April, 1970
Vol. 19, No. 4

computers and automation

Computers and Data Processing in Business

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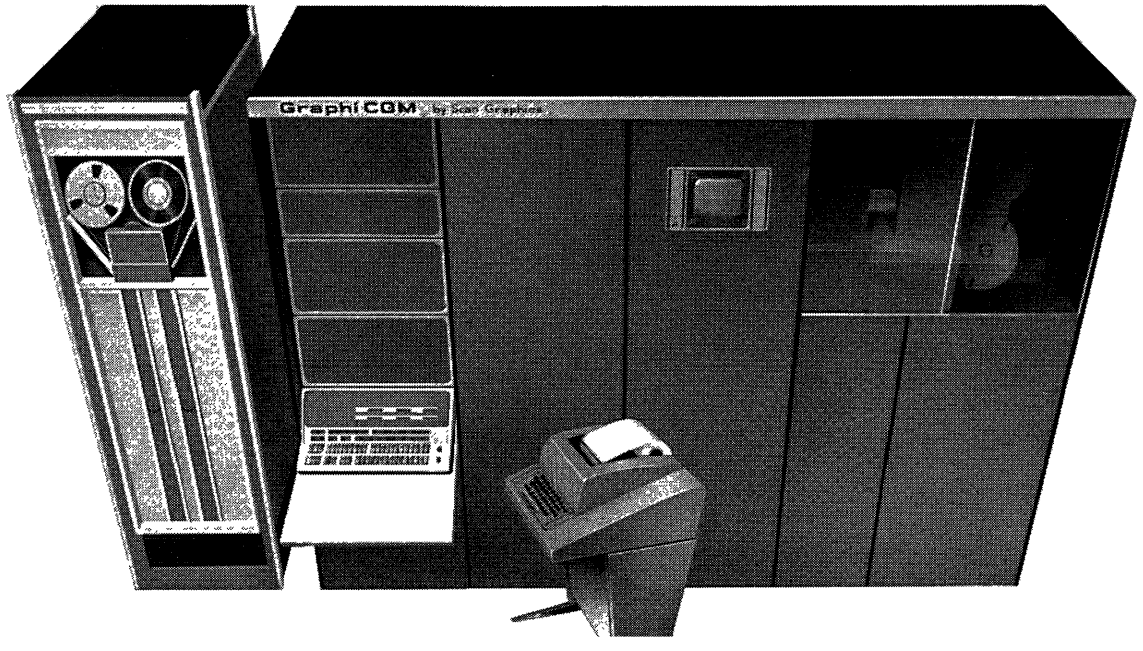

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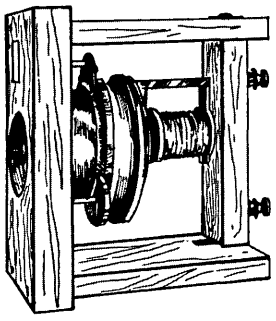

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Letters To The Editor

Commendation

I just want to take this opportunity to commend *Computers and Automation* on its part in the Martin Luther King Memorial Prize Contest. [See "Multi-Access Forum" section in this issue].

CARL RUFF
Ruff, Kiek and McAuliffe, Inc.
342 Madison Ave.
New York, N.Y. 10017

Political Convictions

As computer professionals, we are working in an area extremely dangerous for all mankind Your political opinions and mine seem to meet insofar as both of us try to open the eyes of some of our fellow citizens. There may be differences in our political convictions on a next level, I don't know. But I am glad to know there is a person of your commitment in the computer field.

Best wishes to you!

DR. FRIEDER NAKE
University of Stuttgart
7 Stuttgart 1
Herdweg 51, Germany

Dog Lover

The cover of your January issue was the greatest! It goes without saying I'm a dog lover.

Could we please have your permission to reprint the story and cover photo and story in our house organ, *The Round Table*, and in *The Secretary's Newsletter*, an external publication of ours? Of course we would want to credit *Computers and Automation.*

MARIE COFFEY,
Advertising Manager
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Glen Cove, N.Y. 11542

Ed. Note — Thank you for your kind comments We are pleased to grant our permission to reprint the cover story and photo

Ternary Logic

If any of your readers know where I can obtain an explanation of ternary logic, I would very much like to hear from them.

SIDNEY I. PLOTNICK
4542 W. Avocado St.
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computers and automation

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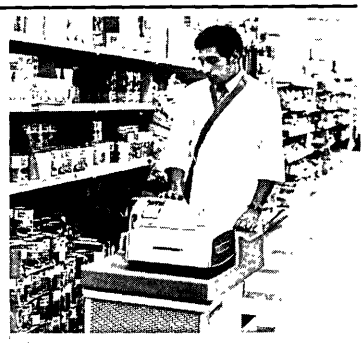
computers and automation

Vol. 19 No. 4 — April, 1970 *The magazine of the design, applications, and implications of information processing systems.*

Special Feature: Computers and Data Processing in Business



The front cover picture shows a supermarket clerk electronically entering orders based on his on-the-spot judgments of supplies on the shelves. He is using mobile data acquisition equipment made by Digitronics Corp. for inventory control. The cart contains an independent power supply. Thus, the process of first writing the order and then recording it is eliminated, and the clerk can enter orders while he walks up and down the store aisles. For more information, see page 56.

Regular Features

Editorial

C&A Worldwide

The Profession of Information Engineer and His Bridges to Society

Computers and Education

Multi-Access Forum

Departments

The Invasion of Privacy

In the January issue of *Computers and Automation* we published an illuminating article by Richard E. Sprague, "The Invasion of Privacy and a National Information Utility for Individuals". Among other things this article enumerated the kinds of files now being maintained about you, the ordinary American, or you, the American who has begun to engage in some kind of protest about anything:

retail credit bureaus
bank credit bureaus
legal information bureaus
Federal Bureau of Investigation file (if you have ever been fingerprinted, they have your fingerprints)
Central Intelligence Agency file
Social Security Department file
Internal Revenue Service file (income tax payments and records)
motor vehicle bureau (motor accidents and violations)
credit card companies who have issued you a credit card
Veterans Administration file (if you are a veteran or veteran's dependent)
etc., etc., etc.

A recent article in the "Washington Monthly"[1] reported that the U. S. Army has begun to keep an extensive file on all persons who have engaged in one way or another in pro-peace or anti-war activities here and there anywhere in the country.

Sprague pointed out that you, the subject of any of these files, have at present no right whatever to:

- see any file kept about you (because the file is the property of the agency collecting the information);
- protest untrue information about you and get it corrected;
- remove from the file information that is irrelevant to its purpose;
- know who consults your file in order to find things out about you; etc.

He advocated a "national information utility" safeguarded by law which would give each person rights in regard to information maintained in the file about him.

Many of our readers, and I also, disagree with him: we have no trust in any data bank system maintained by any central government. It would be just too easy for unscrupulous people in government to make use of the information.

Take, for example, J. Edgar Hoover, who at the age of 74 — way past official retirement age — is still in charge of the Federal Bureau of Investigation. Why does every president reappoint him ... exempt him from national compulsory retirement ... handle the FBI with kid gloves? Answer: because Hoover knows so much about all government officials including presidents that leaking the information to the press could ruin their careers. In a recent, important article in *The New York Times Magazine*,[2] Tom Wicker reports how J. Edgar Hoover regaled President Lyndon Johnson with stories about government officials from the FBI files.

The United States appears to be heading into a period when there will be a substantial conflict between a minority in charge of the government who stand for "law and order" and who are firmly carrying on a most unpopular war in Vietnam, and a vocal majority of the people of the country who want domestic change and progress, the stopping of the war in Vietnam, and the diversion of large funds from the military industrial complex to cities, health, environmental improvement, and socially useful goods and services. When the government no longer represents or even likes the vocal majority of the country, there is bound to be substantial misuse of any national data bank. Therefore every possible obstruction to its coming into existence should be taken advantage of.

One method of course is to seek the passage of laws by the states and the U. S. government safeguarding privacy and giving the American people rights — and rights now — in regard to any personal data file being maintained by any agency.

These rights should include power to:

- read what is maintained in any file kept about you by the FBI, or the CIA, or any credit bureau, or any other agency which compiles information about you;
- inform the agency of errors;
- compel the changing of untrue information about you;
- compel the removal of irrelevant information from a file about you; etc.

A business already enjoys some of these rights: when Dun and Bradstreet updates the credit file of our company, Berkeley Enterprises, they always show us their current credit report about us, and listen to and accept our comments and corrections.

According to a newspaper report I saw about a couple of years ago, the FBI maintains a list of over 100,000 persons who in the event of a national emergency declared by the president are to be picked up and sent to concentration camps. I would like to know if I am on such a list. It is an infringement of my rights not to know whether or not I am on such a list. I wrote to the FBI and inquired about such a list; the FBI never replied to my letter (naturally?) and never acknowledged receiving my letter (naturally?). Now is the time for me and 100,000 other people to acquire the right to find out. Is there any existing law whereby I can sue? I doubt it very much. Yet a country which is "the land of the free and the home of the brave" ought never to maintain a list of 100,000 people to be shipped off to concentration camps when the president declares a national emergency. This kind of arrangement is repugnant to a democratic society.

What can we do?

To try to stop a National Data Bank from coming into existence is only a small part of the problem. To refuse to accept unsolicited credit cards is another small step. To seek legislation is a long, uncertain, and expensive effort.

(Please turn to page 29)

AS WE GO TO PRESS

A NATIONWIDE STUDY OF DATA BANKS AND PERSONAL PRIVACY IS BEING CONDUCTED BY THE NATIONAL ACADEMY OF SCIENCES AND THE RUSSELL SAGE FOUNDATION. The project will be directed by Alan F. Westin, Professor of Public Law and Government at Columbia University, and author of the book *Privacy and Freedom* (1967). The Data Bank Project will collect information about computerized data systems, circulate a questionnaire nationally to a broad sample of government and private data banks, survey the computer hardware and software available to carry out public policies toward citizen rights in computerized record systems, and conduct on-site visits to a sample of data banks.

Dr. Westin has summarized the purpose of the 2 1/2-year study as follows: "The trouble is that the data banks know a great deal about us, but we don't know enough about them. No one today has systematic information on the number, types, and functions of computerized data banks that have been created; what measures have been installed already in these systems to safeguard citizen rights; how effective these measures are; and how these computerized systems plan to expand or are tending to drift in the 1970's.

"The basic question is whether or not computerized data systems are creating patterns of information collection and circulation that are so different from precomputer record systems that new public policies and organizational measures may be needed to protect individual liberties."

Mailing address for the study group is: Project on Computer Data Banks, Computer Science and Engineering Board, National Academy of Sciences, 2101 Constitution Ave. N.W., Washington, D.C. 20418.

IN WASHINGTON, THE INVASION OF PRIVACY ISSUE WAS RAISED IN DISAPPROVAL OF THE PRESIDENT'S REORGANIZATION PLAN NO. 1 of 1970 which calls for the establishment of an Office of Telecommunications Policy. Rep. Cornelius E. Gallagher, a consultant to Dr. Westin's study group [above] and Chairman of the House Subcommittee on the Invasion of Privacy, recommended disapproval of the President's Plan unless it will clearly focus on the issue of computer privacy. In testimony before the Legislative Reorganization Committee, Gallagher proposed the creation of a Federal Data Processing Commission which would clearly have the power to regulate both government and private data processing installations. The proposed Commission would govern data banks and communication links between repositories of personal information within the government, and make general rules for computerized information systems being

(Please turn to page 44)

MULTI-ACCESS FORUM

VOCAL SCIENTISTS

Arthur D. Little, Inc.*
Acorn Park
Cambridge, Mass. 02140

THE annual meeting of the American Association for the Advancement of Science, held in Boston at the end of December, had a different tone from that of previous meetings. This year, there was considerably more participation by the general public, and the scientists themselves expressed much more of their own concern for where science and technology are leading.

One of the objectives of the AAAS is "to increase public understanding and appreciation of the importance and promise of the methods of science in human progress." To this end, Association meetings have always been open to anyone who wished to register for a relatively small fee. This year, however, the public was invited to attend as guests of the Association and the response was so great that many of the lecture rooms were more than filled. As one example, an address by Margaret Mead on "The Changing Significance of Food," followed by a round table discussion on the sociological and psychological problems of nutrition, drew a crowd that expressed considerable displeasure when the doors had to be closed. There was also a session in which students and young scientists were invited to offer a critique of science. Not only was the invitation accepted, but the young people introduced much comment and criticism at other sessions as well.

Actually, the scientific community, more than its critics are often willing to admit, appears eager to turn more of its collective talents to problems of public concern. While the public — students and "the man in the street" alike — asks why a nation that can go to the moon cannot solve the problems of our own planet, the scientists had the opportunity to reply that science and technology can, indeed, offer much help toward solving the problems that involve the basic needs of society — pollution, transportation, population, food, housing, education, weapons control, conservation, and health care — given the national priority and the financial support. The decisions are essentially political, and scientific societies have traditionally been non-political. It appears, however, that scientists must now take active measures to influence public policy and public opinion; they must have a strong voice in deciding how science is applied, and must inform the public of the significance of scientific work, in order that intelligent decisions can be made.

Resolution passed

Individual leaders of the scientific community have often headed protests against waste of the world's resources. Scientific societies, however, have been slow to exert any concerted pressure to influence political decisions, but this year, for the first time, the Association took a step toward supporting redirection of national goals. Three years ago, a proposal had been made to urge that the use of certain herbicides in Vietnam be stopped, because there was considerable evidence that they may cause birth defects. The proposal has been under study, and in the carefully neutral tradition of scientists, data have been accumulating. This year, protests from young demonstrators coincided with the concern of the senior scientists of the Association. The Association's Council passed by a vote of 114 to 51 a resolution demanding an end to the use of the two herbicides. The wording of the resolution is significant both to scientists and to the public: "A new unknown chemical to which man or our ecological system is likely to be exposed in any massive way should be assumed harmful until proven to be safe." In effect, this attitude reverses the approach that has prevailed in the past.

Throughout the AAAS meetings, panels, symposia, and even at the informal get-togethers, as distinguished scientists spoke with each other and with the public, the scientific approach was implicit — no matter how serious the problem, or how misused technological advances have been, there is still a need to find solutions through careful reasoning. Yet many of the participants expressed their feelings of the urgency of the problems now facing mankind. As science becomes increasingly involved in public affairs, it seems reasonable that scientists should consider the consequences of their work, and make appropriate public recommendations for the benefit of people everywhere. □

*Reprinted with permission from **Industrial Bulletin** No. 480, January, 1970.

THE NATIONAL DATA BANK: SOME PROPOSALS FOR PROTECTING PRIVACY

Dennie Van Tassel
Computer Center
University of California
Santa Cruz, California 95060

The National Data Bank controversy rages on with a completely acceptable solution not yet proposed. New proposals are being offered. However, I feel that the removal of the present abuses of other data banks such as credit files, insurance files and police and governmental files is so important that I would like to offer some suggestions applicable to all personal data files with the hope that individual privacy will not become a thing of the 'good old days'. Here are four suggestions:

1. THE NATIONAL DATA BANK SHOULD BE GIVEN NO PRIVACY. Anyone can look up anybody. While this may sound ridiculous it is the only way no single group will gain a privileged power position by control of the information. This way no one will have any privacy either, but much of present day's so-called privacy is just a legend. Today we have a situation where select groups have unlimited, hidden, snooping power.
2. EACH INDIVIDUAL SHOULD BE ABLE TO HAVE HIS COMPLETE COMPUTERIZED DATA FILE ERASED BY HIS OWN REQUEST. It is in the individual's life that the first responsibility for the wise use of that life resides. Allowing people to erase their own data file gives them a definite means of control on their own life.

   One can already see some precedent for this type of action. There is a post office form (PO-125) which can be filled out and returned to the post office and, as a result, a junk mailer is required by law to remove the senders name from his mailing list. Having one's own NDB file removed is a similar action. Granted, if someone has his file erased he will probably have more trouble getting insurance credit, or employment, but this is his business.
3. ALL PIECES OF INFORMATION IN THE NDB SHOULD REQUIRE A RECORDED SOURCE AND ALL REQUESTS FOR INFORMATION ON INDIVIDUALS SHOULD BE DOCUMENTED. Instead of the individual bearing the brunt of whatever the file contains about him, the informer could support it. It is important for the individual to know who is providing the information, what is provided, and who looks at it.
4. ALL OTHER PERSONAL DATA FILES SHOULD BE OUTLAWED. The NDB could be put under central control of a non-political information data gathering board. Companies or governmental agencies requiring information could get it from the NDB. If this is done, standards of accuracy and privacy can be easily maintained and enforced since there is only one data bank. □

"THE INVASION OF PRIVACY AND A NATIONAL INFORMATION UTILITY FOR INDIVIDUALS" — COMMENT

Ronald Sobieraj
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Kingston, N.Y. 12401

Nowhere in his article, "The Invasion of Privacy and a National Information Utility for Individuals" [January, page 48] does Richard E. Sprague define what he means by an "invasion of privacy". If this term means "getting information about an individual without his consent", then obviously the creation of a "National Information Utility for Individuals" will *guarantee* an invasion of privacy unlike anything now known.

Right now a credit file might contain such items as a record of previous credit and legal actions. But if it were to also contain records from the FBI, CIA, Social Security, Internal Revenue, insurance companies, motor vehicle bureaus, credit card companies, individual retailers and banks, hospitals, unions, professional societies, VA, Blue Cross, etc., etc., then the mere quantity of different records results in a new kind of record. It will contain more information than the individual himself could probably recall. What other individual or organization has a need to know all this?

Mr. Sprague lists five "bad things" about the current credit record. [1) You probably don't know the file exists; 2) If you do, you probably cannot look at it; 3) If you can, you probably cannot change the information in it, 4) The file contains "negative" rather than "positive" data; and 5) Others can look at your file without you knowing it.] The first is false (if anyone didn't know about credit bureaus before this article, please say so). The second can be changed by the Fair Credit Report Act (S. 823) which will let an individual know that he was being investigated and allow a free report for the asking. Bad things three and four are minor; they can be discussed by the individual and his prospective creditor. Bad thing five is also covered by the Fair Credit Reporting Act, but brings up investigation by governmental agencies. Mr. Sprague hopes that the citizen will be informed when an agency examines his record. It is more likely that examination by a government agency will be done the same way as wiretapping and bugging are done.

Perhaps his proposal would come under the ban of the Anti-Trust Acts.

I hope that there will be more discussion on this subject. □

"COUNTER-CONFERENCE TO ACM 1971" — COMMENTS

Alden R. Dalzell
Administrative Data Processing
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In reaction to the item in "Multi-Access Forum" about the Association for Computing Machinery (ACM) Counter-Conference (February, page 9), I am sorry to see that you are trying to split the ACM. I could write a good deal about what I think of the events in Chicago in 1968 and the resulting actions. But Chicago is no different now than it was prior to August 1968. What about the other cities whose governments and police forces are as bad; should the ACM boycott them as well? Maybe so. But to wait for some trouble to happen before taking such action is like saying that it is all right to do wrong as long as you don't get caught.

Also, the attitude which says, "If you don't agree with me I won't associate with you" is childish. Certainly someone who is promoting an award in the name of Martin Luther King should be above this! □

AUTOMATING POETRY

Richard W. Bailey
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Ann Arbor, Michigan 48104

The possibility of generating poems — or at least skeletons of poems — was raised in the August 1969 issue of *Computers and Automation* by a professor of operations research who has asked that his name not be mentioned in connection with this essay. His reticence on this matter is not entirely surprising for in drawing attention to this interesting question, he unfortunately makes a variety of blunders in explaining the background of such work and his attempt to justify his efforts in computerized versification may misdirect people seriously interested in the problem. While there has been widespread experimentation of the kind described in this essay, few significant advances have been made, partly through an underestimation of the task and partly because few programmers tackle the problem more than once or consider that their research — like all other research — should build on the efforts of others and point toward new problems to be solved.

Reducing Complexity

Despite his professional commitment to operations research, the author is surprisingly oblivious to the structures inherent in the process he wants to simulate. Describing routines to generate product brand names, for example, he claims that the twenty-six letters in the English alphabet serve as a pool from which groups of six letters are "randomly extracted". The resulting output, he says, is then used by the client as an aid in selecting desirable brand names. Such a procedure would, of course, produce an infinite mountain of output, even if the randomization scheme were modified, the permutations of the letters would produce, as he notes, 308+ million six-letter combinations. In the few cases where potential brand names have actually been generated, sensible programmers have designed algorithms to reduce the complexity of the problem. These rules operate either on facts about English spelling ("*Q* is followed by *U*+), or are derived from the work of linguists on the sound structure of the language ("The second consonant of ***measure*** is not used initially by most Americans"). Thus, when structure is acknowledged by some formulation of "possible English word", the generating scheme turns out a list of names that is of some value to those interested in such novelties.

Word Frequency

Though this example is introduced only marginally in the paper, it does represent the author's hasty and sometimes careless treatment of both linguistic and poetic problems. Farther on in his essay, he claims that an ordinary dictionary has word-frequency information that contributes to his research, though dictionaries are almost wholly lacking in useful information of this kind. Likewise he acknowledges a description of American English for information on "preposition usage", though the account he mentions only lists the prepositions and says next to nothing about their use. Misleading claims like these are unfortunately quite representative of the work of a number of computer specialists who launch short-range and inconclusive projects that ignore appropriate resources and skirt questions of genuine interest to linguists or literary men.

How does the author's scheme work? Apparently he established a syntactic matrix of the following sort as the structural framework for the poem:

TITLE: Adjective + $Noun_1$
LINE ONE: Adjective + $Noun_2$ + Adverb + Verb + Adjective + $Noun_3$
LINE TWO: Adjective + $Noun_3$ + Verb + Adverb + Adjective + $Noun_4$
LINE THREE: ***the*** + $Noun_5$ + Verb + Preposition + ***the*** + Adjective + $Noun_6$
LINE FOUR: $Noun_7$ + Verb + Conjunction + ***the*** + $Noun_8$

In addition to the classes implied in this schematization, some of the nouns were stored in plural form (those subscripted 1, 2, 3, 4, and 7), and the immediately subsequent verbs were drawn from a list containing the proper forms. Further structural constraints on this model were apparently introduced: "the adjectives and verbs were chosen 'at random' among those having reference to that specific noun". His understanding of "having reference" is by no means clear from this or from other parts of his exposition. Judging by his examples, the association of adjective and noun was apparently quite fully specified, though this explanation obscures his quoted phrase, "at random". All of the examples given in the paper have a rather depressing inevitability ***(white blossoms, green fields, mortal creatures)*** and lack the novelty that a really random procedure would be likely to produce. An alternative interpretation that would square the discussion with the example poems is that the poems quoted in the essay may have been picked from a mass of randomized texts by someone with a taste for cliché.

"The" Probability

The author hints that some more sophisticated linguistic constraints than those just described were also imposed on the patterns of selection. Though his initial remarks indicate that ***the*** was specified for the three article positions in the framework, he subsequently claims that ***the*** "had 28 times greater probability of being selected than ***a*** and ***an***)". Why this constraint was introduced is not at all clear. In a large sample of English prose, *the* has a probability of only about three times that of ***a***; it is not all clear why the choice of ***the*** should be weighted by a factor of nine for poetic purposes. In those rare instances when an indefinite article emerged from the pool, the linguistic context would have to be acknowledged ***(a computer*** vs. ***an automaton)***, so the inclusion of ***a*** and ***an*** in the article list would demand considerable refinements in the simple schema outlined above.

What value does the author ascribe to his effort? He suggests that a poet may welcome computer-made poetry: "When poems constructed by computer are available, he may change only the last words of the computerized poem in order to provide rhymes, or to vary nouns and verbs with the purpose of restricting the meaning of the lyric to a specific subject." A comparable suggestion in the field of computer graphics would encourage the artist to color in intervals between computer-generated lines with wax crayons! Given the post-Romantic conception of the poetic act that still pervades western poetry, it would be naive to assume that poets will welcome computer-made poetry in any form. Should anyone doubt the hostility of poets to such efforts, I strongly recommend an essay by a former Consultant in Poetry to the Library of Congress, Howard Nemerov, titled "Speculative Equations: Poems, Poets, Computers" (***The American Scholar*** 36(1967):395-414).

The Real Problems

What are the real problems in the field of automating poetry? First, I believe, is the full acknowledgement of the

many "structures" of poetry — grammatical, thematic, metrical, and so on. To attack all of them at once results in the kind of failure just described. Surely the best approach is to leave most of them invariant in a given experiment while the programmer explores one or two at a time. A fixed grammatical schema, like the one described above, may offer a beginning and allow the programmer-poet to explore dimensions of thematic organization. Such a strategy is employed in an essay, "Computerized Japanese haiku" (*Studio International* [July 1968], 54), in which the semantic networks typical of a particular poetic style are investigated. An alternative approach is suggested in a hypothetical example introduced by Nemerov in which thematic constraints produce something like

Night blindness world.
I darken in.

In this case, the semantic connection of ***night, blind, world,*** and ***darken*** is presented by the algorithm, leaving the poet the job of providing an acceptable syntactic structure:

Night is the blindness of the world;
I darken from within.

Generating similar stimuli to analysis or creativity for metrical pattern or rhyme words would also produce insights into poetic uses of language, or at least greater respect for human craftsmanship.

The Poet's Meaning

One further dimension of structure might also be considered, the purport of the poetic. Mark Adrian has devised an algorithm for concrete poetry in which type size and word placement are randomized to give the appearance of this form of verse (*Studio International* [July 1968], 53). Another approach could build on our cultural mythology about the machine and might profit from the "computer" type style devised for a recent circulation campaign by the *Reader's Digest* or from the use of an IBM Audio Response Unit to *speak* the output of computer-generated verse. Instead of concealing the role of the machine in composing some banal ditty, these experiments would make the medium nearly overwhelm the message.

In most treatments of computers and poetry, the significance of the effort is somehow misunderstood. Surely the goal is not to add to the world's stock of poems by producing instant anthologies. Instead we need to use the computer's inexorable talent for random combinations to explore the thin line between what we recognize as bizarre (and welcome) spontaneity and what we regard as unacceptable gibberish. How can random selection be constrained to filter possible English sequences from mere lists, imagination from mechanism, poetic madness from genuine insanity? □

DPMA ANNOUNCES REGISTERED BUSINESS PROGRAMMER EXAMINATION

R. Calvin Elliott, Executive Director
DPMA
505 Busse Highway
Park Ridge, Ill. 60068

A registered business programmer examination has been developed by the DPMA (Data Processing Management Association) for the purpose of setting standards and raising the competency level of programmers in the fields of business and industry. In development since 1967, the new examination is the work of DPMA's certification council and is designed to measure the ability of an applicant at the senior programmer level. The general areas covered by the exam include: 1) principles of programming; 2) Meta programming systems; 3) problem-oriented languages — ALGOL, LISP, SIMSCRIPT, FORTRAN and COBOL; 4) data processing system design; and 5) computational topics.

The exam will consist of 150 questions and will require 2½ hours to complete. It will be given annually in approximately 100 test sites across the U.S. and Canada. Eligibility to sit for the exam is not restricted to DPMA members. Study guides are being prepared by DPMA.

The first exam under this new program will be given October 10, 1970. Application forms may be obtained from the DPMA at the address above. Applications for the October 10 exams must be filed by August 1. □

IFIP CONGRESS 71 — CALL FOR PAPERS

I. J. Seligsohn
U.S. Committee for IFIP Congress 71
Box 4197
Grand Central Post Office
New York, N.Y. 10017

IFIP Congress 71 has issued a call for papers for the fifth global conference in the information sciences, to be held August 23-28, 1971, in Ljubljana, Yugoslavia.

The main objective of the Congress is to foster information exchange on accomplishments and problems, and to stimulate further research. As an aid in selecting topics for papers, the Program Committee has set up seven major areas of interest: (1) Numerical Mathematics; (2) Mathematical Foundations of Information Processing; (3) Computer Software; (4) Computer Hardware and Systems; (5) Systems for Management and Administration; (6) Technological Applications; and (7) Sciences and Humanities.

Submitted papers should be directed not later than November 30, 1970, to the most convenient of the following addresses:

Academician V. M. Glushkov, Chairman
IFIP Congress 71 Program Committee
Institute of Cybernetics
Ukranian Academy of Sciences
Kiev — 28, U.S.S.R.

Professor C. C. Gotlieb, Vice Chairman
IFIP Congress 71 Program Committee
Institute of Computer Science
University of Toronto
Toronto, Ontario, Canada

Professor H. Zemanek, Vice-Chairman
IFIP Congress 71 Program Committee
IBM Laboratory Vienna
Parkring 10
A-1010 Wien 1, Austria

Further information about the Congress, exhibition, and organized travel arrangements is available from the organizing committee: IFIP Congress 71, Congress Office, Mestni TRG 4, Ljubljana, Yugoslavia; or from the U.S. Committee for IFIP Congress 71, Box 4197, Grand Central Post Office, New York, N.Y. 10017. □

ALL FORMS OF COMPUTER ART SOUGHT FOR 1970 ACM CONFERENCE

Dr. Monroe M. Newborn
Columbia University
Dept. of Engineering
1340 S.W. Mudd
New York, N.Y. 10027

A program designed to dramatize the impact the computer has had on art is being planned as part of the 1970 National Conference of the Association for Computing Machinery (ACM) to be held in New York Sept. 1-3. A multi-media presentation is planned to include computer-generated and inspired art and music, a theater for the continuous showing of computer-related films, and a display of computerized sculpture and weaving.

The Art and Music Sub-Committee is searching for outstanding examples of anything that relates to the computer and artistic endeavor. Prizes will be awarded to winners in various categories, and entries can be offered for sale by the artist.

Anyone interested in contributing to this presentation is encouraged to write me at the address above. □

MARTIN LUTHER KING MEMORIAL PRIZE CONTEST — SECOND YEAR

(Please post this notice)

Computers and Automation has received an anonymous gift and announces the annual Martin Luther King Memorial Prize, of $300, to be awarded each year for the best article on an important subject in the general field of:

> The application of information sciences and engineering to the problems of improvement in human society.

The judges in 1970 will be:

> Dr. Franz L. Alt of the American Institute of Physics; Prof. John W. Carr III of the Univ. of Pennsylvania; Dr. William H. Churchill of Howard Univ.; and Edmund C. Berkeley, Editor of *Computers and Automation.*

The closing date for the receipt of manuscripts this year is April 30, 1970, in the office of *Computers and Automation,* 815 Washington St., Newtonville, Mass. 02160.

The winning article, if any, will be published in the July issue of *Computers and Automation.* The decision of the judges will be conclusive. The prize will not be awarded if, in the opinion of the judges, no sufficiently good article is received.

Following are the details: The article should be approximately 2500 to 3500 words in length. The article should be factual, useful, and understandable. The subject chosen should be treated practically and realistically with examples and evidence — but also with imagination, and broad vision of possible future developments, not necessarily restricted to one nation or culture. The writings of Martin Luther King should be included among the references used by the author, but it is not necessary that any quotations be included in the article.

Articles should be typed with double line spacing and should meet reasonable standards for publication. Four copies should be submitted. All entries will become the property of *Computers and Automation.* The article should bear a title and a date, but not the name of the author. The author's name and address and four or five sentences of biographical information about him, should be included in an accompanying letter — which also specifies the title of the article and the date.

"Many people fear nothing more terribly than to take a position which stands out sharply and clearly from the prevailing opinion. The tendency of most is to adopt a view that is so ambiguous that it will include everything and so popular that it will include everybody. . . . Not a few men who cherish noble ideals hide them under a bushel for fear of being called different."

"Wherever unjust laws exist, people on the basis of conscience have a right to disobey those laws."

"There is nothing that expressed massive civil disobedience any more than the Boston Tea Party, and yet we give this to our young people and our students as a part of the great tradition of our nation. So I think we are in good company when we break unjust laws, and I think that those who are willing to do it and accept the penalty are those who are a part of the saving of the nation."

> — From *"I Have a Dream" — The Quotations of Martin Luther King, Jr.,* compiled and edited by Lotte Haskins, Grosset and Dunlap, New York, 1968.
>
> Reverend Martin Luther King, Jr., was awarded the Nobel Peace Prize in 1964, when he was age 35.
>
> He was in jail in the United States more than 60 times.
>
> He was assassinated in Memphis, Tennessee, April 4, 1968.

THE USES OF DISPLAY TERMINALS FOR BUSINESS APPLICATIONS

Alan B. Kamman
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Cambridge, Mass. 02140

"The uses of display terminals, most particularly alphanumeric display terminals, will have a major effect on the internal operation of businesses in the next five years."

The "Roaring Sixties" of nautical fame had nothing on the Roaring 60's of computer fame. Both winds raged with power against which few corporate individuals successfully stood. Those computer winds swept across the land in the past decade, cutting a broad swath through the existing hardware, and, as in the wake of a tornado, things had changed when they blew themselves out. A third-generation of mainframes grew from its path, and offspring sprouted with names that approached motherhood in sanctity; minicomputers, tape cassettes and display terminals.

The uses of display terminals, most particularly alphanumeric display terminals, will have a major effect on the internal operation of businesses in the next five years; and we've chosen to examine statistics and uses for this period. Since computer graphics, picture-phones, plasma, electroluminescence etc., represent specialized forms of display hardware, we have excluded them from the data. We have also excluded projections for devices which, although having a CRT, are used primarily for off-line operations such as key-to-cassette replacement of keypunch operations. These applications also deserve special treatment.

The Forecast

Forecasting of computer peripheral equipment rivals forecasting of economic trends in complexity and variations. One selects a logical method, surveys the field, trends the data, adjusts for variations and receives the result. Then one discovers that another reputable firm has selected a different logical method, performed the proper additional steps and calculated an answer that differs from yours by an order of magnitude. It is somewhat tragic that professional rivalry and business security prevents rival statistical-types from sitting down and revealing secrets or methods to synergistically build a better mousetrap for future forecasting.

Arthur D. Little, Inc., employed several techniques to establish its statistics. First it used the Withington Tables to establish trended computer mainframe statistics for the years 1969 through 1974. (Recently these were calibrated and results showed only a five per cent variation between 1964 forecasts of 1968 and 1968 actual data.) The growth patterns of display terminals in general, as a function of mainframes, were then determined and projected. Nearly ninety companies using or contemplating using display terminals were interviewed, and sixteen of at least forty alphanumeric CRT vendors were investigated. Based on these company interviews and in-house knowledge, submarket shares of the total market universe were estimated. The statistics, therefore, are presented with confidence, but with the full realization that they fall within a band of five-year estimates made by reputable professional firms ranging from 125,000 to 750,000 CRT's in service.

TABLE ONE

United States Commercial Alphanumeric Display Terminal Market Five-Year Forecast

	Installed Units		
Industrial Category	**1/1/69**	**1/1/74**	**Growth (%)**
Financial	8,000	26,000	225%
Brokerage	30,000	52,000	73
Manufacturing and Sales	7,000	45,000	540
Transportation and Travel	9,000	50,000	455
Utilities and Communication	6,000	23,000	283
Services	9,000	54,000	500
Total	69,000	250,000	262%

Source: Arthur D. Little, Inc., Estimates

The Financial Market

Composed primarily of the banking and insurance fields, the financial market has a relatively low number of CRT's installed at this date. Banking terminals are primarily of the type which update passbooks while interfacing directly with a computer, and Touchtone telephones are in vogue on an experimental basis where short, rapid responses are necessary.

Insurance companies have yet to implement many CRT terminals or their equivalents, and this is somewhat surprising since money is available, and their investment

Alan B. Kamman is a member of the professional staff in the Management Sciences Division at Arthur D. Little, Inc. He consults in the fields of computer peripheral equipment and data communications transmission. He has received recognition for numerous papers, including the Charles Billin Award from the Philadelphia Engineers Club, the Best Paper Award from the Society for Information Display's Ninth Symposium and the Freedoms Foundation Award for a sociological treatise on "Age of the Individual". Mr. Kamman is a past chapter chairman for ACM, and a twenty-five year member of the Franklin Institute. He received his Bachelor of Science degree from Swarthmore College in 1952.

departments are not adverse to purchasing entire computer peripheral companies as excellent repositories for excess funds.

Most banks have CRT's included in their long range plans, and while we forecast a moderate 10 - 15 per cent annual growth rate for the next two years, it should increase to approximately 30 per cent annually near the end of the five-year study period. Applications will increase from simple account and credit checking activities to complete one-terminal service for demand deposit and savings account on-line recording of deposits and withdrawals, credit checking for loans and charge-card purposes, stock transfer functions for corporate trust departments and portfolio analysis for personal trust departments. In effect, this "one-stop" terminal will help implement long-range plans for banks striving to integrate banking accounts, loan activities and credit services so a customer exists as one complete entity from the bank's point of view.

Insurance companies in most fields, including those specializing in health, accident, fidelity, fire, marine, casualty and life policies, have not yet implemented large numbers of CRT devices. Initially the annual growth rate starts at 13 per cent, then will leap to approximately 33 per cent by January 1, 1975.

Applications include on-line changing of name and address, additions or deletions of riders, calculation of policy cost and balance-due, and a conversational mode discussion leading to the design of optimum policy for an individual or corporation, based on personal goals and objectives. Because of the specialized editing functions and character capacity necessary to perform these tasks, the CRT's used will represent the top of the available industrial product line.

Overall, therefore, this category will more than triple in size within the next five years. In addition, complexity of on-line functions will also increase, so the CRT in use in 1975 must have the technical ability and capacity to handle complex operations.

The Brokerage Market

To the brokerage industry, a device to interrogate a computer for stock market statistics is as important as the telephone to accept customer orders. The display terminal is a necessary tool of the business, and exists as an integral part of everyone's daily operation. The market, therefore, has accepted a tremendous number of devices (our statistics exclude the "nixie bulb" terminals), so five-year growth expressed as a percentage appears to be low.

The annual percentage growth will probably remain under ten per cent, reflecting the large base now in existence, then increase near the end of the five-year period. This increase includes new uses of CRT's to help with the clerical problem in back offices.

These clerical problems can cause firms to spend approximately a quarter-million dollars annually to borrow stocks which they already own. Information in the broker's cage can range up to three days old, and although certificates to satisfy trades might exist, records do not show them and shares must be borrowed to cover the transaction at a price.

The New York Stock Exchange's Block Automation System helps set the pace for a different use of CRT's. This system, as well as similar systems under consideration by other financial institutions, help bring together buyers and sellers so that negotiations for trading can occur quickly and efficiently.

As far back as 1965, the Chicago Board of Trade installed its Com-Quote system, which collects commodity quotations from the trading floor, displays current price data to brokers on the floor, and distributes quotations to brokers around the world. Com-Quote gives 1400 members who still trade at open auction in wheat, oats, barley, plywood, silver etc., improved accuracy of price reporting at computer speeds, and provides rapid access to historical prices.

Terminals used primarily for quotations will continue to be relatively unsophisticated, but increased editing functions will be needed when the CRT's are used for improving clerical operations. One vendor has just introduced a terminal which can be used either on a nation-wide information system to get quotations, or switched instantaneously to the customer's own computer for in-house applications such as portfolio analysis. Another vendor uses two small CRT's in the same housing, with different information available on each screen.

In summary, the brokerage industry has, to date, been dominated by basic terminals, dedicated to limited input and output. Complexity will increase as new applications require, and although the market is far from saturated, per cent annual growth remains low because of the large number of existing devices.

The Manufacturing and Retail Market

From a non-regulatory, profit-making, research and development point of view, manufacturing industries should be leading the way toward increased efficiencies through the use of display terminals. Surprisingly, interviews with scores of corporations, most of them included in the ***Fortune*** 500 list, show a relative lack of installations. A number of companies had experimental systems, but few had made major committments.

A large petroleum firm is investigating CRT's as a means of filling the gap between top management information needs and EDP usage. Their experience is now gained from a pilot model where they are experimenting with budgets, project status, market simulation and statistical reporting.

One of the leading container manufacturers has over 30 CRT's on-line for order entry, and has an additional 40 scheduled to be installed within the year. A paper manufacturer has gone one step further by experimenting with an inventory status application. Most of his paper stock is used in the field of paper copiers, and the key to dollar success is the ability to fill an order quickly. If not, another vendor will be contacted, supply the paper, and eventually take away the copier business.

The retail field has also been slow to implement display terminals, but since the industry is noted for low profit margins, the reasons are primarily financial. Growth should occur in this field near the end of the study period when CRT's become less expensive, compatibility problems are closer to being solved, and more standard software packages exist.

A large department store with multiple branches in California has eighteen display terminals in their Accounts Receivable and Charge Authorization areas. Operators of these CRT's provide rapid service to store clerks checking credit for waiting customers. The operators also provide a lookup service for customers who telephone to question their accounts.

Another example which falls primarily in the retail field is the Credit Data Corporation. They use approximately 200 display terminals to interrogate files on 11,000,000 people in response to nearly 100,000 daily inquiries.

The manufacturing and retail fields have just begun to grow, and the results should be startling. By 1975, there will probably be a five-fold increase in installed terminals over current CRT's in service.

The Transportation and Travel Market

The brokerage and airline uses of CRT's bear similarities. The large number of devices in service in 1969 reflect the use of terminals as necessary, daily business tools. With installations imminent at American, TWA, Eastern, Braniff and Pan Am, the 1969-1970 period represents the Year of the Airline Terminal. This should be followed closely by the Air Traffic Conference-approved ATAR system which eventually will place display terminals in travel bureaus throughout the United States to interrogate a master reservation system serving most of the 31 airlines represented by ATC.

Moving from the airlines to the rails, the (formerly) New York Central pioneered the use of CRT's in 1966 to keep tabs on freight cars moving through its system. The Penn Central continues to maintain the application, and can locate all 600,000 cars either owned by or presently being handled by them. The computer supplies to the CRT data on its last three moves, waybill numbers, contents, schedule and specific future instructions.

This initial use of CRT's in the freight business will probably cause installations for the trucking industry (witness that magnificent Sycor advertisement last December!), shipping industry (Standard of New Jersey already uses display terminals to locate all of its tankers) and the bus-freight and air-freight market segments.

Conceivably ticket agencies for theaters and sports will use CRT's in an optimum fashion. They could display on the screen a seating plan with sold locations x'ed out. The customer would merely key in the seats he desired, and a confirmation would come forth on the screen. At the same time, a written notification would be issued on a strip printer. The attendant would peel off a protective backing, place the strip on a preprinted ticket blank, and issue it to the customer.

This market is characterized by a wildly high initial annual growth, representing delivery of previously ordered airline display terminals. The annual percentage drops, then levels in the neighborhood of 20 per cent at the end of this study period.

Utilities and Communications Market

The five-year growth rate of almost 300 per cent will depend largely upon the massive introduction of display terminals in the Bell System, followed by other telephone companies who quickly implement A.T.&T.'s designs. Installations in the Bell System today range from the very simple (Illinois Bell Telephone Intercept Service) to the very complex (Bell of Pennsylvania's Centralized Records Business Office). Additional applications exist in A.T.&T.'s Treasury Department, New Jersey Bell's Trunk's Department, and Ohio Bell's Commercial Department.

Consolidated Edison helped to pioneer the use of CRT's in the utility field. Serving 3 million subscribers and nearly 5 million meters required a great deal of paper. The system developed to reduce this combined microfilm (for little-accessed data) with display terminals (for often-accessed data). Over 200 CRT's are now in use, and Con Ed has decided to replace the microfilm operation with additional CRT's.

In the private sector utility field, Michigan State University's switchboard operators are using display terminals to locate telephone numbers of over 62,000 students and employees. The system provides rapid access to persons on campus, and can locate the number either by keying in the entire surname, or just the last initials.

The Utilities and Communications field should start out with a 20 per cent annual growth, and reach a 30 per cent annual growth by the end of the five-year forecast period.

The Services Market

One of the major areas within the Services Market is that of Social Services. Comprising categories such as hospitals, police departments, education, recreation and local government, the Social Services group should experience rapid and gradually increasing growth in the next five years.

A problem helping to stunt early growth is that non-federal governments are beset by having inadequate computer forces in the organization. In most cases, programmers are trained from within the ranks since the pay scale does not enable local governments to attract the outside variety. Often these men then leave to find more lucrative positions. For this reason, lack of in-house expertise may delay the acceptance of display terminals. We have increased the growth rate in later years to represent the availability of "plug-in" software packages at that time.

Another major category in the Services Market is that of Service Bureaus themselves, and it is a difficult one to define. For example, many manufacturing companies use their own computers as Service Bureaus for terminals located throughout their corporation.

From the standpoint of CRT competition, the greatest nemesis is the teletype machine and other printers because of hard-copy availability and low cost (by comparison) of the units. The Service Bureau customers still demand paper, and since most applications concern complex mathematics or program debugging, the desire is understandable.

The Services Market should expand by a factor of six when comparing sets installed in 1975 with those in service in 1969. Initial annual growth of approximately 20 per cent should exceed 30 per cent annually at the end of the five-year period.

Summary

In conclusion, the introduction of alphanumeric display terminals should proceed in an orderly and gradually increasing fashion over the next five years. As Table Two indicates, the annual growth rate begins in the range of 22 per cent, and rises until it levels in the neighborhood of 26 per cent. The resulting overall growth rate of 262 per cent represents more than a four-fold increase in installed CRT's over the next five years.

TABLE TWO

United States Commercial Alphanumeric Display Terminal Market Growth Rate

Period	Approximate Annual Growth Rate (Percent)
1969-1970	22%
1970-1971	22
1971-1972	23
1972-1973	25
1973-1974	26
1974-1975	26

Source: Arthur D. Little, Inc., Estimates

Certainly it is a prediction calculated to prod businessmen into investigating areas within their own spheres of activity where display terminals can be used effectively. More particularly, the prediction should warm the hearts of the 40-plus vendors engaged in manufacturing CRT's, as well as encourage the usual birthrate of new firms at the next computer conference. □

GUIDELINES FOR CONTRACTING FOR COMPUTER RELATED SERVICES

B. A. Martin, Member
Standards Committee
National Association for State Information Systems
Lexington, Kentucky

Although electronic computers have been used to process business and scientific data for two decades, a precise technology pertaining to procurement and use of computer hardware and software still has not been developed.

Preliminary guidelines have been postulated for procurement of computer hardware. A number of computer programs or systems exist which serve as tools for timing and evaluating hardware performance. CASE and SCERT are examples. Most hardware manufacturers have their own timing systems as well. Government organizations and private sector corporations now issue detailed specifications in the form of a Request for Proposal (RFP), which describes the hardware to be procured in terms of:

- Central processor memory storage size
- Types and performance of peripherals
- Communications interfaces
- Maintenance requirements
- Training and education requirements
- Systems Engineering requirements
- Contractual provisions

The RFP may require successful running of a "benchmark" which is a program or series of programs, usually representative of the organization's workload.

Through the vehicle of detailed specifications and carefully prepared benchmarks, organizations have found that the computer hardware that is procured is much more likely to meet existing requirements. However, in procuring of computer related services, very few guidelines have been developed to help ensure that the service or product desired will meet existing requirements. One can say that procurement of the proper hardware occurs more often than not at the present time and that procurement of the expected computer related services rarely occurs. The problem may be described in two aspects: selection difficulties and performance difficulties.

The Selection Problem

To illustrate the selection problem, the following example is cited. An organization located in one of the major metropolitan areas issued an RFP for computer programming services. The specifications clearly defined the task to be accomplished. Since the organization was a Governmental one, the RFP was sent to every company on the Contracting Officer's software services bidders' mailing list. Fifty-three contractors responded with proposals. The fixed prices quoted ranged from a low of $1,900 to a high of $27,850 to perform the same job. Moreover, there was no grouping of quotations; they ranged about equally from high to low. The agency was at a loss regarding the criteria to be used to guarantee selecting the contractor who could do the best job for the lowest dollar expenditure. Several months were lost before a selection was made.

The Performance Problem

To illustrate the performance problem, another example is provided. This should discourage those who may have concluded in the above illustration that an award could have been made to the low-bidder. A Government Agency issued an RFP for analysis and design of computer program specifications. Once the specifications were designed, it was intended to issue these specifications in another RFP for programming services. The lowest bid was $80,000. The next lowest bid was $210,000, with two additional proposals for prices higher than this. An award was made to the lowest bidder. Halfway through the performance period, the contractor was acquired by another company. After the $80,000 had been exceeded and it was apparent that not even one-half the work was finished, the contractor tried to renegotiate with the Agency. The Agency decided to hold the contractor liable for performance at his original bid price. The contractor chose not to default and continued his analysis and design work with a greatly reduced staff in an effort to cut his losses as much as possible. On the date the specifications were due, only about ten percent were in final form. In order to meet the implementation deadline, the Agency issued the ten percent completed specifications to other contractors and requested a fixed price quotation for programming services. This compounded an already bad situation. The contractor who was awarded the implementation contract for $37,000 later found that once all the specifications were in hand, he could not perform the job for less than $79,000. Thus, the Agency and the new contractor faced much the same problem as had been the case almost twelve months before: delay in delivery, inferior product, and loss of money.

The foregoing examples are experiences common to this field. What causes such problems to arise? Several factors are involved:

- The specifications are often extremely poorly defined and incomplete.
- When specifications are relatively well defined and complete, contractor (as well as the issuing organization) estimating techniques are very crude when

"Almost every person who faces the task of employing a contractor has one he favors because of previous business exposure, personal friendship, personal monetary gain, personal ignorance, an erroneous impression of his own knowledge of the field, or a combination of these factors. To preclude being misled by the existence of any of the foregoing, one should make it a cardinal rule to solicit competitive bids for every job."

it comes to evaluating the speed and efficiency of "people" performance.

- A general state-of-the-art problem. Specifications for computer related services cannot be prepared that are in any degree as precise as those for hardware.

Types of Computer Related Services

Examples cited in the previous section dealt with services for software analysis, design, and programming. Such services address something that is quite tangible compared to other consultant-type requirements. Contractual activities can range from total facilities management to simple programming tasks. Categories of services are outlined below with some comment on each type.

Facilities Management

In this type of activity, a single prime contractor is responsible for obtaining the computer hardware, providing preventive and remedial maintenance, providing systems software for operating the computer, doing the applications programming, and providing all computer related supplies and equipment. This is a comprehensive plan that removes the organization receiving the service from any operational or systems responsibility. A variation on this approach is to ask that a contractor provide all the services to an Agency but then turn the management of the center over to the Agency at a given time. These are sometimes referred to as "turnkey" – although the term has been used for a pure facilities management operation.

In the past, facilities management contracts were rare. However, as separate procurement of peripherals and software become common and as more communications facilities introduce the requirement for interfaces with common carrier representatives and producers of modems, it is expected that a single prime contractor, responsible for the total operation, will be increasingly popular.

Studies

It has been found that implementation of any system that requires the use of a computer for its performance must be preceded by a study if the end product is to be successful. This analysis is often referred to as a Feasibility Study. Before a company or Government Agency obtains a computer, it should examine the feasibility of automating activities and functions that are being performed manually. The question usually addresses the cost-benefits to be realized, if any. The same analysis is usually performed before implementing a new system on existing computer equipment. Many organizations ask outside contractors to perform the study due to a shortage of trained personnel and an expectation that outside help lends objectivity to the final recommendations.

Software Packages or Proprietary Software

An increasing number of generalized software packages consisting of one or more programs are being offered to computer users. These range from flow-chart programs to large data and file management systems. The most popular computer for packages is the IBM 360 series since it dominates the field.

In the early days of packaged software, many contractors offered them as turnkey or immediately operational for a fixed price. As it has become more and more apparent that no user is exactly like another user and that alterations sometimes involve a total rewrite of the package before it meets a given user's needs, contractors have begun to take a safer course by offering the package for a fixed fee plus implementation charges. The future of software packages is great but the dangers inherent to both the contractor and the user are greater.

Analysis and Design Services

Prior to the advent of packages, every user's needs were considered unique. Organizations found that their own manpower limitations dictated that outside contractors be hired to provide analysis and design of systems once a decision was made to implement them. Often the studies which preceded the issuance of RFPs for these services were incomplete and this situation has not changed. Because of this, the services were performed on a time and expense basis with a fixed upper limit. This open-end arrangement has led to much abuse of the organization issuing the contract.

Programming Services

Programming services are usually viewed as the simplest and most straight-forward type to be performed by an outside contractor. The assumption is that the analysis and design phase has been well done and implementation is merely a matter of coding in the selected machine or higher level language. This is a great misconception. Analysis and

design is often performed by senior technical personnel who, due to the rapid and extreme change involved between first, second, and third generation hardware, are out of touch with the state-of-the-art. Consequently, the design and analysis work must be altered greatly prior to programming. The new operating systems defeat the obsolescent knowledge of so-called "experienced" analysts.

Time Sharing Services

Although time sharing is a type of contractual service performed out-of-house, this paper does not address it as a problem. To use this tool, the user himself does the programming. The service can be easily contracted for as well as cancelled. The user's primary concern should be to monitor the costs involved in order to ascertain when they have become excessive and it is time to procure his own computer to do the jobs that he is doing out-of-house. What is said in the balance of this paper does not directly apply to time sharing services.

Training and Education Services

Training and education services will become progressively more available as the effects of the hardware manufacturers' "unbundling" is felt. In the past, the manufacturer supplied training and education as a part of the computer charges. Now that it is becoming a chargeable item, it is easy to obtain from other firms. This will remain true for the next several years until new hardware product lines are introduced. When that occurs, there may be a dependence on the hardware vendor for a while until the non-hardware firms have the chance to develop their expertise.

Systems Engineering Services

As a result of the "unbundling", systems engineering services may now be procured competitively. This is the traditional systems software advisory service which instructs an organization in the proper use of the hardware manufacturers' operating systems, language compilers, sorts, and other utilities, etc. Like training and education, it is a business that will become very competitive in the future.

Data Preparation Services

This category includes the keypunch-keyverifying work that is often done out-of-house. Obtaining this type service is relatively straightforward and is usually done on the lowest bid basis. What is said in the balance of this paper does not directly apply to this area.

Service Bureau Support

This support is one of the oldest and most widely used. The service organization handles some or all aspects of a using organization's computing requirements for a monthly fee. As a function, it is akin to Time Sharing and Facilities Management since it removes the using organization from control and management of the activities performed by the computer. For the small user who does not expect to develop large requirements in the near future, a reliable service bureau operation is the ideal arrangement to handle computer related jobs.

For the user who expects to get his own computer, a service bureau arrangement can be a poor choice. He will pay to develop systems that cannot be transferred to his own operation. As segmented sections of his overall system requirements, the sub-systems provided by the service bureau may be completely incompatible with the eventual applications he must develop. Moreover, service bureaus have been known to lose entire data files that are key to the integrity and profitability of an organization. The fact that they are "outside" operations in a pure sense makes them a questionable venture. The using organizations's management is totally dependent on an independent outside organization.

There is no reason to proliferate categories since all computer related services contracts can be subsumed under those given above. For example, a requirement for translation of programs written in one computer language to the language of another computer may combine both a package software approach and programming services to handle items that are not machine translatable. Consultant services for developing a planning, programming, and budgeting system usually are accomplished in two parts, a study phase and an implementation phase — the latter of which involves computer software analysis, design, and programming.

Sources of Computer Related Services

Many organizations are in the business of providing computer related services on contract. Some offer nothing more than machine time on their computers, while others offer all the services described above. Some offer subject matter knowledge of state and local governments together with a knowledge of related physical and social sciences, while others have only computer-related programming knowledge. Contractors can be divided into three separate groups: (1) governmental agencies and individuals, (2) non-profit, private-sector corporations and individuals, and (3) profit-oriented, private-sector corporations and individuals.

Another type of categorization is shown below. The rationale of these categories is to isolate organizations that have special knowledge of a field of endeavor from those that are purely computer oriented.

(a) Broad line management consulting organizations offering some knowledge of computer-related services. (Examples: Ernst and Ernst; Touche, Ross, Bailey, and Smart; Illinois Institute of Technology Research; State and Private Universities.)

(b) Broad line management consulting organizations offering a broad line of computer related services. (Examples: A. D. Little; Systems Development Corp.; National Bureau of Standards; Stanford Research; State and Private Universities.)

(c) Computer related service organizations with a broad line of subject matter expertise. (Examples: Computer Sciences Corp.; Informatics; Computer Usage Co.; State and Private University Computer Centers.)

(d) Computer related service organizations offering only specialized subject matter expertise. (Examples: Institute for Defense Analysis; Research Analysis Corp.; Systems Science Development Corp.; Washington Data Processing Center, Dept. of Agriculture.)

(e) Service bureau organizations oriented toward one or only a few specialized areas of expertise. (Example: Local (not usually national) organizations, such as service bureaus specializing in supporting the insurance or banking industry, or ones that merely offer keypunch services and machine time.)

(f) Service bureau organizations offering a broad line of specialized areas of expertise. (Examples: Service Bureau Corp.; General Electric Time Sharing Corp.; Univac Information Services Division.)

(g) Individual consultants with computer related

knowledge. (Examples: Private consultants; University personnel; Government personnel.)

Disagreement regarding how the organizations listed as examples should be categorized would be natural. There is no intent to mis-classify. Examples are used to clarify the categories. There are state and local government organizations that would fall into Categories (d) and (e).

Preparation

Once a decision has been made to obtain help from outside sources, there are a number of things that should be accomplished. It is of prime importance to realize that you cannot select the contractor who can do the best job for the least amount of money without competition. It is absolutely necessary that you have three or more organizations and/or individuals competing for the business. This applies whether you are a private-sector company or a governmental agency. Almost every person who faces the task of employing a contractor has one or more contractors whom he favors because of previous business exposure, personal friendship, personal monetary gain, personal ignorance, an erroneous impression of his own knowledge of the field, or a combination of these factors. To preclude being misled by the existence of any of the foregoing, one should make it a cardinal rule to solicit competitive bids for every job. The state-of-the-art related to computers is too fluid to safely confine one's business to any given individual or organization.

Some object to having competition on a given study or contractual effort because:

- The job cannot be clearly enough defined;
- And/or the job requires the peculiar knowledge offered by a given contractor.

The fact that the job cannot be clearly defined should result in a decision not to contract for it until it can be clearly defined, or, if it is essential that work be done, using a selection process not based upon job specifications. In the economy of the United States, no given contractor can possess a sufficiently peculiar knowledge to warrant sole-source. Sole-source may be more convenient to you but, until you have received offers from several potential contractors who may only have a knowledge related to your job, you cannot determine how quickly and economically someone may be able to understand what is to be done.

Selecting Contractors for Proposals

It is recommended that you solicit proposals from no fewer than three and no more than ten firms. It is very difficult for a single individual or a committee to evaluate and rank more than ten proposals. The optimum number is five. If proper pre-RFP selection of five firms has been done, one can perform a competitive evaluation and obtain the best contractor when dealing with this smaller number of responses.

Today's large proliferation of computer related service organizations makes an economically feasible selection of companies with whom you desire to do business rather hard to accomplish.

In the Federal, state, and local government areas, your purchasing or contracting office is likely to have fifty or more companies on its bidders' mailing list. Evaluating fifty to one hundred proposals in response to every RFP is expensive and it is unlikely that you will develop adequate criteria for selection of the best contractor. There are several techniques that can be used to reduce the cost of obtaining outside help to a minimum as well as to ensure that you or your committee do not have to work with an unmanageable number of proposals. The most important selection criteria are as follows:

(a) **Related Experience.** Has the contractor performed any job similar to the one you desire to be done? Have him provide complete data on each job listing:
  (1) Agency or Company for whom the job was performed.
  (2) Brief description of the job.
  (3) Contracting officer's name and telephone number.
  (4) Technical liaison's name and telephone number.
  (5) Names and functions of contractor personnel performing on the job.
  (6) Approximate man-month effort the job required.
  (7) Beginning and completion dates of the job.

(b) **Personnel Proposed.** Have the potential contractor provide resumes of the personnel he is proposing. These can be used as outlined in the techniques given below. If the company has no related experience but one or more of the personnel proposed have performed related contracts while in the employ of another company, request all the information required by (a), preceding.

(c) **Fiscal Posture.** Have the potential contractor provide his latest annual report. Also, run a separate Dun & Bradstreet or similar check on the company. Let your financial experts provide you with an evaluation of the stability of the company. Evaluate key items such as long-term indebtedness. Uncontrolled or excessive overhead rates usually indicate that a contractor has internal management problems. Have the contractor specify his present overhead rate and provide you with the rate he has experienced in his last three fiscal years. This is especially important to check on cost-plus-fixed-fee type contracts.

(d) **Current Contracts.** Ask the potential contractor to list three or more contracts that the *local* office that will be performing your work is currently executing. Have him provide the names and telephone numbers of both the technical liaison and the contracting officer.

Using the criteria given above, there are two techniques that can be suggested. The first technique is to select, prior to the beginning of each fiscal year, five to ten contractors to whom you will issue each RFP for computer related services. This technique is the least expensive since it means that you must evaluate a large number of companies only once each year. The five to ten that you select to receive RFPs can be evaluated quickly each time a contractual situation arises. This technique usually consists of asking each potential contractor on the bidder's list to submit a general capabilities report containing:

- Description of Jobs Performed
- Resumes of Personnel
- Rates for each rank of technical personnel in the organization

It is suggested that the section on jobs performed be as detailed as shown under Criterion (a), above. This will provide you with a much more specific description of what a company has really done. You may also want to limit this to the jobs performed by the potential contractor's local office during the last three years. You should also obtain a Dun & Bradstreet report on each potential contractor selected.

This approach allows you to issue your RFPs only to the selected five to ten contractors. The RFP would then require the contractor to provide a technical proposal addressing the specifications and a cost proposal for the job to be done. More will be said about RFP development and proposal evaluation further on in this paper. Examining the list of personnel who have performed related projects and comparing it with the ones being proposed for your project should give a good indication of how serious the organization is about doing business for you.

Technique Number One may present a problem in one area. Projects can arise during a fiscal year that require experience differing from that which has been the basis of the initial selection. If this occurs, Technique Number Two can be used.

The second technique for selecting contractors for proposals begins when specification development is well under way. Select the five to ten contractors to respond to the particular RFP in the same way as described under the first technique. In requesting capabilities, describe the job that is to be performed so that contractors can be very specific in their responses. Review the capability reports and issue the RFP to five to ten most qualified companies.

The two techniques described do not in any way exhaust the methods used for limiting competition to a workable number. Some contracting officers keep a private list of favored contractors. They are the only ones who receive RFPs and if there are complaints, the contracting officer indicates that copies of his RFP are all gone but that he has a copy that can be reviewed in his office. This and other cruder techniques are discouraged since they do not provide any mechanism to ensure the most qualified potential contractor has an opportunity to bid nor does it provide for getting the most cost-effective job.

A final comment on the preparatory phase is to encourage solicitation of contractors who may not be on the bidders list. There are always a number of reputable and desirable firms who should be actively solicited to bid, since their performance is known to be good. Ensure that they have the opportunity by having your contracting officer notify them of the potential business.

Issuing the RFP

More needs to be said about the RFP itself. In order to guarantee a uniform response that will ensure a good evaluation, the RFP should contain directions on how the proposal is to be prepared. Since jobs vary; there is no universal format that can be applied to all proposals. In content, the formal RFP should include the following information:

(a) Description of the problem or task.
(b) Desired objectives.
(c) Level of effort expected of the contractor and level of competence required. Level of effort can be in estimated man-months or approximate dollars.
(d) Anticipated agency participation.
(e) Time schedule for award of contract, commencement of work, submission of project reports, and project completion.
(f) Selection criteria.
(g) Type of cost proposal desired: Fixed price, Cost plus Fixed Fee, Time and Expense, etc.
(h) Contractual provisions: equal opportunity employment agreement, large/small business certification, penalty clauses for late delivery and non-delivery, etc.

The RFP should specify the information expected of the contractor and the format of his proposal. The following is suggested:

Volume 1 - Technical Proposal

Section I: Statement of the Problem or Task Description
Section II: Technical Approach
Section III: Project Management/Milestones
Section IV: Personnel Proposed (Criterion (b))
Section V: Related Experience (Criterion (a))
Section VI: Fiscal Reports (Criterion (c))
Section VII: Current Contracts (Criterion (d))
Section VIII: Sub-contractors.

Volume 2 - Cost Proposal

Total cost of the proposal with a detailed breakdown of how it was computed and any desired method of payment. Itemized breakdown should include the following:

Item 1: Personnel Direct Labor Costs
Item 2: Overhead Computation
Item 3: Other Costs:
Travel
Machine Time
Reproduction Costs
Sub-contractors
Item 4: General and Administrative Expense
Item 5: Fees, if any

Signed contractual provisions should be included in the cost section. This should be the equal opportunity agreement, business size certification, and other standard clauses. The forms may also include a paragraph on penalty clauses for late and/or non-delivery to preclude this becoming a problem at time of contract signing.

It is best to always have the cost and technical parts of the proposal separate for evaluation purposes. Clearly specify the level of detail required under Section V and VII of Volume 1. Anyone can write a good proposal in Sections I - III, but the pragmatic selection criteria of experience and personnel are usually the best.

In deciding the type cost proposal to use on a given effort, you must determine how clearly the job is described by the specifications issued in the RFP. If the specifications are thorough and complete, a fixed price proposal can be requested. If the RFP is seeking a research and development effort, a cost plus fixed fee effort is usually dictated. If you cannot clearly specify the job except in terms of objectives to be achieved, a time and expense contract with a not-to-exceed price may be the best approach.

Awarding the Contract

The RFP should state the criteria that are to be used for the selection. This enables the contractor to concentrate on that which is most important. An example of the way it should appear in the RFP is as follows:[1]

> Selection of a contractor for the work outlined in this RFP will be made in accordance with the following formula:
>
> | | *Percentage* |
> |---|---|
> | Technical Approach and grasp of the problem | 20 |

[1] George H. Roehm, Chief, EDP Management Section, Management Services Division, Bureau of the Budget, State of Michigan, has made many valuable suggestions that have been incorporated into the remainder of this article. Principally: penalty clauses, in-writing agreements, and "CAVEAT EMPTOR".

Personnel Proposed	30
Related Experience	30
Price	20

You should develop your internal selection criteria and make sure that their use is clear to all personnel involved in the evaluation. A suggested evaluation worksheet is shown in Figure 1. Figure 1 addresses the technical aspects of a proposal. Cost factors should be evaluated and points assigned. A simple formula such as the following can be used:

Agency's estimate = x

- Contractor gets 20 points if his estimate is plus or minus 5% of x
- Contractor gets zero points if his estimate is plus or minus 20% of x
- Contractor gets plus 5 points for each 5% he is less than x up to the 20% factor
- Contractor gets minus 5 points for each 5% he is over x up to the 20% factor

At this stage one has dealt only with the contractor's proposal. No attempt has been made to verify related experience or personnel proposed. One merely has a quantified point system ranking each contractor. If prices have varied greatly, or if no real related experience has been found, the point system may show great disparity. Whether it is a meaningful ranking or a greatly disparate one, the balance of the selection can still be carried out.

Contractor Name _____

Evaluator _____

		Points Assigned
I.	Technical Approach - 20 Points	
	Understanding of task or problem - 5 points	_____
	Validity of approach to solution - 10 points	_____
	Creativity of proposed approach - 5 points	_____
II.	Personnel Proposed - 30 Points, Maximum	
	Man level loading required in RFP / Number of personnel with related experience proposed x 20 points=	_____
	Project Manager proposed has related experience - 10 points	_____
III.	Related Experience - 10 Points, Minimum and 30 Points, Maximum	
	Number of related projects x 10 points=	_____
	TOTAL POINTS	_____

Figure 1. Evaluation Worksheet

If it is a cost plus fixed fee contract requiring an overhead ceiling and no such ceiling is specified, the contractor should be disqualified (see comment number eight below).

Figures 2 and 3 suggest possible worksheets for verification of the contractors' offerings. Taking the two top ranking (in number of points) contractors, one should complete these sheets. If there are personnel changes, the points should be changed on the Evaluation Worksheet and

Contractor Name _____

Evaluator _____

IV. Personnel Proposed Verification

Are all personnel proposed available on start date of _____ ? YES / NO

Is Project Manager the same as proposed if project starts on date _____? YES / NO

V. Related Experience Verification (Acceptable/Unacceptable)

Organization Name	Person Contacted/ Date	Job Performed Well-Fair-Poor?
A.		
B.		
C.		

Were there any overruns in terms of dollars and was project executed early-timely-late?

A.
B.
C.

Would you hire the same firm for other work?

A.
B.
C.

Figure 2. Personnel and Related Experience Verification Sheet

rankings changed before proceeding. Those two contractors with the highest ranking after personnel verification should now have their related experience examined. It is possible that the reference verification will eliminate either one or both of the top contenders. If so, one should start the process again from the Evaluation Worksheets of the remaining contractors. It is not easy to quantify the reference

Contractor _____

Evaluator _____

VI. Fiscal Posture

Annual Report shows a healthy contractor YES / NO
D&B Report indicates a healthy contractor YES / NO
Overhead Proposed _____%
Overhead Experienced in 3 Previous Fiscal Years _____% _____% _____%

VII. Current Contracts (Acceptable/Unacceptable)

Organization Name	Person Contacted/ Date	Job Performed Well-Fair-Poor?
A.		
B.		
C.		

Overruns? Early - On-Time - Late? Hire Same Firm Again?

A.
B.
C.

VIII. Opinion of Evaluator

Would you recommend we engage this contractor? YES / NO
(Explain on back of this sheet)

In your opinion, is the contractor presently over committed? (Explain on back of this sheet) YES / NO / Uncertain

Figure 3. Fiscal/Current Contract Verification Sheet

check. One usually decides that it is acceptable or unacceptable. As the preceding checks work out, one should proceed to evaluate the fiscal posture and check out current contract performance.

Evaluation Factors

The foregoing process should result in selection of one contractor who meets some objective and some subjective criteria. It is not possible to quantify everything in selecting a contractor to perform anything as intangible as computer related services. Figure 4 presents the wrap-up sheet that should result from the selection process. If the verification

Contractor _____

Evaluator _____

		Points Assigned	Evaluation
I.	Technical Approach	_____	
II.	Personnel Proposed	_____	
III.	Related Experience	_____	
	TOTAL POINTS	_____	
IV.	Personnel Proposed Verification		
	Item II. Verified		YES / NO
V.	Related Experience Verification		Acceptable/Unacceptable
VI.	Fiscal Posture		
	Company Looks Good		YES / NO
VII.	Current Contract Performance		Acceptable/Unacceptable
VIII.	Opinion of Evaluator		
	Recommend Contractor		YES / NO
	Contractor Overcommitted		YES / NO / Uncertain

Figure 4. Contractor Wrap-Up Sheet

process has proceeded in a straight line from the two highest ranking contractors, Figures 2, 3, and 4 may be completed for only two contractors. If the checkout process encounters problem areas, it may turn out that one has to go through Figures 2 and 3 for several contractors until acceptable ones check out. The worst case where none check out should rarely occur. Figures 1 through 4 are used to suggest a formal procedure and to emphasize several factors that are important to successful contracting for computer related services. They are as follows:

One: In purchasing services that are solely a function of people, the related experience of a company is not important compared to the direct experience of personnel who are to provide those services.

Two: Many contractors will propose personnel who are already working on contracts and, hence, are unavailable. In order to determine that personnel are available, one must make it clear to a potential contractor that the availability of proposed personnel will determine the award.

Three: In order to ask that certain people be available; i.e., those who are proposed, you must give the contractor a fixed start-up date during the final negotiations.

Four: Prior to contract signing, determine again that the personnel have not changed. Be prepared to show some flexibility if one or more people change as long as they are not key individuals.

Five: Write a stop-work clause into your contract to provide a means to terminate the work if the contractor should run into personnel loss problems or should attempt to move too many people in and out during contract execution.

Six: If the company you want to do business with looks good in every respect except its fiscal posture, ensure that they are bonded for the value of the contract. In this way, should the contractor become bankrupt or be acquired by another firm during the performance period, you will be able to collect damages in lieu of the services.

Seven: It is often difficult to estimate the level of effort required to execute a contract for computer related services. In most cases, an estimate on the part of the agency issuing the RFP will help the contractors respond more meaningfully. If you find that your estimate seems out of line, either high or low, to a contractor or contractors, be willing to re-issue the RFP after you have clarified the areas that have caused the difficulty.

Eight: In negotiating a cost plus fixed fee contract, it is strongly urged that you request the potential contractor to specify an overhead ceiling. For example, if you negotiate on the basis of a 120% overhead, have him then specify that the overhead he expects to collect will not exceed 135% even though the overhead of his company does exceed that figure during the term of the contract. In the computer related services business, it is not uncommon for poorly managed companies to have 180% to 200% overheads. Many government agencies are required by law to pay such excess if their contracts have not specified an overhead ceiling. The contractor's agreement should appear in that portion of his proposal that is legally binding.

Nine: Penalty clauses for late or non-delivery of specified items should be standard to all your contracting situations. Ultimately, such clauses will be of overall benefit to this new industry. They enable you to control the execution of a contract in a way that has to do with the very reason that commercial enterprises exist: to make money. Having a bad name for poor contract performance doesn't hurt a business nearly so much as losing intended profits or actually losing money on a contract.

Monitoring the Contract

No matter how clearly you think your RFP was nor how knowledgeable the contractor appears, no contract is ever successfully completed unless it is closely monitored. Assign one person in your agency to be responsible for monitoring the technical progress of the contract and have your purchasing or contracts office responsible for monitoring the costs. The size of the contractual effort should determine how many full-time personnel (if any) you should assign to work with the contractor.

A fixed price effort that has already provided milestones in the original proposal may not need further clarification if it proceeds on time and there does not develop any change in scope. This only applies to efforts of limited scope of small dollar value. Most contracts that take more than a few weeks for execution develop new directions or problems that require clarification and new milestones.

A cost plus fixed fee effort where new directions should develop as the research progresses suggests that each major step consist of a detailed work statement and cost estimate for that phase. This is very essential. If the contractor cannot provide a clear definitive statement and cost estimate for completing each successive module of work, then he certainly cannot tell you what he expects to derive from that part of the contract and you, yourself, cannot expect anything. This is when dollars are wasted and prices get out of hand.

The same comments apply to time and expense efforts. No matter how vaguely you have outlined the job in the RFP, after a decent study period, the contractor must be able to clearly define what each module of effort is to achieve as well as how much it will cost.

At this point, it is assumed that the selection process has been careful and the contractor chosen has met the following basic criteria:

- Personnel proposed have satisfactory credentials;
- Related experience and current contract verification has assured you of a well-managed company;
- Fiscal posture checks have validated a healthy company;
- Penalty clauses exist for direct control of performance.

Close monitoring of the contract from its inception will help ensure obtaining the desired objectives and results. Taking into account anything but the optimal situation, which rarely is the case, and the effects that personalities have upon performance of computer related services, there is need for a mechanism or two to ensure good faith bids and capable work. Some that can be suggested are:

- Completion of any phase or module of a contract as well as final delivery must be recorded in writing by both parties to the contract. The user agency should signify, in writing, satisfactory performance and completion of the phase or total contract as defined either at its inception or by a subsequent mutually agreed upon modification.
- Penalty clauses for other than successful on-time performance should always be part of a contract. These penalties may be waived if agreement is made in writing after satisfactory performance is subsequently obtained.

After carefully monitoring the contract – clearly defining and cost estimating each step (except on fixed price contracts), it is of paramount importance to remember the cardinal principles of commerce:

YOU GET EXACTLY WHAT YOU PAY FOR . . .
and
CAVEAT EMPTOR – Let the buyer beware!

The former statement reflects the viewpoint of the contractor and the latter reflects that of the user. Neither one should become dominant in contract execution. Proper use of close monitoring, written acknowledgement of changes that result, penalty clauses, etc. should ensure that the mutual objectives of contractor and user agency blend for a successful end product.

In almost every contractual effort in computer related services there is a point where a change in the scope of the contract occurs. This applies to fixed price, cost plus fixed fee, and time and expense. Because of the extreme competitiveness of this new field and the state of the art problems discussed in the first section of this paper, the problem is usually a combination of an error in the specifications on the part of the agency seeking services and a tendency to bid low on the part of the contractor. Always be willing to negotiate a change in scope where one clearly exists. If you are unwilling to do this, your end product is almost guaranteed to be inferior to what it would have been were you willing to pay the proper price for the expected service. There are a number of contractors who are dishonest and who will try to milk your organization for dollars where services have not been performed. If this occurs, it is mostly your own fault. The vast majority of contractors will endeavor to provide you with the services you are purchasing with an acceptable return of effort for each dollar you spend.

Careful preparation of your RFP, proper issuance, careful selection, and close monitoring of execution will keep contractors honest and will guarantee that the money you are spending will achieve the optimum cost-effective effort on the job you are seeking to accomplish with outside help. Remember that add-ons, extensions, and changes in scope should each be evaluated and agreed to in writing, *not* assumed. □

C.a PUNCH LINES

The spectacular rise of computer and communication technologies calls for a new examination of traditional property rights. **How is it possible at all to protect exclusive rights in ideas and their expressions?** One way is to keep them secret, but that is often antithetical to their use. The devices of patent and copyright can be used, and indeed are being used in the new technologies. But to what extent should we permit and encourage such exclusive rights?

– Professor Ralph S. Brown, Jr.
Associate Dean
Yale Law School
New Haven, Conn. 06520

The demand for remote computational problem solving is increasing rapidly with the main emphasis being placed on the results. Engineers and business management will be demanding a bridge between the man and computer so more people can use this problem solving tool. **What must be done is to make computers into people experts, and not people into computer experts.**

– Harold Van Arnem, President
Applied Computer Time Share (ACTS)
29200 Southfield Rd.
Southfield, Mich. 48075

The use of the computer to date by man has been a magnificent accomplishment, but it can't compare with the complexity of the long-range job that lies ahead. What must be encouraged is exceptional performance by creative people in a sophisticated new field where the machinery is way ahead of our ability to use it. **Applying concepts and computer to the needs of management is one of our present goals. Applying these tools to the needs of mankind may be our future quest.** It is a formidable undertaking.

– Gaylord A. Freeman, Jr., Chairman of the Board
The First National Bank of Chicago
1 First National Plaza
Chicago, Ill. 60603

Technology during the years ahead should focus on health services, biology, ecology, urban transportation, education, behavioral sciences and aesthetic values. **Directing an ever more intricate society and solving its problems will require a leadership versed in technology's complexities. And this leadership will have to come from scientists and engineers.**

– Benjamin Adler, Acting President
Polytechnic Institute of Brooklyn
333 Jay St.
Brooklyn, N.Y. 11201

Our incredible technological achievements have left us with an array of conflicting situations in respect to their consequences. We have the highest per capita income ever; yet we can't seem to cope with the problem of disease, starvation, and the other ravages of poverty among millions living in the midst of our unparalleled prosperity. Thus today, and in the foreseeable future, management in American industry will be influenced as never before by forces which, up to now, have been only indirectly related to traditional executive responsibilities. **Top management will now have to spend an increasingly greater proportion of its time on people, rather than machines, methods, or money.**

– Robert E. McDonald, President
Univac Div., Sperry Rand Corp.
P.O. Box 8100
Philadelphia, Pa. 19104

□

THE COMPUTER IN BUSINESS EDUCATION

Dr. Daniel J. McCarthy
Computer Environments Corp.
Lyme Rd.
Hanover, N.H. 03755

"In view of their faith in (or in some cases resignation to) the power of computers, business educators are beginning to see their function as being the training of managers who will be able to use and control this power."

Although the computer has had a profound effect on business in the United States, it has not as yet had nearly the same degree of influence upon business schools or business education. It is not at all an overstatement of the situation to state that Colleges of Business Administration in the United States, in the main, are just beginning to become acquainted with the computer, and the proper role of the computer in business education is not yet fully apparent to those who administer these schools, who teach in them, or who study in them. Neither is it totally clear to those in business who hire the graduates of these schools and support school research efforts.

Some few business schools, however, are now beginning to show the way, "to lead", as was called for by Dean George Kozmetsky of the University of Texas College of Business Administration. He stated in a lecture at Harvard Business School "that the proper function of our schools of business is to provide the leadership for the evolution of the proper role of present as well as future computer systems for top management."[1] Some, like Dartmouth's Amos Tuck School, have moved far ahead of the group of business schools, due often to a unique circumstance at the particular university rather than to a high degree of successful advanced planning to fit the computer into its proper role in the business school. More prevalent to date has been the experience of another business school within a large Eastern University, which only two years ago was omitted from the university "computer user" committee because it was felt by the university in general that such things were of no interest to a college of business. Happily this misconception was corrected, but as yet little real progress has been made in introducing the computer to a proper role at this particular business school.

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Causes of the Present "Primitive" Situation

But although the situation is still quite sketchy and unclear for the most part, some general directions are beginning to become clearer, as are the sources of some knotty problems with which the business colleges will have to wrestle in discovering and implementing the proper role of the computer for business education. Among the problems are conflicting philosophies, lack of faculty with the necessary "computer" background, lack of adequate "applications," problems of curriculum structure, and of course, the expense associated with computer hardware, software and personnel.

Particular problems aside, however, the single most obvious reason that the present "primitive" situation exists in most business schools is simply the newness of the computer to business schools and business education. That the computer does not approach common use in university classrooms has been made clear. "It is in the teaching area that the Presidential Scientific Advisory Commission reported that less than 5% of the total college enrollment had access to computing services."[2] And it has been true in most universities that computer service, once available in the educational environment rather than only in the administrative environment, is utilized primarily as a research tool for faculty members and to some degree for graduate students. Moreover, among the various colleges of a university system, the business school, as was noted earlier, has been one of the last to be recognized as an interested party with regard to the computer. And as in most schools of a university, when computer power finally has arrived in the business school, a few faculty members have associated themselves with it for research purposes rather than for classroom utilization. Although advances have been made in some business schools, these less desirable situations are still more common today.

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1. **Computers And Management,** Harvard University Graduate School of Business Administration, Boston, 1967, p. 80.

2. **Ibid,** p. 81.

Emergence of Leadership

A number of exceptions to the general situation have arisen in recent years, however, and have influenced markedly the direction for the utilization of the computer in business schools. In 1963, the Amos Tuck School of Business Administration at Dartmouth College began a rather amazing chapter in this subject. Dartmouth, primarily an undergraduate liberal arts college, initiated a policy under Professor John Kemeny that all students should become familiar with the computer and computer power. During this process, the most widespread use of time-sharing to that time was undertaken. Professors Kemeny and Kurtz, and a group of students, wrote the BASIC language which was needed if time-sharing was to function as planned in the university environment.[3]

Soon after the time-sharing was initiated, several professors at the Amos Tuck School began utilizing the computer's power in research and to a slight degree in course work. A beginning had already been made at Tuck School with a course in "computers and management" which included an introduction to computers and to FORTRAN. The rapid spread of the computer's popularity at Tuck School had not been planned or foreseen by the Dartmouth officials, the computer experts, nor even by the Tuck faculty or administration. The major impetus, in fact, came from the students whose natural resourcefulness was fostered under Dartmouth's policy, since they had nearly unlimited access to computer power. They forced the issue and a willing faculty took up the gauntlet. Today the Tuck School could be considered a model for a Business School with regard to the amount of "computerization" in its curriculum and in its philosophy of education for business.

A number of other leading colleges of business administration, management or industrial management also have made noteworthy progress in utilizing computers in the educational process, and to some degree in studying computers and computer power per se. M.I.T.'s School of Management, the Harvard Business School, the University of Texas College of Business Administration, and the Carnegie Institute's School of Industrial Administration, to name a few, have made significant advances in turning out graduates who possess a fairly high degree of knowledge and abilities relative to the use of computers in the managerial functions. The focus of these schools differs with regard to the place of the computer in business education, but all are forging ahead with the objective of finding and implementing the most valuable role that computers can play in this particular educational environment.

The Direction and Philosophy of Business Schools

Although no single philosophy serves all schools, the direction which most business schools have followed thus far has been to consider computers as tools of management which should allow managers to perform better the job of running business as well as other types of organizations. The computer is seldom if ever studied for its own sake or to learn more about the computer per se such as might be the case in an engineering curriculum. Rather, the focus of inquiry has been to determine how computer power can best aid the manager in analyzing problems and in making decisions. Consequently, most business schools have been interested primarily in applications of computer power. Schools have been content, in the main, to follow industry by considering the areas wherein the computer has been applied successfully by companies. Accounting courses now cover often computerized accounting systems with automated routines for accounts receivables, payables, payroll, and the like. Production and Operations courses will cover production control and inventory control models, and finance courses may have incorporated computerized methods of analysis.

The primary impact of computers on business education, however, has been to make feasible for management use, quantitative techniques which without the computer were not considered to be particularly useful areas of study because of the magnitude of computational work required. Generally studied in courses with a title like Quantitative Techniques for Business Decisions, these topics are now almost standard fare in colleges of Business. Risk analysis, probability theory, PERT, decision tree analysis, monte carlo techniques, and others aim at quantifying in some respect the problem-solving and decision-making processes of management. The computer has allowed such techniques to become meaningful for managers and as such they have influenced greatly the curriculum in many colleges of business. Again, however, it is the applications which are considered important in this environment and the computer itself is considered only a tool for assisting the educational process: "a supplement to, and extender of, existing methods of analysis, . . .: It permits a sharper and higher level of problem definition, but the quality of the output of the computer can be no better than the quality of problem definition, of the choice of analytical methods used, and of the quality of the data inputs."[4]

Management Information Systems

This last comment is particularly true in the realm of management information systems, where the computer has been expected to play a very valuable role. Here too, the computer has been viewed as an aid to management in processing, developing, and reporting information to aid in the analysis of the business and its environment, and to be helpful in making decisions. Although the Business Schools have again observed industry's progress and, for the most part, considered management information as a series of subsystems, some schools have been developing and investigating simulation models for an entire firm or organization and its environment. In these situations, a complex flow of information is regarded as a fully integrated information system. And though yet exceedingly rare in operation, the proponents of such fully integrated systems would propose with good reason that the ever-increasing complexity and power of computers will allow such systems to function once designed to management's specification. It is at this level that the aforementioned comment becomes most appropriate. Because top management has thus far been basically unsuccessful in defining the necessary specifications, parameters, data inputs, and the like, information systems of a highly sophisticated nature which would greatly aid top management in decision making are exceedingly rare.

This obstacle in now way, however, has minimized the immense role that the computer has played already at the operating level in outlining and solving problems and in making decisions. At this level, the informational interrelationships are not so vastly complex as at the strategic level of top management. This state of affairs is quite well recognized by operating managers and Business Schools alike. It has been particularly difficult for business or

3. Bueschel, R.T. et al, **Commercial Time Sharing Services And Utilities,** American Management Association, 1969, p. 18.

4. **Computers and Management,** op. cit., p. 3.

education to develop the sophisticated models which can serve as parallels to actual operating conditions of an entire organization. More often, less complete models depicting areas of a firm have been developed which have allowed among other pedagogical advances the playing of business "games" in which decisions are made by participants which affect greatly and are affected by the various informational interrelationships of the model. Here too the computer has been the tool which allowed the process to occur. And from the progress made thus far, it seems clear that in time even the obstacles at the top management level will be cleared or grossly diminished. Even this quantum jump, however, will not particularly alter the philosophy of the Business Schools who will look upon the computer as a tool for management. It will, though, establish irrevocably the place of the computer as an ever-increasing influence upon the managerial process, and will thus solidify even further the necessity for the computer in business education.

The Value of the Computer "Doing Its Thing"

It should be clear that the computer in business education is considered important not for what it is or how it gets things done, but because it is so well able to "do its thing". That business educators generally take this point-of-view is not surprising on several counts. First, the power of computers has already been taken quite for granted by faculty and students in Business Schools as well as by management of operating companies. Most of these people, I believe, are well convinced that computers will continue to do more and more of what they do now, and in better and better fashion. They place no realistic limits on the computational power, speed, and accuracy of computers in handling larger and more complicated masses of information. These individuals have already heard or read of heuristic processes of which computers are becoming more capable as time goes by, and thus may even anticipate "thinking" machines in their environments. In view of this faith or resignation to the power of computers, the Business Schools see their own function as being the training of managers who will be able to use and control this power. Such can be achieved, one argument goes, by knowing more about the things the computer deals with in the business organization, rather than knowing how the computer goes about it.

The second reason for the attitude held by most Business Schools is based on the objectives of such schools to educate general managers rather than functional specialists. The Accrediting Association for Collegiate Schools of Business, only accredits institutions with broadly based curricula. At the undergraduate level, for instance, no more than 50% of the curriculum may be devoted to business subjects over the usual four-year course. The other half of the curriculum must be in areas outside business such as liberal arts, science, humanities, and the social sciences. Such breadth in the curriculum leaves little room for specialized courses such as computer operations or computer programming.

In a recent article in the Canadian ***Financial Post*** it was noted that "Federal Government computer officials claim Canadian universities have ignored a need in the training of people who must run the growing stock of computers.".[5] The article noted further that the computers in universities were under the control of the engineering, science, and mathematics faculties and seldom in the schools of business administration. Because of this situation, it was concluded, FORTRAN and not COBOL is taught to students and generally to technically oriented ones. The implications of the article are that students should be taught to program, that COBOL should be the language, and if the business schools had greater access to computers these results would occur.

Nothing in the U.S. experience, however, would indicate that such would be the case. Given the objectives and attitudes of Business Schools in the United States, such results clearly would not materialize. Business School students here will generally not learn much about computer programming, and if they do it will seldom be either COBOL or FORTRAN. The entire direction of business education mitigates against these eventualities on anything but a limited basis. There is little evidence to indicate that the Canadian experience will be very different. Interest will instead develop in what the computer can do rather than in what it is or how it accomplishes tasks. In this, Canadian schools will follow much the same direction as sister institutes in the United States.

Time Sharing as the Vehicle

In view of the objectives of Business School education, and the resultant view of the computer as important for what it does or might do rather than for what it is or might be, the focus to date might be said to be on computer power. Because of this orientation Business Schools have naturally taken to time sharing and have readily embraced developments in this area. Time sharing has met most of the needs for computers in business education at its present stage of development. In the future, Business Schools may demand more from computers than time sharing is able to give, but as yet there is no sign that this will occur.

If we look again at the situation in Business Schools, it will be apparent why time sharing has caught on so well. We have discussed at length the disposition to be interested in what the computer does rather than what it is; in short, the interest in computer power. Moreover, the ease with which the computer can be made to function is of vital importance to a faculty who like their businessmen contemporaries gained their experience in a "pre-computer" generation. The reluctance of many faculty members to accept the computer is negated substantially when they are able to simply "call out" a program, insert variables, and in a day's time become computer oriented. And even writing programs has become relatively painless and realistic with the availability of BASIC. Further, the interactive nature of time sharing is most appropriate for business problems and decisions. Many business situations call for a "what if" analysis, and time sharing with its apparently instantaneous response is a natural mode in which to analyze such situations, problems and decisions.

With the experience of Tuck School, other Business Schools need not look far to see that they can introduce computer power by utilizing time sharing. And through Tuck's experience and that of other schools, an ever improving library of appropriate programs is becoming available for fairly general use. Again the transition in introducing computer power to a school of business is eased through the use of time sharing. Finally, since economics is always important to a school, a Business College can move into the computer age with a relatively minor investment. It can begin moderately with portions of the curriculum and build as favorable experience is gained. With reasonable control a school can stay within a budget which is attractive to a university administration.

All of this is not to say that time sharing is the only route for a Business School to go, but at the present level of development and sophistication in these institutions, it appears to be the most popular and reasonable way to introduce computer power to the curriculum, faculty, and students.

5. **Financial Post,** October 16, 1969.

Summary

This article has aimed at providing a perspective on the place of computers in Business School education, and to provide an understanding of the current situation. It is too early to predict with much certainty what will develop in the future, because even the discussion here was appropriate primarily to the leading schools in business education as far as computers are concerned. Again, it should be remembered that relatively few Business Colleges are even now making any more than minor use of the computer. As more schools become involved, however, the leaders will move ahead in directions as yet unchartered. As was the case at Tuck School, the students can be expected to take hold and foster a great deal of the progress.

To maintain perspective it must be remembered that only five or six years ago it was common to complete a doctoral program in almost any major business school in the country without getting even a brief introduction to computers or computer power. Like business, the Business Schools have just crossed the threshold into the computer age and the role of the computer is only now beginning to be clarified for these schools. In fact, business education lags significantly behind business practice in this regard. The leading schools are now moving ahead with more assurance than in the past, however, but no major changes in direction are yet obvious. What is certain though, is that the pace of the next five years will be far more rapid than the last five years which might have been called a development stage. The applications phase of the cycle has now begun and many more Business Schools will find themselves increasingly involved with the computer. Such a marked increase in the use of computers by business schools could well be the impetus for a new direction in business education. □

EDITORIAL

(Continued from page 6)

But as a last resort we should remember that large files are very vulnerable to error. It would be highly desirable for everyone engaged in unpopular activity to adopt three names and three social security numbers. This ought to throw any data system, computerized or not, into convulsions. Furthermore, if one adopted a new name and a new social security number every four months or so, I believe the convulsions in the data system would never die down — oscillation would continue indefinitely.

Another possible technique is the Art Buchwald technique: tell preposterous lies that contain impossible contradictions, so that the information produced by the data system about you is full of howlers. For example: "On November 14, 1908, I was arrested for transporting an elephant across state lines in my suitcase, and I was sentenced to 19 days in jail in Fort Leavenworth, Kansas, of which I served 30 days."

The Association for Computing Machinery should certainly appoint a special interest committee which could be nicknamed "Special Interest Committee of Underdogs to Maintain Privacy": SICUMP.

Edmund C. Berkeley

Editor

[1]Pyle, Christopher H.: "CONUS Intelligence: The Army Watches Civilian Politics" in **The Washington Monthly,** Vol. 1, No. 12, (January 1970), published at 1150 Connecticut Ave., Washington, D.C.

[2]Wicker, Tom: "What Have They Done Since They Shot Dillinger?" in **The New York Times Magazine,** Dec. 28, 1969.

DECISION TABLES AS A SYSTEMS TECHNIQUE

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"Decision Tables suffer the same handicap as any new tool, invention, or technique in that they must overcome people's inherent resistance to change."

Suppose you heard about a new systems technique that provided better communication with programmers and was also understood by users and management; a universally applicable presentation piece written in English and in tabular form.

Suppose it also was an aid to creative analysis and expressing a business situation in cause and effect relationships.

Now, let's further suppose that this new methodology was not a complicated mathematical or scientific breakthrough, but it was easy to learn. You could be taught the fundamentals in less than one workday and the workshop would equip you to begin to use the technique immediately to solve problems in systems analysis. Its format was easy to draw, easy to read, and was its own free standing documentation. It possessed the latent ability to go directly to the computer without flowcharting and coding.

This technique exists. It is called Decision Tables. After a slow start Decision Tables are being accepted and used by analysts who are seeking to improve their effectiveness and obtain more personal satisfaction from their work.

Two Kinds of Tables

Tables in themselves are not new. People have used them for centuries, and "table lookup" is a phrase that gets instant recognition in the world of data processing. Familiar examples exist in the Income Tax Tables, Insurance Rate Tables, Mileage Tables, mathematical tables, Railroad Time Tables and the others that we see every day. Two dimensional, they give a constant result based on two variables, hence are often called "passive" or "inert" tables.

Results Tables use an IF-THEN relationship as the basis of their construction. For example, IF you earned $5000 and IF you had 5 dependents, THEN your tax is $76. IF the angle is 30° and IF the function is the Sine, THEN the value is .500. IF the train number is 502 and IF the railroad station is Boston, THEN the departure time is 6:54 a.m. In all of these examples, two variables produce a single result.

Decision Tables are a more powerful adaptation that prescribe actions in response to one or more conditions. They are of matrix construction, and are not restricted to two variables nor to a single directive, but can specify any number of them.

Decision Tables use the IF-THEN relationship, but in an active sense whereby a course of action is indicated. For example, IF the gauge says EMPTY, THEN put in some gas. IF the alarm clock goes off, THEN get up, close the window, and get back in bed. Unlike Results Tables, we are not restricted to two IF statements and a single THEN statement in Decision Tables. The parameters are limited only by the creativity of the analyst working within a set of basic standards.

Decision Table Symbology and Construction

A Decision Table has four quadrants, separated by two sets of double lines at right angles to each other. The quadrants are called (1) Condition Entry, (2) Condition Stub, (3) Action Entry and (4) Action Stub. (See Figure 1.)

The Condition Stub, in the upper left quadrant, contains the IF statements that define the variables that affect the

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decision making process. Sometimes called "tests", the statements are arranged horizontally in rows in logical descending order. Rows are identified by letters.

The Action Stub, in the lower left quadrant, contains the THEN statements, also in horizontal rows, that describe the possible and/or desirable responses to the situation. If there is a sequential dependency, the arrangement should be in that order.

The Condition Entry, in the upper right quadrant, has the possible responses to the list of IF statements in the Condition Stub. The responses can be YES or NO in a Limited Entry Table, or can be descriptive such as (1) Red, Yellow, Green, Black and White, or (2) Indian, Negro, Chinese and Caucasian, or (3) Steam, Gasoline, Diesel and Electric in an Extended Entry Table. Limited Entry can have only the two responses, but Extended Entry can have as many as the analyst chooses in defining his situation, subject only to the size of the paper.

Although Limited Entry Tables tend to be longer than Extended Entry Tables, Limited Entry Tables are binary and naturally suited to computer applications. This is especially important if you are considering Machine Processing of Decision Tables, and this discussion will only deal with Limited Entry.

The Condition Entry responses are arranged in vertical columns called Rules, each one identified by a number and having a unique series of Yes or No responses.

The Action Entry, in the lower right quadrant, contains an X at the intersection of each row and rule if the action should be taken as a consequence of the responses in the rule. If the action is not prescribed, a • is put there. There are no blanks in the Action Stub since a blank indicates that the action or inaction decision has been overlooked instead of specified.

The Table Header is a box located immediately above the Condition Stub. It contains a descriptive name or title of the Decision Table.

Situation Definition

We have determined what a Decision Table is, that it exists to communicate information, and that it is action oriented. Now we can demonstrate the ability of Decision Tables to aid in situation definition by analyzing a typical business problem in narrative form.

THE FOUR QUADRANTS OF A DECISION TABLE

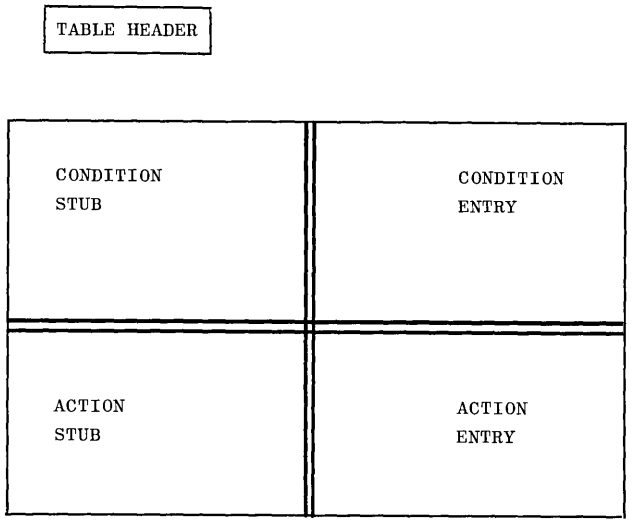


Figure 1

> The ticket seller at an airlines counter uses these guidelines in serving customers. There are two classes of tickets – First Class and Coach. If the request is for First Class and if space is available, reserve a First Class seat. If the request is for Coach and space is available, reserve a Coach seat.

Analysis tells us there are four IF statements or Conditions to be put in the Condition Stub.

1. Request 1st Class
2. Request Coach
3. 1st Class Available
4. Coach Available

We can reduce these to two Conditions by judicious examination of the responses in the Condition Entry. Since there are only two classes of service, a YES for Request 1st Class is a positive response. A NO response tells us that the request is not for 1st Class, and by logical deduction that it is for Coach. Similarly, we rephrase conditions 3 and 4 to Requested Space Available, and satisfy both classes, depending on the previous Rule. Having defined the possible conditions, we now add the two actions listed in the narrative. We put the appropriate X or • codes in the Action Entry and our table is as shown in Figure 2.

INITIAL AIRLINE DECISION TABLE

	AIRLINE TICKET CLERK	1	2	3	4
A	REQUEST IS FIRST CLASS	Y	Y	N	N
B	REQUESTED SPACE AVAILABLE	Y	N	Y	N
C	RESERVE 1ST CLASS	X	•	•	•
D	RESERVE COACH	•	•	X	•

Figure 2

However, in looking at what we believe to be a completed table, we can see that no action is specified for the conditions where the response to Space Available is NO. This presents a problem to the ticket seller because he has no instructions for this plausible condition. Our assumed status of completeness is untrue even though we have converted the given narrative to conditions and actions. We have discovered one of the benefits of Decision Tables, i.e. we know whether we have satisfied all the possible combinations and if not, which ones must be analyzed further.

In our airlines problem, we could add another action statement, "Place on Standby" as a means of getting a "hit", but since one of our business goals is to fill as many seats in the plane as possible, we ask the customer another question such as "Would you accept the alternate class of service?" This has a Yes or No response and we ask one more question "Alternate Available?"

Now, we can subdivide Place on Standby into 1st Class, Coach, or Either and add the Actions to the Action Stub.

We have expanded our table to cover four conditions and their possible action. Now we direct our attention to enlarging the Condition Area to supplement the enlarged Stub Area.

Expanding the Condition Entry Quadrant

In our initial table building work, we intuitively recognized that as conditions increase, the number of Rules must also increase.

Some practical conventions exist to help us in determining the number of Rules and the arrangement of the Yes-No responses in the Condition Entry. Given the number of

conditions in the Table, the number of Rules will be 2^n where n is the number of conditions. Thus a two condition table has 2^2 or 4 Rules, a three condition table has 8 Rules and so on. This convention is called the 2^n factor.

Once we know the number of Rules, we can begin to fill in the Yes-No responses. Here, another simple guide permits us to proceed with confidence, irrespective of the logic contained in the conditions. Start at the row directly above the Action Entry (the bottom row of the Condition Entry) and write a series of single Y and N responses across the row. Then move up one row and enter responses in pairs. (Y Y N N etc.) Then next row is in fours, the next in eight, sixteen and so on. By following this pattern in conjunction with the 2^n factor, the analyst is assured that

1. Every possible combination is included
2. There is no duplication of Rules

This arrangement, called "bifurcated" or two-branched is especially helpful in larger tables.

Completing the Action Entry Quadrant

The remaining quadrant, the Action Entry, is filled by logically moving down through each Rule and placing an X in the row if the action statement is to be done and a • if it is not. There can be more than one X in any Rule.

Remember, there must be ***at least*** one X in every Rule or the problem has not been solved, since no action has been specified for that particular combination of Yes-No responses. To complete the solution, the analyst must specify an action and add it to the Action Stub with the appropriate X or • added to every Rule. Thus, the analyst is assured that he has prescribed a complete solution to the situation before coding begins, a feature not included in conventional flow charting.

In our Airlines Problem, the 2^n factor tells us that there will be 16 Rules, and we can complete the Condition Entry in bifurcated form. Then, we can complete the Action Entry, creating the Decision Table in Figure 3.

INTERIM AIRLINE DECISION TABLE ILLUSTRATING USE OF THE 2^n FACTOR AND BIFURCATED FORM

	AIRLINE TICKET CLERK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	REQUEST IS FIRST CLASS	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
B	REQUESTED SPACE AVAILABLE	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N	N	N
C	ACCEPT ALTERNATE CLASS	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N
D	ALTERNATE AVAILABLE	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
E	RESERVE FIRST CLASS	X	X	X	X	•	•	•	•	•	•	•	•	X	•	•	•
F	RESERVE COACH	•	•	•	•	X	•	•	•	X	X	X	X	•	•	•	•
G	PLACE ON STANDBY, FIRST CLASS	•	•	•	•	•	•	X	X	•	•	•	•	•	•	•	•
H	PLACE ON STANDBY, COACH	•	•	•	•	•	•	•	•	•	•	•	•	•	•	X	X
I	PLACE ON STANDBY, EITHER	•	•	•	•	•	X	•	•	•	•	•	•	•	X	•	•

Figure 3

Examination assures us that the Decision Table is complete, since there is a "hit" for every Rule. We have utilized the 2^n factor and bifurcated form in the Condition Entry, giving us assurance that we have considered every possible combination.

Compressing the Decision Table

Thus far we have been concerned with building completeness of problem definition and ensuring that we consider all possible happenings in our business situation.

Now that we are assured that every combination of responses is visible, there is the possibility that analysis will reveal opportunities to compress the table. Once more, we can draw on methodical guidelines for assistance.

Looking back at Figure 3, the Airlines Problem, we observe that Rules 7 and 8 prescribe the same action even though the responses to the Alternate Available condition are opposite. It is obvious that the response to this condition doesn't make any difference in the outcome.

This has been formally expressed as the Redundancy Concept, stating "When two Rules result in the same action(s) and the Condition Entry responses are the same except for the last condition, this difference has no effect on the outcome, the test can be ignored and the two rules combined into one." A dash (—) is put in the Condition Entry to represent the redundant test.

Thus, we can condense Airlines Problem Rules 7 and 8 into one Rule. Further analysis indicates we can condense Rules 1 and 2, 3 and 4, 9 and 10, 11 and 12, and 15 and 16 into single Rules. Then, we can apply the Redundancy Concept again and shrink Rules 1-2 and 3-4 and Rules 9-10 and 11-12 into single Rules. Figures 4 and 5 illustrate the tests that are found to be redundant and Figure 6 illustrates the resultant compressed Decision Table. It is common practice to renumber the Rules after compression is completed.

Another method of removing Rules is to examine each Rule to ensure that the situation described can logically exist. If a Railroad Ticket table has four conditions, e.g., One Way, Round Trip, 10 Ride Weekly and 12 Ride Monthly, a Yes response to more than one condition cannot logically exist and the Rule can be eliminated. Similarly, a fuel tank cannot be full, half full, and empty.

Since illogical conditions can be detected without referencing the actions, Illogical Rules can be eliminated before the Action Entry is constructed.

Intuitive Construction

There is another method of constructing the Condition Entry that does not demand the discipline of the 2^n factor nor the bifurcated form of Yes and No responses. It relies, instead, on the skill and knowledge of the Analyst to develop Rules at random. These Rules follow no pattern, but are intuitively constructed according to plausible combinations of Yes and No responses in the business situation. After these are written in, one final Rule called the "ELSE" Rule is noted (but not filled in with Yes and No) and an action is specified to cover all combinations that have not previously been specified.

It can be claimed that intuitive construction with the ELSE Rule works as well as the 2^n factor and bifurcated form, especially in small tables. It is even possible that the resultant Decision Tables will be the same in many situations regardless of which method is used.

On the other hand, intuitive construction is risky when analysts move into real business situations. The ELSE rule becomes an expedient way to convert haphazard system study into table form, and missing actions only come to light after the system is installed when it is too late. The intuitive method lacks the mathematical certainty that all possible conditions have been considered. Furthermore, most analysts will find that after a short learning period the 2^n factor and bifurcated form are faster and easier as well as more reliable.

Solving Large Problems with Decision Tables

Our discussion and work thus far has been concerned with single tables and our problems have been simple enough to be solved within this constraint. While this has provided a climate of stability in which to learn the basics, it is obvious from the 2^n factor that real business problems quickly outgrow a single Decision Table.

INTERIM AIRLINE DECISION TABLE ILLUSTRATING APPLICATIONS OF THE REDUNDANCY CONCEPT

	AIRLINE TICKET CLERK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	REQUEST IS FIRST CLASS	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
B	REQUESTED SPACE AVAILABLE	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N	N	N
C	ACCEPT ALTERNATE CLASS	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N
D	ALTERNATE AVAILABLE	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
E	RESERVE FIRST CLASS	X	X	X	X	•	•	•	•	•	•	•	•	X	•	•	•
F	RESERVE COACH	•	•	•	•	X	•	•	•	X	X	X	X	•	•	•	•
G	PLACE ON STANDBY, FIRST CLASS	•	•	•	•	•	•	X	X	•	•	•	•	•	•	•	•
H	PLACE ON STANDBY, COACH	•	•	•	•	•	•	•	•	•	•	•	•	•	•	X	X
I	PLACE ON STANDBY, EITHER	•	•	•	•	•	X	•	•	•	•	•	•	X	•	•	•

Figure 4

INTERIM AIRLINE DECISION TABLE ILLUSTRATING EFFECT OF REDUNDANCY CONCEPT APPLICATION

	AIRLINE TICKET CLERK	1	3	5	6	7	9	11	13	14	15
A	REQUEST IS FIRST CLASS	Y	Y	Y	Y	Y	N	N	N	N	N
B	REQUESTED SPACE AVAILABLE	Y	Y	Y	Y	Y	Y	Y	N	N	N
C	ACCEPT ALTERNATE CLASS	Y	N	Y	Y	N	Y	N	Y	Y	N
D	ALTERNATE AVAILABLE	–	–	Y	N	–	–	–	Y	N	–
E	RESERVE FIRST CLASS	X	X	•	•	•	•	•	X	•	•
F	RESERVE COACH	•	•	X	•	•	X	X	•	•	•
G	PLACE ON STANDBY, FIRST CLASS	•	•	•	•	X	•	•	•	•	•
H	PLACE ON STANDBY, COACH	•	•	•	•	•	•	•	•	•	X
I	PLACE ON STANDBY, EITHER	•	•	•	X	•	•	•	•	X	•

Figure 5

FINAL AIRLINE DECISION TABLE AFTER ELIMINATION OF ALL REDUNDANT RULES

	AIRLINE TICKET CLERK	1	5	6	7	9	13	14	15
A	REQUEST IS FIRST CLASS	Y	Y	Y	Y	N	N	N	N
B	REQUESTED SPACE AVAILABLE	Y	N	N	N	Y	N	N	N
C	ACCEPT ALTERNATE CLASS	–	Y	Y	N	–	Y	Y	N
D	ALTERNATE AVAILABLE	–	Y	N	–	–	Y	N	–
E	RESERVE FIRST CLASS	X	•	•	•	•	X	•	•
F	RESERVE COACH	•	X	•	•	X	•	•	•
G	PLACE ON STANDBY, FIRST CLASS	•	•	•	X	•	•	•	•
H	PLACE ON STANDBY, COACH	•	•	•	•	•	•	•	X
I	PLACE ON STANDBY, EITHER	•	•	X	•	•	•	X	•

Figure 6

Earlier, we determined that a Decision Table is not complete unless there is at least one action prescribed for each Rule in the table. In the Airlines Problem, we added conditions and actions to meet this requirement within the boundaries of a single table. In other situations, it is better to construct a network of separate but interrelated tables to describe the logic of the situation.

This is especially true where one set of conditions remains relevant and another set becomes redundant based on early responses. For example, the career of a young man takes totally divergent paths depending on the response to: "Draft Notice Received?" and "Physical Examination Passed?" Similarly the course of action for an automobile driver on the turnpike is drastically altered depending on his response to "Destination Hartford?" and "Take Hartford Exit?" In cases like this, separate tables are more effective since they permit us to access the conditions that still have impact on the situation and eliminate repetition of redundant tests.

An Exit Routine is used to get from one Decision Table to another when no action has been specified and/or because we want to bring the logic of another Decision Table into play. The Exit Routine always uses the Table Header of the accessed table as a destination.

Given a Table with a Table Header called INVENTORY that we wish to access, one form of Exit Routine is to add a row to the Action Stub specifying GO TO INVENTORY with appropriate X or • signals in the Action Entry. This is especially efficient when a majority of the Rules exit into the same table, but requires an additional row for every additional table that is accessed.

Many analysts prefer to use a different instruction, EXIT TO – which is an extension of the Rule and unique to that Rule. It requires that a destination be specified for every Rule, but permits assignment of different destinations in the same space as if a single destination applied. Figure 7 shows this method.

DECISION TABLE ELEMENTS

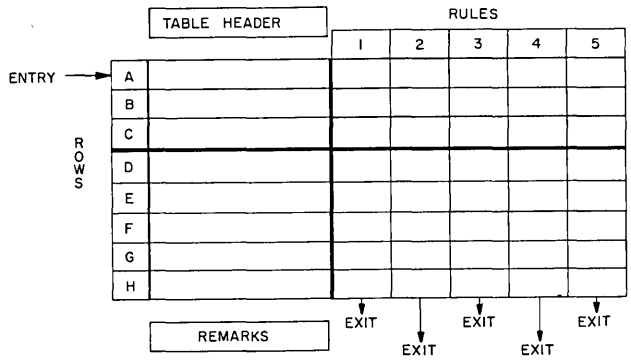


Figure 7

The choice of Exit Routine is an analyst's option although you should not combine the two types in one table or in one network of tables.

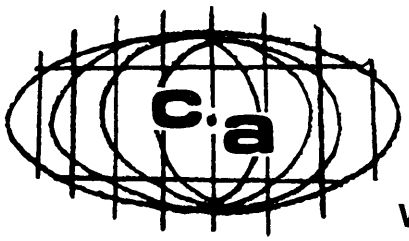
Summary

The preceding paragraphs have discussed Decision Tables as a method of business problem analysis. The symbology and format have been supplemented by examples of business problem narratives and conversion to Decision Tables. Lack of space and time have forced me to allude to certain communication and documentation features rather than describe them in detail. Hopefully, the reader has been equipped and stimulated to begin work and develop the skill and familiarity that come with experience.

Not everyone will respond to Decision Tables. They suffer the same handicap as any new tool, invention, or technique in that they must overcome people's inherent resistance to change.

On the other hand, the simplicity and straightforward nature of Decision Tables permit an analyst to become proficient in their use very quickly.

After research into Networks of Tables, he will begin to accrue the benefits of Decision Tables in system analysis, design, and presentation. Then his wisdom and judgment can be concentrated on problems that have successfully resisted solving in the past. In combination with computers, Decision Tables will enable us to reach new levels of professional attainment and personal satisfaction. □



WORLDWIDE

REPORT FROM GREAT BRITAIN

In yet another outbreak of Britain's post-war malady, which can best be described as a form of self-mutilation, a sub-committee of the Houses of Parliament is taking a close look at the computer industry in Britain. In particular, the committee is looking at how the Government goes about buying computers to serve its various departments (this is a bad joke as I will shortly explain); and why, and wherefore, it became tangled up in a complex support scheme for the big UK computer company which emerged from a whole series of fusions over the past three or four years.

Sub-committee D of the Select Committee on Science and Technology, a body with wide powers of subpoena since it can and will quiz Ministers of the Crown (but with no powers of coercion since it can only submit recommendations which need not even be debated in the House if the relevant Minister so decrees) is launched on this marathon. It should be reporting in June. But its chairman — Airey Neave, one of the dauntless men who escaped from the grim top-security POW prison of Colditz during World War II — told me that they would be hard put to get together all the evidence they needed. It had never been done before and he would have welcomed another year of Parliament in which to do it. "But we may have a completely new Parliament then", he said, referring to the now widely held belief that Britain will go to the polls by October.

A Bad Joke

I said above that Government computers are a bad joke for the simple reason that the UK Government has in all the mighty total of 200. True the number is growing fast at all of 20% a year. But compare this with the 7,000 machines of all types — 4,000 above the $50,000 level — owned, leased or rented by British industry and commerce. There are, naturally, some very large contracts in the pipeline. But the market outside Government is much bigger and will remain so.

"We Wuz Robbed"

It is somewhat surprising therefore to find a sub-committee of this calibre involved in an inquisition on what Government departments have been up to in computers. But there has been extreme pressure for a definition of Government (or more precisely Ministry of Technology) buying policy for some time, particularly from American companies who manufacture and/or operate in Britain. In other words, Parliament with its innate sense of fair play has at last given in to the constant hollering of "we wuz robbed" by IBM, Honeywell and Burroughs. The hunt is on to find who has been exercising undue and unfair pressure to swing contracts towards International Computers, the computer builders formed with Government sanction from three smaller companies and in which the Minister of Technology has invested close on $50m of Government money.

The U.S.-controlled companies point a finger of suspicion at a body set up four years ago by the then Minister, Frank Cousins, called the Computer Advisory Unit (CAU). It was an organisation which "sprang fully armed" from Treasury, where it was known as the Treasury Support Unit (TSU), and helped select the best machines for the job. But Treasury did not take kindly to this loss and when Government put the pressure behind the new CAU so that its "advice" should have teeth, Treasury refused to bow and replaced TSU by another contract assessment group called OM2. Whatever the U.S. companies think, it is OM2 which has the final say in public contract awards.

Or Were They?

Myself, I think the ones who are complaining the hardest are being the most disingenuous. First of all, every one of them has had some very nice contracts. I would like to know how many British-built computers are being used by the United States Government, or for that matter by U.S. Government agencies in Britain or in countries where British computers are easily sold and maintained . . . Everyone knows the answer to that.

In fact, Britain is being over-scrupulous to a degree which is harming vital foreign trade. As a supporter of the western hemisphere alliances, the UK is a party to the COCOM arrangements which deny so-called strategic goods to eastern bloc countries. Strategic goods include computers of the latest designs and when ICL wants to export large commercial machines to the Soviet Union, for instance, the request goes up to the Board of Trade which sends a man to COCOM in Paris where the request is discussed. It invariably is passed to participating Governments to look at and ultimately finds its way to a desk in the U.S. Department of Commerce.

What happens then disappears in a fog of supposition. However, one of my contacts in ICL assures me that an ingenious technique of dilly-dally is applied. The requests are never denied. But the boys on the spot look at the configuration suggested and lop a little off here and a little off there so that the equipment, while it will work, is something of a "dog's breakfast". Although it is third generation, the system as modified to suit COCOM requirements, will now perform less well than a good deal of the second generation configurations which *could* be put up by American companies against east bloc contracts without incurring the wrath of the appropriate U.S. authorities.

Is this actually what happens? I do not know. But we are all aware that IBM maintains some 300 sales and support staff in Vienna and these men are not there because they like Wiener schnitzel. I also know of several UK contracts which have had to be modified or abandoned because of COCOM pressure. There is a large contract outstanding at the moment — worth $12m and for two 1906A computers — which would go into the Serpukhov high energy physics

(Please turn to page 62)

"THE EMPTY COLUMN" REVISITED

William J. Wiswesser
Fort Detrick
Frederick, Md. 21701

A Chemical Notation that Appeared with Computer Languages in 1950

"These are just starting examples of computer benefits that the chemical world will enjoy when more manpower, money and talented attention is devoted to this 20-year-old chemical notation with the empty columns."

William J. Wiswesser, a research chemist at Fort Detrick, Frederick, Md., probably is best known as the inventor of the Wiswesser Line Notation (WLN), which "The Empty Column" parable introduced 20 years ago. He is a native Pennsylvanian, graduated from Lehigh University in 1936, later taught chemical engineering courses at Cooper Union, and probably created the WLN as a hybrid of long-rooted interests in atomic art, molecular structure, history of chemistry, and information theory.

The parable about a "New Notation" of Long Ago (*Computers and Automation,* January 1970, page 16) has a significance that was not fully appreciated when it was written twenty years ago — that this imagined rejection of Arabic numerals by users of Roman numerals ***may have occurred many times*** during the past two thousand years! Medieval merchants were jailed if they were caught manipulating "those heathen signs and symbols". The battle lasted for some 300 years, because official examiners — like the Roman in the parable — just did not see how the positional Arabic numeration profoundly simplified all mathematical operations.

Martin Gardner gave the following fascinating background details on this mathematical blindness in the January 1970 issue of *Scientific American* (pages 124-125):

> For more than 15 centuries the Greeks and Romans and then Europeans of the Middle Ages and early Renaissance calculated on devices with authentic place-value systems in which zero was represented by an empty line or groove or by an empty position on the line or groove. Yet when these same people calculated without mechanical aids, they used clumsy notational systems lacking both place values and zeros. It took a long time [from 1202 to the 16th century] . . . to realize that in writing numbers efficiently it is necessary to draw a symbol to indicate that a place in the number symbolizes nothing.
>
> . . . In some European countries calculating by 'algorism' actually was forbidden by law, so that it had to be done in secret. There was opposition to it

even in some Arabic countries. Not until paper became plentiful in the 16th century did the new notation finally win out, and soon after that the shapes of the 10 digits became standardized because of printing.

The corresponding need today for simplified chemical descriptions should become obvious with just three relatively simple statements, but chemists — like all humans — continue to overlook the obvious:

(1) all chemical information has a cosmic common denominator — the sharply defined atom-to-atom structure descriptions;
(2) there are some 4,000,000 such reported structures in the chemical world — needing concise computer descriptions for their efficient retrieval; and
(3) the most frequently used atomic symbols ***and groups*** should be ***single***-mark symbols.

This last point was made 157 years ago by J. J. Berzelius, "the organizer of chemistry" and editor of many pioneering chemical journals. But his point was soon forgotten. Computers can help the chemists far more if the chemists recognize and provide a notation that reflects overall "least effort" (in the ***long***-term view!). Least effort implies being easy to learn, to read, to write, and to remember — easy to use in every man/machine aspect.

Line-Formula Notations

The occasion for writing the "Empty Column" parable was an internationally publicized development — the search for an international chemical notation by a "Commission on Codification, Ciphering, and Punched Card Techniques," established in 1947 by the International Union of Pure and Applied Chemistry (IUPAC). In 1949 the author had been appointed to serve in what then was called the "Punched Card Committee" of the American Chemical Society; he wrote this parable a year later (May 1950) as a needed preface to his proposed standardization of "line-formula" structure descriptions. Chemists had been using "rational formulae" or "line formulas" as ***delineated*** structure descriptions, ever since the age of Structural Chemistry dawned in 1861. All that seemed necessary was a careful standardization for tabulating equipment (and today's computers) of this world-wide, time-tested tradition. The parable was written as a caution to the IUPAC and other examiners that any new notation may have a strange and puzzling appearance at first glance.

Cosmic Identification

Line-formula notations developed in a simple and natural way that most chemistry accounts overlook; so a few explanatory figures and historic examples seem appropriate here. The cosmic identification of a chemical compound is its structural (or constitutional or "rational") formula — a two-dimensional diagram showing how all the atoms in a molecule are connected. Thus the three structure diagrams in Figure A not only explain "rationally" what the substances are — they also explain how ethyl acetate can be hydrolyzed (split apart by the addition of H-O-H or water and suitable catalyst) to ethyl alcohol and acetic acid, or how the alcohol and acid combine to form the ***ester*** with a suitable dehydrating agent.

The corresponding "new" notations (introduced with the parable 20 years ago) are given under the names in Figure A. These notations reflect a natural reduction in writing effort that started almost as soon as structure diagrams appeared. Thus within a brief seven-year period (1861-1868), simpler and more compact linear expressions replaced the two-dimensional diagrams in journal discussions: the 2-carbon "ethyl" chain was contracted to $CH_3.CH_2$- or CH_3CH_2- or C_2H_5- or simply ***Et*** marks. The corresponding "acetyl" group was simplified to $CH_3.CO$.- or CH_3CO- or simply ***Ac*** marks. Thus to this day ethyl alcohol is frequently symbolized as EtOH, acetic acid as AcOH, and ethyl acetate as EtOAc. The corresponding "new" notations Q2, QV1, and 20V1 give even more concise descriptions, with simpler typography and more logical (language-free) sets of symbols.

Comparing Old and New

Table 1 compares these names, old line-formulas, and new notations with those of other related and important

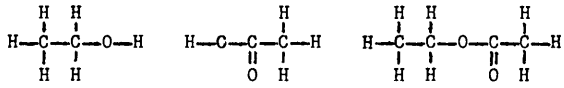
Table 1. UNBRANCHED OPEN-CHAIN COMPOUNDS

NAME	OLD LINE-FORMULA	NEW NOTATION
acetone	CH_3-CO.CH_3	1V1
ethyl ether	C_2H_5-O-C_2H_5	2O2
ethyl acetate	C_2H_5-O-CO.CH_3	2OV1
butyl acetate	$CH_3CH_2CH_2CH_2$-O-CO.CH_3	4OV1
ethyl alcohol	CH_3CH_2-OH	Q2
acetic acid	CH_3-CO.OH	QV1
carbonic acid	HO-CO.OH	QVQ
ethylamine	CH_3CH_2-NH_2	Z2
acetamide	CH_3-CO.NH_2	ZV1
urea	NH_2-CO.NH_2	ZVZ

Note: The period in the CO-groups denotes the end of a doubly-bonded or :O side group, distinguishing this from an -O- link.

compounds. The structure diagrams for the hydrocarbon fragments are like those shown in Figure A. An amateur code-breaker can see at a glance that analogous things have analogous notation symbols. ***numerals*** denote the number of carbon atoms in the hydrocarbon chains, and ***letters*** denote "functional" groups that characterize the chemical types. For example, ***alcohols*** have the lone -OH or Q-terminal, ***ethers*** the lone -O- link, and ***ketones*** the lone -CO.- or -V- link; ***acids*** have the -CO.OH or -VQ combination, and ***esters*** the -O-CO.- or -OV- combination. (The period in -CO.- denotes the ***end*** of the :O ***side*** group, distinguishing it clearly from the connecting -O- link.)

Nitrogen analogs of alcohols and acids also have notations that show more direct similarities than the corresponding (unspaced ***amine*** and ***amide***) names. The appropriate pairs in Table 1 are those in which the terminal -OH or Q-group is replaced by a $-NH_2$ or Z-group· Q2 and Z2, QV1 and ZV1, QVQ and ZVZ.



ETHYL ALCOHOL — Q2

ACETIC ACID — QV1

ETHYL ACETATE — 2OV1

Figure A.

Branched Structure

The first branched structure in Figure B, copied from an 1866 report, shows how naturally the line-formula convention arose as a one-dimensional printing simplification of two-dimensional structure diagrams. At that time the "carbon skeleton" usually was drawn vertically, like the human

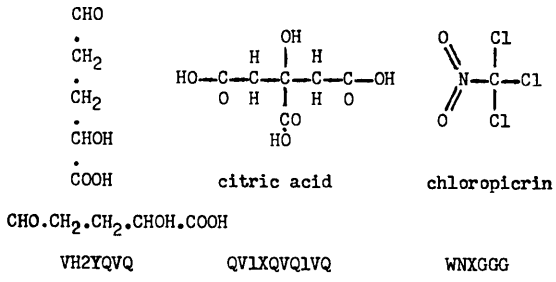


Figure B.

skeleton, but with *all* of the "appendages" extending to the right (and in more compact groups than those shown in Figure A). Thus the line-formula delineation of these compacted groups is simply a television-like scanning of the two-dimensional diagram – left to right and top to bottom. This illustrated notation introduces two new features: a terminal VH-group for the top aldehyde or CHO-group, and a Y-symbol for the Y-branched or ternary carbon (attached to three atoms other than hydrogen). This *branching* distinction is a very important "connection table" specification. The *linking* -CH_2CH_2-group is denoted simply as a 2-carbon chain, without the extra H-atom that the corresponding *terminal* chain must have.

Citric acid, the second example in Figure B, illustrates a typical partial compacting of the pictured groups, the reduced cluttering of lines emphasizes the distinct X-branching nature of the central carbon atom; hence the X-symbol denotes a quaternary carbon (attached to four atoms other than hydrogen).

Chloropicrin, the third example in Figure B, also illustrates an X-branched carbon and two other new features: (1) a *single* G-mark "fusion" of the Cl symbol for the very frequently cited chlorine atoms, and (2) a branched dioxygen group, important enough to be denoted by a single-letter *W* (its "double-U" name alludes to the two double-bond connections seen in most branched dioxygen structures).

The R-mark

Three graphically distinct kinds of benzene derivatives are illustrated in Figure C. All have a characteristic regular-hexagonal C_6-ring that is more prominent in chemical

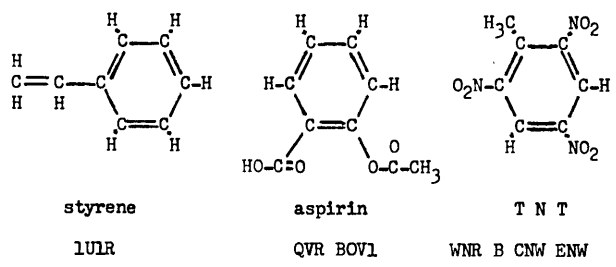


Figure C.

catalogs than all other rings combined Accordingly this ring is denoted most efficiently as a *single* mark – the letter *R* (for Ring) – and subordinated to all other atomic-group symbols because of its superprominence. This R-mark saves more writing effort than any other notation mark (reflecting traditional abbreviations *Ph* or the "phi" sign ϕ for the *phenyl* or C_6H_5-group), it also eliminates the graphical need to show the ring-forming connections as alternating or "resonating" single and double bonds, often called *aromatic* bonds to distinguish them from the quite different open-chain double bonds.

Styrene, the first example in Figure C, illustrates the open-chain kind of double bond, an *unsaturation* – hence denoted with the letter *U*. These groups are so active that they will spontaneously link together, forming the *saturated* chains of polystyrene, with a C_6H_5 or phenyl side group on every other chain atom. Many other phenyl or C_6H_5-derivatives (with only one replaced H-atom), like styrene, have structurally unrevealing names and pictorially direct notations. A few of these many examples are listed in Table 2.

Table 2. COMMON PHENYL DERIVATIVES

NAME	OLD LINE-FORMULA	NEW NOTATION
anisole	C_6H_5-O-CH_3	1OR
toluene	C_6H_5-CH_3	1R
styrene	C_6H_5-CH:CH_2	1U1R
phenol	C_6H_5-OH	QR
benzoic acid	C_6H_5-CO.OH	QVR
nitrobenzene	C_6H_5-NO_2	WNR
aniline	C_6H_5-NH_2	ZR

Note: The C_6H_5-ring fragment is frequently denoted as Ph or Ø (phi). In the new notation, the ZERO mark is slashed as a Ø mark.

Aspirin, the second example in Figure C, appropriately shows the "empty column" solution to what is a real headache in many other chemical notations: the need for a logically distinct set of symbols to locate ring positions. In 1866 Kekulé used *lower case letters* for this purpose, so in 1950 his meaning was put into "Teletype" equivalents *by prefixing each locant letter with a blank space.*

TNT, the third example, illustrates how this spaced locant alone suffices when the located group is the commonplace *methyl* group or unit-carbon chain.

Space as a Mathematical Operator

The "Empty Column" thus seemed an appropriate title for the parable because a corresponding "empty" or *blank* space is an essential and unique part of the notation that it prefaced: this SPACE serves as a mathematical operator or shift key to *convey lower case meaning to the letter that follows,* and all such *LO*wer *CA*se let*TE*rs LOCATE ring positions. This spaced "locant" also begins a new unit of information, mentally translating to mean "and at this ring location the following atomic group is attached." Thus in addition to the gain of a doubled keyboard without a penny of cost, the heavily used spaces facilitate manual reading, like the spaces between words. Similarly spaced *numerals* also give them distinct meaning as *multipliers* of the preceding string of symbols; these operate like a "Polish string notation" in omitting the need for quantity-enclosing

marks, which were not available in 1950-vintage tabulating equipment.

Other notation designers overlooked this obviously profitable use of a "blank space" character, but that is not surprising to historians: the Greeks and Romans, for all their intelligence,

> rantheirwordstogetherlikethisbecausetheydidnot realizethat SPACES greatly facilitated the reading thereof! This spacing of words also was a medieval discovery.

In 1950 there were no punctuation marks available other than the ampersand, which has served well ever since then to *end* side groups other than the few that are strictly terminal by definition (like the illustrated G, H and Q marks). Notations for all ring structures other than the C_6-hexagon of benzene ideally were enclosed in parentheses, and the 1950 letter-substitutes for *carbo*cyclic ring notations were inspired from an 1866 diagram. In that year Emil Erlenmeyer (the flask man) tried to explain the two-ring structure of naphthalene with the diagram shown in Figure D. His L-shaped and J-shaped marks indicated a

NAPHTHALENE (Erlenmeyer, 1866)

L66J

VITAMIN B_6

T6NJ B CQ D1Q E1Q

Figure D.

connecting line between those carbon atoms; this suggested the use of L. . .J marks to "enclose" carbocyclic (including a*L*icyclic) ring-descriptions, and T. . .J to enclose he*T*erocyclic equivalents. Rings in general can have so many topological complications that it is not possible to summarize other details here. Vitamins B_6 in Figure D is a *hetero*cyclic compound of average complexity.

"Connection Table" Specifications

The first rule of this "empty column" chemical notation is to cite chains of atomic groups in end-to-end connecting order, following the line-formula tradition. The "least effort" gain is that no search has to be made for some arbitrarily preferred "central component," as in the IUPAC notation, and no related "assembly instructions" are needed for the pictorially direct attachments. The gain in minimizing "connection table" specifications seems so obvious that one wonders why others had not applied this same gain in complicated ring systems, where this least-effort notation follows a longest-possible path of connections. This maximized path thereby minimizes ideal ring descriptions to a simple recitation of the *non*consecutive links.

The second rule also is so simple and obvious that it was overlooked until this line-formula notation appeared in 1950. Resolve all otherwise equal alternatives by the simple alpha-numeric order of the notation symbols. Long afterward, this proved to be the simplest thing a computer could do: compare "equals" until a higher or lower resolution is reached! Even here, intellectual complications have become rooted; thus in 1950 the notation followed the seemingly natural Hollerith-sorting sequence of *numbers* before *letters.* (We could not imagine anyone counting his peanuts as A, B, C, and then when he ran out of letters, going to 1, 2, 3!) The 1950 terminology defined the letters as having *higher* rank than the numerals, just as the value of 9 is higher than that of 1. The notation's rule 2 specified a *descending* citing order — letters before numbers, because in open-chain structures the letters feature the characteristic chemical functions like acid, alcohol and aldehyde; these determine the properties and uses, whereas the *numbers* denote the *number of carbon atoms* in the relatively inactive paraffin chains (*Par affinis* means low affinity or low activity). Thus rule 2 tends to bring together chemically similar things like open-chain alcohols in simple, alphabetically arranged lists like those in Tables 1 and 2.

Pope Paul described this "least effort" aim when he advised "Avoid complicating simple things; strive to simplify complicated things."

The Character Set

The "program language" of this *chemist*-oriented notation is best illustrated, not with more recited rules, but with a summarizing review of the basic descriptive tools — the character set. If these are well chosen, and cited in pictorially direct connecting order, the rules for handling them almost come naturally.

Berzelius, as previously noted, gave the first long-overlooked requirement for citing chemical structures with least effort: the most frequently cited atomic groups should have *single* marks. Thus in 1813 he established nine perfect choices for the very frequently cited *non*metallic atoms of boron, carbon, fluorine, hydrogen, iodine, nitrogen, oxygen, phosphorus, and sulfur. His apt recommendations can be remembered as a tic-tac-toe that appropriately "begins with BC," "has an *I* in the middle," and appropriately "ends with a PS." (See first part of Figure E.)

Figure E.

Bromine was not yet discovered when Berzelius assigned B for boron. Today it is extracted from the sea in ton-a-day plants (to make lead-scavenging gasoline additives like ethylene dibromide), so the ideal *single*-letter symbol is "extracted" from the front part of the *Br* symbol. An equally obvious clue was overlooked until some ten years ago, when a Syracuse University student showed the lecture audience that the hinted *E* can be extracted directly from s*E*a!

Chlorine was first known by an appropriately frightening appellation as "dephlogisticated muriatic acid gas"; so Berzelius aptly assigned a single letter *M* for the muriatic radical in his first (1813) list of atomic symbols. To this day the *Cl* replacement continues to give trouble in letter-number ambiguities, so these are fused into a *single*-letter *G,* the 7th letter of the alphabet for the leading atom in the 7th Group of the Periodic System. This choice is triply appropriate because *G* and *E* stand next to each other in the word halo*GE*n as well as in the Periodic Table. The symbols F, H and I combine with these to form *an alphabetically closed set,* with obvious indexing advantages.

Lengthening

Berzelius analyzed the importance of symbol selections so well that no new single-letter symbols need to be assigned for high-frequency structural atoms, other than the above *E* and *G* for bromine and chlorine atoms. However, he and his followers overlooked an obvious gain in his original intent to give *all* metallic atoms *two*-letter symbols, like his original *PO* for potassium; metallic atoms are cited

much less frequently than nonmetallic atoms, and there are far more kinds of them. Trends in "least effort" usage gave overlooked clues like the ***lengthening*** (for easier recognition) of *L* to *Li* and *R* to *Rh* for the rarely used lithium and rhodium symbols. A late 19th century Harvard textbook of chemistry showed a more helpful *Ur* instead of *U* for uranium, *Va* instead of *V* for vanadium, and *Wo* instead of *W* for wolfram or tungsten. A more recent (1921) textbook of inorganic chemistry from M.I.T., and other reference books of that period, showed *Yt* instead of *Y* for the really rare yttrium in Periodic Tables. Chemistry students would welcome the simplification that ***all*** metals have ***two***-letter symbols, as in this notation. The generalization extended to the equally rare noble gases, for the 1954 notation manual used *Ar* to denote argon before IUPAC made this an official international atomic symbol.

Computer Restrictions

What happens when these two-letter symbols must be written with the "Teletype" and computer restrictions of strictly upper-case letters? Here another aid to recognition was overlooked and insufficiently generalized in the original 1954 manual. *All* two-letter symbols now are set off in hyphens. Then the computer chemistry can wax poetic and show that -AR- pairs with -KR- in Periodic Group 8, -KA- with -NA- (after Latin ***kalium*** and ***natrium***) in Group 1, -VA- with -TA- in Group 5, and two for good measure in Group 6: -UR- with -CR- and -WO- as a "spitting image" of -MO-. Rare -YT- matches the rare earth -YB- in Group 3.

The hyphenation intensifies recognition in printed lists, and the two-letter standardization releases six precious single letters for nonmetallic structural groups, most of them cited more frequently than the previously introduced *E* and *G.*

Astronauts as well as aquanauts now behold the beauty of our water-covered blue earth. The OH-group always had great prominence in AQUEOUS chemistry, and now it has cosmic prominence as a free OH radical in outer space. The obvious single-letter choice for this very important group is extracted from pure or polluted A*Q*UA, and this old letter *Q* can be well remembered as an O-atom with an H-tail (Figure E, center).

(Old radioman-practice slashes the ***zero,*** not the frequently used letter O).

Nitrogen chemistry parallels oxygen chemistry in many ways, but this can be shown more refreshingly with a programming aim to have the important NH-group match the OH-group in retrieval sharpness. The notation symbol for this linking or Mid-aMino NH-group is carefully selected from the middle of the alphabet. the nitrogen counterpart for *Q* is the letter *M,* an N-atom with an H-prop (Figure E).

Computer Retrieval

Carbon, of course, is the characteristic element of the ***organic*** compounds that comprise some 94% of the 4,000,000 reported chemicals, and carbon atoms are found among these structures far more frequently than any other atoms excepting the stellar-wide hydrogen atoms; more frequently, in fact, than all others combined. Thus good computer retrieval requires distinctive single-letter symbols for the different kinds of combined carbon. The obviously best choice for an X-branched carbon atom in open-chain structures is the letter X (denoting a quaternary carbon, or one connected to ***four*** non-hydrogen atoms). Its quaternary nitrogen parallel is denoted with the letter K, the characteristic feature of "kwat" and "kationik" salts. The Y-branched CH-group likewise is best denoted with the letter Y (a carbon or CH-group attached to ***three*** non-hydrogen atoms). A related *V*ery common di*V*alent connecti*V*e, the -CO.-group, is denoted with the letter V (first part of Figure F).

Roman stone-masons made a "least-effort" V-cut for the vowel U. (Its F-related meaning was a later medieval addition to the alphabet.) Thus the V-group has within itself an etomologically related U-mark, elsewhere used for the *U*nsaturating double-bond link. This notation gives considerable ***freedom from chemical bondage,*** because the unsaturating symbol *U* is used only when it is necessary to show the corresponding physical removal of H-atoms from the connected carbon group (as in the previously illustrated and listed styrene, 1U1R). A third related letter *W* was chosen to denote the ***branched dioxygen*** part of nitro and analogous O_2-groups, because it literally whispers its embedded ***double-U*** bonding pattern! (Figure F). The letter W also was a medieval addition to the English alphabet, designed to represent the "UU" or long "ooo" vowel sound, hence its double-u name.

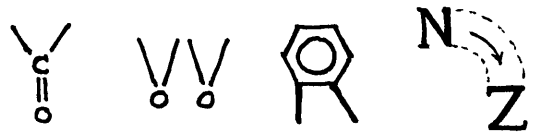


Figure F.

Since the benzene ring occurs more frequently in structure descriptions than all other rings combined (including benzo-fused rings with the others), the most appropriate remaining letter selection for this *R*esonating, *R*egular-hexagonal *R*ing therefore is the letter *R,* visualized as in Figure F with two adjacent (or ***ortho***) attachments. The enclosed circle in this diagram is the logical "least-effort" way of showing the "resonating" or alternating double bonds. (The author was circling his benzene rings in this "lazy-boy" manner some 35 years ago, so it is hardly a modern innovation.)

Mnemonic Associations

Fastidious professors may feel deeply annoyed by the mnemonic associations in these single-letter selections, and they are not likely to be "turned" by the last of these "dirty dozen" memorizing irritants: the terminal NH_2-group in this notation is denoted with the terminal letter Z (from aZine and hydraZine), a doubly appropriate selection because it is pictorially the very same as the letter N turned ***on end*** (end of Figure F and end of the program-language remarks!).

Perhaps the best way to emphasize and summarize this "Empty Column" lesson about resisting change is a brief recitation of what other users —thousands of miles away — have done with this chemical notation in spite of its officially unrecognized status. About ten years ago the users simplified its identification; people have endless difficulty with this three-syllable, nine-letter WISWESSER word (a lifelong lesson to its bearer), so they speak of the Wiswesser Line Notation simply as the WLN.

This WLN now has an "authorized manual," voluntarily written by Elbert G. Smith (Professor of Chemistry at Mills College in Oakland, California) and published by McGraw-Hill in 1968 — after eight years of rule revisions and user-tested improvements. All royalties from this book go to a Chemical Notation Association, organized in 1965 "(1) to promote and conduct research in the field of chemical notation systems and to advance the development and application of these systems; (2) to educate chemists in the uses and advantages of these systems, and (3) to act as an official adjudicating body to determine and control the

standard rules of any chemical notation system entrusted to this Association for this purpose by its authors, inventors, and developers." The 70-some members of this Association in the United States, the United Kingdom, and France are still concerned with only one notation the WLN.

The appendix contains a partial list of organizations that have put an investing interest in WLN, as evidenced by publications. Programs based on this standardized line-formula notation now have daily usage in IBM 360 or 1130, Burroughs 5500, Honeywell 200 or 400, CDC 3150, GE 635, PDP-10 and other computers in chemical information centers throughout the world.

Dow's CHECKER Program

One pioneering program, known as Dow's CHECKER program, calculates a molecular formula from the notation and compares this with manually calculated input formula; notation errors are about 2% and formula errors are the same order of magnitude – around 2%.

"WLN-permuting programs" identify another series of routines for IBM, Burroughs, UNIVAC, Honeywell, and GE computers. These programs "permute" or rotate the notation records such that the repeatedly offset atomic symbols form a "key-letter-in-context" alphabetized list. Copies of this WLN-permuting routine have passed around at least a half-dozen computer centers in the United States.

Imperial Chemical Industries, Ltd. have CROSSBOW programs that generate three possible outputs from input WLN records: (1) connection tables for fine structure searching, (2) open-ended "fragmentation codes", which are chemically significant structural components that can be printed as WLN symbol clusters and organized into file records, and (3) computer-generated and high-speed printed-composed structure diagrams. Complementing programs elsewhere are now in process to yield computer-composed notations from input tapes of connection tables, or from hand-drawn diagrams made with light-pen communication by a clerk or chemist at the console.

The PATHFINDER Program

The PATHFINDER program, written for Dow's Burroughs 5500 computer, is a very powerful routine that exhaustively checks all trial paths in extremely complicated ring structures, holding the correct lower-valued choice in all comparisons; the final holding is converted to the infallibly correct carbocyclic notation. Its input is our long-overlooked "nonconsecutive links".

Binary "bit screens" can be searched at phenomenal speed, compared with higher-language alternatives that suffer much input/output processing translation. A computer-generated equivalent of the 1950-vintage multi-punched cards makes binary "scratches" for the distinctively spaced or unspaced WLN symbols and yields a ***30-fold*** increase in speed in sophisticated chemical structure searches.

These are just starting examples of computer benefits that the chemical world will enjoy when more manpower, money and talented attention is devoted to this 20-year-old chemical notation with the empty columns.

The "least effort" advantages of the author's proposed "Line-Formula Chemical Notation" were not acknowledged at the decisive meeting by representatives of IUPAC and the ACS Punched Card Committee, held at M.I.T. in August 1951: the IUPAC examiners decided to "give the axe to the line-formula tradition" and favored an unfamiliar departure that has a more complicated set of resolving rules and a much more complicated character set. It has two or three known users in the chemical world today, in spite of a number of official promotional efforts by the IUPAC authorities.

Like the Arabian mathematician in the parable, we can only guess why we failed to interest official examiners at M.I.T. in 1951 – and elsewhere since then. Perhaps the simplest and most obvious solutions to complicated problems are the most easily overlooked. The power of the human brain to deceive itself – even when healthy and free of disabling drugs – must not be underestimated. We submit the comparisons listed in Table 3 of century-old line formulas and their standardized WLN equivalents, for those who wish to see the conservative correspondence with tradition.

Table 3. COMPARISON OF EARLY LINE FORMULAS (1861-1867) WITH WLN

1861-1867 Line Formula	WLN
$C_2H_5,O,C_3H_4O,O,C_2H_5$	2OV2O2
$CH_2CN.CO.Br$	NC1VE
$ClCH_2\text{-}CO_2H$	QV1G
$H_2N\text{-}CH_2\text{-}CH_2\text{-}CO_2H$	Z2VQ
$CHCl_2.CCl_3$	GYGXGGG
$CO.OH\text{-}C(OH)_2\text{-}CO.OH$	QVXQQVQ
$CH_3.CHI.COOH$	QVYI
$CH_3\text{-}CH.OH\text{-}CO.OH$	QYVQ
$C_6H_5\text{-}CH_2\text{-}Br$	E1R
$C_6H_5.CCl_2H$	GYGR
$C_6HBrHBrHNO_2$	WNR CE EE
$C_6H_5.SO_2.OH$	WSQR

Note: The CH_3-groups attached to Y-branched C-atoms are understood by definition of the Y mark (or X).

The last cited report on computer applications of the WLN (44) gives in its appendix some 500 additional examples, all identified by common name; most of them are grouped into 18 sets, sequenced in increasing order of structural complexity. The chronological arrangement of the 71 reference citations in this same report also reflects the "exponential" growth of user interest in the WLN: only twelve references appeared in the first ten years (1950-1959), then ten in the next five years (1960-1964), followed by twelve in two years (1965-1966), seven in 1967, and no less than nineteen in 1968. This is gratifying growth!

We acknowledge the growing signs of user interest in the WLN as a keen appreciation of their interest, and we submit this "excursion in symbol-land" as special thanks to ***Computers and Automation*** for recognition of the parable that was written in 1950 to introduce our "empty column" notation. □

APPENDIX

A partial list of organizations that have expressed an interest in the WLN and published or presented papers on it, is given below. Their reports are keyed to the numbers in the literature references (which also include the earliest citations on the WLN).

J. T. Baker Chemical Co. (2, 3, 26, 43)
Chemical Abstracts Service (9)

Diamond-Shamrock Corporation (13, 14, 26)
Dow Chemical Company (7, 8, 26)
Food & Drug Administration (1)
GAF Corporation (35)
Goodyear Tire & Rubber Co. (10)
Hebrew University (Israel) (19)
Hoffmann-LaRoche, Inc. (26, 34)
Imperial Chemical Industries (21, 22, 26, 36)
Institute for Scientific Information (23, 28)
Eli Lilly and Company (29)
Mills College (E. G. Smith) (31, 32, 33)
Ministry of Defense of Israel (27)
National Bureau of Standards (11)
National Library of Medicine (1, 30)
Olin Mathieson Corporation (18)
G. D. Searle & Co., Inc. (5, 6)
Stanford Research Institute (20, 26)
University of Pennsylvania (24, 26)
University of Sheffield (UK) (25)
U. S. Army, CIDS Program (26)
U. S. Army, Edgewood Arsenal ILO (12, 15, 16, 17, 26)
U. S. Army, Fort Detrick (2, 3, 21, 26, 42, 43, 44)

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C·a

"The House is on Fire"

THE PROFESSION OF INFORMATION ENGINEER AND HIS BRIDGES TO SOCIETY

Computers and Automation believes that the profession of information engineer includes not only competence in handling information using computers and other means, but also a broad responsibility, in a professional and engineering sense, for:

- The reliability and social significance of pertinent input data;
- The social value of the output results.

In the same way, a bridge engineer takes a professional responsibility for the reliability and significance of the data he uses, and the safety and efficiency of the bridge he builds, for human beings to risk their lives on.

Accordingly, this department of *Computers and Automation* will publish from time to time, articles and other information related to socially useful input and output data systems in a broad sense. To this end we shall seek to publish here what is unsettling, disturbing, critical — but productive of thought and an improved and safer "house" for all humanity, an earth in which our children and later generations may have a future, instead of facing extinction.

The professional information engineer needs to relate his engineering to the most important and most serious problems in the world today: war, nuclear weapons, pollution, the population explosion, and many more.

In this issue, we are publishing some of the comments we've received in reaction to the editorial in our February issue, "The House is on Fire", which set forth this thesis and inaugurated this department in *Computers and Automation.*

INTOLERANCE

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Intolerance is a communicable disease.

Man has well established, over the years, his vast capacity for intolerance. The early tribal animosities were based on intolerance born of a desperate competition for sustenance. The aristocracy/serfdom/slavery relationship was based on intolerance born of economic imbalance. The early explorers conquered and stole out of intolerance based on greed. Today's racial friction is intolerance in capital letters.

Some may argue that intolerance is inherent in man, a part of that (hopefully, small) diseased element present in us all. But, more importantly, intolerance is shared and nurtured in a social environment. The little child, in many ways an unwritten slate, becomes intolerant by what he sees around him. The youth becomes intolerant either in emulation, if his environment is favorable, or in rebellion, if it is not. And the man, intolerant by early exposure, solidifies his intolerance by seeking out those who will sustain it.

Thus does intolerance become a communicable disease.

The focus of the articulate today is on the intolerance in our society. This intolerance is clearly there for all to see, and disturbingly long-lasting. The small social knives that drive the black man back to his ghetto are hidden in the souls of people all around us; the large legal machetes which systematically strip the Indian of his treaty rights flash less often but more openly; the pin-pricks of a mass society ignoring the individuality of its component souls probe constantly at us all. And in some way, all of this is a form of intolerance . . . mix it with ignorance, or egotism, or evil, if you will — but intolerance is there, at the heart of it.

But there is another form of intolerance which is rampant today. It is the intolerance of the articulate *towards* our society. "Our society," they say, "is sick. Our society must be made well."

And these things are true. "Let us shoulder our responsibilities," they say, "and seek ways of change. And directions of change. And vehicles for change." Intolerance, one of their foes, is alien to their thinking. "The House is on Fire," and they are the firefighters.

But in that caldron of change lie the seeds of man's old foe. Associating together, reinforcing each other's opinions, the spectre of intolerance rises among those in whom you would least expect it. All too often, the foes of intolerance adopt their enemy in the course of fighting him.

Somehow the people with whom they disagree begin to have labels attached to them. The "military-industrial-complex" becomes a whipping boy. "Imperialist" becomes an often-aimed adjective of derision. The motives of those whose opinions differ from theirs are challenged. The force of rhetoric is used to attack, not to seek truth. The efforts of those who design weapons of war are equated to those who design Nazi crematoria. The sense of social responsibility of those who support our government's position is dismissed without consideration. Belief in some elements of our society is equated with fear of rocking the boat.

Intolerance, still the enemy, somehow has gotten behind the lines. Because it is communicable, and because the society tends to be closed, it runs rampant. And what is worse, it goes unrecognized.

The heroic firemen, fighting our "House on Fire," soon begin running gasoline through their hoses.

Socially responsible professionals, aware that the house is on fire, have a responsibility to speak what they believe, even when what is said is "unsettling, disturbing, and critical". This article is both an expression of belief, and a warning. Intolerance, that communicable disease, is being spread by those from whom we least expect it. □

RESPONSIBILITY

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This letter is being written in order to present an opposite view from that which was the content of your editorial of February, 1970.

The theme of this editorial *could be* interpreted to mean that we should all become involved because we are all part of the human race and therefore all equally share the responsibility of our earth and the fruits of it. If this defines your point, I would agree wholeheartedly. However, your outline of group philosophy does not lend credence to this theme; rather it is the essence of destruction to society.

To infer that every individual should make his own decision as to the merit of a project, the moral aspect of a company or government decision; and then enforce this against the law of the land, or the regulations of his group, is no more than revolution – against society – which is the ultimate environment for man.

Reflect on the following:

- Can a decision be made when the decision maker lacks the information required; the capacity to not lose sight of the forest for the trees; the motivation of all those who are affected rather than just his own well being?
- Can group (1) be really compared to the slaves of a dictatorship when they have the ability to seek other areas of endeavor if they so choose?
- Did the dinosaur become extinct because they were a society banded together for the common good or because each made his own decision as to right and wrong and to the well being of only himself?

Does survival depend on each one determining the right or wrong of an issue and then following that path, *or* does it depend upon the society (of the people, of course) choosing as its leaders men who will perform this function under the critical eyes of the masses? Your examples of disaster are based on the "one" theory and not on the theory of society. You contradict yourself when you call for some control of population, from this anarchy, no doubt, but what if I want (30) children and consider it against all moral principle to restrict anyone's family size?

You very conveniently blame everything on international anarchy – beautiful – the fault lies *in all OF US* – not because we will not conform to your philosophy of "one" but rather because we do. Too many of us will not get involved in the right places, but think only of ourselves and become involved when something directly affects us.

Don't blame a word – or those who *do* become involved when they make mistakes; blame each and every one of us for saying "Hooray for me and the hell with you."

It is my fervent hope that your new department will not follow your revolutionary policy and will really attempt to point out that we are all responsible for this earth and that we should become involved. But, please, show them how to do it within the framework that has evolved out of darkness, for ages of man: the society – together for the well being of all. □

CONSERVATIVE VS. REACTIONARY

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I have been a reader of *Computers and Automation* for many years and believe it to be the best in its field. I was interested in your editorial in the February issue, and as a result this is one of the few "Letters to the Editor" that I have ever written.

Your analysis of the two attitudes about computers and data processing in "The House in on Fire" I found to be very sound. I too am very concerned about the fire in the house. However, in the middle third of the editorial you drew some conclusions which I found very *un*sound.

As a member of the ACM, I voted against the proposal that the ACM take a stand on political matters. This does not mean that I feel *members* should not take stands, but that the ACM is not a political organization and should not try to become one.

I feel that you are doing what a great many other people are doing, which is to equate conservative with reactionary. Your "Group I" describes the reactionary who does not even want to claim a positive attitude. The conservative, on the other hand, does feel that "The world can be much better than it is now", "It is important to try to improve", etc., but he differs sharply from the liberal when it comes to the means and impetus for that improvement. The conservative believes that the initiative must be with the individual while the liberal feels it must come from without (e.g., government). The liberal would hire the expert to determine what the black student should study; who should rule Viet Nam, the Dominican Republic, Nigeria; how to develop South America. The conservative says that as individuals we must help the black find the means to determine for himself what he should study; that we must give the poor the opportunity to move themselves out of poverty; that we must not interfere with the Vietnamese, Dominicans, or Nigerians as they determine their forms of government; and that we must help the South Americans to develop their own industry and means for social betterment.

Obviously there are both liberals and conservatives who talk but do nothing. The liberals have the excuse that the government, or the agency of the expert, is at fault. The conservative has no such scapegoat and must bear the blame for failure himself. We have few real conservatives because people do not like to admit their own shortcomings.

Here at Ohio University we have the usual liberal groups (faculty and student) demanding that the administration or the city or the state or someone should do something about a variety of problems. But organizations like the Conservative Club and the Vets Club are the ones who raise money to help the families of the Viet Nam prisoners, who paint homes for the poor, who collect clothing and furniture for families whose homes are burned, who tutor children in poor school districts.

P.S. Do *not* cancel my subscription. Your publication is still the best and I feel one reason is that you are "concerned". □

SOCIAL CONSCIOUSNESS

T. D. C. Kuch
7554 Spring Lake Drive
Bethesda, Md. 20034

I disagree with your assumption in your February editorial that "the proportion of Group I" [the non-socially conscious] "to Group II" [the socially conscious] "is about two to one" judging by the ACM vote.

The proposed ACM position was a two-edged sword. If ACM were empowered to oppose the Vietnamese war, it could instead support it; if ACM were empowered to take a stand on measures to ensure that blacks get a number of computer-related jobs, it could as easily take a stand against, as for.

I believe that I am obliged to speak out and act responsibly towards society as an 'information engineer', a 'computer professional', or whatever we are to call ourselves. But I feel very uneasy at the prospect of the Council of the ACM, or any other body, being given carte blanche to speak on social issues in my name. Therefore I voted against the ACM resolution.

I think that there are many others who feel the way I do, and that the real proportion of Group I to Group II in our industry is more nearly 1:1. □

DICTATORSHIPS

I. From Belden Menkus
7 Blauvelt Ave.
Bergenfield, N.J. 07621

I would appreciate your clarifying one aspect of your February editorial. Do the problems you are alluding to include such matters as U.S. support of Latin American dictatorships such as the regime of Dr. Duvalier in Haiti?

II. From the Editor

Based on my present limited knowledge of the dictatorship of Duvalier in Haiti, I would say "no" to your question. Here are my reasons: This new department in *Computers and Automation* is entitled "The Information Engineer and His Bridges to Society". It seems to me that, most of the time, the seven to ten major, urgent problems for humanity should here be discussed or treated, if possible, in the form of articles that provide orientation for information engineers.

In my opinion the major, urgent problems facing human society at this time are:

1. Control over nuclear weapons, and chemical, bacterial, and radiological warfare
2. Environmental pollution
3. Food or hunger for millions of human beings
4. Military-industrial complexes, the arms race, and their inevitable results — war
5. Racial prejudice, communist prejudice, anti-communist prejudice, religious prejudice, apartheid, and other varieties of master race myths and other-people hatreds that lead eventually to massacres, pogroms, genocide, etc.
6. The population explosion
7. The democratic freedoms: of thought; of discussion; of the press; of assembly; to picket; to strike; to associate in organizations; to vote; to enjoy privacy in talking, telephoning, letters, etc.; to a trial by a jury of one's peers; etc.
8. Secret police, secret intelligence agencies, cloak and dagger operations

In the 1800's I would also have included slavery; as late as the 1500's I would have included cannibalism.

I include No. 7 because it seems to me that these freedoms are the safety valve for the steam engine of society — these are the techniques to help people to think and talk about problems, to plan desirable changes, and to work politically or socially to make them happen. If you tie down the safety valve, the engine is sure to explode.

If problem numbers 1 to 6 are not solved, then the earth becomes extremely unsafe for human beings to continue to live on it. I cannot assert this degree of unsafeness about nearly all dictatorships in small countries (unless they obtain nuclear weapons); so even if these dictatorships continue, I do not see as a probable result the deaths of hundreds of millions of human beings. □

AS WE GO TO PRESS

(Continued from page 7)

developed by states, localities, and individual firms.

Gallagher cited his Subcommittee's recent discovery of the Army's computer data bank containing information about individuals involved in potential civil disturbances as an example of the need for a Federal Data Processing Commission: "If they [the Army] had known that a Federal Data Processing Commission was going to inspect their system and write enforceable rules and regulations, then this very threatening and chilling expansion of the Army's internal mission probably would not have taken place." This particular Army data bank, which was maintained at Ft. Holabird, Md., has reportedly been destroyed.

CONTROL DATA CORPORATION (CDC) HAS ANNOUNCED NEW SOFTWARE POLICIES. An outgrowth of CDC's unbundling, the new policies will give customers proprietary rights to CDC software that is modified or improved by the customer or by CDC analysts working for the customer. In addition, customers will have a 90-day period to accept or reject CDC software before he is charged for it, providing he does not use it for his own productive purposes during that time.

RCA HAS ANNOUNCED THE COMPUTER INDUSTRY'S FIRST PRICING PLAN WITH OPTIONS TO EITHER BUNDLE OR "UNBUNDLE". Under the new plan, customers will have the option of leasing or purchasing RCA computers without systems support at 3% price reduction, or of acquiring the computer hardware with full systems support at present rates. RCA also announced a new lease-purchase plan which offers its commercial customers up to a 15% reduction in monthly charges for its computer systems over a six-year period, at the end of which they will own the computers.

C.a

NUMBLES

NUMBER PUZZLES FOR NIMBLE MINDS —AND COMPUTERS

Neil Macdonald
Assistant Editor
Computers and Automation

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions.

NUMBLE 704

```
          R O G U E S
        X   S P E A K
      -----------------
        Q U U N R G N
      E I H R O A R
    N O O K I U U
  S K K P G E E
O T K A F O P
-----------------
= K S K U E K K G I H N
```

AGF = INP = ANT

599034 805258

Solution to Numble 703

In Numble 703 in the March issue, the digits 0 through 9 are represented by letters as follows:

C,K = 0	W = 5
D,T = 1	E = 6
I,S = 2	N = 7
H = 3	L = 8
O,U = 4	M = 9

The full message is, "He who thinks well need not think much."

Our thanks to the following individuals for submitting their solutions to **Numble 702:** A. Sanford Brown, Dallas, Tex.; T. Paul Finn, Indianapolis, Ind.; Paul Freiberg, Skokie, Ill.; Phil Hollenbeck, San Leandro, Calif.; T. A. Peters, Nacodoches, Tex.; Nathan Relles, St. Paul, Minn.; Lambert J. Simon, Irving, Tex.; Robert R. Weden, Edina, Minn.; and Wayne Ziegler, Madison, Wis. **Numble 701:** LTC Charles D. Ford, Jr., APO San Francisco, Calif.; and Robert Kaplan, New Orleans, La.

Our thanks also to Steven K. Sullivan, Fort Hood, Texas, for sending us a listing of his program that solves for the unknowns in a multiplication problem written out in long form. The rules set up for his program were: (1) It would solve a multiplication problem up to a seven by seven; (2) There would be up to ten variables, no two having the same value (this restriction would be easy to eliminate); and (3) The leading digit in any row may be zero. The program was run on an IBM System/360 Model 40. □

C.a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 704: BUTTONS AND BULBS

When John Lawthorne saw ESP PROGRAM at the top of the sheet Joe was working on he couldn't resist saying, "Don't tell me you're trying to get a computer to do mind reading!"

Joe looked up, "No, this program is for on-line analysis of an experiment Professor Volga is conducting."

"What experiment is that?"

"Well, he's going to have a subject sit in front of a box with two light bulbs and two buttons. The idea is to press the button corresponding to the light the subject thinks will flash next."

"Are the lights going to flash in a random order?"

"Yes, but the proportions of left and right will be under the control of the operator."

John thought a moment. "Is he going to have it 50-50 right and left?"

"I think the scheme is to start out that way and then gradually change to some other proportion, say 75% right, 25% left."

"Does he expect the subjects to become aware of this three-to-one bias and end up pressing the right button three times as often as the left?"

"I don't know," Joe said. "They may think they're optimizing their scores that way."

Are they?

Solution to Problem 703: Tournament Turmoil

If the players are numbered 1 to 9, the four rounds might be: 123, 456, 789; 592, 148, 367; 571, 268, 394; 169, 247, 385, with the first two playing and the third acting as referee.

Readers are invited to submit problems (and their solutions) for publication in this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

How Computers Can Discover People

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This paper attempts to describe the new world of school administration that now lies before us. The thesis of the paper is that the computer makes practical an entirely different view of human behavior. This is not to say that human behavior will be in any way different than before, but to aver that we now have new ways and greater power to apprehend the nature of that behavior; to view it anew with stronger vision and a thousand eyes.

At Disneyland in California, one can be entertained in a circular motion picture theater, the walls of which appear as one great cylindrical projection screen. The effect is similar to being inside a very large glass bottle, viewing a well lighted and rapidly moving world through its walls. The picture that you see was filmed with nine cameras aimed radially from a central point so as to cover the whole compass of 360°. It comprises a record of the view as seen with nine eyes instead of a single eye, and it views a world of only three dimensions. Yet it is a marvelous attempt to capture reality more fully than can be done with only one camera and one viewing screen. In such a view, objectivity is supplanted by completeness, validity by truth itself.

The View from a Thousand Eyes

We believe that a modern computer system can be made to record, store, and coordinate the view from a thousand eyes, so to speak. If we substitute ***data*** for ***view,*** and data ***sources*** for ***eyes,*** computers can be used in this manner. Indeed, the power of the modern computer exceeds the ability of men to define data or data sources. It is reasonably certain that the director of a 360° motion picture must be careful in his choice of location, if the view in every direction is to prove worthwhile. The viewer of the film has the same problem, in reverse, because he can look at not more than 1/3 of the compass at any given time.

How much more complex is the problem of the director of a system which can record data collected in a thousand ways! Fortunately, computer system data acquisition and storage is more flexible than optical system (or camera) acquisition and storage. Problems of time, space, and continuity are less acute; and the coding of data permits an editing more sensitive than can be had in the motion picture cutting room.

The Stupid Use of Hardware

Yet for all its power, the best of hardware can be used stupidly. There are sophisticated systems placidly printing thousands of school report cards, each of which bears no more meaningful message than "English grade A-". There are systems which score tests with blinding speed and awesome accuracy, yet report the pupil performance in such terms as ***Grade Equivalent, Percentile Rank,*** or the newer ***T-Score Band.*** There are systems that have memorized all the legally collectible data about all the pupils and teachers in a city of a million population, yet can't report to the administrator the probable effect on educational efficiency of any of the major administrative decisions he and his staff must make each year. In all probability, the system does not even have means to measure educational output.

A modern, high speed computer system can be set up and operated so as to make obsolete such crutches as report card grades, standardized tests, one-shot experiments, annual budgets, and dozens of other demeaning devices which all have in common one thing: they compromise individual differences in favor of a middle ground known as the "norm", the "average", or the "standard". These devices are the cost to society of the inability to acquire, store, and correlate enough data about individual people, this inability has kept us from discovering man as an individual among men.

As we have said, the computer offers a potential, but the potential is only a hardware potential. If we use that hardware to implement logical traps that were developed within the limitations of the abacus, then we will not discover man. We need logical traps with greater comprehension and scope, that spin a finer web and net a greater detail.

Such a logical trap has been made, and it is being used now with interesting results. One version is known as PACER* (Prescriptive Analysis for Curriculum Evaluation and Review), and its field of search is achievement testing analysis. The preceding remarks are intended to indicate that PACER is only one possibility in the larger methodology which may be based in the power of a modern computer system. It is true that the current version of PACER does not require as powerful a system as it does use at Oakland Schools; yet in its ultimate usage it may well do so. For that reason, we shall describe the Oakland Schools computer system briefly, then PACER as an example of use of such a system.

The Oakland School System

The Oakland Schools computer system is based on an IBM 360 system model 50 CPU, with 393,000 bytes of core and (currently) 500,000,000 bytes of random access storage. It comprises a teleprocessing network which includes several levels of terminals; as low level as touch-tone telephones, and as high level as other computers. A commonly used terminal is the card-reader, line printer known as 2780. The teleprocessing and system software is an Oakland Schools property known as RAMS*, which is an

*Trademark, Oakland Schools.

acronym for Randomly Accessible Management System. The subscribers to the system are all school district administrations, some as far away as 80 miles. RAMS contains randomly accessible on-line files and computing programs which permit the user to do financial accounting and payroll, pupil accounting and reporting, personnel accounting and performance responsibility research, class scheduling, testing analysis, and special purpose studies of which PACER is an example. The file system of RAMS is designed to permit school efficiency studies through multi-dimensional, multi-variate analyses at all levels including the individual teacher-station (classroom). While functioning as a multi-programmed, multiple-tasked computer, RAMS maintains continuous input-output communication with all active terminals.

The Logic of PACER

PACER is a testing analysis system which preserves and organizes all the data detail available in the source document. Data source documents are optically scanned answer sheets on which pupils have recorded their choice of answers to test questions of the multiple-choice kind. Ordinary testing analysis would consist of scoring and score conversion, with output of score listings, profiles, frequency distributions, and parametric statistics. The logic of ordinary testing analysis is based on the assumption that *item* achievements are additive to form a sum score, and that a score is a useful index to compare pupil achievement with a standard (or norm). The logic of PACER is that *each* item achievement is a variable, and that adding across items produces a score with very limited usefulness. PACER analysis therefore retains and reports the achievement of every pupil on every item, and analysis proceeds upon the principle that every answer choice is a meaningful response. The every-pupil output consists not only of scores, but includes the *response listing* which shows, for every item, the choice result in the following code: + for right answer, – for no answer, (A, B, C, D, E) for which wrong answer chosen. Since every item may be a member of one or more curricular subsets, the every-pupil listing gives as many item response listings as there are defined subsets (up to 20) together with the number and percent of items *right* in the named subset.

Further, the every-pupil listing contains a reporting of concept analysis. The system permits the user to specify the response pattern which is indicative of a concept. Concepts may be right-concepts, wrong-concepts, level-concepts, or lie-concepts. Concept patterns (up to 40) may be specified by listing the specific item-answer patterns which are members of the concept. The operating rule is that if a pupil's response pattern fits the concept pattern more often than not, then the concept identification number appears in the every-pupil listing.

From the every-pupil listing we can discern not merely the level of achievement, but the pattern of response and the actual response to subsets of items and to items. These discernments are useful in a diagnostic-prescriptive mode to aid in the guidance of class and pupil activities.

While standard testing analysis is designed to make "measurements" of pupils against a norm, PACER analysis takes measure of the curriculum-in-being against pupils. The every-pupil listing is merely the first level of program (or curricular) measurement.

The Teacher-Station

The next level is the teacher-station (classroom) level, wherein we find the number (and percent) of pupils choosing each answer to every item. The logic is that teaching programs are measureable in terms of the proportion of pupils who have learned *each* piece of the course content. The PACER output used for this purpose is the every-class item analysis.

From this second kind of listing, it is possible to discover the strengths and weaknesses of the teaching in terms of items, subsets of items, and concept patterns. Since the listing is given for achievement-level subsets of pupils as well as for the total class, the item X total validity is observable not only for *right* but also for *wrong* answers. Appended to the item analysis listing is a listing of pupils by achievement-level subsets. This is useful to index the every-pupil listing in a class-comparative way.

Two more levels of item analysis listings are provided, in exactly the same format as the teacher-class listing. These are the building-group listing and the *total* or district-group listing. Exactly the same usages are made of these higher level listings as of the lower, and in addition the total set of item analysis listings permits comparative studies between levels as well as within levels, not merely on a score basis, but on an item basis, on an item subset basis, and on a concept basis.

Threats to Teachers?

We are often asked whether teachers do not find this sort of detailed analysis threatening. The answer is *no,* provided only that the listings are carefully explained and wisely used. There is reason to believe the contrary; that armed with detailed and specific analyses, teachers and supervisors can move confidently and directly toward program improvement. It is uncertainty and vagueness that threatens; real truth sets men free.

Armed with analytic tools like PACER, we are finding that no pupil, no teacher, nor any school is describable in normative terms, because the best pupils have specific areas of ignorance, while the worst know some things well. The best teachers fail in some areas, and the worst are successful in some. No school program is adequately describable in terms of the number of pupils who are "below grade level". The old statistics are simply inadequate to discover man, and worse yet, do not tell us how to improve him.

Value of Standardized Achievement Tests

Analysis is the computer software end of the logical trap called PACER. Equal in importance is the set of achievement tests used by PACER. Just as normative statistics have proved inadequate for program evaluation, so have the standardized achievement tests themselves. The reason is obvious, the tests were designed for a different purpose. They are not intended to discover man, but to rate him. The items in standardized tests are not useful in measuring a curriculum-in-being partly because they are not sufficiently representative of that curriculum, partly because they are designed to rate pupils, and partly because the distractors are not curricularly significant. For program evaluation, the items must be pertinent to that program and useful in a prescriptive and diagnostic way. Each test item becomes a logical trap in itself, and subsets of items and item response patterns are extensions of the logical trap.

Useful Data

As a part of a total system, PACER analysis aims at providing useful data for administrative control in the total RAMS system. Here again the computer system currently has more power than men can use. While the total system can correlate, integrate, and extrapolate at any and all control levels of school administration, it is up to men to load into the system those viewings of man that will make the result of most use to men. □

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

Table of Contents

APPLICATIONS

MOTION PICTURES OF LIVING HEARTS ANALYZED BY COMPUTER-BASED SYSTEM

A computer-based system for analyzing motion pictures of living human hearts has been devised by researchers at Toronto General Hospital (Toronto, Ontario). The system examines the pictures to determine ventricular volume — a physical characteristic that has a great bearing on the heart's ability to do its required work.

Motion pictures of a functioning human heart are taken with an x-ray image intensifier/cine camera combination. The film is then viewed with a TV camera connected to a device interfaced to a Digital Equipment Corporation PDP-8/I computer. The device scans the pictures line by line; the computer inputs and stores the data. From the information, it is possible for the computer to determine the dimensions of the heart and calculate the ventricular volume.

The research at the hospital's cardiovascular unit (funded through a grant from the Ontario Heart Foundation) is under the direction of Dr. Douglas Wigel and Dr. Allan Adelman. Other studies also are being pursued in the areas of ventricular premature heartbeats and blood flow.

COMPUTER PREDICTS BEACH EROSION ALONG LAKE MICHIGAN

To test what effect weather conditions have on shore areas, Dr. William T. Fox of Williams College (Williamstown, Mass.) is simulating wave and weather conditions on a computer for some 1,000 feet of Lake Michigan shoreline. Beach erosion is especially critical for Lake Michigan this year because the lake is at its highest level since 1886 — almost six-feet above the previous low-water mark. During the past five years, the high waters have not only eroded Lake Michigan's choicest beach areas, but also have caused cliffs to fall into the lake and shoreline highways to collapse.

Using a mathematical model simulation technique, Dr. Fox feeds data on the segment of Lake Michigan's shoreline into an IBM 1130. In all, 17 variables on the interaction of weather, wave and sediment are fed into the computer. This represents data which has been collected every two-hours over a 30-day period. More than 6,100 separate readings, including information gathered by photographers in planes and scuba divers, are used to develop the simulation model.

Using the computer to simulate actual conditions of shore areas, Dr. Fox hopes to obtain a set of mathematical formulae for predicting how varying weather conditions will alter any shore line. By mathematically increasing the size of waves or altering the contour of offshore bottom, the computer enables Dr. Fox and his associates to predict the erosion of any given strip of beach. "Once we can predict the amount of erosion that can be expected under certain meterological conditions, we can intelligently decide where to place breakwaters and the best type of breakwater to construct," explained Dr. Fox.

While Dr. Fox's main area of study is the strip of beach along Lake Michigan, he also is working on computer-generated wave models for several New England beaches including Cape Ann, Mass., Horseneck, Mass., and Watch Hill, R.I. The professor's three-year study is being funded by the Office of Naval Research which hopes to use his technique to predict changes in near-shore bottoms and beaches.

NEW YORK PUBLISHER ISSUES FIRST BOOK COMPOSED ENTIRELY BY MACHINE

The first book composed entirely by machines — from manuscript to print-ready page size negatives — has been issued by the New York publisher William Morrow & Company. The book is V.C. Clinton-Baddeley's "Death's Bright Dart," previously published in England. The machines responsible for producing the book were a computer-driven cathode ray tube system and an Optical Character Recognition prototype design. Morrow states that, "The all-electronic composition of this book represents the first successful achievement in the ultimate application of automation technology to a heretofore man-limited process."

The OCR system (designed by Mergenthaler Linotype Co., a division of ELTRA Corp.) "read" the text directly from a non-marked-up copy of the British edition, converting it into digital, electronic impulses for computer input. The author's words, as "recognized," then were fed into a computer and reformatted into a completely new typographic style, with Americanized spelling and punctuation. As the final step, these electronic impulses were "translated" into the physical typographic form visible in the book by the Linotron 1010 photocomposition system (developed by Mergenthaler and by CBS Laboratories, a division of the Columbia Broadcasting System).

The OCR system, believed to be the first to be capable of reading intermixed, proportionally-spaced and uncontrolled typography, was designed for sophisticated graphic arts purposes. It can read virtually any material, ranging from printed text, typewriter manuscript, computer output and even handwriting. Mr. W. H. Granville, General Manager of Mergenthaler, explained that the system is not yet on the market, and added: "To avoid any possible misunderstanding, Mergenthaler wishes to make it clear that its OCR system is a prototype machine, and that the company presently is studying a number of alternate plans to produce the system commercially."

TEXAS COMPANY USES COMPUTER TO MAP UTILITY POLES, OIL PIPELINES

A computer that never leaves San Antonio is mapping power lines in Wyoming and tracing oil pipelines in the Alaskan wilderness for the Tobin Aerial Survey Co. After gathering information for the computer, primarily from aerial photographs, Tobin uses an IBM 1130 and a plotting device to generate the specialized maps.

In the Wyoming project, Tobin photographed the entire city of Cheyenne from the air. From the pictures, photogrammetry experts established longitude and latitude coordinants for each pole, substation and transformer in the city. The information then was transferred to punched cards and sent to the computer. From these pictures and coordinants, the IBM system turned out maps that showed the lines carrying electricity to each customer in Cheyenne. Now, if a customer complains of power failure, a repairman can tell from the maps, at a glance, the substation providing that power and the actual pole that carries it to the customer's house.

Once the basic information has been recorded on punched cards, maps can be updated every time poles are moved or circuits changed. Moreover, the IBM system allows engineers to "modify" the city system without moving a single pole. By adding the factors for a new installation to the existing system stored in the computer, the 1130 can demonstrate how the new power needs would affect the entire system.

Pipelines thousands of miles long are mapped in similar detail. Tobin's Alaska pipeline, also created from information gathered by aerial photos, even shows such things as ownership of the land crossed by the pipeline.

HEALTH THREATS OF AIR POLLUTION BEING PROBED IN COMPUTERIZED RESEARCH PROJECT

Penn State University is engaged in a 3-year project (funded by a National Institute of Health grant) to establish the correlation between the greater incidence of colds, or other respiratory ailments, and air pollution. In cases where air pollution is a problem, cells in the lungs become loaded with carbon particles. These same cells are needed to produce antibodies for fighting disease and infection. It is believed this loss of antibodies makes the lung susceptible to respiratory infection and colds.

Experiments being conducted already have established that large particles discharged in the air, including fly ash and other particulates, create an aesthetic problem, but are not necessarily hazardous to health. The smaller non-visible particulates and gaseous materials, such as sulphur dioxide and nitrogen dioxide represent the real, potential hazard.

To study the effects of air pollution, four test colonies of laboratory animals are exposed to different, and controlled, environments, and examined medically. Data from the experiments is fed into an IBM System/360 Model 67 at the University's Computation Center. The computer-generated information is the basis of reports for the National Institute of Health and the Department of Health, Education and Welfare. Government agencies are looking at studies like this to establish acceptable levels of pollution for regulatory purposes.

PPG INDUSTRIES USES COMPUTER TO EVALUATE BUILDING GLASS FOR ARCHITECTS-ENGINEERS

An unusual cost-estimating computer service by PPG Industries has helped evaluate and select the best glass to resist the cold Minnesota winters at North Central Airlines' new $15 million headquarters complex at Minneapolis-St. Paul International Airport. The service, a computerized glass-conditioning program which PPG offers its customers, provides a means of estimating the benefits of insulating glass. It is offered through PPG's regional architectural representatives for buildings in the design stage.

The architect reviews the details of the project with the representative, as well as the performance of PPG's environmental glass products. The architect, with the help of his consulting engineer, collects essential input data for the computer program, such as building location and orientation, total glazed and non-glazed areas, number of occupants, and building life and cost. PPG adds computer input on product performance, weather, heat flow and accounting data, plus technical data.

The computer prints out a comparison of the PPG environmental control glasses under consideration. Comparisons for each glass include the estimated purchase price, size and operating costs for the heating and air-conditioning systems and a long range savings from reduced heating and cooling loads. In addition to cost and performance data, architects also consider aesthetic effects in selecting the glass.

EDUCATION NEWS

HIGH SCHOOL STUDENTS GRADUATE FROM XDS COMPUTER COURSE

Fifty-two junior and senior high school students recently graduated from a computer science workshop cosponsored by Xerox Data Systems and the Compton Union High School District. These Los Angeles area students are part of an educational experiment that may help reduce student drop-out rates and lead to the increased use of computer courses in high schools. The program is based on the theory that the knowledge of any second language — in this case computer programming — will broaden a student's aural and visual senses and motivate him to stay in school.

Aided by city, county, state and university educators, XDS is offering this pilot program to approximately 300 high school students from Compton. Classes are held at the XDS headquarters complex in El Segundo (Calif.) for two hours each Saturday morning for 20 weeks. The students receive both classroom and laboratory training in the operation and use of computers. The first group of 50 students to complete this program was graduated August, 1969. A third group will graduate in June, 1970. Because of the program's success, computer science may soon be incorporated into Compton's normal curriculum, and into the curriculum of other Los Angeles schools as well.

APPLICATIONS ARE AVAILABLE FOR 1970 DPMA RESEARCH GRANT

The Data Processing Management Association has set May 1 as the deadline for filing applications for the 1970 doctoral candidate research grant program. A number of individual $2,000 awards are made available annually to candidates who perform research in preparation for doctoral dissertations in the field of data processing systems and management.

Applicants must be advanced doctoral candidates at accredited graduate schools, ready to devote full time to the dissertation. The doctoral committee must have already been appointed by the university and the proposed research, including content and methodology must have been approved by the committee. Application forms are available from DPMA's International Headquarters, 505 Busse Highway, Park Ridge, Illinois 60068.

COMPUTER INSTALLATION COURSE AIDS ACCOUNTANTS TO DIRECT AND ADVISE CLIENT COMPANIES

Computer Conversions, Inc., Jenkintown, Pa., a consulting firm specializing in EDP conversion assistance, has developed a course on the installation of computer systems for the American Institute of Certified Public Accountants (AICPA). The course has been designed to enable member accountants to direct and advise their client companies during the critical months of preparing for and installing a computer system. The accountant, because of his experience and sound knowledge of business and financial practices, can often prevent otherwise impressive computer installations from becoming financial disasters. In each of the conversion and installation activities, the accountant is alerted to avoid specific pitfalls typically encountered by users installing their first — or even second, computer system.

The first course will be held on May 11 and 12 in Cherry Hill, N.J. Interested members can contact Mr. Jerome Mauze, of the AICPA in New York.

NEW PRODUCTS

Digital

SERIES 15 COMPUTER FAMILY / Honeywell EDP

The Series 15 marks Honeywell's first entry into the fast growing small scientific/commercial market. Additionally, it greatly expands communication capabilities for users of its Series 200 general purpose computers. The new family includes Model 1530 (for scientific/commercial use) and the Model 1540 (for communications processing).

Both processors include a magnetic core memory expandable to 16,384 words; memory cycle time of 1.6 microseconds; priority and power-failure interrupt; single addressing; integrated circuitry; and a repertoire of 72 instructions. The Model 1530 includes the following features as standard: hardware multiply/divide; double precision add and subtract, and integrated peripheral controls. These features are available as options on the Model 1540. A typical 1530 configuration includes a central processor, console, line printer, punched card equipment and disk storage; the 1540, instead of disk storage, would include communications interface.

Series 15 computer systems will be marketed under the EDP Division's package pricing policy that includes software, education and maintenance as an integral part of the cost. Delivery of both systems will begin in July.
(For more information, circle #41 on the Reader Service Card.)

P9200 TIME SHARING SYSTEM / Philips' Data Systems Div.

Philips' new time sharing system, the P9200 Time Sharing System, has an 'echo' feature. The system can accept 32 terminals simultaneously, effectively serve 70 terminals and separately accomodate 245 users. All input information is 'echoed' back to each terminal, so that the operator has a continual check and the facility to correct mistakes before the information is processed. Another feature of the system is that communication is simplified. Instead of the usual symbols that are used as commands to create programs, a very wide range of English words and mnemonics are used such as AHOY, PASSWORD, DESTROY, SLIB and NURS. They are easier to remember than D/,,^E)!

The hardware configuration includes two intercommunicating processors from the P9200 series of general purpose computers. The main processor has a 32K 16-bit word core store with a cycle time of 960 nanoseconds; the terminal controller has a 4K 16-bit word core, also with a 960 nanosecond cycle time.

The system software libraries include: elementary functions required for two program languages — FORTRAN IV and BASIC; mathematical routines plus special functions such as gamma, beta, binomial; demonstration and engineering programs. In addition, provision is made for each user to reserve up to 15 cylinders — 270K words of disc space for his own library. Part of the systems peripherals includes two disc units each of which can store 3.6 million words.
(For more information, circle #42 on the Reader Service Card.)

MICRO/MAGNUM SYSTEMS / American Computer Technology

Described as mini-computers (designed for use in hazardous environment) the new ACT-16 and ACT-18 Micro/Magnum Digital Computers function as Central Processing Units for a wide range of applications. Applications of the computers include: as a timeshare central, data controller, communications switch, automatic test sequencer, or process and control computer.

Standard features include: one microsecond full memory cycle time, six memory index registers, simple command structure, parallel I/O bussing, octal readout on front panel, DMA interface, integrated circuit and MSI electronics, lithium core expandable to 65,536 words (either 16 or 18 bits). The new systems offer unlimited expansion with mainframe and peripherals without changing equipment brands or types.
(For more information, circle #43 on the Reader Service Card.)

Memories

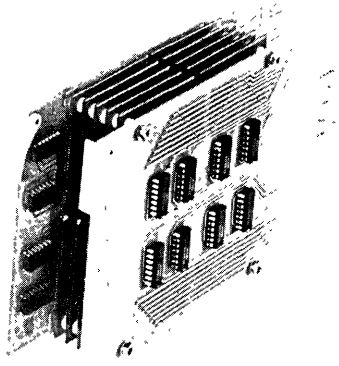
PLUG-COMPATIBLE DISC-MEMORY SYSTEMS FOR HP AND VARIAN MINI-COMPUTER FAMILIES / Data Disc, Inc.

Two lines of plug-compatible disc-memory systems have been developed exclusively for the Hewlett-Packard and Varian families of mini-computers. Data Disc is offering the systems at prices beginning below the cost of the computer with which they interface. Included in the prices are installation, familiarization training, mini-disc software, and one year's service.

The basic Data Disc plug-in memory for the Hewlett-Packard computers, Model 1757 Disc Memory, has word capacities of 46,080; for the Varian 620/i, Model 1703 memory has word capacities of 32,768. Both the 1757 and 1703 are available in four capacities, and can be expanded easily in the field. Average access time for both models is 16.7 milliseconds.
(For more information, circle #44 on the Reader Service Card.)

PLUG-IN MEMORY STACK FOR MINI- AND MIDI-COMPUTERS / Ferroxcube Corp.

Series 200 memory stacks have direct plug-in capability and cycle times as fast as 750 nanoseconds. The series is available in 4K, 8K and 16K words with word lengths from 4 to 40 bits per word. Series 200 stacks use 18 mil memory cores (20 mil core stacks also are available) with a 3D, 3 wire organization.



Printed circuit board construction is used throughout and sub-miniature diodes are employed. The new series are particularly adaptable for high density packaging applications in mini- and midi-computers due to each plane being double-matted.
(For more information, circle #45 on the Reader Service Card.)

MASS MEMORY SYSTEM / Iomec Inc.

The new disc drive, "IODISC 2012", has twice the capacity and transfer rate of its predecessor, IODISC 1012. The new mass memory system is capable of storing up to 44 million bits of information. Data transfer rate is 1.4 megabits per second.

Two discs operate from a single drive; each disc holds up to 22

million bits of data, packed at 2200 bpi. One of the two discs is removable, and comes in a standard cartridge housing, permitting unlimited, low-cost off-line storage. The other disc is fixed. Iomec says that its new 2012 and earlier 1012 are the first low-cost systems that provide, on a single drive, the capability to exchange data between a removable and a fixed disc.

The company feels the new 2012 will fit into a broad range of applications, including commercial data processing. Accordingly, the systems are being offered in both rack mounted enclosures and business machine consoles. Controllers for interfacing the 2012 with various computers are available.
(For more information, circle #46 on the Reader Service Card.)

DISC STORAGE SYSTEM EXPANDS IBM 1130 CAPACITY / Memorex Corp.

The Model 3610 Disc Storage System is a 6-disc file with 10 recording surfaces. The system, fully compatible with IBM 1130 computers, provides up to five times the storage capacity, and 10 times faster access than the IBM 2310 drive. No reprogramming is required when the 2310 disc file is replaced by the Memorex Model 3510 with its built-in controller. The 3610 interfaces directly with the IBM 1130 on SAC (storage access channel) or with an IBM 1133 multiplexer on SAC II channel. Deliveries of the 3610 Disc Storage System will begin in the second quarter of 1970.
(For more information, circle #47 on the Reader Service Card.)

Software

CIMS (Computer Installation Management System) / Booth Resources International, Los Angeles, Calif. / Package operates with IBM OS/360 MFT-II or OS/360 MVT, using less than 1K of core memory; CIMS provides a variety of functions necessary to perform job accounting in a multiprogramming environment and for configuration analysis purposes. Price per installation is $3500.
(For more information, circle #48 on the Reader Service Card.)

DSP (Documentation Standards Package) / Advanced Management Systems Inc., Santa Ana, Calif. / Consists of an actual set of standards for a typical company with all EDP forms, documented procedures, functional tasks, and matrix, as well as a complete set of reproducible masters of 46 data processing forms with full instructions to customize the package to fit any installation. DSP is written in easily understood terms and phrases rather than in computer language and is applicable to any hardware or configuration. DSP sells for $1,250 and is available now.
(For more information, circle #49 on the Reader Service Card.)

FIND 2 (File Interrogation of Nineteen-hundred Data) / International Computers Ltd., London, England / Improves on the original FIND in every field; user's ideas have been built into the specification from which FIND 2 has been produced. Includes two separate elements: the Single Enquiry System (SES) designed to answer ad hoc enquiries and to allow simple interrogation and report requirements; and, the Multiple Enquiry Systems which allows for the specification of highly complex reports and tables and can deal with up to 96 questions at a time. The "dictionary" of terms and flexibility of input allows non-computer people to write their own requests.
(For more information, circle #50 on the Reader Service Card.)

INTEGRATED ACCOUNTING AND BUSINESS MANAGEMENT SYSTEM / Delta Data Systems, Inc., College Park, Md. / System consists of modules developed from Delta's Accounts Payable, Accounts Receivable, Payroll, and General Ledger System. Written in COBOL, the system is available for IBM, Honeywell, Burroughs and NCR equipment and can operate within 32K of core. It is marketed at $32,000 under a perpetual licensing agreement, which includes source decks, user and operator documentation.
(For more information, circle #51 on the Reader Service Card.)

PERIPHERAL MONITOR / National Software Exchange, Inc., Great Neck, N.Y. / Developed by Computer Efficiency Corp. of Miami Shores, Fla., the new package enables any IBM 360 system, Model 25 and up, to use its own accuracy and speed to monitor, measure, compare, and document the actual performance of IBM/360 peripherals against the manufacturer's rated (sales information) speed. The program (operating system independent) is self-loading and requires only two control cards. An average installation can measure performance of all its peripherals in fewer than three minutes. Purchase price is $4,000. A lease plan is available.
(For more information, circle #52 on the Reader Service Card.)

PROSPEKTES / Software Assistance Corp., Ann Arbor, Mich. / An automatic testing program, designed especially for the RCA Spectra 70 user, to provide automatic compilation and testing of programs with no operator intervention. PROSPEKTES can be used in a multi-programming environment.
(For more information, circle #53 on the Reader Service Card.)

SPEEDPLOT II / Pacific Software Services Co., Bellflower, Calif. / For businesses, engineers, scientists, teachers, and students who do not normally have access to a digital plotter, but can submit jobs for a computer run, this data plotting program provides an economical automatic tabulation, screening, and plotting capability. Prevents tedious hand plotting by having the values plotted on a standard line printer; values may be plotted directly from input data or can be calculated using stored formulae. SPEEDPLOT II sells for $750.
(For more information, circle #54 on the Reader Service Card.)

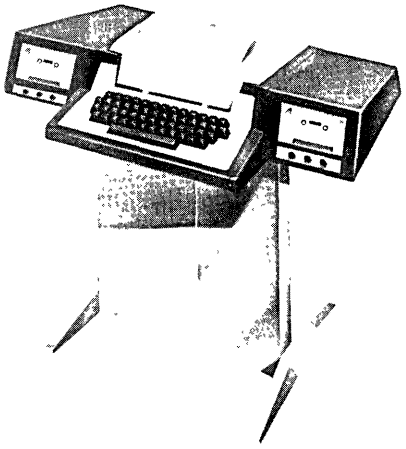
THE VALIDATOR / Data Management Services, Inc., New York, N.Y. / Provides systems input validation. The Validator will execute typical validation processes within parameters specified by the user. Minimal programming and/or computer time is needed because debugging is not required. A non-programmer can fill out specifications. The package will handle various combinations of input and output configurations through parameters without recompilation. System may be used for reformatting, data transcriptions, conversion of files and other data manipulations. The Validator consumes less than 32K of memory. Installation support requires five man days. There is a six-month warranty.
(For more information, circle #55 on the Reader Service Card.)

Peripheral Equipment

MINI-COMPUTER CONSOLE / Computer Devices Inc.

The Mini-Computer Console 8310, designed to satisfy the needs of most data handling, combines the keyboard and printer functions of such equipment as the Teletype Model 33 with the recording and storage functions of the versatile magnetic tape cassette. Using the same subset of the ASCII code, the CDI 8310 can replace the TTY33 and be compatible with all TTY33 sys-

tems. Reading speeds equal to high speed readers, and 30 times faster than with paper tape readers, are possible. Program libraries can be stored on a tape cassette under computer program control using the same technique as employed with magnetic tape drives and discs.



With the CDI 8310 the keyboard, printer, tape cassette and computer can be connected together in nine different on-line and off-line configurations. The Mini-Computer Console interfaces directly with several minicomputers.
(For more information, circle #56 on the Reader Service Card.)

COMPUTER PRINTER WITH DIRECT BUILT-IN INTERFACE TO MINI-COMPUTERS / Vogue Instrument

The Shepard Division of the Vogue Instrument Corporation has developed a computer line printer with direct built-in interface to the PDP-8, the HP2116, the Varian 620i or the Honeywell 316/516 minicomputers. The Shepard 880D line printer prints 80 columns wide at speeds up to 400 lines per minute. The compact printer has an ink roller printing mechanism that eliminates the fabric ribbon, tractor feed sprocketed multi-copy paper capability and full line buffer memory (80 characters). The 880D also is available for interfacing with other popular minicomputers.
(For more information, circle #57 on the Reader Service Card.)

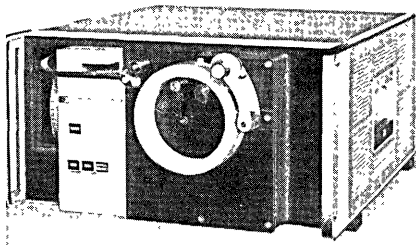
E8000 ELECTRONIC ACCOUNTING SYSTEM / Burroughs Corp.

The largest and most powerful in the company's Series E electronic accounting system line, the E8000, approaches full-scale computer systems in size, power and performance. The new system functions either under operator control in the manner of an electronic accounting machine, or under internal program control, like a computer system. It is completely modular and can utilize a variety of plug-in peripheral devices.

The E8000 has 400 words of high speed magnetic memory. Information can be entered into the system by dual punched card readers, by the magnetic striped ledger reader, or by an electronic keyboard. Information output can be obtained on a wide line printer, in the form of punched cards or perforated tape, and as data encoded and printed on ledger cards. COBOL programming is also available for the system.
(For more information, circle #58 on the Reader Service Card.)

TAPE READER REROLLER / Hewlett Packard

A new peripheral for Hewlett-Packard and other digital computers, not only reads punched tape at high speeds (up to 500 characters per second) but also automatically rewinds the tape into the clear plastic storage canister, with its leader on the outside of the roll — ready to use again immediately. No special threading is required for the



HP 2758A Tape Reader Reroller. Tapes are read photoelectrically, character by character. Model 2758A reads standard one-inch, eight-level code tape, made of any material with less than 60% transmissivity. Tapes can be intermixed without any adjustments. The only restriction is that metal mylar tapes can't be used in the canister; hence can not be rerolled. The reroller has a tape capacity of 250 feet.
(For more information, circle #59 on the Reader Service Card.)

UNIVERSAL COMPUTER INTERFACE / EG&G, Inc.

The newly introduced EG&G 832 Data Interface can couple any computer to any peripheral device — regardless of type or make of computer or peripheral. The universal data interface has block transfer and priority interrupt capability for all peripherals. Different types of peripherals are controlled by individual device cards; each can service several peripherals of the same type. The system can contain up to eight device cards. This allows the system designer great freedom and flexibility. The 832 Data Interface is organized into three major sections: (1) the host computer interface; (2) the peripheral device interface; and, (3) the commandable executive structure, which contains those portions of the peripheral equipment interfaces and those of the host computer interface that are common; it handles all commands for data transfer between memory and peripheral in either direction.
(For more information, circle #60 on the Reader Service Card.)

UNIVERSAL DATA TRANSFER SYSTEM / Data Graphics Corp.

The DGC-300 Universal Data Transfer System (UDT) will accept data from any digital output device and will then store the data in memory, decode the data and present it to a recording device. The 200-point program patch panel allows data to be recorded in any sequence desired. Programming is accomplished by placing jumpers from one terminal point on the panel to another.

The system also contains all the controls necessary to activate special features of various recording devices. The DGC 300 may be purchased alone, or Data Graphics will supply an entire data acquisition system.
(For more information, circle #61 on the Reader Service Card.)

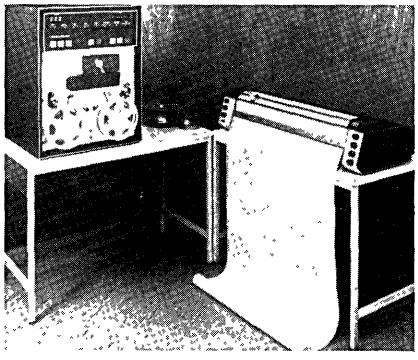
DIGITAL TO VOICE CONVERTER / Instrumentation Systems Inc.

The DATAVOX I, a digital to voice converter, reads numbers in correct English from .00001 to 999.99; reads numbers as digits from .00001 to 9999.9; and announces polarity and function, e.g., volts, amps, ohms, etc. Panel switches inhibit polarity or function announcements. Full numbers or individual digits may be selected according to operator preference. A front-panel jack permits use of private earphone or a remote speaker.

Most digital instruments with a maximum of five digits can be adapted to the DATAVOX (over-range digits produce an internal voice warning) — in many cases simply by adapter cables. In addition to the number reading capability, for special applications, the DATAVOX can be furnished with unique messages and vocabularies.
(For more information, circle #62 on the Reader Service Card.)

N/CV DRAFTING SYSTEM / Boston Digital Corp.

The N/CV Drafting System provides a low cost method of producing accurate drawings from prepared tapes. It also can be used for the verification of numerical control tapes. The integrated circuit system consists of a digital control unit and a high speed plotter. With a large (29½" x 120') plotting area, continuously fed and reversed, the



N/CV system can produce large drawings at very high speeds. It is designed for table-top placement, operates on standard 60 Hz 120V ac power, and is easy to operate and to maintain.
(For more information, circle #63 on the Reader Service Card.)

UNIVERSAL DATA COUPLER / Prentice Electronics Corp.

A new universal data coupler, the Model DC-22, permits the user to select all operating modes; originate or send (terminal to terminal), full or half duplex, accoustic, magnetic or direct (DAA) coupling, and provides the appropriate interface for teletype or EIA terminals. In addition to selection of the most frequent operating modes by pushbutton switching, the DC-22 has DAA level adjustments and straps for the selection of other operating modes at its base. The DC-22 is available from stock.
(For more information, circle #64 on the Reader Service Card.)

Data Processing Accessories

ROLLAWAY NOISE CONTROL CURTAINS / Consolidated Kinetics Corp.

New flexible noise barrier curtains, the Kinetic Coustifab Noise Control Curtains, provide a movable noise barrier between noisy and quiet areas, easy access for flow of materials from one area to another, and a flexible retrofit around noisy equipment. The curtain material consists of lead-powder loaded vinyl, coated on both sides of strong Beta-glass fabric. The material resists passage of sound waves and minimizes noise transmission; average increase in sound transmission loss is up to 25 decibels. Curtain panels are sound-sealed to adjacent panels with easy-to-open and self-closing Velcro self-adhering nylon closures. A wide variety of versatile support framing members, rollers, and associated hardware is available for flush ceiling, suspended, and self-supporting installations.
(For more information, circle #65 on the Reader Service Card.)

BURSTER-STACKER / Uarco Inc.

Immediate trimming, separating, and distribution of documents is possible with Uarco's Model 1771 Burster-Stacker. While primarily designed for independent operation at up to 300 feet per minute, the Model 1771 easily adjusts to run on-line with any printer. A combination of a wide range of speeds down to 15 feet per mintue, systems bar, and automatic stacking of forms, permits the 1771 to adjust to printer output with no direct mechanical or electrical connection required. Casters permit easy movement from the printer to other processing areas. If numerical or alphabetical sequence is needed, an Optional Model 1771-3 Sequence Accessory is available.
(For more information, circle #66 on the Reader Service Card.)

TRANSMISSION TEST SET / International Communications

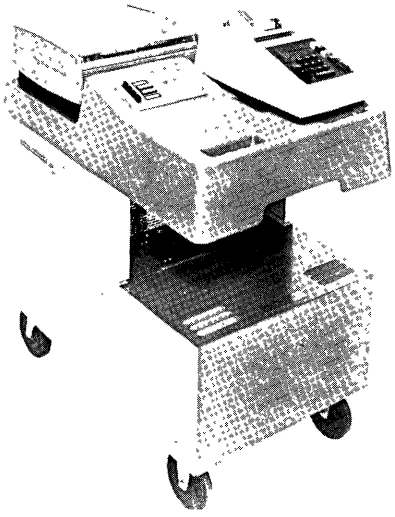
ICC's new test set (Model 110D) is a compact, eight-pound device which includes its own carrying handle for easy portability. It provides accurate isolation of fault in data communications systems, and is designed for use by both technical and non-technical personnel. A removable cable expander allows easy access to the 25 pins of the EIA RS232 Connector for testing while data processing equipment operates normally.
(For more information, circle #67 on the Reader Service Card.)

VARIABLE-SPEED FORMS BURSTER / Standard Register Co.

The Series 1500 Burster's variable speed control drive allows settings from 75 to 450 feet per minute. It bursts single or multiple-ply continuous paper forms, up to eight copies, in a variety of widths and lengths. It can process up to 1,000 continuous tab cards per minute. The Series 1500 will handle form widths from 4¼" to 19¼" (under 4¼" optional) and lengths between 2½" and 17" (up to 22" optional). Paper weights may range up to 125-lb. in single copy forms; multiple-ply forms (8-part maximum) have a 200-lb. total high limit. All controls are conveniently located and no special operator training is required.
(For more information, circle #68 on the Reader Service Card.)

DATA-VERTER MOBILE CART FOR ELECTRONIC ORDER WRITING / Digitronics Corp.

The Model MC-21 Mobile Cart provides a mobile power supply and platform for Digitronics' DATA-VERTER® data acquisition equipment. This mobility facilitates electronic order writing for store entry and inventory control directly from store shelves. With the DATA-VERTER Mobile Cart, orders are keyed-in and recorded on magnetic tape for phone transmission to the computer center.



Power source is a standard 12-volt, storage battery. Under normal operating conditions, power can be generated for a full working day; connection to an ordinary wall outlet fully recharges the battery overnight.
(For more information, circle #69 on the Reader Service Card.

COMPUTING/TIME-SHARING CENTERS

COMPUTER SCIENCES CORP. ENTERS AUSTRALIAN AND SOUTH AFRICAN MARKETS

Computer Sciences Corporation has joined with two leading international organizations in Australia and South Africa to provide

computer time-sharing and technical services in those and adjacent countries. The company's partners in the two joint ventures are the Australian Mutual Provident Society and the Anglo American Corporation of South Africa Ltd.

The two companies to be formed by the joint ventures will be known as Computer Sciences Australia, Ltd., with headquarters in Sydney; and Computer Sciences South Africa, Ltd., to be based in Johannesburg. Each of the new companies will establish a computer-based information network which will provide Infonet's wide range of time-shared services to business and governmental organizations throughout the countries in which the companies will operate.

TYPESCAN — FROM TYPEWRITER TO COMPUTER THROUGH NEW OCR SERVICE

CompuScan, Inc., Leonia, N.J., has announced the development of a universal typewriter software program, said to permit "direct" computer input of alphanumeric data prepared on standard office typewriters. The new service, tradenamed TYPESCAN, reportedly eliminates costly and time consuming keypunch conversion of typewritten texts.

The basis for the new service is the company's OCR system, in conjunction with the TypeScan "package". In effect, the typewritten manuscripts can be fed directly from the source to the computer, bypassing keypunching by personnel unfamiliar with original data. Detailed descriptive literature, entitled "TypeScan Instruction Manual", is available from the company.
(For more information, circle #70 on the Reader Service Card.)

COMPUTERIZED ACCOUNTING SERVICE AVAILABLE TO INDUSTRY FROM ITEL CORP.

A low cost system developed by ITEL Corporation, Data Processing Division, reportedly offers 24 out of 25 companies a complete accounts receivable service. The system eliminates the need of confidential records leaving the client's office. ITEL's automated payroll service includes preparation of payroll registers, checks and envelopes, cash breakdown, union and welfare reports, individual earning statements, tax information returns, quarterly schedule of taxable and non-taxable earnings and quarterly tax reports. A client can be provided with more than 400 options according to specific data required.
(For more information, circle #71 on the Reader Service Card.)

COMPUTER-RELATED SERVICES

CUSTOM FLIGHT PLANS PROVIDED BY LOCKHEED AIRCRAFT SERVICE CO.

A new service, offered by Lockheed Aircraft Service Co., Ontario, Calif., provides custom flight plans in less than five minutes. The plan is printed in cockpit format, contains latest weather information, lists the complete route and altitude profile (optimized for either speed or economy at the pilot's discretion), and predicts arrival time at each check point to the nearest minute. Lockheed's JETPLAN computer center became operational in late February.
(For more information, circle #72 on the Reader Service Card.)

ESTI-PAK INC. COMPLETES A COMPUTERIZED ESTIMATING SYSTEM FOR BUILDING INDUSTRY

Completion of a new computerized estimating system, which is now being made available to the building industry, has been announced by Esti-Pak Inc., of Utah. Esti-Pak's computerized estimating system is based on an inclusive materials reference manual. The manual provides a complete, easy-to-use and accurate listing of materials related to mechanical systems. It also provides a current list of prices for calculating material costs, and the number of man hours required for installation of each item.

Using the manual, estimators fill out a take-off sheet and send it to the Esti-Pak center. This information is fed into the company computer which provides a complete and current cost breakdown of each different system, a detailed bill of materials of each of these systems, floor by floor, and a cost breakdown of total systems. The coding system used by Esti-Pak reportedly is organized in such a complete and logical sequence that the system may become a standard for the industry.
(For more information, circle #73 on the Reader Service Card.)

NEW LITERATURE

INDEX TO COMPUTER ASSISTED INSTRUCTION, Second Edition, edited by Helen A. Lekan, Instructional Media Laboratory, The University of Wisconsin at Milwaukee. Published by Sterling Institute, Boston, Mass. / A comprehensive compilation of information on the 910 CAI programs currently operational and available from 85 sources, including elementary and secondary schools, colleges and universities, military installations and industry.
(For more information, circle #74 on the Reader Service Card.)

A MANUAL ON COMPUTER UNBUNDLING is available from Oyer Professional Computer Services, Inc., a New York consulting firm. The 200-page annual analyzes the effects of unbundling on computer users, on IBM itself, on IBM's competitors and on computer products and services markets. Topics covered include: pricing techniques; consultants; software; EDP personnel; computer education costs; and economic alternatives.
(For more information, circle #75 on the Reader Service Card.)

PROCEEDINGS OF THE SPECIAL INTEREST GROUP ON UNIVERSITY COMPUTING CENTERS CONFERENCE ON UNBUNDLING Resolutions adopted by the SIGUCC of the Association for Computing Machinery at the Conference on Unbundling held February 16-18, 1970 in Atlanta, Ga., consisted of instructions to the SIGUCC Chairman to relay to vendors, government agencies, local control boards, etc., information about the plight of university computing centers with a request for modification of their policies to help universities keep their computer center resources operating. The Proceedings are being distributed to SIGUCC members and other conference participants as Appendix I to the SIGUCC Newsletter of March 2, 1970. Others may receive copies at $1 each by sending prepaid orders with checks payable to SIGUCC-ACM to: Dr. E. P. Miles, Jr., Computing Center, 110 Love Bldg., Florida State University, Tallahassee, Fla. 32306

WEEKLY REPORTS OF HIGH GROWTH INDUSTRIES AND COMPANIES; STUDIES OF NEW INDUSTRIES; AND TAILORED, CONFIDENTIAL SINGLE CLIENT STUDIES are available from Robertson & Associates, Inc., Engineering, Marketing & Investment Consultants, Newark, N.J. Among the computer industry studies available: "Remote Data Terminals", "Minicomputers", "Computer Software & Computer Time-Sharing Service Companies," "Disc Packs & Drives," "Key Tape & Disc Units," "Data Transmission Equipment," "Medical Electronics," and "Process Control Instruments & Equipment." A free table of contents is available from the company.
(For more information, circle #76 on the Reader Service Card.)

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Burroughs Corp., Detroit, Mich.	CompuTerminal Corp., San Francisco, Calif.	Forty Burroughs B5500 Dual Processor Computers for installation at their regional computer/terminal centers in major cities throughout the country; centers will be established nationwide during the next two and one-half years	$60 million
Sperry Rand Corp., Philadelphia, Pa.	The Boeing Company, Seattle, Wash.	Electronic subsystems for installation in two U.S. supersonic transport prototypes now under development at Boeing; Sperry will build the automatic flight control, electrical command and stability, and the hardened stability augmentation systems	$10+ million
Honeywell, Inc., Wellesley Hills, Mass.	Inventory Management Systems, Inc., Los Angeles, Calif.	Production and delivery of major elements for the Marketron and its multiplexer unit; the Marketron is a computerized customer checkout and instant inventory system for grocery stores	$9.7 million
Hoffman Electronics Corp., El Monte, Calif.	U.S. Navy	Production of microminiature TACAN (Tactical Air Navigation) Systems for Navy aircraft; equipment keeps a pilot apprised of his range and bearing to ground or shipboard stations	$7 million
Sperry Rand Corp., Philadelphia, Pa.	Commonwealth of Pennsylvania	A centralized information system to provide up-to-the-minute data for agencies and offices throughout the state; keystone of the system will be a UNIVAC 1108 computer	$4.5 million (approximate)
Fischer & Porter Pty. Ltd., Australia	Nabalco Pty. Ltd.	Design, engineering, manufacture, supply, installation training and project management for process control instrumentation	$4 million
Datacraft Corp., Fort Lauderdale, Fla.	Recognition Equipment Inc., Dallas, Texas	Sixty computer systems for use as the central processor in their current line of OCR products	$3.4 million (approximate)
Sperry Rand Corp., Philadelphia, Pa.	Microsystems International Limited, Ottawa, Ontario	A UNIVAC 1106 Computer System for use in a complete Management Information System, including extensive on-line production information data	$2 million
Systems Capital Ltd., London, England	Sanaco Computer Services, Birmingham, England	Computer lease; GE-615 (first to be ordered by a British service bureau organization) will be installed at Birmingham	$1.9 million
	Ford Motor Company Ltd.	Computer lease; GE-615 will be used for engineering and scientific purposes	$1.84 million
Burroughs Corp., Detroit, Mich.	COMSERV, Philadelphia, Pa.	Burroughs' TC500 terminals	$1.7 million
Digital Development Corp., San Diego, Calif.	Inventory Management Systems Inc., Los Angeles, Calif.	DDC 73-02 series Digital Rotating Memory Systems for use in IMS' new electronics system	$1.5 million (approximate)
Ampex Corp., Culver City, Calif.	Litton Industries, Van Nuys Calif.	Core memory stacks being incorporated in the core memories of various data processing systems produced the Litton's Data Systems Division	$1 million
Sperry Rand Australia Ltd. Canberra, Australia	Totalisator Agency Board (TAB) of the Australian Capital Territory (ACT)	Two UNIVAC 9400 computers and peripheral equipment; real-time system will provide improved service to Australian bettors on horse and dog racing events	$1 million
Westinghouse Electric Corp., Pittsburgh, Pa.	U.S. Department of Defense	A detailed systems analysis of U.S. military hospitals	$892,000
Data-Design Laboratories, Cucamonga, Calif.	Naval Air Engineering Center, Philadelphia, Pa.	Design and manufacture of shipboard computers for weapon control/direction systems	$700,000+
Ampex Corp., Culver City, Calif.	City and County of San Francisco, Calif.	Model RM-50 extended core memory system for use on an IBM 360/50 computer to speed processing of police, hospital and social service records	$400,000+
Sylvania Electric Products Inc., Mountain View, Calif.	California Department of Motor Vehicles	A 17-month study of the state's traffic enforcement and driver control procedures; development of integrated system aimed at reducing accidents on the highways	$336,000
Information Displays, Inc., Mount Kisco, N.Y.	Federal Aviation Administration	Equipment (lease of graphics display system IDIIOM) and services in connection with a nine-month evaluation of an oceanic air traffic control graphic display	$210,000
Information International, Los Angeles, Calif.	General Computing Co., New York, N.Y.	Lease of a $314,000 FR-80 Computer Output Microfilmer (COM) for use (1) to plot all of the 1,700 stocks on the New York Stock Exchange and the 1,300 stocks on the American Stock Exchange, for a number of stock-brokerage firms and financial advisory services; (2) also will make animated movies	—
Digital Equipment Corp., Maynard, Mass.	Integrated Systems Technology, Garland, Texas	Twenty-five PDP-8/I computers for use as the central processor for IST's Medi-Lab systems (a cardio-pulmonary system)	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B350 system	Hyde Athletic Industries, Inc., Cambridge, Mass.	Modernization of administrative details (system valued at about $90,000)
Burroughs B500 system	Hancock Bank & Trust Co., Quincy, Mass.	Standard banking operations (system valued at about $350,000)
Burroughs B3500 system	Computer Servicenters, Inc., Greenville, S.C.	Data service applications including general commercial or customed designed data processing, demand inventory and invoicing, on-line capability, etc., for customers (system valued at over $600,000)
Control Data 1700 system	Laval Hospital, Institute of Cardiology, Quebec, Canada	Electrocardiogram analysis; also for medical laboratory research applications and to monitor proceedings during heart catheterization
Control Data 3150 system	California State Colleges (8 systems)	A computer network stretching from the Oregon to the Mexican border; applications include the relaying of administrative and business data to the central 3300's, operating as separate entities to support computer education courses and faculty research on the various campuses; future plans include a wide range of student services and a library system. Other computers already at some of the colleges have been programmed for communication with the central CDC 3300 systems
Control Data 3300 system	(2 systems)	
	Data Industries Inc., New Orleans, La.	Remote processing services through a variety of terminals located in customers' offices
	Norges Statsbaner (NSB), Bispegaten, Oslo, Norway	Business data processing as well as scientific and technical computations
Control Data 7600 system	Los Alamos Scientific Laboratory (LASL), Los Alamos, N. Mex.	Expanding information processing for the growing number of nuclear research projects
Digital Equipment PDP-10	Univ. of Manchester, Institute of Science and Technology, Control Systems Centre, Manchester, U.K.	Investigating various methods of control for multivariable industrial situations such as found in the manufacture of chemicals, cement, and other materials and in control of aircraft gas turbines
GE-635 system	Kerr-McGee Corp., Oklahoma City, Okla.	Processing large amounts of business information and solving numerous scientific and technical problems
	U.S. Military Academy, West Point, N.Y.	Broadening computer instruction program; system provides more than 100 times capabilities of the Academy's present GE-225 system
Honeywell Model 110 system	Air Balance Inc., Chicago, Ill.	Accounts receivable, invoicing, order entry, and inventory control
	Antler Ltd., Bury, Lancs., England	Inventory control, invoicing and statistical work
	Falcon Products Inc., St. Louis, Mo.	Invoicing, aging, inventory reporting and shop orders
	Pilling Co., Fort Washington, Pa.	An order/invoice cycle using indexed sequential organization of master inventory and master customer files
Honeywell Model 120 system	The Ealing Corp., Cambridge, Mass.	Order processing, inventory reporting, invoicing and accounting functions
	First United Supermarket Services Inc., Canton, Mass.	Billing, sales order processing, inventory control accounting and sales analysis
Honeywell Model 125 system	Giant Stores Corp., Lowell, Mass.	Inventory control; sales analysis; merchandise, dollar classification, and unit control
ICL 1901A system	Waller & Hartley Limited, Blackpool, Lancashire, England	Order analysis, invoicing, and ledger work, with stock, wages, and purchase programs in the future
NCR Century 100 system	Brevard County Sheriff's Department, Cocoa, Fla.	Pinpointing crime activity and mapping police activity and assignments
	Citron Oil Co., Detroit, Mich.	Dealer billings, vehicle maintenance management, payroll and sales forecasting; warehouse inventory
	Tunbridge Wells Equitable Friendly Society, London, England	Processing contributions by members, maintenance of sickness benefit data, and handling of members' accumulated surplus accounts and mortgages
Univac 418-III system	Spiegel Inc., Chicago, Ill.	Expediting business operations; ultimate goal is computer control of packaging/billing information (system valued at over $600,000)
	Taiyo Bank of Tokyo, Japan (3 systems)	On-line processing of current and time deposit, savings, and loan accounts, and domestic exchange and remittances (system valued at about $5.8 million)
	Transport Data Communications, Inc., Greenville, S.C. (2 systems)	On-line, real-time computer system serving trucking firms throughout the United States (system valued at about $1.6 million)
Univac 1106 system	Computer Com. Inc., Birmingham, Ala.	Data processing service for the medical profession (system valued at $1 million)
Univac 9200 system	Abraham Baldwin Agriculture College, Tifton, Ga.	Educational and administrative applications
	Global Collection Agencies, Inc., Hicksville, L.I., N.Y.	Debtor dunning, sales analysis, general accounting and skip tracing
	Life, Quito, Ecuador	Production scheduling, inventory control, billing, payroll and general accounting
XDS Model 940	Telesystemes, Boulogne, France	Time-shared computing services to commercial, governmental and educational agencies in French Republic

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

The following is a summary made by COMPUTERS AND AUTOMATION of reports and estimates of the number of general purpose electronic digital computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide. Please note the variation in dates and reliability of the information. Several important manufacturers refuse to give out, confirm, or comment on any figures.

Our census seeks to include all digital computers manufactured anywhere. We invite all manufacturers located anywhere to submit information for this census. We invite all our readers to submit information that would help make these figures as accurate and complete as possible.

Part I of the Monthly Computer Census contains reports for United States manufacturers. Part II contains reports for manufacturers outside of the United States. The two parts are published in alternate months.

The following abbreviations apply:

(A) -- authoritative figures, derived essentially from information sent by the manufacturer directly to COMPUTERS AND AUTOMATION
C -- figure is combined in a total
(D) -- acknowledgment is given to DP Focus, Marlboro, Mass., for their help in estimating many of these figures
E -- figure estimated by COMPUTERS AND AUTOMATION
(N) -- manufacturer refuses to give any figures on number of installations or of orders, and refuses to comment in any way on those numbers stated here
(R) -- figures derived all or in part from information released indirectly by the manufacturer, or from reports by other sources likely to be informed
(S) -- sale only, and sale (not rental) price is stated
X -- no longer in production
- -- information not obtained at press time

SUMMARY AS OF MARCH 15, 1970

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part II. Manufacturers Outside United States							
A/S Norsk Data Elektronikk	NORD 1	8/68	2.0	0	20	20	10
Oslo, Norway	NORD 2	8/69	4.0 (S)	0	2	2	3
(A) (Jan. 1970)							
A/S Regnecentralen	GIER	12/60	2.3-7.5	0	39	39	1
Copenhagen, Denmark	RC 4000	6/67	3.0-20.0	0	8	8	6
(A) (Jan. 1970)							
Elbit Computers Ltd.	Elbit-100	10/67	4.9 (S)	-	-	120	75
Haifa, Israel							
(A) (Jan. 1970)							
GEC-AEI Automation Ltd.	Series 90-2/10/20						
New Parks, Leicester, England	25/30/40/300	1/66	-	-	-	13	X
(R)	S-Two	3/68	-	-	-	1	X
(Jan. 1969)	130	12/64	-	-	-	2	X
	330	3/64	-	-	-	9	X
	959	-/65	-	-	-	1	X
	1010	12/61	-	-	-	8	X
	1040	7/63	-	-	-	1	X
	CON/PAC 4020	-	-	-	-	0	X
	CON/PAC 4040	5/66	-	-	-	9	-
	CON/PAC 4060	12/66	-	-	-	5	-
International Computers, Ltd. (ICL)	Atlas 1 & 2	1/62	65.0	0	6	6	X
London, England	Deuce	4/55	-	0	7	7	X
(A)	KDF 6 - 10	9/61	10-36	0	58	58	X
(March 1970)	KDN 2	4/63	-	0	1	1	X
	Leo 1, 2, 3	-/53	10-24	0	59	59	X
	Mercury	-/57	-	0	13	13	X
	Orion 1 & 2	1/63	20.0	0	17	17	X
	Pegasus	4/55	-	0	30	30	X
	Sirius	-/61	-	0	22	22	X
	503	-/64	-	0	16	16	X
	803 A, B, C	12/60	-	0	83	83	X
	1100/1	-/60	5.0	0	22	22	X
	1200/1/2	-/55	0.9	0	68	68	X
	1300/1/2	-/62	4.0	0	196	196	X
	1500	7/62	6.0	0	110	110	X
	2400	12/61	23.0	0	4	4	X
	1900-1909	12/64	3-54	0	1233	1289	C
	Elliott 4120/4130	10/65	2.4-11.4	0	151	142	C
	System 4-30 to 4-75	10/67	5.2-54	0	105	115	C
							Total: 564
Japanese Mfrs.	Various models	-	-	-	-	4136 E	800 E
(N) (March 1970)-							
Marconi Co., Ltd.	Myriad I	3/66	£36.0-£66.0 (S)	0	37	37	9
Chelmsford, Essex, England	Myriad II	10/67	£22.0-£42.5 (S)	0	17	17	12
(A) (Jan. 1970)							
Saab Aktiebolag	D21	12/62	7.6	0	37	37	-
Linkoping, Sweden	D22	5/68	13.4	0	15	15	10
(A) (Jan. 1970)	D220	4/69	9.8	0	1	1	10
Siemens	301	11/68	0.75	-	-	20	C
Munich, Germany	302	9/67	1.3	-	-	24	C
(A)	303	4/65	2.0	-	-	69	C
(March 1970)	304	5/68	2.8	-	-	43	C
	305	11/67	4.5	-	-	51	C
	306	-	6.5	-	-	-	C
	2002	6/59	13.5	-	-	41	C
	3003	12/63	13.0	-	-	38	C
	4004S	-	4.0	-	-	1	C
	4004/15/16	10/65	5.0	-	-	89	C
	4004/25/26	1/66	8.3	-	-	34	C
	4004/35	2/67	11.8	-	-	147	C

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Siemens (cont'd)	4004/45	7/66	19.8	-	-	130	C
	4004/46	4/69	34.0	-	-	3	C
	4004/55	12/66	25.8	-	-	14	C
							Total: 230
USSR	BESM 4	-	-	-	-	C	C
(N)	BESM 6	-	-	-	-	C	C
(May 1969)	MINSK 2	-	-	-	-	C	C
	MINSK 22	-	-	-	-	C	C
	MIR	-	-	-	-	C	C
	NAIR 1	-	-	-	-	C	C
	ONEGA 1	-	-	-	-	C	C
	ONEGA 2	-	-	-	-	C	C
	URAL 11/14/16	-	-	-	-	C	C
	and others	-	-	-	-	C	C
						Total: 6000 E	Total: 2000 E

CALENDAR OF COMING EVENTS

Apr. 2-3, 1970: First National Symposium on Industrial Robots, IIT Research Institute, Chicago, Ill. / contact: Mr. Dennis W. Hanify, IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616

Apr. 3, 1970: Computer Graphic Workshop, Marriott Motel, Rosslyn, Va. / contact: Special Interest Group for Graphics, Box 933 Blair Sta., Silver Spring, Md. 20910

Apr. 7-9, 1970: COMPSO-West, Computer Software & Peripherals Show & Conference, Western Region, Anaheim Convention Center, Los Angeles, Calif. / contact: Show World, Inc., 254 West 31st St., New York, N.Y. 10001

Apr. 8-10, 1970: Seventh Annual Meeting and Technical Conference of the Numerical Control Society, Statler-Hilton Hotel, Boston, Mass. / contact: Numerical Control Society, 44 Nassau St., Princeton, N.J. 08540

Apr. 13-16, 1970: Computer Graphics International Symposium, Uxbridge, England / contact: R. Elliot Green, Cg. 70, Exhibition Organiser, Brunel University, Uxbridge, Middlesex, England

Apr. 14-17, 1970: Conference on Automatic Test Systems (IEEE), Birmingham, Warwickshire, England / contact: Conference Registrar, The Institution of Electronic and Radio Engineers, 8-9, Bedford Square, London, WC1, England

Apr. 17-19, 1970: National Gaming Council Ninth Symposium, Hotel Sonesta, Washington, D.C. / contact: Dr. Peter House, Envirometrics, Inc., 1100 17th St. NW, Washington, D.C. 20036

Apr. 26-28, 1970: Data Processing Supplies Association, Affiliate Membership Meeting, Rome, Italy / contact: Data Processing Supplies Association, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904

Apr. 26-29, 1970: National Automation Conference of the American Bankers Association, Masonic Temple, San Francisco, Calif. / contact: American Bankers Association, Automation Dept., 90 Park Ave., New York, N.Y. 10016

Apr. 28-May 1, 1970: National Microfilm Association, 19th Annual Convention, Hotel Hilton, San Francisco, Calif. / contact: Dave Banks, National Microfilm Association, P.O. Box 386, 250 Prince George St., Annapolis, Md. 21404

Apr. 29-30, 1970: Fifteenth Annual Data Processing Conference, Univ. of Alabama, Engineering Bldg., 1919 Eighth Ave., South Birmingham, Ala. / contact: C. E. Adams, Coordinator of Conference Activities, Box 2987, University, Ala. 35486

May 5-7, 1970: Spring Joint Computer Conference, Convention Hall, Atlantic City, N.J. / contact: American Federation for Information Processing Societies (AFIPS), 210 Summit Ave., Montvale, N.J. 07645

May 7-8, 1970: Seventh Annual National Information Retrieval Colloquium, Sheraton Hotel, Philadelphia, Pa. / contact: Philip Bagley, Information Engineering, 3401 Market St., Philadelphia, Pa. 19104

May 10-13, 1970: 1970 ASTD (American Society for Training and Development) Training Equipment and Services Exposition, Anaheim Convention Center, Anaheim, Calif. / contact: ASTD, P.O. Box 5307, Madison, Wis. 53705

May 11-13, 1970: 24th Annual Technical Conference and Exhibit of the American Society for Quality Control (ASQC), Pittsburgh Hilton Hotel, Pittsburgh, Pa. / contact: Robert W. Shearman, Admn. Secy., American Society for Quality Control, 161 West Wisconsin Ave., Milwaukee, Wis. 53203

May 13-15, 1970: 8th Annual Convention of the Association for Educational Data Systems, Deauville Hotel, Miami Beach, Fla. / contact: Dr. Henry C. Fox, c/o SIRS Project, 3525 N.W. 79th St., Miami, Fla. 33147

May 17-20, 1970: 23rd International Systems Meeting, Las Vegas Convention Center, Las Vegas, Nev. / contact: Richard B. McCaffrey, Assoc. for Systems Management, 24587 Bagley Rd., Cleveland, Ohio 44138

May 18-20, 1970: Sixth Annual Data Processing and Automation Conference, National Rural Electric Cooperative Association, Cosmopolitan Hotel, Denver, Colo. / contact: C. E. Aultz, NRECA, 2000 Florida Avenue, N.W., Washington, D.C. 20009

May 18-22, 1970: "Image 70," 23rd Annual Photographic Science and Engineering Conference, New York, N.Y. / contact: Society of Photographic Scientists and Engineers, 1330 Massachusetts Ave., N.W., Washington, D.C. 20005

May 19-21, 1970: G.E. 400 Computer Users Association Annual Conference, Towne House, Phoenix, Ariz. / contact: Bruce H. Reinhold, Pittsburgh National Bank, 10th St. and Fort Duquesne Blvd., Pittsburgh, Pa. 15222

May 20-25, 1970: Nippon Office Management Association (NOMA) 40th Business Show, Tokyo International Trade Center, Tokyo, Japan / contact: Masaharu Takeuchi, Executive Director, NOMA, Shuyodan Bldg., 25-2, 4-chome, Sendagaya, Shibuya-ku, Tokyo, Japan

May 21-22, 1970: International Computing Symposium 1970 (Joint meeting of all European ACM chapters), Bonn, Germany / contact: Chmn. of the German Chapter of the ACM, 7032 Sindelfingen, Iseler Str. 1, Germany

May 24-25, 1970: Southern N.E. Telephone Co. SET-GUIDE Group Meeting, Selection, Evaluation, and Training of EDP Personnel, Minneapolis, Minn. / contact: Mr. Joseph Andreana, Southern N.E. Telephone Co., 300 George St., New Haven, Conn. 06506

May 24-28 1970: 29th General Meeting of GUIDE, Leamington Hotel, Minneapolis, Minn. / contact: Allan J. Burris, Northern Trust Co., 50 So. LaSalle St., Chicago, Ill. 60690

May 25-27, 1970: Forum of Control Data Users (FOCUS) Annual Conference, St. Paul Hilton, St. Paul, Minn. / contact: William I. Rabkin, FOCUS Exec. Sec., c/o Itek Corp., 10 Maguire Rd., Lexington, Mass. 02173

May 26-28, 1970: IDEA, 11th Annual Symposium & Exhibit of the Society for Information Display (SID), Statler Hilton Hotel, New York, N.Y. / contact: William M. Hornish, Western Union, 82 McKee Drive, Mahwah, N.J. 07430

May 27-29, 1970: Eighth Annual Workshop Conference of the Interagency Data Exchange Program (IDEP), Cosmopolitan Hotel, Denver, Colo. / contact: James D. Mason, TRW, 1 Space Pk., Redondo Beach, Calif. 90278

June 1-3, 1970: "Session 70", the Inaugural Joint National Conference of the Information Processing Society of Canada (formerly the Computer Society) and the Canadian Operations Research Society, Vancouver, British Columbia / contact: W. J. Sheriff, Suite 1404, 1177 W. Hastings St., Vancouver 1, B.C.

June 9-10, 1970: Grenoble Workshop on Microprogramming, Mathematiques Appliquees, CEDEX 53, 38 — Grenoble-Gare, France / con-

tact: Guy G. Boulaye and Jean P. Mermet, Mathematiques Appliquees, CEDEX 53, 38 — Grenoble-Gare, France

June 15-16, 1970: Conference on Solid State in Industry, (IEEE), Statler-Hilton Hotel, Cleveland, Ohio / contact: A. J. Humphrey, Technical Program Chairman, The Reliance Electric & Engrg. Co., 24701 Euclid Ave., Cleveland, Ohio 44117

June 16-18, 1970: Computer Group Conference and Exposition (IEEE), Washington Hilton Hotel, Washington, D.C. / contact: Bob O. Evans or Donald E. Doll, IBM Federal Systems Div., 18100 Frederick Pike, Gaithersburg, Md. 20760

June 22-23, 1970: Eighth Annual Conference, ACM Special Interest Group for Computer Personnel Research, Center for Continuing Education, Univ. of Maryland, College Park, Md. / contact: Robert A. Dickmann, The Johns Hopkins Univ., Applied Physics Lab., 8621 Georgia Ave., Silver Spring, Md. 20910

June 22-24, 1970: Data Processing Supplies Association, Spring General Meeting, The Olympic Hotel, Seattle, Wash. / contact: Data Processing Supplies Association, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904

June 24-26, 1970: 11th Joint Automatic Control Conference (JACC), Georgia Institute of Technology, Atlanta, Ga. / contact: Prof. Eugene Harrison, Dept. of Mechanical Engineering, Clemson University, Clemson, S.C. 29631

June 29-30, 1970: Conference on Optimisation Techniques in Circuit and Control Applications, Institution of Electrical Engineers, Savoy Place, London, WC2, England / contact: Manager, Conference Department, IEE, Savoy Place, London, WC2, England

Aug. 24-28, 1970: IFIP World Conference on Computer Education, Amsterdam, Netherlands / contact: A. A. M. Veenhuis, Secretary-General, IFIP Conference Computer Education 1970, 6, Stadhouderskade Amsterdam 13, Netherlands

Aug. 31, 1970: Fifth Annual ACM Urban Symposium, New York Hilton Hotel, New York, N.Y. / contact: Paul R. DeCicco, ACM Urban Symposium Chairman, Polytechnic Institute of Brooklyn, 333 Jay St., New York, N.Y. 11201

Aug. 31-Sept. 2, 1970: American Society of Civil Engineers, Fifth Conference on Electronic Computation, Purdue University, Lafayette, Ind. / contact: Robert E. Fulton, Mail Stop 188-C Structures Research Division, NASA Langley Research Center, Hampton, Va. 23365

Sept. 1-3, 1970: 25th National Conference, Association for Computing Machinery, New York Hilton, New York, N.Y. / contact: Sam Matsa, ACM '70 General Chairman, IBM Corp., 410 E. 62nd St., New York, N.Y. 10021

Sept. 2-4, 1970: The Institution of Electrical Engineers (IEE) Conference on Man-Computer Interaction, UK National Physical Laboratory, Teddington, Middlesex, England / contact: Roger Dence, IEE Press Office, Savoy Place, London WC2, England

Sept. 14-24, 1970: 1970 FID (International Federation for Documentation) Conference and International Congress on Scientific Information, Buenos Aires, Argentina / contact: U.S. National Committee for FID, National Academy of Sciences, 2101 Constitution Ave., Washington, D.C. 20418

Sept. 17-18, 1970: Computer Science and Statistics Symposium, sponsored by the Los Angeles Chapter of the ACM, University of California, Irvine, Calif. / contact: Dr. Mitchell O. Locks, C-E-I-R Professional Services Div., Control Data Corp., 6060 W. Manchester, Los Angeles, Calif. 90045; or Dr. Michael E. Tarter, Assoc. Prof., Dept. of Mathematics and Dept. of Medicine, University of California, Irvine, Calif. 92664

Sept. 22-24, 1970: The Computers and Communications Conference (IEEE), The Beeches, Rome, N.Y. / contact: Jerold T. McClure, Conference Chairman, P.O. Box 182, Rome, N.Y. 13440

Oct. 5-9, 1970: Computer 70—International Computer Exhibition, Olympia, London, England / contact: M. F. Webster, Leedex Limited, 100 Whitechapel Road, London, E.1., England

Oct. 11-15, 1970: 33rd Annual Meeting of the American Society for Information Science (ASIS), Sheraton Hotel, Philadelphia, Pa. / contact: ASIS 1970 Convention Chairman, Dr. Eugene Garfield, Institute for Scientific Information, 325 Chestnut St., Philadelphia, Pa. 19106

Oct. 12-13, 1970: Sixth National Data Processing Conference of the Information Processing Association of Israel, Tel Aviv Hilton Hotel, Tel Aviv, Israel / contact: S. Shalish, Chmn., Information Processing Association of Israel, P.O.B. 3009, Jerusalem, Israel

Oct. 14-16, 1970: 1970 IEEE Systems Science and Cybernetics Conference, Pittsburgh, Pa. / contact: Prof. A. Lavi, Carnegie-Mellon Univ., Pittsburgh, Pa. 15213

Oct. 14-17, 1970: International Symposium on Digital Computer Applications in Engineering Sciences, Technical University of Istanbul, Turkey / contact: F. A. Akyuz, I.T.U. Hesap Merkezi (Computation Center), Taskisla 114, Istanbul, Turkey

Oct. 15-16, 1970: 1970 Atlantic Div. of Assoc. for Systems Management Eighth Annual Atlantic Systems Conference, New York Hilton, New York City, N.Y. / contact: Malcolm B. Foster, A.S.C., Box 461, Pleasantville, N.Y. 10570

Oct. 19-21, 1970: 11th National Meeting of The Institute of Management Sciences, Los Angeles Hilton Hotel, Los Angeles, Calif. / contact: Gene Saxby, Security Pacific National Bank, P.O. Box 2097 Terminal Annex, Los Angeles, Calif. 90054

Oct. 26-28, 1970: Data Processing Supplies Association, Fall General Meeting, The Park Sheraton Hotel, 7th Ave., and 56th St., New York, N.Y. / contact: Data Processing Supplies Association, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904

Oct. 26-28, 1970: Forum of Control Data Users (FOCUS) Regional Conference, Statler Hilton Hotel, Washington, D.C. / contact: William I. Rabkin, FOCUS Exec. Sec., c/o Itek Corp., 10 Maguire Rd., Lexington, Mass. 02173

REPORT FROM GREAT BRITAIN

(Continued from page 34)

research centre where the USSR has a giant 70 GeV accelerator about twice the size of anything now operating in the United States.

Looking Ahead

Of course, if the British Government changes from Labour to Tory in October, we can forget about "discrimination" because the Tories are in favour of the free-for-all. We have already discussed what could happen if they took Government support away from ICL — the most likely outcome would be a close link with Control Data Corporation, Philips and possibly Computer Sciences Corporation, to make an international group which might for the very first time, become something which would give IBM a headache.

Ted Schoeters
Stanmore, Middlesex
England

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency, if any

At 4½ she's reading 3rd grade books

a child prodigy? not at all! your child, too can be reading one, two or three years beyond his present age level...even if he's a "poor" reader now

Prove it to yourself...with this 10 day free trial!

Reading is fun for Sarah—as it *should be* for every child. At age four and a half, she's already choosing her own books at the San Diego, Cal. library.

She reads books many third graders find "hard going." Yet she won't enter first grade for another year.

Sarah is typical of thousands of children who learned to read with "Listen and Learn with Phonics" — a reading kit that actually makes reading fun.

"Listen and Learn with Phonics" was developed by a reading expert. It has been endorsed, after extensive testing by teachers, schools, and educators.

This practical (and inexpensive) home-learning kit *fascinates* eager young minds from three to ten. The child *hears* the letters or sounds on the phonograph record, *sees* them in his book and repeats them himself. This makes an absorbing *game* of better reading—with amazing results!

FOR EXAMPLE:

- Slow or average readers show sudden, often spectacular improvement in reading, in spelling, in understanding.
- Older children often advance their reading skills several years beyond their age levels.
- Young "pre-schoolers" actually *teach themselves to read* by this simple but startlingly effective phonics method of words, pictures, and records.

6 TEACHING GAMES INCLUDED FREE
Set includes six separate "word building" games. All six are sent with your Listen and Learn Phonics Set FREE of charge!

TEACHERS & PARENTS ACCLAIM RESULTS

"I received your Combination Teaching Set and am positively delighted with it! . . . your marvelous approach to reading is just what we need."
Mrs. Rogavin, Central High School, Snyder, N.Y.

"We purchased 'Listen and Learn With Phonics' . . . for our nine year old son... within two weeks his reading had improved 100%."
Mrs. Gregory Knight, San Leandro, Cal.

4-MONTH UNCONDITIONAL GUARANTEE
If not delighted with the progress shown by your child—just return the set for complete refund.

These "Learning Tools" Simple to Use!
You don't need special teaching skills to use this program. Nor do you need any special knowledge of phonics.

In fact, your child needs no special supervision on your part. This set is so simple, so fascinating, he can learn "on his own" *without help.*

10-DAY FREE TRIAL—PLUS 4-MONTH MONEY-BACK GUARANTEE!
Results are so dramatic, the publishers will make the complete kit available to your child with an equally dramatic FREE trial and guarantee.

Under the terms of this unusual offer you can test the kit free of charge for ten days. Moreover you may use the kit for four months and then return it for *full refund* if you're not completely satisfied with your child's progress!

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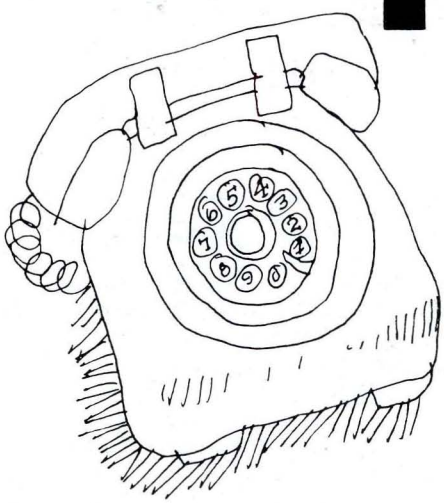

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