MEMORIES, Huntington Beach, Calif.

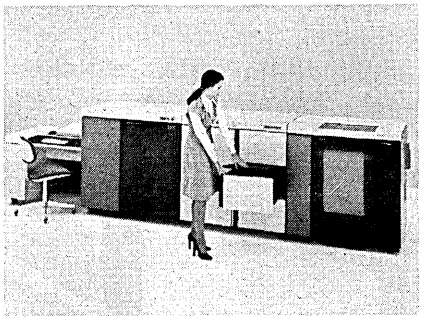
FOR DATA CIRCLE 222 ON READER CARD

Burroughs Communication

Burroughs never seems to announce anything simple and easy to comprehend, but maybe that's because the systems usually perform so many separate functions. That's certainly true with the B 870 and B 860 communications processors. They are expected to be used in communications network management, data collection, store and forward message switching applications, branch bank processing and terminal control, and almost any other communications related application.

The hardware consists of three models, not just the new numbers listed above (it gets complicated already!). The B 866-1 is a 1 MHz processor that can have up to 114,688 bytes of main memory. It also has a 32-48K MOS memory with a 632 nsec access time characteristic it shares with its siblings. The B 866-2 has the same main memory ration but a 2 MHz processor rate, and gets a 24-32K byte control memory. The B 876 has the 2 MHz processor and can have up to 147,456 bytes of main memory.

The systems can control terminals locally or remotely while concurrently



accessing their own data files and/or communicating with one or more central processors. The two smaller models can connect up to a separate box called the data communication processor, which serves up to seven lines. (The B 876 can control two of these boxes, or 16 lines.) Line speeds supported range from asynchronous 1800 baud rates, through 9600 baud synchronous, on up to 64,000 bps

broadband transmission.

For software, Burroughs has its own network architecture, implemented through a high-level language called NDL. Beneath NDL runs another high-level language called MPL, a message processing language used to develop message processing and data communications applications programs. If these languages aren't familiar enough, there's always COBOL and RPG. Components are priced starting at $33K for a B 866-1 up to $75K for a larger B 876, but these components are usually symbols in a corporate-wide distributed processing network that is tailored to each user's particular needs, so true prices might run into the six figure altitudes very quickly. BURROUGHS CORP., Detroit, Mich.

FOR DATA CIRCLE 225 ON READER CARD

Microfiche Reader

The DataMATE 80 will significantly improve readability for computer output microfilm users, say its developers. This due to a brighter display, improved resolution and contrast, and 80 percent enlargements generated from 24X, 42X, and 48X page reductions. The increase in brightness is nearly 40 percent, even though a 50-watt lamp is retained, attributed to faster projection lenses and condensers. Also new is a feature called Gyro-Mount for keeping lenses in constant focus despite rough handling. The DataMATE 80 is priced at $179. DATAGRAPHIX, INC., San Diego, Calif.

FOR DATA CIRCLE 218 ON READER CARD

Forms Imprinter

The Model 150 imprinter handles repetitive document imprinting operations, such as signing checks or writing short messages, at speeds ranging up to

100 fpm. It can process single copy continuous forms having weights from 12-125 lb. and with widths ranging from 2-¼ to 19-¼ inches, including one and two-wide tab cards. The ink-impregnated roller, good for up to 400,000 impressions, has a protecting cover to shield the operator against smudges and stains during set-up and actual operation. At $895, the 150 will be sold to the business minicomputer market. The 150 is priced at $895. STANDARD REGISTER CO., Dayton, Ohio

FOR DATA CIRCLE 223 ON READER CARD

3741 to GRI 99 Commo

The GRI 99 can now handle remote IBM 3741 data entry stations operating at speeds up to 4800 baud over voice-grade lines. Using the manufacturer's high-level communications control language (CCL), users can now generate remote output or receive remote input for local processing. Users can access remote 3741's interactively or by a command that activates disc-stored communications control streams. Up to three synchronous ports can be supported concurrently on a 64K byte System 99, and any partition having at least 14K bytes can be accessed. Including synchronous interface, a modem control unit, and the supporting software, the package is priced at $4,335. GRI COMPUTER CORP., North Brunswick, N.J.

FOR DATA CIRCLE 214 ON READER CARD

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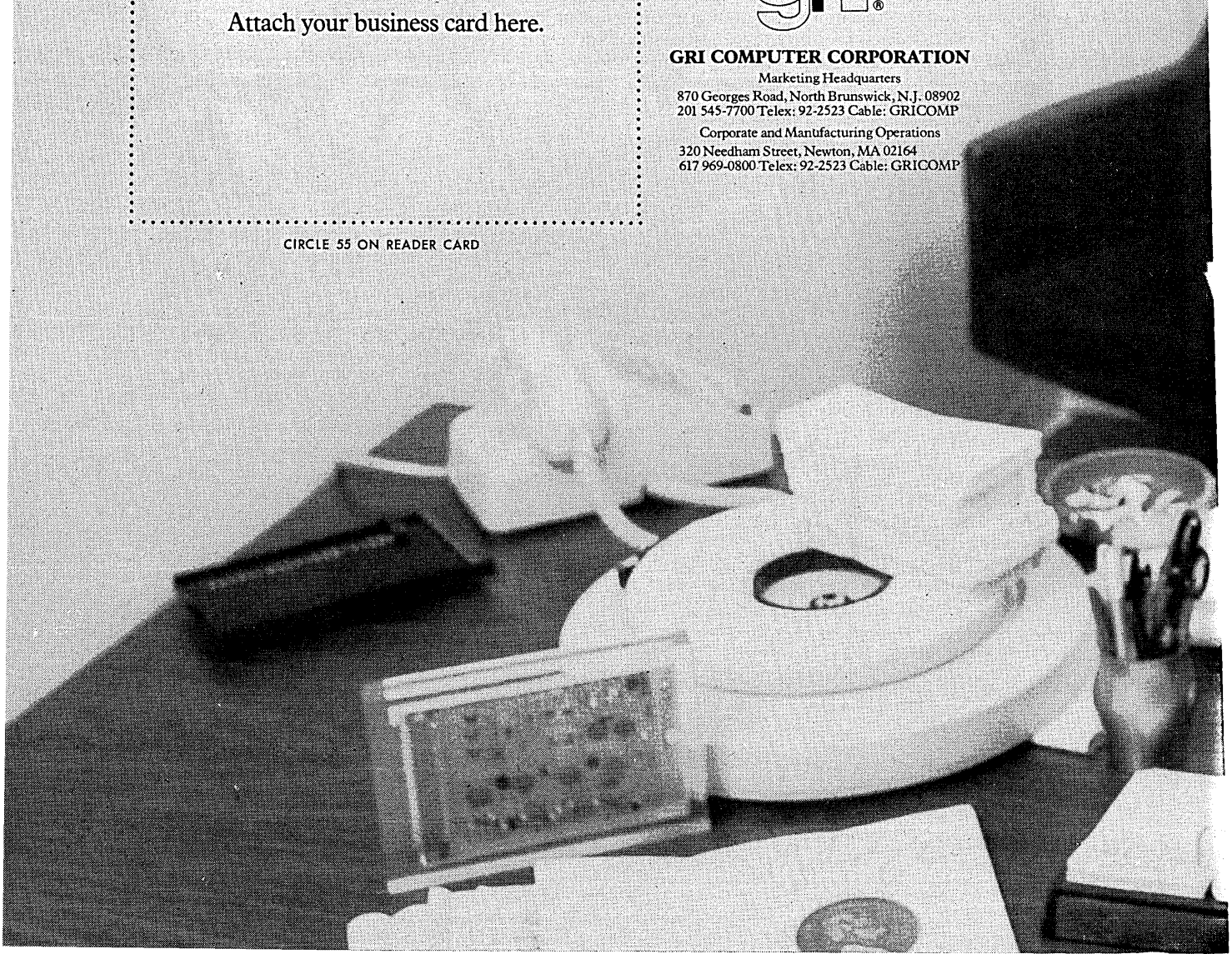

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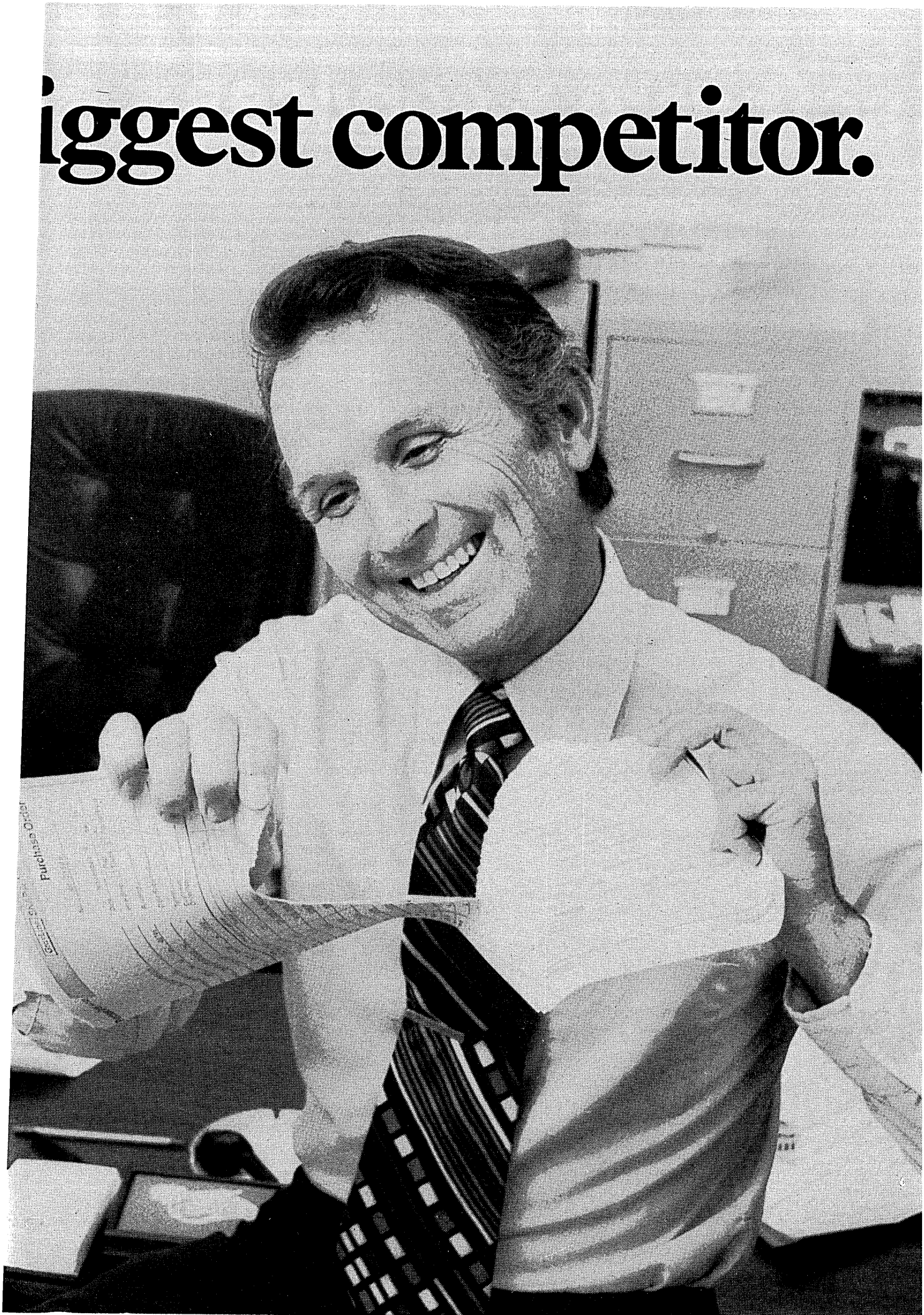

software & services

Updates

If you are a devoted FORTRAN user you probably are already aware of both the contributions made to the language by the Univ. of Waterloo in Ontario, Canada. On the off chance that you don't know about products like WATFOR (and a COBOL derivitive called WATBOL), the January issue of the newsletter WATNEWS would be a good way to come up to speed. The month's feature article describes facilities for structured programming in FORTRAN using the WATFIV and WATFOR-11 compilers. Six additional control statements have been added to FORTRAN in these compilers: IF-THEN-ELSE; WHILE-DO; DO-CASE; AT END; EXECUTE-REMOTE BLOCK; and WHILE-EXECUTE. The University's systems group has ordered an IBM Series/1 minicomputer and plans to convert much of the school's existing software so it will run on the new equipment.

The Avert Litigation Program (ALP) is the basis of a new service offered by a new company in Glen Ellyn, Ill. Equal Employment Opportunity Consultants, Inc. assists companies and their legal advisors in preparing their side of class action discrimination suits. It's claimed that the new service has already been used successfully in a number of major cases.

Not Since The Sixties Dept: GE's Information Services Div. announced a good looking resource management system called STAR in December, and then refused to give any idea of what it would cost a potential customer to use it! The lawyers get a little nervous about giving out prices, said a spokesman.

SPACEWAR, perhaps the most famous of all computer games, is now available on Cromemco's Dazzler, a microprocessor that attaches to an ordinary tv set. A paper tape listing goes for $15, and is available at computer stores or directly from the manufacturer in Mountain View, Calif.

ATLAS (Abbreviated Test Language for All Systems) has been approved by IEEE as Standard 416-1976. Originally developed to check aircraft avionics, ATLAS is now used in numerous military applications.

Distribution Management

The Distribution/transportation Management Information System (DMIS) was developed by a manager who claims to have spent nearly half his life (since he was 19) in the field. The intent is to provide businesses engaged in this function with more control, especially in financial considerations. One of the nicer aspects of the package is that the developers individually customize reports for the customer according to what the customer wants to see in the way of information. Not a bad deal considering the price of $7,500. The price includes five standard reports. For twice the price, the customer gets a report writer so that DMIS can be used by non-dp-oriented personnel.

All relevant data from freight bills and bills of lading for the company are entered and maintained on the DMIS data base. The data is then analyzed, summarized, compared (year-to-date, etc.) and reported on in a variety of modes to yield the appropriate information. Reports can be used in finance to allocate freight expenses by cost, center, product line, plant, etc., for a given time period; in manufacturing to identify transit times for material coming from vendors; in sales to relate freight expenses to product pricing; and in traffic control to develop cost and service standards, track material movement by zip codes, regions, dollars, etc.

Written in ANSI COBOL, the DMIS package ran first on a DEC PDP-10. It's now up on a 370/158, and a time-sharing version will be available shortly. The $7,500 price includes a year of maintenance and documentation. DISTRIBUTION MANAGEMENT SYSTEMS, Northboro, Mass.

FOR DATA CIRCLE 202 ON READER CARD

System Modeling

If you agree with this company's premise that computer/communications systems are getting so complex that human beings are hard pressed to accurately judge or measure their performance, then you'll understand why it is bringing CADS to market. CADS (Computer Analysis and Design System) models computer/communication systems as a network of devices and processors. Models can be constructed, evaluated and validated in a matter of hours, it's claimed, because no programming is necessary: everything is handled with parameter cards. Only a few seconds of processing time is required, but that's understandable, since the package is basically set up to run in either batch or interactive mode on a CDC 6600. (Only a few system-dependent routines are incorporated, making it possible for the developers to offer versions for IBM or other gear if the demand is there. CADS is mostly written in ANSI FORTRAN IV.) The representational capabilities of the system include three different job types and division of the subject system into subsystems for more detailed analysis. CADS is available on a paid-up license for $3,695 including source code, documentation, and system updates for one year from purchase. CADS may also be leased. INFORMATION RESEARCH ASSOCIATES, Austin, Texas.

FOR DATA CIRCLE 203 ON READER CARD

H-P Dual Processing

A component of this vendor's manufacturing applications software for Hewlett-Packard 2100 and 21MX systems was working "so well" that the developers have decided to see if there isn't a market for it alone. Some changes, primarily in the disc driver routines for these systems, make it possible to couple the systems into a dual-processor configuration. (One of the first users has assigned all I/O activity to one processor, leaving the other free to handle computation.) Up to four model 7900 (5 megabyte) or 7905 (15 megabyte) discs can be used with either processor, with the contents accessible to either processor at all times. Both the DOS-M and DOS-III operating systems are supported. The assembler language routines are distributed on magnetic tape, or a user can send a disc cartridge and have both the source and object codes recorded by the vendor. The price for the module is $4,750, including documentation, with installation and assistance, if required, provided on a time and materials basis. DATA SYSTEMS FOR INDUSTRY, Long Beach, Calif.

FOR DATA CIRCLE 204 ON READER CARD

CICS Aid

The Resource Allocation Control Tool (REACT) is another product attempting to turn IBM's CICS communications interface into something more flexible. This particular routine is available to CICS/MVS users only, for it makes use of the MVS dynamic allocation features. This makes it possible for CICS users to allocate and deallocate I/O resources

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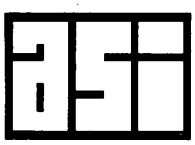
IMS users such as *American Airlines, Dow Chemical, TWA, American Can, The Hartford, Union Carbide;* and TOTAL users like *Combustion Engineering, Northwestern Mutual Life, Anheuser-Busch, Corning Glass Works, Eli Lilly* and *Holiday Inns* are a few who agree ASI-ST and data base belong together. In addition, ASI-ST provides an unequalled return on investment by maximizing the productivity of both man and machine. Since ASI-ST fully supports conventional data files as well as complex data bases, these benefits are not restricted to IMS and TOTAL users. To obtain more information contact:



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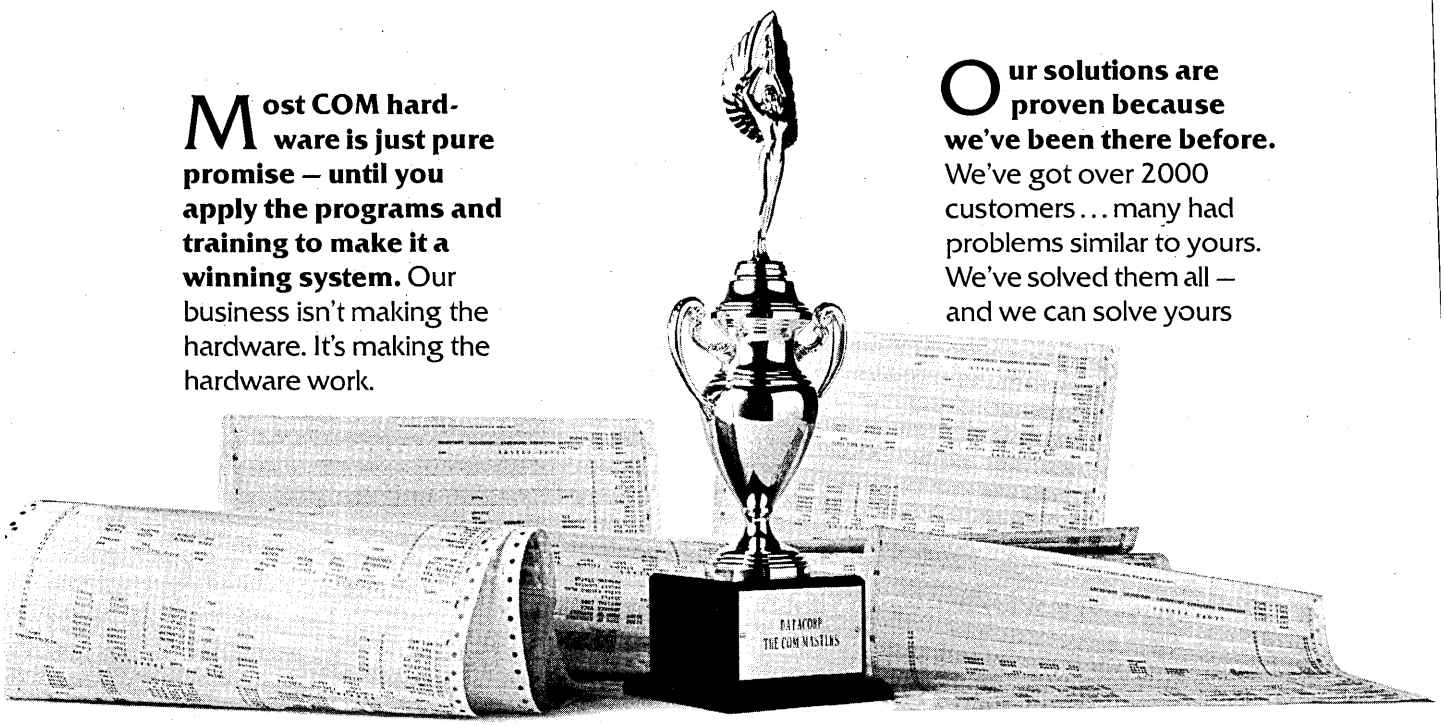

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CIRCLE 33 ON READER CARD

software & services

on-line. The user also has the capability of switching communication lines and terminals between CICS and TSO or other CICS environments. No modifications to CICS are required, with REACT providing new prompting messages to guide users through entry requests. REACT is priced at $7K; it can also be leased or rented. Though only presently offered CICS/MVS users, the developers will provide modifications of other communications interfaces, including TaskMaster, Environ I, Intercomm, and IMS. ON-LINE SOFTWARE INTERNATIONAL, Hawthorne, N.J.

FOR DATA CIRCLE 205 ON READER CARD

Multiple Mini Users

If you're a Data General user running the unmapped RDOS operating system and have been trying to figure out how to put multiple concurrent users on the air, be advised that this software house has solved the problem. It's called the Virtual Machine Simulator (VMS) and it provides virtual 32K Nova machine facilities for up to nine users. Each virtual machine can execute standalone programs, or RDOS programs such as the Command Line Interpreter, text editor, assembler, loader, FORTRAN, etc. A typical installation might have VMS running the RDOS batch system in the foreground, leaving the background free for job development and regular processing. The system "prefers" 8K storage partitions, sufficient to support two users. Additional users require additional buffer space. VMS is priced at $2K, including a lifetime guarantee and all documentation. POLYMORPHIC COMPUTER SYSTEMS, Boulder, Colo.

FOR DATA CIRCLE 206 ON READER CARD

IMS Information Retrieval

This vendor's EASYTRIEVE information retrieval and data management system

software spotlight

Information Security

This software house thinks it has discovered a kink in the armor of Informatics' MARK IV application programming system—and indeed, perhaps it has. It's claimed that several MARK IV users approached about a security "front-end" for the system responded very favorably, saying that the great power of MARK IV is somewhat hard to control, and that they were sensitive to data being too easily available to unauthorized users.

CHEKMARK is intended to change all that. It essentially consists of a set of assembler language routines (currently for IBM equipment only) that control usage of the system. CHEKMARK monitors who is using MARK IV, how they are using it, and what items are being utilized by what user. Working through CHEKMARK, users are issued authorization levels to restrict and allow access to specific or general file classifications. General levels grant retrieval authorization (100), and update authorization (500), and levels in the 900 region are required to update master files. At the head of this hierarchy should be someone functioning as the installation's MARK IV security administrator, who is responsible for providing passwords and ciphers. Only 3-4K of storage is required to be added to the MARK IV region. CHEKMARK is available only for OS and OS/VS 360/370 users. Complete with documentation, it's priced at $7,950. COMPUTER INFOMATRIX, INC., Los Angeles, Calif.

FOR DATA CIRCLE 201 ON READER CARD

software & services

has been outfitted with a DL1 option that permits IBM DOS and DOS/VS users to access DL1 files in the IBM Information Management System. This means that any DL1 data base can be sequentially read as the primary input into the report generation phases of EASYTRIEVE. The user can only define the DL1 segments, keyfields, and data base hierarchy desired, and the retrieval system takes care of the rest. Selection criteria can be specified at the root level of the data bases so only those paths meeting selection criteria will be accessed. The EASYTRIEVE option is priced at $5K on a perpetual license agreement. Maintenance is free for the first year and $300/year thereafter. PANSOPHIC SYSTEMS INC., Oak Brook Ill.

FOR DATA CIRCLE 208 ON READER CARD

Commercial Software

NCR is finding a myriad of uses for its flexible little 8200 system announced recently, with the latest emphasis being an order processing/inventory control and sales analysis system that will be pitched to medium-sized manufacturing companies that fill customer orders from stock and generate annual sales in the range of $5-20 million. The interactive manufacturing control systems require a 48K Century 8200 processor, a video terminal, a 9.8 megabyte disc, and a line printer, which runs about $40, $420, or $1,150/month on a five-year lease.

There are four modules: order processing/sales analysis, inventory control, accounts receivable, and a planned receipts routine. They are subject to an initial payment, plus a monthly license fee, and are, respectively: $1,895/$75; $800/$40; $500/-$30; and $250/$10. Each of the modules can operate concurrently in separate memory partitions and can be accessed by visual display terminals being conversational in design. As transactions are processed in the system, disc files are automatically updated.

The order processing/sales analysis application accepts customer orders that are entered on the terminals, validates the orders, processes the new data on the file, and prints the required documents and reports. Sales analysis reports break out sales into various categories such as product, customer class, salesman, product class by salesman, customer class by salesman, and product class by customer class. The planned receipts module projects receipts and orders in a weekly summary for each product and calculates availability within certain lead times. NCR CORP., Dayton, Ohio.

FOR DATA CIRCLE 209 ON READER CARD

TSO Control

A package to help control and manage IBM's popular time-sharing option (TSO) feature on 370 systems has been developed. Called TSO/MON, the monitor systematically collects performance and utilization information at the system and user level and writes this information onto either the SMF file or a user-defined data set. It operates continuously, the overhead is said to be low, and generates a small number of records. It's available for OS/MVT, and SVS environments, and will shortly be available for MVS installations.

The key to the product's effectiveness is in providing management with visibility on how TSO is being used, growth trends, and how system utilization is changing. These come in the form of response times, system load factors, user access statistics, and system availability figures. A number of reports are generated. TSO/MON is priced at $8,900, requires no modification to the operating system or TSO, and is already operational at several sites. MORINO ASSOCIATES, INC., Arlington, Va.

FOR DATA CIRCLE 210 ON READER CARD

The Wangco Micro-Floppy™ Disk Drive is the number one choice to be number one.

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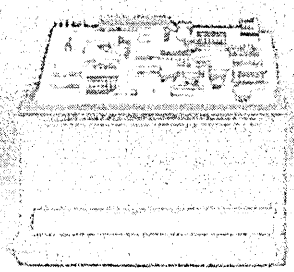

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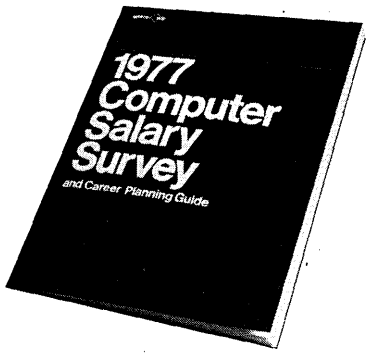

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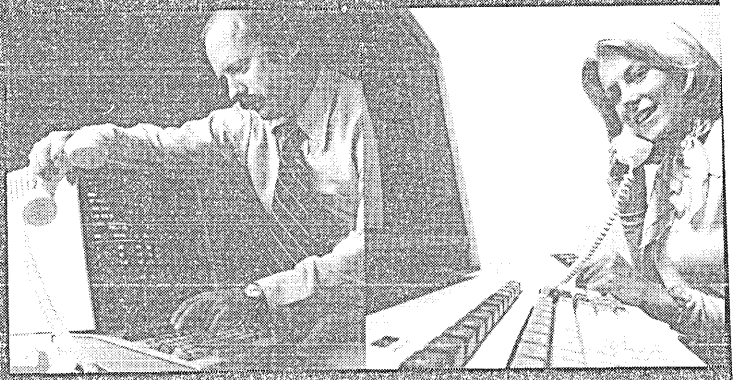

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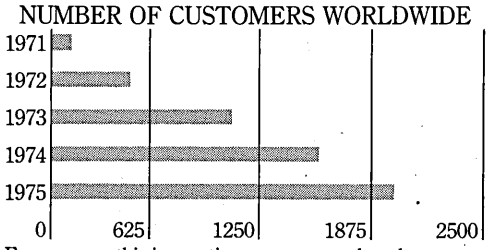

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This forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

the forum

Put Your Budget Where You

(Note: This piece is derived from a talk presented to a breakfast meeting of a professional society at 7:30 A.M. This accounts for the author's somewhat acerbic tone.)

We all say things like "hardware gets cheaper while people get more expensive," "the life cycle cost of software is a multiple of its initial development cost," "the user should have responsive, interactive service," and "the user should evolve his own applications." But when it comes time to commit money—to establish a budget or acquire tools—most of us continue to act according to traditional behavior patterns which are often contrary to these assertions. If you really believe them, you will adopt spending rules such as the following.

1. Hardware expenditures should be 20% to 50% higher than necessary. The low end applies to giant computers and wide band lines, the high end to minicomputers and low speed lines.

One of the worst ideas ever promulgated in data processing is that facilities should be fully loaded around the clock, that the "necessary" facility expenditure level is the fully loaded level. Following this principle means poor service to all, catastrophic lack of service whenever a glitch occurs, and a general contempt for dp among users. If the assertions are true, excess capacity should be consciously provided to assure responsiveness and room for application growth.

2. Software development expenditures should be 20% to 50% higher than necessary. Reversing the previous order, the low end applies to small jobs and the high end to large jobs. The idea is that if the entire life cycle of the software is considered, expenditure of "excess" amounts on careful initial design, prototype testing, modular and high level implementation, and multi-level documentation will pay off handsomely in later years.

3. All software should die. We talk about "life cycles" of applications, but how often do we really kill one? Should software go on forever, supporting increasingly rickety structures of modifications and being run on facilities not even dreamed of by the initial designers? Obviously not. Let's face the music and kill moribund software, investing in reimplementation that will provide handsome annual returns.

4. All software should be done at least twice. This is a variation on the "death" theme, but emphasizing the idea

Mouth Is

that we don't know how to do it right the first time. The user's world with a new system is different from his world without it, particularly if the new system offers a new dimension of interactive service. Experience says that we just can't anticipate the new world in detail, and that major reworks are generally indicated after operational experience has been gained. It's just as well to plan and budget for the rework: you'll probably be doing it anyway.

5. Users should be forced to pay more for dedicated equipment than they want to. You want to proliferate minicomputers among users so that each can have responsive, evolving applications under his own control? Right. So each user department should be out talking to vendors and getting what it wants? Wrong. Users rarely have the experience to appreciate the implications today's acquisitions will have down the years. Users rarely understand the life-cycle implications of software noted above; they usually succumb to second generation type temptations to dash off quick and easy programs in assembly language or RPG for minimal machines, thereby showing up central dp as inflated and bureaucratic—and painting themselves into corners.

Even if user departments are wiser than this, total independence leads to proliferation of nonstandard systems and duplication of effort that just can't be right. By all means let's give users their own tools, but let's make sure the tools incorporate enough standardization, expandability, and high-level interaction to permit future evolution. This means that spending rules (1) and (2) should be followed, and that user departments will be required to spend more than the minimum they deem necessary. This also means that the central dp specialists still have a key role to play as tool procurers, even though (in the extreme) all central hardware and software development may have disappeared.

Most people accept some form of the assertions with which this piece began, but few have changed their spending behavior appropriately. It is difficult to change deeply ingrained behavior patterns, especially when the new behavior looks like dangerous radicalism. Nevertheless, it appears that the interests of our employers require us to change. Those unable to change might consider a final rule, seriously held by some:

6. No one should stay in data processing for more than ten years.

—Frederic G. Withington

Mr. Withington is a noted industry consultant with Arthur D. Little, Inc., Cambridge, Mass., and a long-time Datamation contributing editor.

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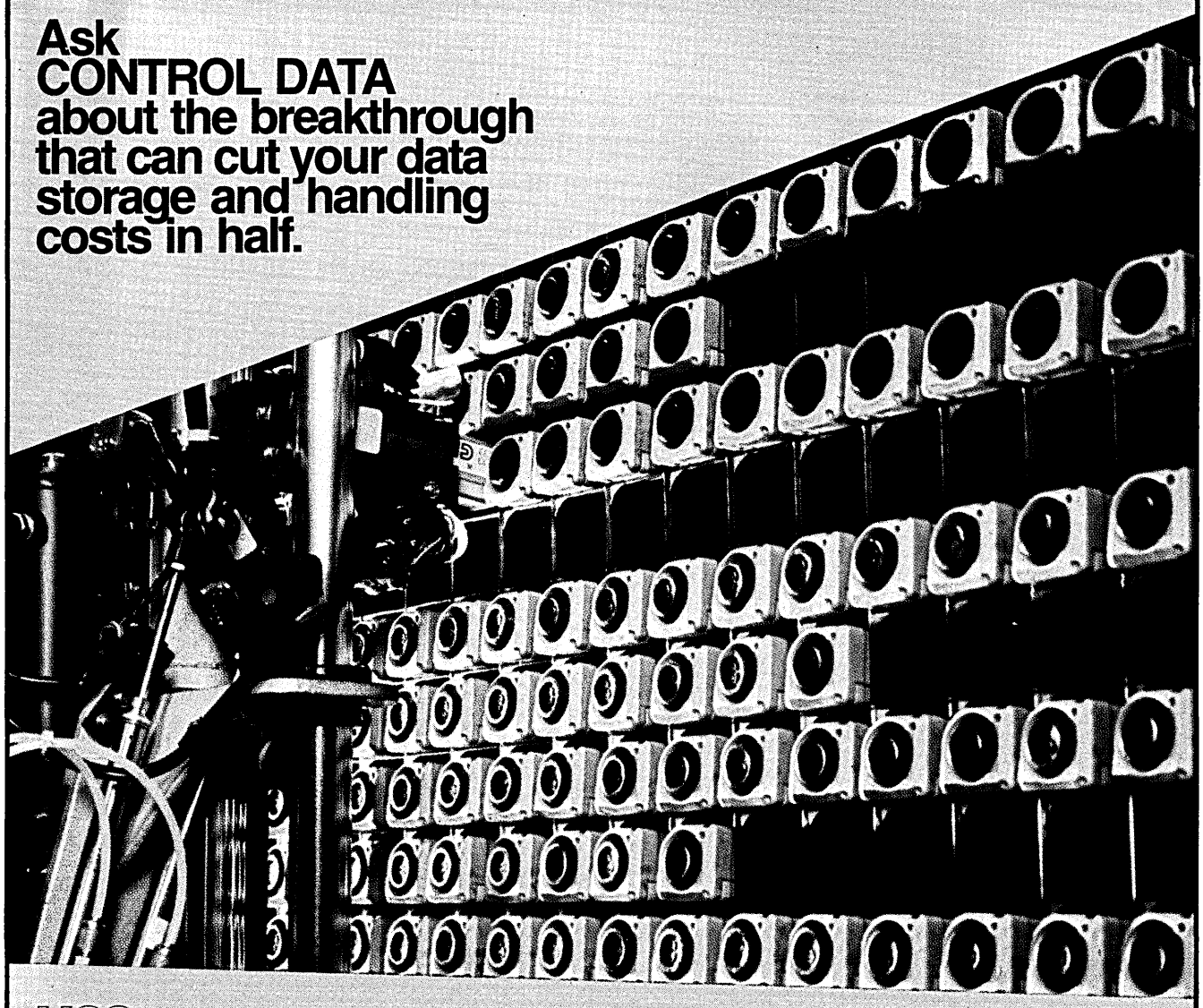

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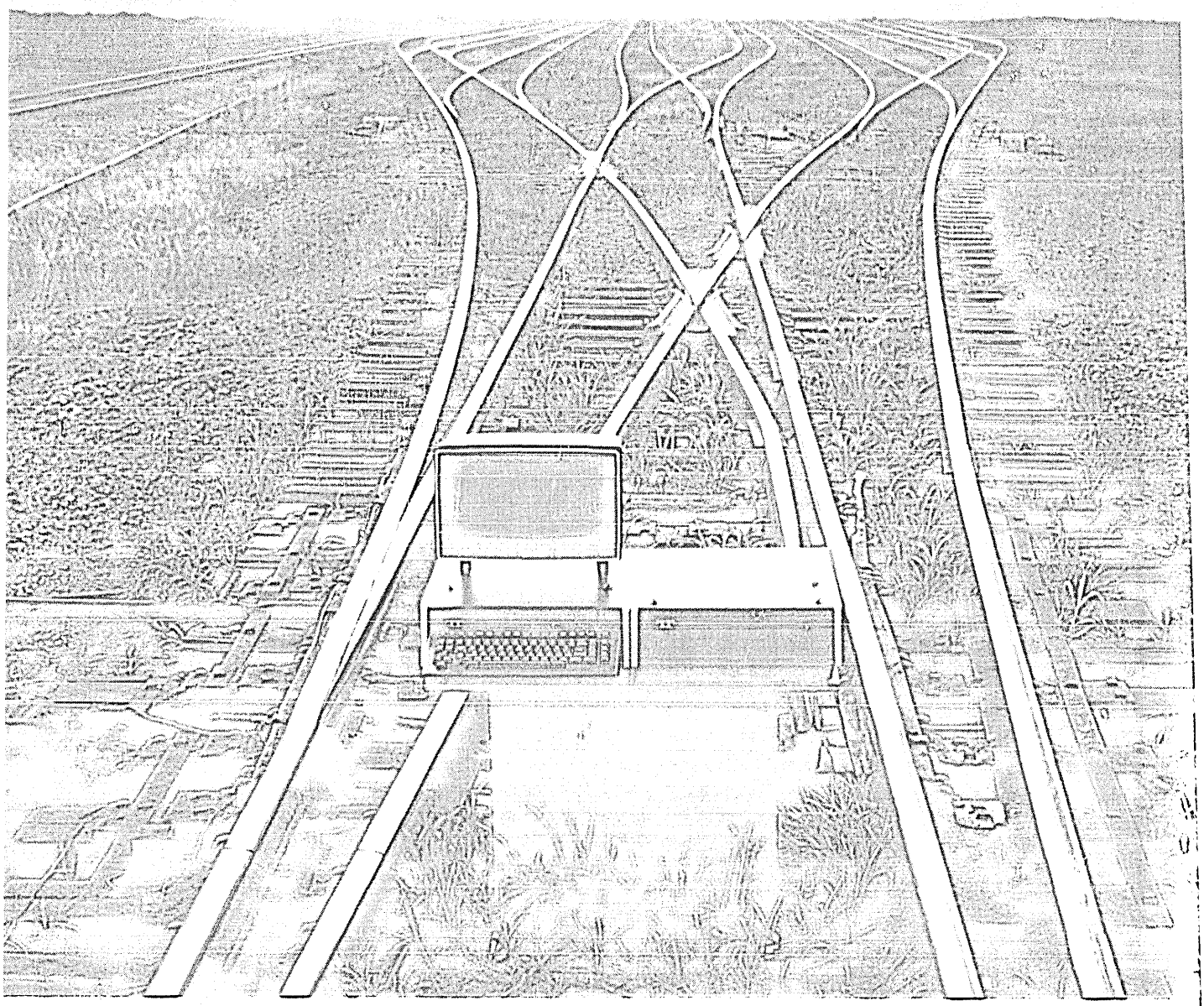

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