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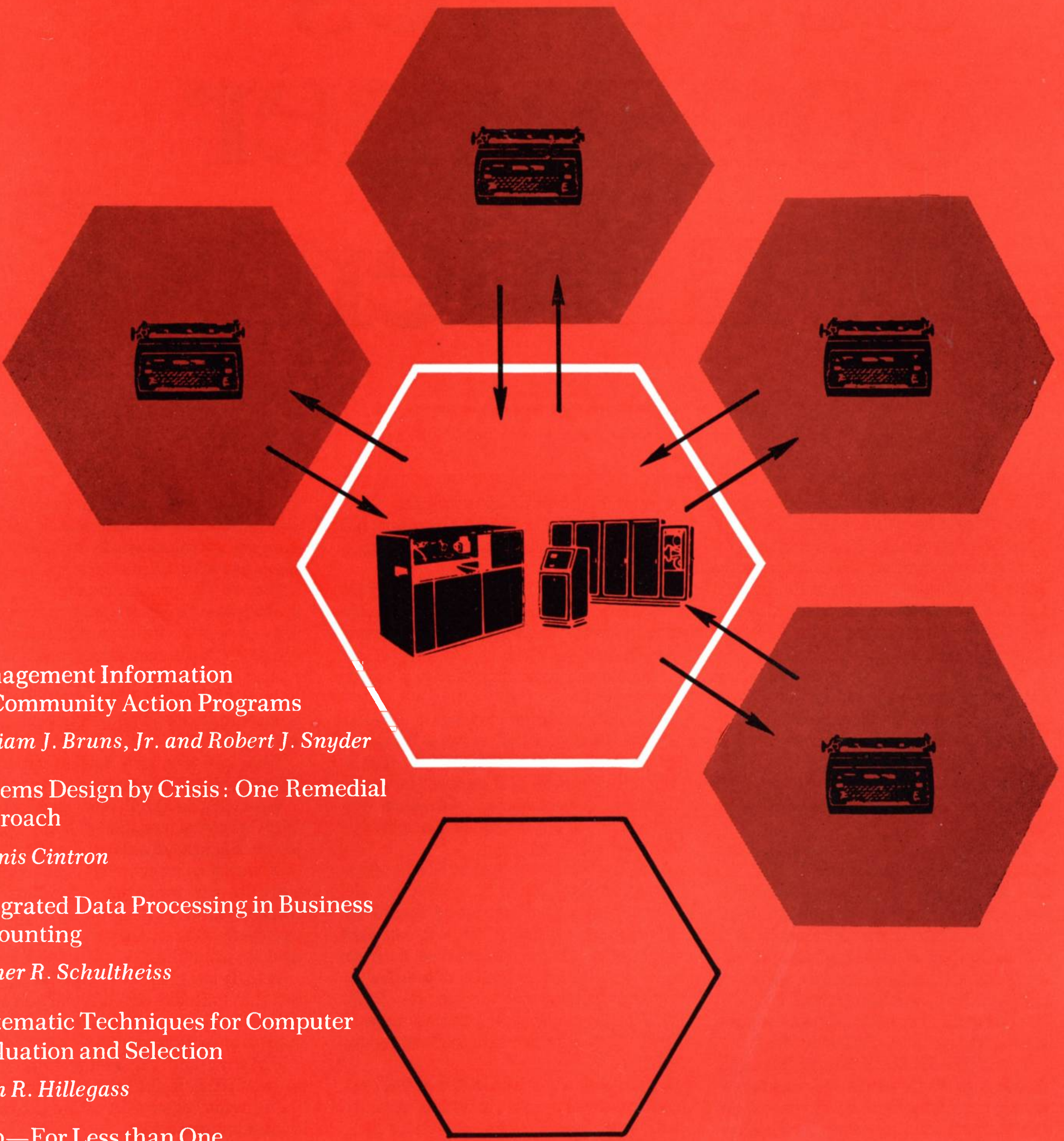
July-August, 1969



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DEPARTMENTS

people, events, techniques

Time Sharing Services Already Run Risk of Glutting Market, Provider Warns; Many Now Provide Services Below Costs

Time shared computer services —only a gleam in a few visionary eyes five years ago— have arrived to such an extent that there is real danger of an oversupply of service, Patrick J. McGovern, president, International Data Corporation, told a recent meeting of the American Bankers Association Automation Conference in Chicago.

A growing overabundance of service, a weakened price structure, and too narrow an approach to market needs create a "precarious future for conventional time sharing," he said.

He declared that recent studies by his company have indicated a growing trend toward internal time sharing systems and a growing requirement for either specialized knowledge of specific jobs or proprietary data bases for success in the open market.

Prices steadily dropping

He said that prices for time sharing have been steadily declining and now average about $13 per input-output terminal per hour of use.

For many of the time sharing computer services now in existence that revenue rate is actually below the cost of operating the system, he said.

While the pressure on companies offering time sharing services may be increasing, the number of potential users is expected to continue rising, according to a recent survey by The Diebold Group. The report says that 40 per cent of the nation's computer users employ remote terminal devices today; this number is expected to increase to 90 per cent of all computer users by 1972.

The Diebold report was based on a survey of 1,687 firms using computers.

There were, however, some reservations noted, the most important of which was terminal prices: more than 40 per cent of survey respondents consider a price cut of

50 per cent or more necessary before increasing their use of terminals, and more than 80 per cent consider a 30 per cent price reduction essential.

Of all the terminal users surveyed, the transportation industry showed the highest number of terminals within single organizations, primarily due to the "large number of airline reservation system terminals and railroad car accounting system terminals presently installed."

In the next three years, however, the greatest increase in number of terminals is expected to occur in educational institutions.

These findings do not necessarily conflict with the McGovern report, since airline, railroad, and educational time sharing systems would all be "in-house" affairs.

However, the report also indicates that terminals are being planned for nearly all functional applications that can be performed by computers.

Survey gives additional support

Another indication of support for the McGovern position came with the Diebold survey finding that many aerospace and electronic companies, currently the largest industrial users of commercial time sharing services, plan "to discontinue the use of outside services when their own time sharing systems become operational."

Most popular output terminal, the report says, is the cathode-ray tube display screen. Most popular input device is the alphanumeric keyboard.

Copies of the report are available from The Diebold Group, Inc., 430 Park Avenue, New York, New York 10022, Attn: Diebold Data Files.

Meanwhile, independent companies, undeterred by the dire warnings, continued to join the time sharing service complex. It's now reached the point where independent, but previously unaffiliated, companies have joined in a two-nation organization.

EDP Central, a time sharing corporation with sales offices in Portland, Oregon; Kirkland, Washington; and Boise, Idaho, has announced its association with a newly formed company, REACT Timesharing Ltd., of Vancouver, B.C., Canada. The name of the joint American-Canadian Company will be REACT Network Associates, and it has already granted exclusive marketing rights for the REACT System to the Canadian firm for Canadian clients.

REACT, a "conversational" version of IBM's PL/1 language, is the primary language of the REACT System, although a modification of the Basic language can be used.

IBM Wins One; Programmatics Suit Is Dismissed

Legally embattled IBM has one less case to worry about; Programmatics, Inc., a Los Angeles-based software company, has been refused a preliminary injunction that would have prevented IBM from distributing its sort program free to its computer users.

Of the five civil antitrust cases IBM has been currently involved in, this is the first to result in a ruling of any consequence. Other IBM legal opponents are the U.S. Department of Justice; Control Data Corporation, a manufacturer specializing in large-scale EDP machines; Data Processing Financial and General Corporation, a software manufacturer; and Applied Data Research, a software company, which has postponed its scheduled acquisition of Programmatics as a result of this injunction's denial. (For details of other cases see M/S Jan.-Feb. '69, pp. 14-15; March-Apr. '69, pp. 5-6; May-June '69, pp. 11-12.)

The Programmatics action centers around its PI SORT program for the IBM System/360 computer. The company claims PI SORT does the same work that IBM's 450-Sort does and in half the time. About half a dozen clients now rent PI SORT for $200 a month.

However, this year, after spending more than $800,000 in development, IBM introduced 483-Sort free of charge to its computer users. The program has features similar to those of PI SORT. Programmatics contends that IBM introduced 483-Sort to drive the small Los Angeles company out of business.

Programmatics' net income for the year ending March 31 was $600,000, and the company reported to the court that it was already in bad financial condition.

New York Federal Court Judge Edward C. McLean ruled, after a four-day hearing, that Programmatics had not presented sufficient evidence to support its charge, nor had it shown it would suffer irreparable damage if IBM continued to distribute its new program gratis.

Attorneys for Programmatics said they were considering an appeal from the decision.

EDP Salaries Have Risen $2,000 Since 1968, Agency Says

Starting salaries for financial and EDP executives have risen as much as $2,000 since last year, reports a 1969 prevailing wage survey conducted for the Robert Half Personnel Agencies, Inc., a nationwide firm with New York headquarters.

The survey included two separate but related groups: the controllers, accounting executives, and corporate and public accountants and the EDP, or computer-directed, groups. These two groups, about 1,250,000 people, constitute 25 per cent of the entire U.S. executive force, according to Robert Half, president of Robert Half Personnel.

Their all-time peak starting salaries are at their pinnacle in New

York, Los Angeles, Chicago, and San Francisco, where salaries run ten per cent above the national average.

Controllers, accountants up

Comparing salaries of 1969 to those of 1968, the survey found: In companies where annual sales range from $5 to $10 million, controllers now start at $14,000 to $20,000, compared with last year's $11,000 to $13,000. Companies making over $250 million show no change for controllers; they still command $40,000 to $60,000. Senior internal accountants in large firms currently start at $14,000 to $16,000, while last year they ranged from $12,000 to $15,000; though minimum salaries for senior internal accountants in medium-size firms have risen from $10,000 to $11,000, the top of the range, $14,000, has remained the same. New graduates starting in medium-size firms as internal accountants receive from $8,000 to $9,000, $500 more than last year, but in larger firms they may get $10,000; beginning public accountants in small-size firms draw $6,500 to $7,500, as opposed to last year's $6,000 to $7,000.

Age, sex barriers dropping

There is an increased demand for male financial executives who are in their mid-50's or 60's and for women, reports Robert Half. He attributes this to the experience and reliability of the older men and the draft-free status and good detail work of women.

Mr. Half also observed that the EDP field is now being separated from the financial and accounting function and is showing a trend to becoming a semi-autonomous unit within the corporate structure. Although job jumping has traditionally been discouraged by corporations, Mr. Half maintains that recently these moves have been tacitly encouraged, with some EDP executives changing jobs several times a year.

Iowa Legislators Given Visual Display Units; Congress Weighs Possibility of Using EDP

Iowa legislators now can literally "watch out" for their constituents' interests; computer-linked visual display terminals provide state senators and representatives instant graphic status reports on all bills and resolutions introduced in the current session.

Many state governments have installed computers to ease the legislative load, but Iowa is one of the first to use the display terminals, rather than simple printouts from the computer.

Thirty-three IBM 2260 display units, which look like small television receivers with keyboards, are connected by telephone lines to an IBM System/360 Model 40 computer, which stores legislative information. The terminals are stationed near the House and Senate chambers as well as in the offices of the governor, State Insurance Commission, comptroller, and departments of revenue and finance. State officials expect the system will handle about 1,000 inquiries daily.

It is estimated that approximately 1,500 bills will be introduced in the current legislative session. These will be categorized under 600 different subject headings ranging from "agriculture" to "zoo." The legislator can either request a subject directly or, if he prefers, he can call up one of these general categories for display on the screen and then electronically run through the file until he comes to the bill he wants.

Additional indexes catalog the legislative proceedings according to

Iowa's lieutenant governor, Roger W. Jepsen (right) and house speaker, William H. Harbor, check legislative information on new terminal installed in Iowa legislature for quick reference by state legislators.

sponsoring legislator, sponsoring committee, or under such headings as "Senate Concurent Resolutions" or "House-Senate Companion Bills." Each status report that is flashed on the screen includes the name of the bill's sponsor, a phrase describing the bill's contents, and the page reference in the House Journal or State Journal on which the pending item is printed.

The new legislation network joins Iowa's two-year-old computer-based statute retrieval system which indexes and stores some 3,000 pages of state laws and 30 pages of the state constitution.

Meanwhile, Congress, never noted for precipitate action, continued to ponder whether display equipment of the type in use in Iowa could help its members to get the facts on the 29,000 bills they're required to consider at each session.

Congress far behind

Despite the fact that the Federal Government is the largest user of electronic devices of one description or another in the country, the legislative branch lags far behind the executive branch. Of a total of 4,600 electronic machines in use by the government, exactly three are used in Congress' halls—one in the Senate, one in the House, one in the Library of Congress. The three are used for the most limited of functions; the Senate uses its IBM 360 to address Senators' mail; the House its N.C.R. 500 to make out the payroll and keep track of mechanical equipment. Only the Library of Congress has reached the point of digesting proposed or pending legislation, and only the House Banking and Currency Committee has so far installed a high-speed printer connected to the Library's computer for retrieval of information about such legislation.

Now, however, there is mounting pressure for some radical modernization of information processes, particularly in the House, which has much smaller research staffs to collect and present needed information than does the Senate. Representatives have recently been exposed to a demonstration of a remote terminal visual device, Control Data's Digiscriber, which can either present on a screen pertinent information about any bill or print a transcript of the entire text.

The demonstration, held in the Rayburn House Office Building, was arranged by the clerk of the House, W. Pat Jennings.

One of the most determined of the proponents of greater use of computer abilities, Rep. William Moorhead (Dem., Pa.), has been joined by Rep. Robert McClory (Rep., Illinois) in his drive to establish a new legislative data processing center.

Human obstacles still loom, however. According to *The New York Times,* many committee chairmen feel freer access to information will lessen the magic influence of seniority. What is the use of years of service when any newcomer, by diligent attention to his information retrieval unit, can become more knowledgeable on any particular bill than the most seasoned veteran?

Another factor to be considered, the *Times* reports, is the entrenched interest of congressional staff workers who fear they will become unnecessary if a congressman can get any information he needs simply by dialing a request to a computer center.

The Lester Witte Foundation, which some time ago established an award for the best article published in the Practitioners Forum of The Journal of Accountancy, is establishing a similar award for the article appearing in Management Services best promoting or exemplifying the practice of management services by a small or medium-size firm. An illuminated plaque and a check for $100 will be presented to the winning author at the AICPA Annual Meeting in the fall of each year. The winner will be selected by the board of consulting editors of Management Services from all articles published during the preceding year. The first award will thus be made at the AICPA Annual Meeting in October, 1970, in New York and will cover the period from this issue through the May-June issue, 1970.

NASA Grants $50,000 For Study of Space Technology in Business

The National Aeronautics and Space Administration has just granted the Research Institute of the University of Denver a $50,000 grant to study the opportunities for applications of aerospace management innovations to government and industrial projects.

Particular attention will be devoted to the use of advanced management and systems analysis methods in attacking complicated public administration problems such as housing and transportation.

The study will also attempt to provide a clearer understanding of the processes by which management technology can be transferred from one type of activity to another and will match as far as possible realized and anticipated management needs with advanced management techniques developed within the aerospace field.

The research is expected to result in a published report illustrating the potential translation of aerospace management technology to nonrelated fields.

The 16-month research study will be directed by Dr. J. Gordon Milliken of the Research Institute's Industrial Economics Division.

Commercial, Scientific Capacities Linked in Marketing Agreement

Scientific computing ability will be linked to commercial data processing marketing facilities and capacity under a new agreement negotiated between the Chi Corporation, Cleveland engineering service company, and Stat:Com, the commercial concern.

The joint marketing agreement reached will use Stat:Com, the Statistical Communications Division of Statistical Tabulating Corporation (STC), of Chicago, sales offices and data centers throughout the country. The Chi Corporation, owned by Case Western Reserve University, has its headquarters in the University Circle Research Center, Cleveland. Stat:Com will establish an office there too, in which a team of consultants will be trained in the use of Chi Corporation's UNIVAC 1108.

The first terminal tied into the 1108 will be an IBM 1130 computer at STC's Chicago data center. Eight other major city data centers will also serve as terminals.

Stat:Com will market

Stat:Com will market the 1108's abilities as an extension of its services, calling on Chi for specialized support when necessary. Chi will directly market its own services in the northeastern Ohio area.

"The third generation 1108 computer and Chi's excellent staff will provide STC with a logical extension of its services into the area of complex computing," said Michael R. Notare, president of STC, "while our established national sales structure and network of data centers will allow Chi to greatly broaden the marketing of their computer time." STC, established in 1936, is one of the nation's oldest commercial data processing companies.

Importation of Company Presidents From Outside the Company Is Accelerating; Succession Problem Seen in Age of Vice Presidents in Most Concerns Surveyed

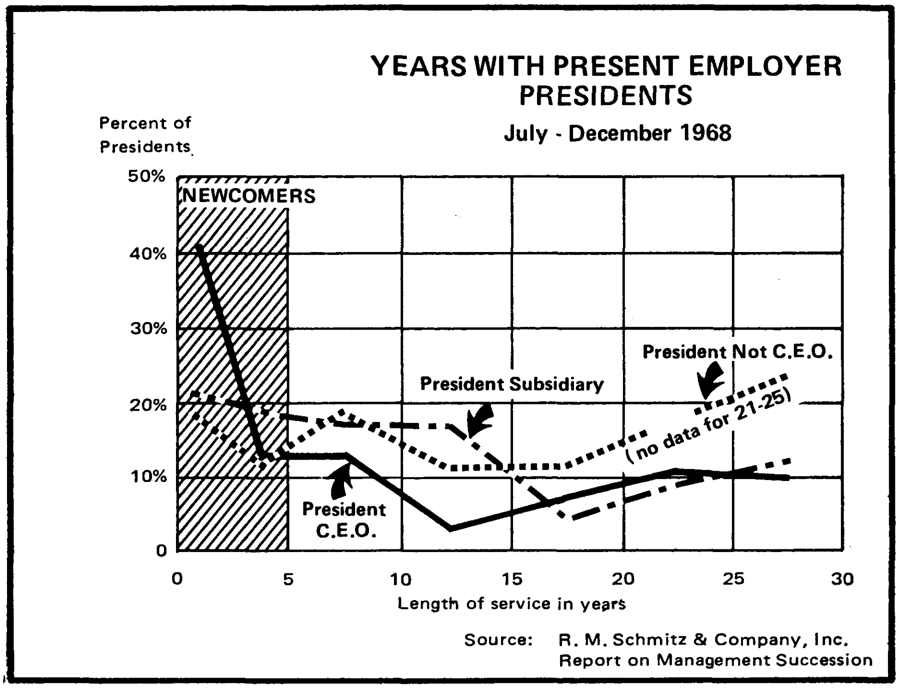
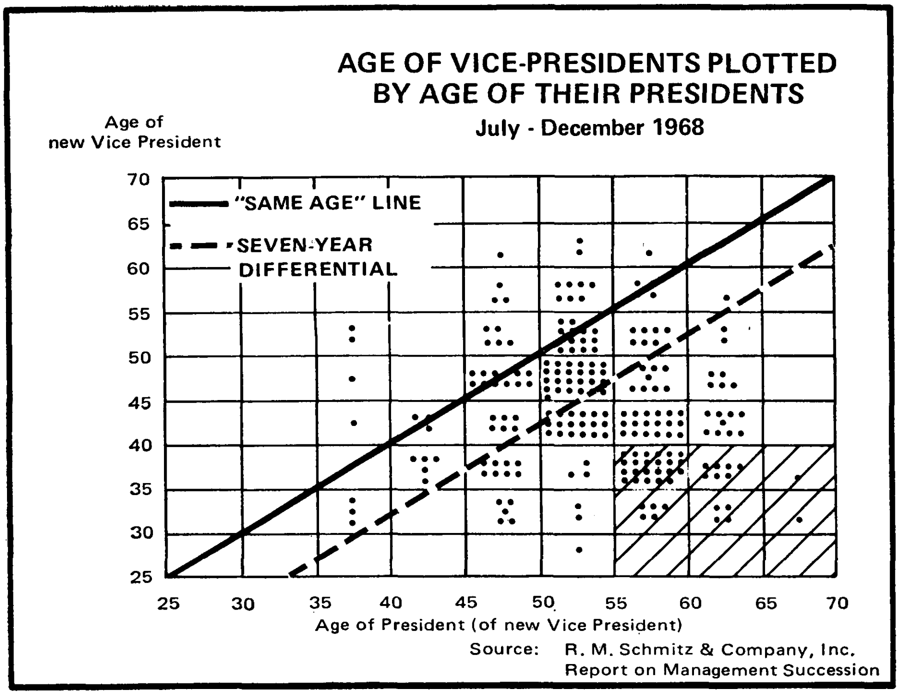


Chart shows Schmitz findings of length of service with company for company presidents covered in survey.

The number of company presidents imported from outside the company is continuing to rise, according to an ongoing survey launched in 1966 by R. M. Schmitz & Co., Inc., Chicago and New York management consulting firm.

The survey, which covers about 500 executive promotions per year, shows that 29 per cent of newly promoted presidents came from outside the company in the last six months of 1966; 30 per cent in 1967; and that the figure increased to 43 per cent in the last half of 1968.

The study conducted by the Schmitz organization in cooperation with Dr. W. A. Owens of the Graduate Studies Research Center, University of Georgia, indicated that the very slight age differential between company presidents and their vice presidents may account for so many companies' going outside their boundaries for new top men.



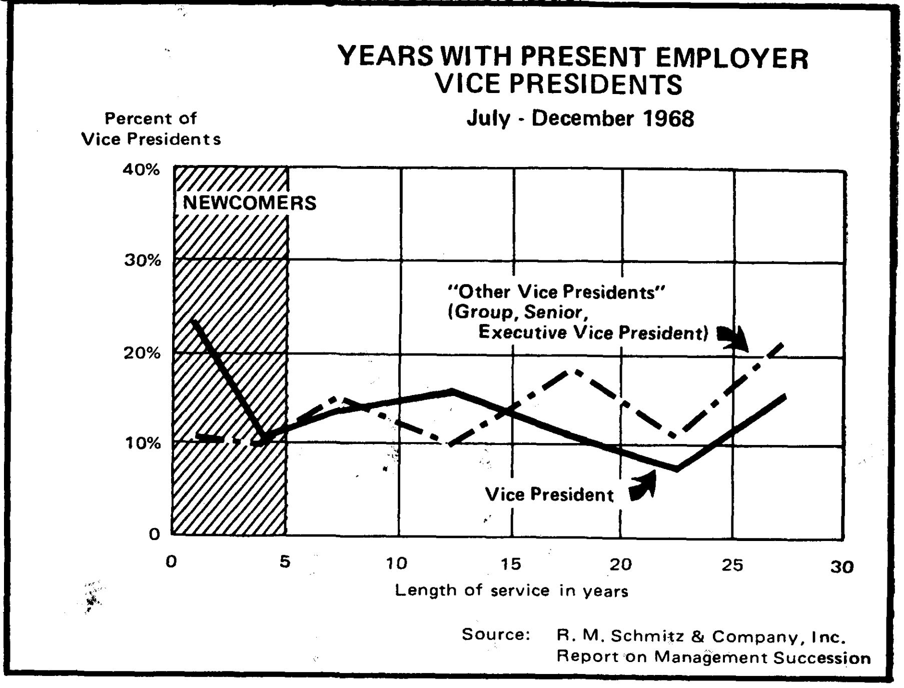
One of reasons for failure of vice presidents to be promoted to top spot was given as nearness of age group to presidents'.

Age differential important

"The average new vice president is 46 years old and the president of his organization is 53—a seven-year differential," commented Roy M. Schmitz, president of the consulting organization. "Only half the new VPs are seven years younger than their presidents. Most boards like to look to a minimum of 10 years of service for their new president and realistically can only choose from 40 per cent of the company's vice presidents."

The 544 executives surveyed in 1968 included 106 new presidents, 97 presidents of subsidiaries or divisions, 42 executive vice presidents, 35 senior vice presidents, 27 group vice presidents, and 237 vice presidents of various functional areas.

The men selected for promotion to presidencies and vice presidencies seem to have different personal characteristics too. Of those promoted to president only 11 per cent had been in their former position for more than five years. Of the newly promoted senior vice presidents, 39 per cent had had more than five years' experience in their former jobs. Similarly, promotion to the presidency usually was accompanied by an immediate pay rise; only 13 per cent of the new president-chief executive officers moved without an increase in compensation. On the other hand nearly half of the senior vice presidents received their new titles without pay increases.



(Right) Vice presidents, unlike new presidents, had generally served some years with company.

New Processing Service Launched by Commercial Credit, Control Data

The progeny of last year's combination of the Commercial Credit Company, Baltimore, Md., and Control Data Corporation, Minneapolis, Minn., has arrived. On June 2, Central Information Processing Corp., the new offspring, began a new computerized processing and management decision service at its Baltimore headquarters.

"By coordinating Control Data's technical abilities in the computer field with Commercial Credit's expertise in providing commercial and financial services to business and industry we have been able to develop a comprehensive service which will fill a wide void for tens of thousands of companies throughout America," Donald S. Jones, president of Commercial Credit Company, said.

Subscribers will be able to process any volume of information on business subjects ranging from accounting applications, such as payroll and accounts receivable, to complex decision problems, including cash flow forecasting and lease-versus-buy analysis, said Mr. Jones.

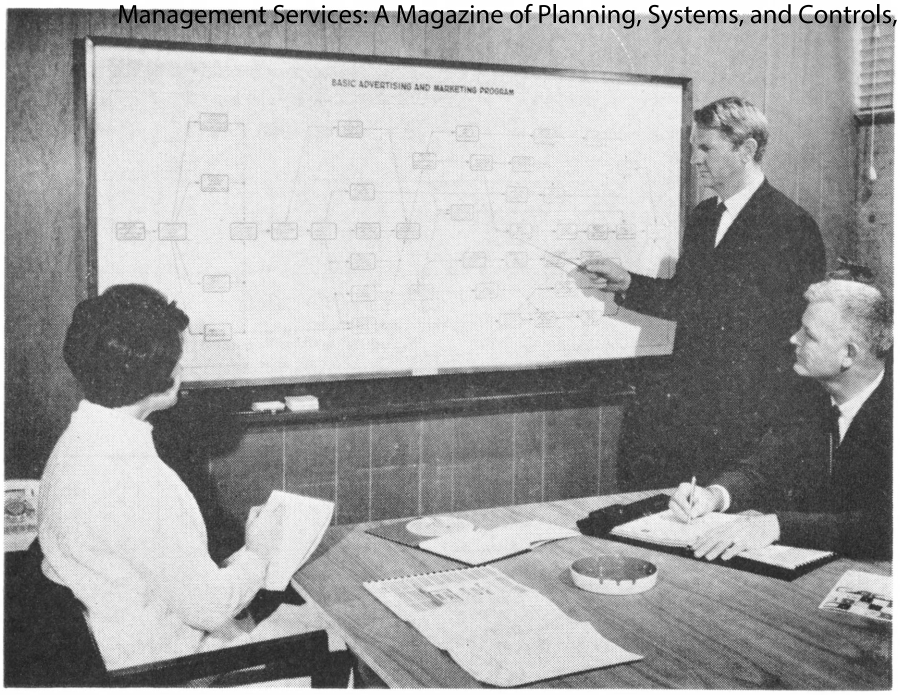
Control Data's 3000 series computing systems will be used. Subscribers can have their work handled at the center either through on-site batch operations, which need no connections to the subscribers' offices, or by remote batch facilities, which employ telephone or private wires between client and central computer for immediate response.

According to President Jones, his company will provide subscribing professional accountants and small businessmen with millions of dollars worth of electronic equipment and processing programs available to them "on an as required basis."

Physical PERT-Charting System Shown on Coast

A PERT-charting method employing magnetized physical symbols and a board to which the symbols adhere was introduced recently in San Francisco at a meeting of the Society for the Advancement of Management.

The new device, according to its inventor, James Halcomb, eliminates the time-consuming pencil and paper PERT drafting phase which has prevented many management people from becoming directly involved with PERT. It



Magnetic PERT-O-GRAPH, besides easing chart preparation by executives, is large enough to be used in demonstrations.

permits direct placement of the magnetized network event symbols on the board, while the frosted mylar board surface allows the connecting lines of the network to be drawn in by pencil, felt pen, or china marking crayon. Since symbols can be easily moved and lines altered, the board is said to encourage quick generation of original management plans by permitting instant organization and reorganization of management milestones and the interconnecting logic between such milestones.

The procedure used in the PERT-O-GRAPH system consists essentially of five logical planning steps. The first is to establish the overall objective of the program, which is symbolized by identifying and locating the program completion event on the right side of the board. Then each of the end item achievements necessary before completion of the overall program objective is identified. Next, management milestones are selected and organized on the board in proper sequence. Interconnecting arrows between these milestones are drawn in and time durations marked in. Then critical path times can be identified and firm dates entered.

The PERT-O-GRAPH permits easy management control and allows management-by-exception decision making when actual progress deviates from planned progress, the manufacturers, Halcomb Associates, 149 San Lazaro Avenue, Sunnyvale, California 94086, point out.

Greater Sharing of Information Foreseen At Hospital Meeting

Representatives of 70 hospitals' time sharing central computer facilities began working toward greater sharing of information among themselves at a conference held recently in Scottsdale, Arizona.

The conference, sponsored by Arizona Blue Cross and Blue Shield at the Executive House Arizona, covered the administrative, technical, and programing aspects of hospital computing systems.

Important points of agreement reached at the meeting included: Small computers used to control medical processes or other special applications will be communicating with larger time sharing computers; increased use will be made of systems creating microfilm files from computer magnetic tape; and Common Business-Oriented Language (COBOL) will become the accepted standardized computer language.

More patient use foreseen

A holder of many hospital contracts, the Electronic Data Processing Division of Honeywell Inc., Wellesley Hills, Mass., recently completed a market research study that predicts more hospitals will use computers and that there will be increasing use of computers for clinical laboratory and patient care systems. Although currently only five per cent of the nation's approximately 7,200 hospitals use computers, the Honeywell study forecasts 75 per cent of the hospitals will be sharing time on computer facilities by 1980.

While today laboratory systems only account for about five per cent of the hospital dollar volume, by 1980 the study predicts a rise to nearly 25 per cent. Business uses will grow from the current 25 per cent to about 40 per cent, and insurance and medical research will average slightly less than 40 per cent, as compared with their present 70 per cent.

J. Richardson Adams, medical services market manager for Honeywell, said, "During the next two years at least, data processing will still be used mostly to solve the mundane paper work problems but there is a gradual but definite trend toward developing systems for clinical laboratory use in areas related to direct patient care."

Currently a feasibility study on the use of a computer in the hospital laboratory is being conducted by the Hospital Services Division of Minnesota Blue Cross, the first organization to use the shared computer concept in hospitals. The organization also plans to do a similar study later this year on computer analysis of electrocardiograms, and a third on the creation of a medical information system, which would involve cathode-ray tubes and light pens for entry and data retrieval by doctors at nursing stations.

Development costs not covered

The Hospital Data Center of Virginia, a service corporation handling data processing for six hospitals, now applies the system to payroll, discharged patients' accounts receivables for some 76,000 accounts, property ledger and in-house patient accounting, tumor registry, analysis of blood counts, and, in one instance, an operating room utilization report. The charge is $11 per available bed per month. "The charges don't come anywhere near covering the $2.7 million already spent developing applications on the computer," Carter Sullivan, the Data Center's executive director, said.

Costs for hospital computer systems range from $10 to $15 per bed per month, depending on the number of beds in the system. "Computers will never sufficiently reduce the cost for hospitals so they can pass savings on to the patient. Computers will only slow the spiraling increase," said Martin McDonough of the Massachusetts Hospital Association, an organization which handles on-line patient accounting data processing for 17 hospitals.

The national Blue Cross Association, with headquarters in Chicago, plans to install a $2.5-million communications system linking 150 member plans nationwide, Honeywell reports.

While the major part of Honeywell's computer contracts are for medium-scale equipment shared by several hospitals, hospital industry manager James B. Turner said there were at least a dozen hospitals installing smaller computers, mostly for general patient accounting use.

Allegheny General, a 700-bed Pittsburgh hospital, began implementing an in-patient accounting system on a small-scale computer recently installed. Presbyterian-St. Luke's, Chicago, added a medium-scale Model 1250 computer last year to an existing larger Model 2200 and two smaller Model 200 computers assigned to general administrative data processing tasks. The Children's Hospital in Boston (see *Management Services*, May-June 1968, p.52 and July-August 1966, p.48), a pioneer in the computer utilization field, has a fully computerized clinic scheduling and bed allocation system.

Line Managers Fail To Utilize EDP, Says Diebold Conference

Ways of encouraging line management to make more adequate use of electronic data processing were among the problems discussed at the Diebold Research Program's 20th regular meeting, May 20 and 21 at The Homestead, Hot Springs, Va.

The findings result from an in-depth survey of approximately 50 large-scale computer users. The Diebold researchers interviewed four or five levels of management in each firm.

Two hundred corporate executives attended the conference sponsored by the international consulting firm.

Communications roadblock

One third of the largest companies questioned for the Diebold study found poor communications between data processing and line functions a major obstacle in developing EDP applications. Signs of this problem include the high turnover of EDP executives and systems personnel, as well as increasing under-utilization of EDP services by line managers and the employees of their departments.

Investigators found to promote more significant and high-payoff applications of EDP some companies are: requiring their divisions to include projected EDP use in their one-, three-, and five-year plans; offering department managers frequent consultation with systems planners and analysts; and concentrating their sales effort on middle management, which as the direct beneficiary of EDP will work to win over senior management.

Updating personnel practices

Revision of personnel practices also has produced more effective EDP use. Companies studied are attempting to place EDP project managers and other systems personnel in line organizations. In one company both a general manager and a vice president were promoted from the EDP department. Movement in the opposite direction is also being used; companies are making people from the line organization "information coordinators," responsible for finding new and profitable areas for EDP use.

"Partial approach" attacked

Another highlight of the Diebold conference was an address by Sir Stafford Beer, executive of the United Kingdom Automation Council and British authority on cybernetics and computer technology. Sir Stafford accused nearsighted systems analysis, which inadequately identifies a total systems problem, of minimizing the gains of modern technology.

As an example, he pointed out that a total systems approach to travel problems in the airline industry should not focus only on plane scheduling but on the entire journey from point of departure to final destination. He observed that the advantages of jet travel are lessened when the time saved in flight is lost by inadequate connections for the final leg of the journey.

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The financial and control aspects of a community social welfare program have much in common with business, yet accountants are just beginning to take a key role in such programs. Here are some guides—

MANAGEMENT INFORMATION FOR COMMUNITY ACTION PROGRAMS

by William J. Bruns, Jr.
University of Washington
and Robert J. Snyder
Alexander Grant & Co.

PROBLEMS OF PLANNING and control in publicly sponsored social programs are receiving increasing attention from program managers, government officers, and taxpayers. Social problems such as those stemming from urban and rural poverty weigh heavily on the public conscience. However, the resources available for pursuing solutions to national problems and fulfilling international commitments are limited and must be allocated carefully. Better management techniques are needed at every level of the public resource allocation process.

Accountants can and should play a major role in the development of these techniques. One pioneering effort in this field, the development of a computerized information system for planning and evaluation of results in Detroit's war on poverty, was conducted by a CPA firm. (See insert on pp. 18-19.*)

This article deals with techniques that have been found to be appropriate for one endeavor of the Office of Economic Opportunity, the Community Action Program, based on experience with Seattle's Community Action Programs. Our focus is at the agency level.

The broad, overriding goals of a Community Action Program are established by the legislation that created it—to alleviate the conditions and causes of poverty. However, the determination of specific operational goals requires specific information about the geographic location, population variables (age, sex, etc.), educational levels, regional economic status, cultural background, and so forth of the people to be helped. Only with this kind of information can the policy-making management of a CAP set the scope and direction of agency operations. CAPs were meant to be innovative and aggressive; to be successfully so, their

*See also "Management Approach to Social Improvement," *Journal of Accountancy,* March, 1969.

management needs a realistic understanding of the poverty environment in which they work.

Poverty "market" needs

The poverty in a CAP's geographic area defines the "market" the CAP will serve; the services to be offered depend upon the market needs. The similarity to a business's market for goods and services is clear. The profit success of a business is decided by market acceptance of products at a price in excess of cost. A prime input to business success, then, is market information. Exactly the same is true for CAPs. Success in achieving goals demands thorough understanding of the "market."

Good information about conditions may make it possible to predict both client and nonclient response to programs, side effects, and ramifications, including congressional reaction. The success of a project or program may depend upon ability to predict outcomes, and prediction for a CAP, just as for a business, depends on proper understanding of the market to be served.

One source of "market" information is, of course, the CAP policy and advisory boards. Congress has required that the poor participate in CAP decision making "to the extent practicable"— at least partly, one speculates, to ensure that their feelings, observations, and poverty "expertise" will be a source of information.

A second source is the collected statistics of poverty. Data such as crime rates, school dropout rates, incidence of disease, housing conditions and occupancy levels, unemployment and underemployment, birth rates, racial relations, etc., are indicators of the problems and pinpointers of the location of poverty. To know something about these conditions is to know something about the affluence and/or poverty of a community, and it is, of course, just such information that CAP management planners must have.

Such statistics of poverty are usually collected by other public agencies. Medical, employment, and educational data are often available in a form that suits the needs of CAP planners, or they can be modified to satisfy those needs. The Bureau of Economic Research of Rutgers University prepared a document entitled *The Dimensions and Location of Poverty in Burlington County, New Jersey*[1] by working primarily from existing census information. In Detroit a well developed system was designed to transform data from many agencies into information useful for planning and managing antipoverty activities.

The individual techniques of information gathering and processing that can be used depend very much on the size of the agency, the nature of the poverty area, and the sources of data available (such as police records, school statistics, etc.). But in all cases a formal document setting forth the known "market" information to be considered (similar to the New Jersey document prepared by Rutgers) should be prepared for the policy and advisory boards and other interested parties. This document becomes the basis for planning programs.

CAP capacity for service

In addition to an appraisal of the "poverty market," CAP planners must have an understanding of the internal capabilities and limitations of the operating agency. Appraising the capability of the CAP organization is a two-part job. First, the objectives of the organization as expressed in tentative projects or programs must be translated into organizational demands. That is, quite simply, the CAP planners must decide what type of organization is needed to carry out a project. The second step is to measure the existing organization against these requirements. If the organization is inadequate, either it must be strengthened or the program must be re-evaluated. If the organization is more than adequate, then perhaps additional opportunities for service should be sought, subject, of course, to other constraints.

The elements of organizational strength that must be catalogued are several; they include personnel members and qualifications, physical facilities, professional expertise, leadership availability, morale, ability to attract additional talent, political climate, etc. It is clear that each of these factors presents problems of quantification and objectivity; however, planners for CAPs must in some fashion evaluate the characteristics of their organizations if they are to direct activities realistically and successfully.

Each tentative project should be considered in light of factors in addition to organizational demands, of course. The physical and financial resources required for the project need to be considered in several ways. The resources needed must be compared to those available; it is useless to begin a project for which funds will never be allocated. Often, more than financial resources must be considered; for example, the necessary physical space to carry out some project may be essential information if space is limited. All resource requirements, availabilities, and shortages are important information for planning.

It is hard to be specific about the sources of and procedures for collecting information. *The Community Action Program Guide,*[2] published by the Office of Economic Opportunity, explains some of the expectations of and limi-

[1] *The Dimensions and Location of Poverty in Burlington County, New Jersey,* a report prepared at the request of the Rural Community Action Program, New Jersey State Office of Economic Opportunity (Rutgers University, New Brunswick, N. J., 1965).

[2] United States Office of Economic Opportunity, *Community Action Program Guide,* 2 vols. (Government Printing Office, Washington, 1965).

tations on an agency. Experience of managers and discussions with other CAP managements, regional OEO administrators, etc. can add to this information. Information regarding the community's willingness and ability to participate can be collected from people experienced in the community with a knowledge of the political tenor of the area. The organization's capabilities may be the most difficult information to obtain; since people very close to the organization will be doing the appraisal, they may be excessively optimistic (or pessimistic) about the organization's potential or may overlook the real problems because they are focusing on desired ends.

The early stages of planning should lead to an understanding of the restrictions and limitations that are present in the situation of the CAP. A document should then be prepared that states specifically the goals of the agency and the best judgments on each factor critical for success so that they are clear to all persons involved and can be referred to again when reviews of progress are undertaken. However, planning is not complete when goals are selected; it becomes more detailed and specific as it seeks to establish means for achieving them. We call this process operational planning and scheduling.

Planning and scheduling

Operational planning and scheduling are concerned with the major requirements and expectations for each step of a project; they deal with flows of funds, material, and personnel; with dependence on other projects; and with the dependence of other projects on the planned project. Information needed for operational planning and scheduling relates to the transformation of resource inputs into results. Therefore, the kinds of information needed include transformation functions, the factors which affect them (for example, regional economic conditions affect the transformation of unemployed people through a job training program), the inputs required, and the results demanded by policy management and the funding entities. The significant variables that appear to be least predictable and the effect of that unpredictability on desired results are of particular interest; information about them provides the basis for judgments about project risks.

Typically, there are many sources of useful information. The policy board of the CAP supplies the objectives—the expected results—and very probably some broad outline of the desired timetable of results. The experience of the CAP in past projects and the related experience of other agencies are often helpful. Some other kinds of information commonly relevant to the operational planning and scheduling process in CAPs include:

1. *Personnel requirements*: numbers, skills, experience, whether organization employees or community volunteers are needed
2. *The exact "market" to be served*: a certain segment of the juvenile population, school children, etc., or a certain neighborhood, for example
3. *Time constraints and goals*: a project that must be completed before another can be undertaken, for instance
4. *Other programs*: programs that must be integrated and meshed
5. *Physical requirements*: school space, hospital space, etc.
6. *Other resources required*: supplies, materials, training equipment, etc.
7. *Budget requirements*: how much money must be spent to procure the resources needed and the timing
8. *Community receptiveness*: Will the client population participate? Will the project conflict with any religious or cultural values? How difficult will it be to attract (communicate with) participants?
9. *Participation*: What is the "maximum feasible participation" of the poor? How will their participation affect the outcome? How

The physical and financial resources required for the project need to be considered in several ways. The resources needed must be compared to those available; it is useless to begin a project for which funds will never be allocated. Often more than financial resources must be considered; for example, the necessary physical space to carry out some project may be essential information if space is limited.

The Detroit Story–

The attempt to apply much of the precision of accounting control methods and the latest in statistical sampling techniques to the problems of Detroit's social welfare agencies' war on poverty was developed by the office of Touche, Ross, Bailey & Smart in that city. Basically, the program was designed to establish a central file record for each welfare client, which is updated as the client gets more services from any of the city's agencies. From this central file, statistical sampling techniques would be used to determine what are the most pressing human needs and what are the most effective means used to combat each of them.

According to the design, at first interview each client's file would be opened with his name, an identification number, and his history by the social worker. That file is then added to the central computer record used as a basis both for individual client histories and also as a source for the sampling techniques used for general long-range conclusions as to the efficiency of various programs and the funding needs of such programs. The individual file is known as the base line data file and is the building brick on which all the rest of the program is constructed.

The base line data file, updated monthly, would attempt to rate each client against a norm in numerical terms. Thus, if the client's health record were 4 and the norm were 7, he might be referred to remedial medical centers. All of this is recorded in his file and the subsequent improvement in his health is also filed at monthly intervals afterwards. The goal of the program design is to make each client as well equipped as anyone else in the community to become self-supporting on a reasonable living scale.

Subsequent interviews would not trouble the client for information.

will it affect planned progress? What extra resources/efforts will it require? How can the project derive maximum benefit from the "expertise" of the participants and give them maximum benefit in return?

10. *Results*: What is the frequency distribution of probable outcomes? That is, what is the range of possible outcomes and side problems? What is the "risk"?

11. *Scheduling*: How much time must be allowed as "slack" to absorb the results of one stage of the program before the next stage can begin?

12. *Public reaction*: What cooperation/objections will the members of the nonparticipant population offer? What is the best way to communicate with them to exchange views of the project?

Usually a formal plan is only as good as the assumptions and intelligence that went into making it; therefore, a statement of those assumptions and that intelligence on relevant variables will be important to many readers of the plan. This entire flow of information from external source to ultimate statement of the plan is a vital part of each CAP management information system.

The planning process—ideally well informed with such information as mentioned—culminates, informed or not, in some statement of actions to be taken, resources to be committed, and results expected. This statement, especially its financial aspect, is often referred to as a budget. A discussion such as this can hardly end without taking up the place of budgeting in the information system of a CAP.

Budgeting

A budget is the middle ground between a plan and a review of performance. It is both the tool by which the plan is communicated to operating personnel and the standard against which performance is evaluated. Therefore, the essence of budgets and budgeting might be summed up as follows: (1) A budget serves both as control and plan, according to the user, and (2) a budget is largely financial in nature.

The isolation of variables in a budget can be extremely useful; in a profit-motivated organization those variables that affect revenue and cost are of vital importance to the manager and should be included in the budget. One problem in budgeting for a Community Action Program is that the goals of any Community Action Program are financial only in the long run. In the short run, measures of CAP performance are mostly nonfinancial and only partly quantitative. In considering the performance of a CAP for immunization, for example, a manager is interested in how many people can be immunized, how many will be missed, what the costs per immunization are, what kindred effects there may be (such as stimulating parent concern with child health problems), and how the project fits into the overall program. In considering these criteria it seems evident that financial and nonfinancial, quantifi-

An on-line identification center for the entire system is to be maintained, accessible by telephone from every service agency. These centers would be authorized to communicate the client's identification data and the location of his base line data file in the original service center.

Files restricted

The files are not to be open to the clerical personnel, so confidentiality is maintained. There should be a monthly updating of all files and production of reports. These files result in information for two types of reports: those required for statistical reports and funding and those for improving management of service centers.

The second part of the social accounting system was designed to quantify human needs. It calls for aid recipients to be divided into eleven different categories, depending on age and sex. Each client is rated according to characteristics social scientists feel tend to eliminate poverty. Then each characteristic is weighted to reflect its importance to the appropriate population group. The client's total score is then compared with the set target level, the point at which the client is able to stand on his own feet and not require aid.

This point system would provide a client profile which spotlights his needs and also shows the efficacy of the services he should utilize.

Adapting social problems to computer techniques enables optimal program alternatives to be used. If less than hoped for funds are available, the computer can project the effect the shortage will have on the total program. The computer has virtually unlimited ability to formulate program by program comparisons, analyze different alternatives, combinations of programs, and varieties of client mixes.

able and nonquantifiable information are all important. It is not clear which is most important; and such is the problem of budgeting for CAPs: *Although the financial cost can be fairly well planned and stated the nonfinancial results often cannot be.*

Control of a Community Action Program—like control of any organization—is a process of measurement. Drucker says, "The basic question is not 'How do we control?' but 'What do we measure in our control system?' "[3] And this is precisely the question that every agency manager must ask himself as he exercises control over the activities of a CAP. What variables must be considered in order to evaluate the progress of the whole organization, individual project, or subpart?

[3] Peter F. Drucker, "Controls, Control and Management," *Management Controls: New Directions in Basic Research*, Charles P. Bonini, editor (McGraw-Hill Book Company, New York, 1964), p. 289.

The importance of considering all types of relevant information—demographic, socio-economic, political—without neglecting the importance of the financial budgeting process was stressed earlier. In this discussion of control it should again be emphasized that measurements of all types are indicators of CAP performance but not to the exclusion of, or with sole reliance on, financial cost data. Cost data most often are used as a measure of *efforts*; other information must supply the measure of *effects*.

"Effort" measurement

The Office of Economic Opportunity has published a *Community Action Program Guide, Financial Instructions* that defines in general terms the type of accounting system expected of a CAP. Such an accounting system is but part of the record system, which includes detailed records such as client contacts, personnel records, correspondence, purchase contracts, etc. The OEO *Instructions* state: "OEO recognizes that the accounting system utilized in grantee organizations will vary from a pure cash receipt and expenditure system to a very extensive accrual system. OEO will not dictate the type and for-

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mat of the system to be used, since the interest of the Federal Government is satisfied if a system is established which is adequate to account for program funds, which provides accurate and current information relating to program progress, and which may be audited without undue difficulty."[4]

Cost accounting

In designing, operating, or renewing a CAP cost collection system, the same considerations involved in any managerial accounting system should be taken into account. Such considerations include the materiality of an expense, whether it is variable or fixed, whether it can be assigned to a responsibility center or not, precisely what kind of an expense it is, whether a valid allocation can be made, what goes into any transfer prices, and so forth. Because an accounting system is part of the information system, it should yield relevant and useful information. In this regard, it is well to remember that much information of an accounting nature is meant for users outside the organization—the OEO, the public, Congress, etc.—and as such might not be in useful form for managerial use. Thus, in the design of a cost collection system for a CAP, both the need to report externally and the needs of management must be considered.

The exhibit on page 21 shows two account systems; one is designed only to furnish the reporting minimum, and the other is designed to provide management with significant data in excess of the minimum.

The depth and detail of the cost accounts depend on the need for management information. Obviously, if $250 a year is spent on rent and the total grant runs to six figures, there is little justification for collecting any more than minimal data. However, in a situation where labor is the principal expenditure, a relatively complete classification and analysis might be warranted.

In general, the criteria for judging the appropriateness of a CAP cost system are these:

1. The requirements of external reporting
2. The requirements of management for planning, controlling, and operating
3. The essentials for safeguarding assets and ensuring efficient allocations of resources
4. The cost of collection, summarizing, and reporting.

Incorporated in the budgeting system, at least in complex CAPs, there should be potential for review by exception. The system illustrated in the exhibit has such a potential. In addition to the cost information already discussed, data on receipts, contributions, progress toward fulfilling the community's responsibility to contribute X per cent, etc. must be collected, processed, and reported. Such information is an important part of the system, but it is probably not as voluminous as the cost information in most cases. The accounting system to handle this task should reflect the same considerations as the cost collection system, namely, external reporting requirements, internal management requirements, basic efficiency and protection requirements, and the cost of the system itself. The reporting for this portion of the financial information, like cost reporting, should be on an exception basis.

Measurement of "effect"

The following passage illustrates the problem of measuring the effects of Community Action Programs: "How does the data required differ from that necessary to measure the performance of an industrial concern or a commercial enterprise? Of course, the War on Poverty does not have a profit motive in the business sense; but in all other respects the similarity is striking! Businesses as well as any of the programs of the Office of Economic Opportunity have goals they attempt to reach through a plan.... They can compare the results obtained after a given period of time to the results which were expected from the plan and then take the necessary corrective action. By reporting against the plan they can measure both performance and can also update the plan, review the allocation of resources procedure, identify the areas which deserve more attention to meet objectives on schedule, and, finally, provide the information necessary for internal management as well as the data which will satisfy public demand."[5]

The ultimate success of every poverty program would be elimination of the causes and effects of those social conditions defined as poverty. In movement toward this ultimate goal, many subgoals will be set that should build toward final accomplishment, and one subgoal certainly will be basic CAP management efficiency, including a system for recording, retrieving, and using financial data.

But a CAP that does not ultimately contribute to elimination of poverty is not successful, regardless of how sophisticated its cost accounting system may be. Similarly, any CAP that alleviates poverty in its assigned geographic area is successful; the lack of an adequate accounting system might decrease its efficiency but does not take away from its ultimate success. The essential task in CAP performance measurement, then, is to evaluate its success in affecting the indicators of poverty considered representative of community ills.

There is no definitive list of indicators for measuring this success, nor are there definitive methods of collecting data. Because the problems are unique and diverse, the

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[4] United States Office of Economic Opportunity, *op cit.*, Vol. II: *Financial Instructions*, p. 15.

[5] Jean-Paul A. Ruff, "Poverty Programs—A Business Management Approach," *Touche, Ross, Bailey and Smart Quarterly* (June, 1966), pp. 24-25.

A Minimum Cost Account System and a More Inclusive One

Minimum: For a Period

Cost	Program	Components	(Grants)	Total
Personnel				
Consultants				
Travel				
. . .				
Total				

More Inclusive: For a Period

Cost	Responsibility Centers and Components (Grants)					
	Component I					
Overhead G & A	Center A			Center B		
	Budget	Actual	Variance	Budget	Actual	Variance
Personnel						
Consultants						
Travel						
. . .						
O/H Allocation						
Total						
Total	Total—Component I					

	Component II								
Overhead G & A	Center A			Center B			Total		
	Budget	Actual	Variance	Budget	Actual	Variance	Budget	Actual	Variance
Personnel									
Consultants									
Travel									
. . .									
O/H Allocation									
Total									
Total	Total—Component II								

statistics and procedures must also be diverse. But some indicators may be common to many CAPS. The Detroit system has designed into it a selection of indicators, covering a broad range of variables and sources of data, that might be generally applicable to many other CAPs.[6] They include the following:

- Police Department offense complaints
- Police Department arrests
- Police Department Youth Bureau contacts
- Police Women's Division law enforcement
- City Welfare relief openings
- City Welfare food stamp openings
- City Welfare food stamp closings
- Registration Bureau service inquiries
- Visiting Nurses service requests
- Social Hygiene Clinic VD cases
- Tuberculosis Clinic TB cases
- Sanitary Engineering complaints and violations
- Health Department births
- Health Department deaths
- Health Department stillbirths
- State Welfare Aid to Dependent Children openings
- State Welfare Aid to Dependent Children closings
- State Unemployment openings
- State Unemployment closings
- State Welfare Old Age Assistance Aid to the Disabled or Blind openings
- State Welfare Old Age Assistance Aid to the Disabled or Blind closings
- Legal Aid Bureau requests for aid
- Board of Education truancy
- Board of Education dropouts

This list suggests the type of analysis that is required to evaluate the success of a CAP. In very large programs a sophisticated computerized system might be necessary. In smaller programs a manual system with many fewer indicators might be adequate. For example, actual canvasses of the poverty population and area or use of a sampling technique might be possible, depending on the size and diversity of the problem area.

The CAP's primary tasks are to identify the problem of poverty, its causes, and its effects and to plan to alleviate those factors. The variables that indicate the existence of poverty to the planner ought to be, of course, among the variables used to measure program success. For example, it is obvious that for any program meant to improve school dropout rates the change in dropout rate should be an indicator of success.

The essence of CAP control is to seek out those measurements and measurement techniques that indicate progress toward meeting established goals. Necessary for such measurement are a stated set of goals and a plan of action against which to compare the results of efforts.

The list of social indicators offered earlier could be extended, of course. Some indicators may very well be inexact, perhaps even misleading, but this should not detract from the search for variables to test progress. If CAP managers are to allocate efforts effectively, they must have indicators of success; if the taxpaying public—through its legislators—is to continue to support programs, measures of overall performance must be made available.

Our examination leads us to the following conclusions about management information for community action programs:

1. The task of managing a CAP is quite complex and is different in important respects from the task of managing a profit-oriented business. A management information system provides a means of linking objectives to management processes, processes to efforts, and efforts to achievement. The nature of the CAP requires careful attention to the design of the management information system to provide information for goal formulation, project selection, operational planning and budgeting, and control and appraisal of progress and performance.

2. In most cases the management information for a CAP will have to be created by program managers for each program. Differences between programs prohibit creation of a standard system for all CAPs. A system to provide needed information should be installed at the inception of a program, nurtured to develop needed information if it is not originally available, and evaluated periodically to eliminate useless data or unnecessary detail.

3. Planning processes in a CAP depend upon management information just as they do in a business. Planning forms a basis for operational statements such as budgets which direct activity and provide a basis for performance review and control. The management information system is the communication link among each of these processes.

4. Control of a CAP depends upon the measurement of *effect* as well as *effort*. Control of efforts is required by the public nature of support for the CAP; evaluation of effects is required for sound allocation of resources and for evaluation of the alternative courses of action open to a program.

5. When the management information system is operating, planning and control processes operate simultaneously, each providing data and information for the other. Haphazard phasing of these processes is eliminated, and the likelihood of effective use of resources is increased. Data on efforts and effects provided for control lead to information for goal formulation, organization analysis, and project selection. Goals and plans lead to statements of expected results to which actual performance can be compared. Management information becomes the basis for systematic management.

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[6] See *The Detroit Social Data Bank*, a report on its design, implementation, and operation prepared for the Mayor's Committee for Community Renewal (Touche, Ross, Bailey and Smart, Detroit, 1965).

The need for thorough documentation of each step in a systems study has been repeated ad infinitum. Here are some specifics—what one federal bureau has done to ensure that everyone knows what's being done and why—

SYSTEMS DESIGN BY CRISIS: ONE REMEDIAL APPROACH

by Dennis Cintron
Federal Highway Administration

"THE MANAGER of Department X needed his data processing system yesterday. You promised it for then, and now you can't even deliver it tomorrow."

This crisis situation may sound familiar. It should, for it is all too common in data processing departments that fail to plan far enough in advance to provide for well defined, well documented, and well structured systems—or whose planning is too sketchy to be of real value in the design phase of the systems process.

It is true that much, if not most, systems design cannot be done five years in advance. Data processing equipment and programs become obsolete far too rapidly.

But there is one phase of systems design that can and should be done well ahead—the analysis and projection of the system user's needs. This article describes the way in which this is done in the Federal Highway Administration and the use of our principal planning tool, the Systems Folder (a tool, incidentally, that goes a long way toward establishing the documentation whose importance accountants are so strongly emphasizing these days).

The typical user of data processing, of course, does not know enough about the field to be able to define everything that the systems designer and programer need to know about his system. He needs plenty of help from the systems staff before he can identify his present, let alone his future, needs. Our technique is to assign a representative from the systems and programing staff to talk to each user about his needs now, a year from now, five years from now, and even further in the future if possible. If the systems man really understands the user's plans, he can help him define his true wants and needs in detail.

When the system requirements are properly defined, the designer can produce well structured modular system designs that will meet or surpass the user's needs. The programer will have enough lead time to debug the system completely. The programer will not have to keep going back to the user asking, "What do you mean by this?"

The cost of carefully defining requirements in advance may be $15,000 to $25,000 a year. It is money well spent. The systems representative is acting as an internal data processing consultant for the user. If he keeps a single large system from being sent back for reprograming after it has been completed and tested, he has covered the costs.

The systems designers gain. The primary function of a professional systems designer is to apply creativity to the task of producing data processing efficiency. If the systems representative has done his job well, the designer can concentrate on making full use of the valuable skills of his profession.

Programer morale improves and turnover rate declines because the programers have more level workloads and do not have to reprogram as frequently.

The users gain. Nearly any user would prefer to work with one person who understands all of his needs. Trying to work with ten programers, each of whom understands only a part of the problem, presents the user with a burden of coordination that he is not likely to enjoy.

The data processing manager gains in all respects. His recognition in the organization increases because he gets things done. He also gets time to think. That means new ideas and more efficiency in the data processing organization.

Crises arise less frequently than before, but if one does occur, the organization is in a better position to meet it. The user is no longer on the data processing manager's back to "get things done." The user is working with a systems representative who has served him in the past and understands the nature of his problems. The user knows that the only way he can ease his own crisis is by defining. He knows that he must define before detailed design and programing can proceed. If the system has first been defined and approved by the user, the designer can create a sound design and programers can produce easy-to-follow, bug-free programs. Everyone has a well defined, well thought out, firm plan of action from which to proceed. All documentation, from definition through programing, looks good, too, because the system was properly defined the first time.

The time spent defining needs is never wasted. Even if the system as originally conceived never materializes, the systems and programing people still have acquired considerable insight into the users' future needs. With this insight, they are in a better position to see that the users get what they need when they need it.

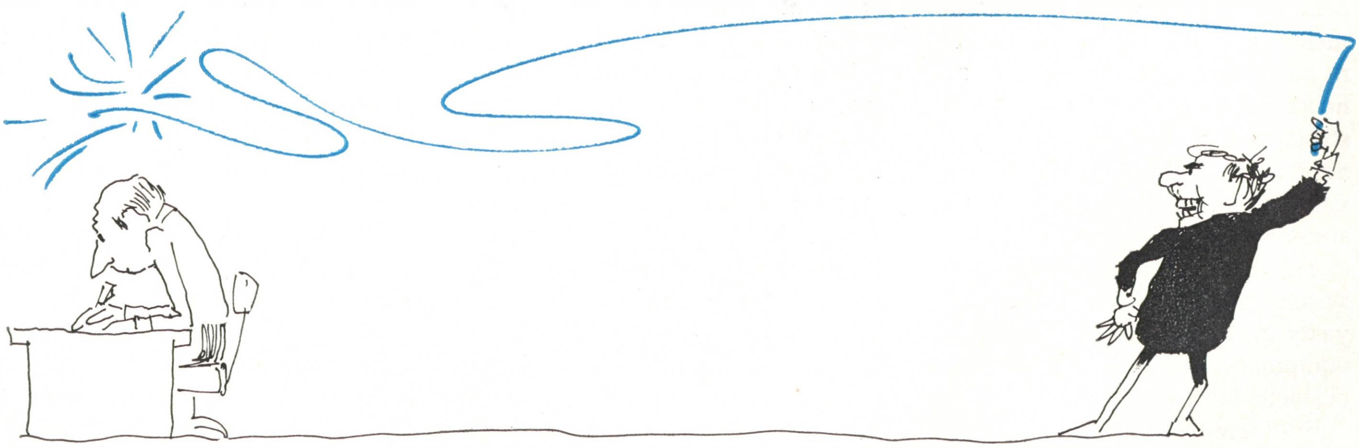
The process

The top executive should take the initiative in requiring that computer users submit their planned data processing needs five years into the future. These plans should be oriented to the users' problems, not tied to specific hardware or software. It is never wise to be bound to specific hardware when defining a system that is to be designed in the future. Data processing software and hardware become obsolete far too quickly to define a system inflexibly.

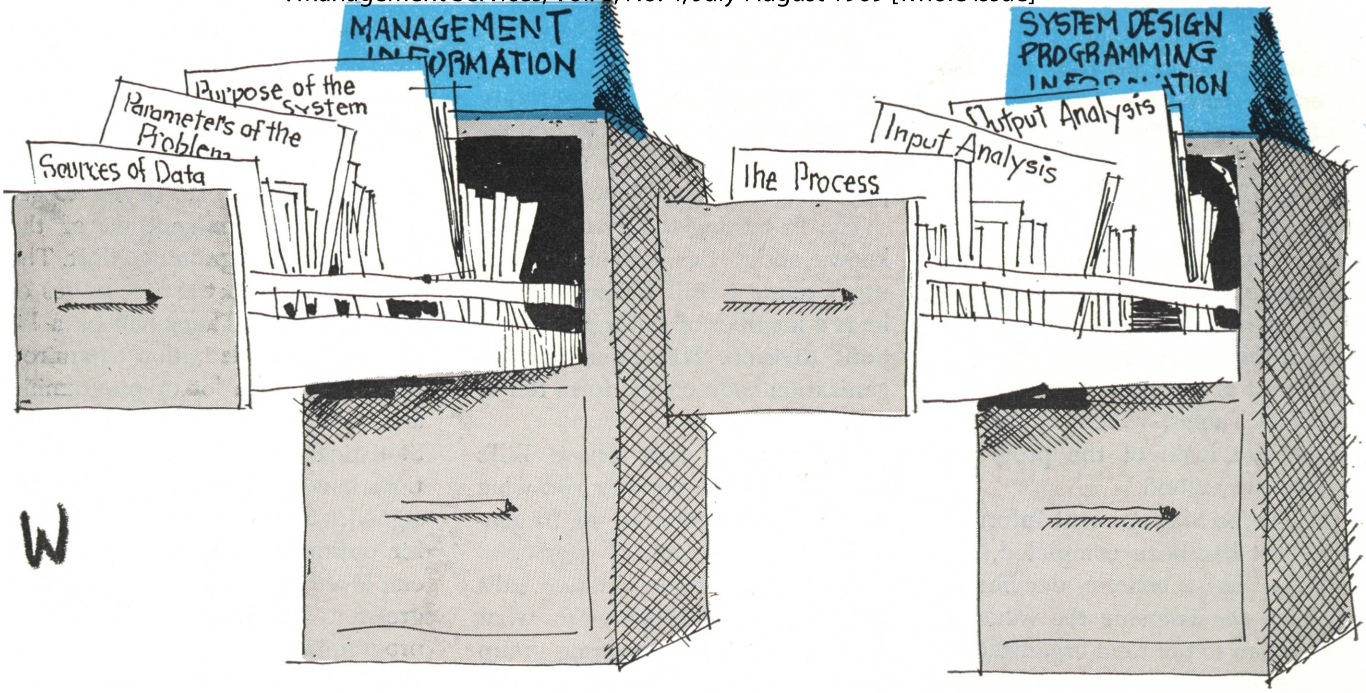
We start with a standard one-page form that gives only the essentials of the planned system. Information on the form includes the user's organization, his office, his name and his phone number, the status of the system, the due date, and a four-line narrative description of the purpose of the system.

After the data processing manager receives the completed form from the user, he makes a copy of it and sends it back to the user together with a letter stating that the systems representative will be contacting him soon. Then he sends the original request to the systems man. This request form provides the systems representative with enough information for his first contact with the user. The systems man now can schedule an interview. On the telephone he usually gives the user a general idea of the needs of systems and programing so that the user will be prepared to think in the same terms as the systems representative during the interview.

The systems man's purpose in the first interview generally is to get acquainted with the user and his requirements and begin to think about problem-solving procedures that could be applicable in the user's problem area. He brings the discipline of systems analysis to



The top executive should take the initiative in requiring that every computer user submit his planned data processing needs five years into the future.



The Systems Folder at our installation is a six-section, two-part folder, which links all information together. The first part, Management Information, contains all managerial decision making information. The second part, System Design/Programing Information, contains all problem information linked for systems design.

the user and attempts to bring about an exchange of ideas that will benefit both the user and the systems and programing group.

The systems man takes notes on what the user wants the system to do. Later he organizes his notes and analyzes them. By organizing the notes in a manner that links the steps of the problem from the input to the output, the systems man can find the holes that lead to future misunderstandings. He will try to plug the holes when he finds them; if he cannot, he will flag them.

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In this manner, everyone knows what is needed and, also, the things that are missing.

Systems folder

The systems representative has a great number and variety of systems to handle. He will not be able to remember everything about all the systems he defines. And that is good. If he had that type of recall and wrote down nothing, the organization would have nothing if he left. His analysis must be captured on paper. A good system definition folder is composed of forms so designed that they make errors and omissions obvious to everyone at first glance. When the analysis is organized in this manner, the organization has tangible, useful documentation for as long as the problem exists. We prefer forms because they clearly define the system to the systems designer with a minimum of narrative.

The Systems Folder at our installation is a six-section, two-part folder. This folder is composed of forms that link all information together. The first part, Management Information, contains managerial decision making information that is clear and concise. The second part, System Design/Programing Information, contains problem information that is completely linked for systems design and programing.

The Management Information Part, Part One, has three sections. Section One, the Purpose of the System, contains a four-line narrative of what the user wants from the system. Section Two, the Parameters of the Problem, indicates the variables that enter into the solution of the problem. Section Three, the Sources of the Data, shows where the user obtained his data.

The System Design/Programing Information Part, Part Two, contains three sections. Section One, the Output Analysis, defines the ends sought by the user. Section Two, the Input Analysis, defines the type of input that the user will enter into the system. Section Three, the Process, describes the flow of data from input to output and all the procedural steps to be taken to reach that goal.

If the systems representative must also serve as a systems designer (as he may have to in small installations), there should be an optional third part of the systems folder, the Decision Tables, which would describe the logic of the programs within the system.

When the Management Information Part has been completed, the manager has a concise, documented basis for assessing the value of the system to the total organization and assigning priorities on system design, programing, and computer time. When the System Design/Programing Information Part has been completed, the system designer has all the user data already gathered for him and can devote his time to producing well structured modular programing systems that optimize the use of the existing hardware.

If the systems man is serving as the systems designer, the third part, the Decision Tables, provides the programers with a clean modular design that will help them build bug-free programs from the start.

The Systems Folder creates concise system documentation with all loose ends flagged. Both the user and the systems staff know if holes exist and where they are. A powerful package like the Systems Folder puts a sound basis for resolving the user's problem in the hands of management, systems designers, and programers.

Example

The best way to illustrate how this technique works is to present an example of the process that the systems man follows in a particular application area.

Let us take an example from traffic operations research. The user has to verify a theory and a technique called conflicts analysis. According to the user, it is a "method for inexpensively optimizing the safety of an intersection design. This will resolve a municipal planning safety problem."

The first thing the systems man knows about this job is that the user's name is Bill Baker and that he is a member of the traffic operations division. His name and organization code on the form tell us this.

The systems man knows Bill's room and phone number and what he wants the system to do, in generalized user's terms, of course.

The systems representative calls Bill and gets him prepared for what the systems and programing group wants. He tells him what his own function is and schedules an interview with him to discuss his system. Bill now knows more about the systems representative and his function.

During the initial interview the systems man finds out a little about Bill. He is looking for answers to questions like these: What is his research background? What are his sources of data? How reliable are they?

During the first interview the systems man will probably not be able to define the system well enough for data processing, but he will begin to understand what Bill wants out of the system. The systems representative knows from experience that in a research project it may take several interviews to define a system adequately from a data processing standpoint.

As it turns out, the systems man finds that Bill has had a lot of pure research experience and is well versed in data processing. He has a traffic operations project that is much needed by state, local, and municipal governments: a way to forecast the safety of an intersection even before an accident takes place on it. In addition, using the same data, he has found a way to maximize the safety of any given urban or rural intersection at minimum cost. The systems man also finds that enough interest has already been generated so that there will be demand for the results of the project in all the states and in foreign nations as well.

After several interviews with the user the systems man begins to get a feel for the magnitude of the systems and programing effort. The project is still in the first stages of basic research. There will be a lot of problem definition required from Bill and a lot of programing and detailed systems work to do. Statistical techniques for correlations have yet to be selected or designed. Sophisticated procedures for optimality analysis have to be employed, possibly requiring regression analysis, mathematical programing, and game theory. In short, it looks like a very complicated project. The systems and programing effort and the computer time will be costly.

We will begin to receive data from the state highway departments that are collecting the data in about four months. This implies that the initial phase of the system, the sort, edit, and update programs, should be completed by the time initial inputs are already. The system will be completely defined by the user in about six months. This implies that the processing phase of the system will not begin until some actual data have become available for testing. Although data submission by the states will not be complete until a year from now, it may be possible to accelerate completion of systems and programing before then. This can be accomplished if the user can define his system in stages. If this breakdown is feasible, the system can be designed and programed in modules on the basis of the user's definitions.

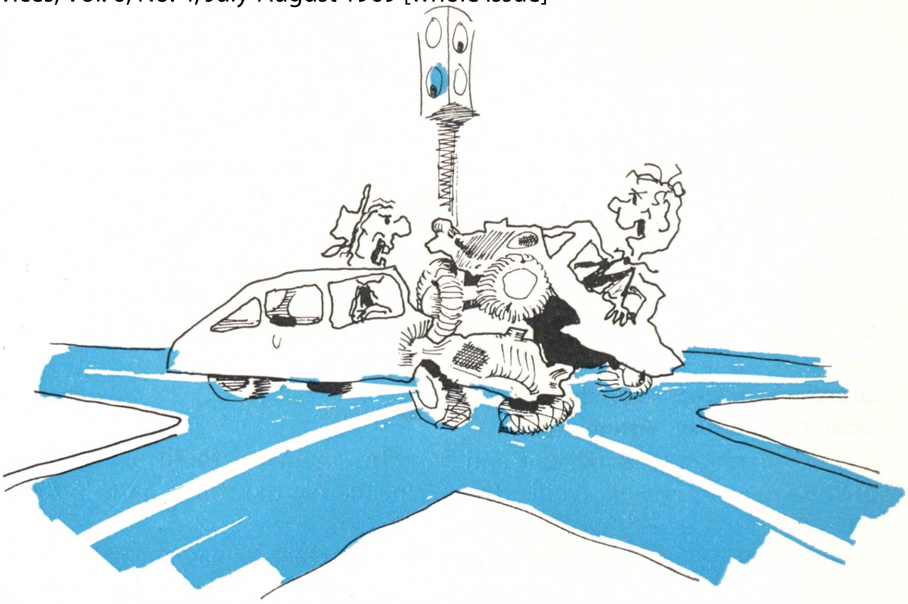
With the deadlines known, the system can be divided into logical phases and defined, approved, and scheduled for design and programing in acceptable modules.

The first part of the Systems Folder contains management information. In Part One, Section One, the Purpose of the System, the systems man documents that Bill's system is an attempt to verify the theory that if there are a number of near accidents (or conflicts) in an hour, there will be a proportional number of actual accidents in a year.

If the correlation of historical accident data to conflicts proves significant, counting conflicts at an intersection in an hour could give a good indication of the number of accidents that will occur at that intersection in a year. Statistically relating information about the type and number of conflicts to the types of correlative measures that alleviate conflicts can provide a basis for designing an optimally safe intersection.

The second section, the Parameters of the Problem, indicates that the variables surrounding the problem include the traffic flow, the conflicts, and the intersection data. The Systems Folder shows the numerical method that Bill will use for describing the flow of traffic through an intersection, for describing conflicts, and for describing the type and size of the intersection.

The third section, the Sources of Data, shows that state highway departments will collect data for the user through established data collection procedures, which are also described in the third section. These forms are shown to be easily keypunchable. Gathering the data accurately on these forms requires little skill or training.



The number of conflicts (near accidents) at a given intersection per hour could give a good indication of the number of accidents that will occur at that intersection in a year.

Other benefits

The data processing manager now has an idea of what Bill's project is about. He has an estimate of the cost of the project. He can see the project's impact and value to the entire organization and can allot resources accordingly. He does not spend time or money on ill-conceived projects or projects of questionable value to the organization as a whole. He has the information needed to reconcile the objectives of this project with total organizational objectives, which puts him in a position to be more valuable to top management.

So, even if the systems man only fills out the Management Information Part, he has covered his costs. But now he has established a working relationship with Bill. As a result, he can now define his system in greater detail than before and at the cost of little additional time. The input and output analysis sections of the System Design/Programing Part, Part Two, are completed by entering a line-by-line detailed analysis of both the input and the output. After the analysis of the input and output formats has been completed, the analyst relates each item of the output to the input or to some intermediate step in the process. By this process of linking input to output, he has helped the systems designer in the same manner as he helped the manager. Documentation that is problem-oriented is never obsolete. The system designer can always use the systems documentation to create the most efficient machine-oriented techniques and processes to arrive at the output from the input.

By filling out Section Three of the Systems Design/Programing Information Part, the Process, the systems man gives the designer a description of the links between input and output. If any link is missing, that will be demonstrated in this section. This section also contains a system decision table and a preliminary systems flow chart that can be used to divide the system into modules for scheduling. If any items are missing, the systems man can follow up on these until Bill has given him a completely clean definition. Bill's vital interest in meaningful output ensures that he will be most happy to fill in any omission that may prevent completion of a perfectly clean definition. The systems representative has already seen the value of the system to the organization and can give the designer complete information that is well tied together. The designer can afford to spend more time in planning and creating a clean, efficient modular design that employs the hardware currently installed and the capabilities of his personnel most efficiently. This time is well spent. It will pay high dividends in the programing phase.

The systems man can perform all of the liaison between the user and the systems group. Systems designers and programers need to contact the user with much less frequency. The systems man has flagged the holes. The designer can ask the user specific questions on the basis of these flags. When questions like "What do you mean by this?" or "How did you get to this?" have all been answered or flagged, the Systems Folder is submitted to the user for approval. The user's approval is the green light that indicates that the system is ready for detailed systems design and programing. Approval avoids the embarrassing situations caused when a user says, "This is not what I said I wanted."

An additional benefit of this approach is that the systems man educates the users in systems definition techniques for data processing. Since the systems representative has proved that the systems approach really has helped the user to define his problem, users begin to turn in complete, well defined statements that only need examination and approval by the systems man. When this happens, the systems man has worked himself out of a job—and, if the manager is smart, into a bigger one. He has become familiar with the many application areas in the organization and their problems. Training of this nature provides a solid foundation for any top-echelon executive.

Review

In summary, these are the elements of the three-part Systems Folder.

Part One, Management Information, provides the preliminary information required to understand what the user intends to do and to evaluate how well he will be able to do it—in short, a basis for judging the value of the user's system to the organization as a whole.

Part Two, Systems Design/Programing Information, describes the outputs desired and the inputs from which to derive the outputs as well as a process by which the work flows from input to output. The process serves as a basis for determining whether a system is completely unified and a method for tying any loose ends together.

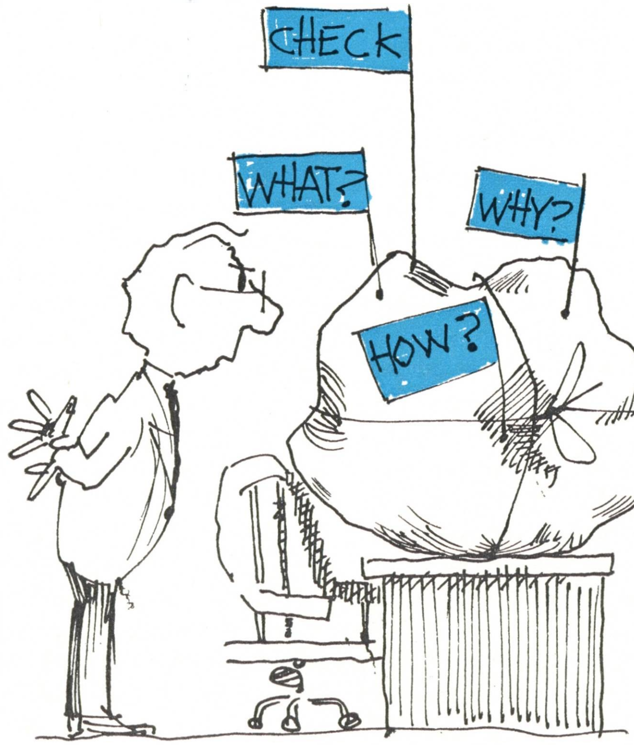
Part Three, Decision Tables, is an optional section used when the systems man also does detailed design and analysis. This part provides the programer with a complete series of decision tables that can be used to prepare well structured modular programs.

At a more detailed level, each section interrelates.

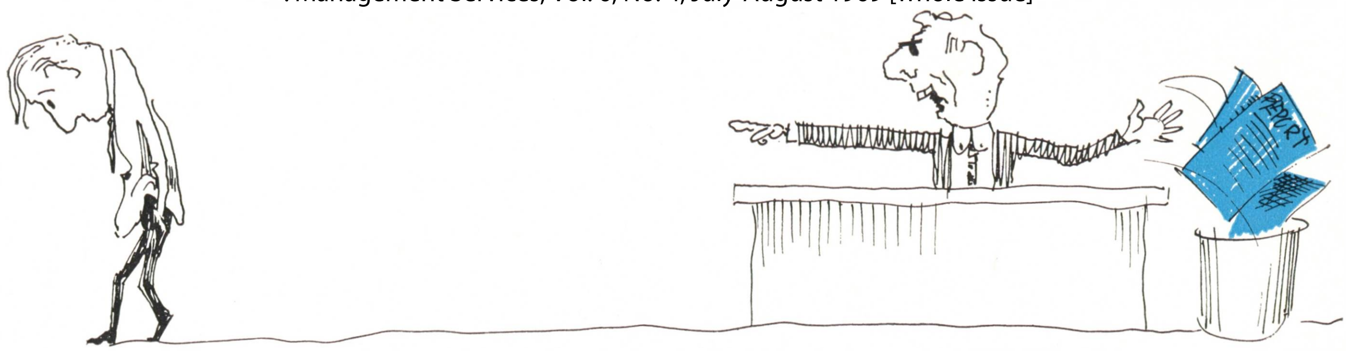
Part One, Section One, the Purpose of the System, provides the manager and the systems designer with the system purpose. This section provides an integrating point for the manager to judge the worth of the system: How well does the planned system serve its own purpose? Placing this integrating point first on the report keeps the purpose that the system is trying to fill paramount in everyone's mind.

Part One, Section Two, Parameters of the Problem, indicates the type and scope of the data to be processed. An examination of the parameters will indicate the important variables whose absence may endanger the validity of the results. A parameter may have been overlooked by the researcher. Putting the information in this format makes it likely that any missing parameter will be discovered long before programing begins. If the researcher is aware of the missing parameter but has not yet established it, that fact will be shown in this section. The manager thus has another basis for judging the worth of the system: Are all parameters well thought out and adequately defined? If the answer is no, the researcher cannot logically expect his system to meet his needs.

Part One, Section Three, Sources of Data, indicates whether the data will meet the requirements established by the Parameters of the Problem. If the sources of data are poor, the validity of the end product is seriously in question. Is



The systems representative has flagged holes. The designer can ask the user specific questions on the basis of these flags.



When errors are discovered too late, the user complains, "It's the programer's fault," while the programer argues back, "You didn't say what you wanted."

it an integrated system that completely fills the requirements of the problem? How much does the user know and expect from data processing? If he knows too little and expects too much, he may not be able to communicate with the systems man, or he may be unable to accept data processing definition techniques that could be helpful in creating a more purposeful system. By analyzing this section, the manager has a final basis for judging whether the system can fill the needs of the user: Are the sources of data reliable? Will they give meaningful, representative data, or will we get garbage in and, as a result, fail to meet the ends sought by the system?

Part Two, Systems Design/Programing Information, Section One, Output Analysis: What does the desired output look like? The system designer can judge this output against the purpose of the system to see if it is compatible with the requirements. By placing the output first in Part Two, the system designer can keep the end result sought firmly in mind.

Part Two, Section Two, Input Analysis: What does the data base look like? What documents will be submitted by the user? How will they be converted to machine-readable form? How are the fields tied to the results desired? By studying the Input Analysis, the designer may meaningfully relate the purpose and the parameters to input and output.

Part Two, Section Three, Process: How do the data flow through the system? This section ties inputs to outputs. Process provides the designer with major decision points and computations in the system. It shows the relationships among the results sought and the input. If any portion of the data base fails to relate to the output desired, that is documented here.

No loose ends

This document is the basis for discovering missing inputs, parameters, or interrelationships. "Missing links" are now obvious to any reader at the outset. There are no loose ends to tie together at the last moment when programing changes would be costly and frustrating.

By organizing through the Systems Folder the systems man can see loose ends and ask the user specific questions. When a system is defined this tightly, there is considerably *more plan* with *less aimless action.*

The only alternative to a well defined approach is systems design and programing by crisis. In this instance, programing is done from the top down. The programs are then compiled and debugged. Output is then corrected and returned to the user for reprograming. Errors are discovered too late; then time is wasted in fault-finding. The user complains; "It's the programer's fault." The programer argues, "You didn't say what you wanted."

What are the implications?

Programers' professional needs are to be vitally involved in resolving a problem that is interesting and complex in and of itself. They are only secondarily interested in making certain that the user has communicated his needs properly. As a result they may not be aware of the true requirements of the user.

The user, on the other hand, is so completely involved in his project that he often fails to define requirements that are quite obvious to him yet quite obscure to the data processing group.

Problems of definition have to be solved, regardless of who is found to be at "fault." These problems can and should be avoided. The net loss is to the entire organization, not just to the user group or the data processing group.

In the last analysis, when the organization as a whole loses no group within it wins.

There is no one at "fault" who "causes" a crisis. Crisis situations result from the usual lack of communication between any two disciplines. Crises are prevented through understanding. Understanding is created through effective communication.

The systems man and his tool, the Systems Folder, help create the communication that is needed to cut the interdisciplinary understanding gap.

Mechanization of accounting functions permits use of a single item of data for a number of purposes. Here are some suggestions for the use of common data through a wide variety of uses in business—

INTEGRATED DATA PROCESSING IN BUSINESS ACCOUNTING

by Rainer R. Schultheiss
Management Consultant

THE AIM OF integrated data processing in business accounting is the optimum combination of individual functions, i.e., financial accounting, costing, payroll, stock control, investment accounts, statistics, planning, and management.

In a materials costing program, for example, integration of data processing demands not only that the costing should be carried out consistently and that summary stock and flow lists should be prepared but also that the same program should create output data that can automatically be used for

1. financial bookkeeping for entries in appropriate accounts
2. costing to establish the curve of operational costs
3. statistics for grouping materials used according to type, methods of production, or cost
4. planning for analysis of different types of material.

The output may also be in a form suitable for specifying or automatically printing orders. Integration may have the further meaning that these operations are carried out in the same program, depending on the requirements of the particular undertaking.

Types of integration

We must therefore endeavor in the statement of functions to set up the accounting headings so that there are minimum duplication and maximum use of all input data. As a matter of fact, the extent to which this double aim is achieved is the measure of functional integration.

Mechanical integration, in contrast, aims to carry out simultaneously, so far as is possible, the separate stages of data processing, whether input, output, or internal computation. Success in mechanical integration depends on the type of configuration of the data processing system being used. For example, extensive sorting and collating operations are needed to extract data from conventional punched card machines, and separate processes are necessary for calculation, printing, and punching. With the introduction of punched card computers, on the other hand, these operations can to some degree be carried out simultaneously.

With automatic data processing installations using magnetic tape units and/or magnetic disk storage, mechanical integration reaches a still higher level, particularly through the economy in sorting and collating operations that results from the availability of larger memories and through the possibility, available in many modern systems, of running several programs simultaneously but independently of each other with common data.

Computer essential

The problems of mechanical and functional integration are, of course, intimately connected. It is seldom possible to handle the costing of materials and their specification on a properly integrated basis with a conventional punched card installation. The two can be functionally integrated only with the help of mechanical integration through a computer system.

No integrated system is eternal. It must be modified whenever the pattern of requirements or the available data processing systems or both are substantially modified. There is no such thing as optimal functional or mechanical integration once and for all.

Economic operation of the accounting system calls for analysis of the relationships among individual programs and their organization in such a way that the information needed for a particular program—and the results yielded by it—may be used for as many other programs as possible. Substantially increased efficiency can be obtained by using a single input of data in different ways in different programs. The relatively high cost per individual program of preparing data, in punching cards, for example, can be reduced if more programs can be constructed to use the same cards.

Costs

Unfortunately, the cost savings that can be achieved through the integration of data processing are difficult to quantify. It can be said, however, that the accounting system will operate more economically

- with a higher value of information output for a given expenditure on data preparation, transport, and processing and
- with a lower expenditure on these data operations for a given value of information in a desired limited form.

This proposition often facilitates decisions in practice. Suppose that, in the example of the material program cited earlier, it is proposed to calculate and print out future orders. Against the costs of reprograming, a trivial increase in card punching, and some minimal increase of machine operating time can be set a reasonably concrete value of information: Orders will be geared to requirements, minimizing risk of interrupting production; the most favorable order quantities can be calculated in each case; the possibility of exploiting rebates on substantial orders is enhanced; the workload of the purchasing staff will be reduced; etc.

The first requirement, therefore, is understanding and utilization of the functional interdependencies among the individual parts of the accounting system.

Interdependencies

To make use of interdependencies in the context of functional integration it is first necessary to recognize them clearly. To take an extreme example, it would be disastrous if the identities of sales representatives were omitted in invoicing details when there might be need, either now or later, to develop statistics on sales of products by sales representatives.

It is unwise to look too far ahead in introducing data processing systems in management accounting. In practice, however, all too often, because of ignorance of functional relationships and mechanical possibilities, attention is devoted only to the kinds of exploitation of information that are already in use—sometimes not even to all of these.

An important principle to be observed in the introduction of data processing systems is that the specification and construction of input should be planned in such a way that advantage can be taken of the maximum number of possibilities for exploiting individual data. Existing uses of information should be examined in terms of their necessity and their appropriateness to the purpose, and possible future requirements for information should be allowed for to the extent that is possible and economically acceptable.

The ancient principle, moderation in all things, applies to functional integration of data process-

RAINER R. SCHULTHEISS has his own management consulting firm in Stuttgart, West Germany. He studied economics and industrial engineering at the University of Karlsruhe and received his technical diploma there in 1965. Mr. Schultheiss is the author of two books and some thirty periodical articles, many of them on automatic data processing, and is a member of several technical societies.

Table of Functional Interdependen

Routine Programmes

		Book-keeping 1		Statistics 2		
Sales (S)	In	m(F11) S51	In	m(items) (items) Card index of items S51	In	
	S 1	Accounts Receivable	S 2	S 21 Orders entered Orderbook position; S 22 Turnover	S 3	S
	Out	Register of Accounts Receivable Statements of Account Sales Tax Records Bonus Records Commission Lists (Commission allowance on payments received)	Out	Statistics under:- Types of Customer Market Areas Types of Products Costings; As on left	Out	Ty Ma
Labour (L)	In	π aR Card-index of Staff	In	m(order) L1 aR Order Index (Order)	In	
	L 1	Wages and Salaries	L 2	L21 (Est.) Wages and Salaries; L 22 Work Performance	L 3	
	Out	Payslips (Gross, Net, Deductions) Payroll Records Coin Tallies Deduction Lists Pay Accounts	Out	Statistics under:- Methods of Payment Working Groups (personal records) Costings; Statistics of:- Types of Work Types of product Costings	Out	Su an ne
Plant (P)	In	L2 P2 M1 F12 Past records of plant	In	m(order) P1 aR Order Index (Order)	In	m
	P 1	Assets (Book values)	P 2	P 21 Assets (Est.); P 22 Use of Plant	P 3	P 31 Pl
		Stock in hand Stock movements (incl. internal production) Land and Capital Tax Records	Out	Statistics of:- Est. Depreciation Est. Residual Value Est. Taxes by Cost attribution and types of plant; Statistics of:- Types of Plant Types of Product Costings	Out	Survey number for eac
Materials (M)	In	m(Materials) F12 Materials Index (Materials) Index of old Materials	In	M1	In	m
	M 1	Materials	M 2	Materials	M 3	Pla
	Out	Materials on hand Movements of Materials Lists of Materials entering	Out	Statistics under:- Types of Materials Types of Products Costings	Out	Plann tities
Finances (F)	In	m(S51) L 1 S51	In	F11	In	m
	F 1	F 11 Day-Book; F 12 Creditors	F 2	Records of Payments in	F 3	Fin
	Out	Day-Book Payments In Payments Out; Register of Creditors Statements of Account Lists of Balances	Out	Statistics under:- Payment Targets Discounts Bonuses	Out	Plan Payme Payme
Summary (Sy)	In	m F1 S 1 L1 P1 M1	In	m P2 S22 M2 L2 Sy3 Costings Index Orders Index	In	Sy2
	Sy 1	Financial Book-keeping	Sy 2	Sy 21 Operational Costs; Sy 22 Audit	Sy 3	Over
	Out	Main Accounts Gross Balances Turnover/Assets Accounts	Out	Curve of Operational Costs Output records; Audit Stocks of finished, semi-finished goods	Out	Deb Esti List

Notes
In = Input of data units: S1, L 2, M 4, Sy 22, etc = Programme designation
Out = Output of printed lists and data units, which appear as inputs to other programmes (m) =Dat
m(...) = Part of the required data can be taken over automatically, either from bole indexes (e.g. Ite
S51 = Input data units, registered automatically from other programmes (e.g. S 51 in invoicing prog
aR = Input data units, registered automatically (e.g. time - clocks for attendance, vehicle load.

: Management Services, Vol. 6, No. 4, July-August 1969 [whole issue]

he Accounting System				
lanning 3		Disposition 4		Other Related Programmes 5
S2	In	S 2/3, L 2/3, P 2/3, M 2/3	In	m(Item) Customer Index Item Index; S51, F11 Customer Index
nning	S 4	Deployment of Sales	S 5	S 51 Invoicing; S 52 Reminder
Surveys by:- Customer reas roducts	Out	Confirmation of Orders (where relevant) Deployment of Travelers and Publicity Resources	Out	Preparation of Delivery Advice Preparation of Invoices Goods Dispatched; Preparation of Reminders
L22 Staff Index	In	S 2/3, L 2/3, P 2/3, M 2/3	In	L1; Staff Index
our uirements; L 32 Labour redundant	L 4	Deployment of Labour	L 5	Wage and Salary Accounts
of types ers; Surveys of types and sections	Out	Job - cards Job - lists	Out	Preparation of Pay cheques and Remittances
P22 Plant Index	In	S 2/3, L 2/3, P 2/3, M 2/3	In	as required
ired; P 32 Plant abandoned	P 4	Deployment of Plant	P 5	Investment Calculation; Preventive Maintenance
e and eeds tion; Survey by type of plant and sections	Out	Job - Cards and Lists of Personnel engaged	Out	Rates of Return Forecasts of effect of investment needs on liquidity (Financial Planning); Inspection or Maintenance Plans Lubrication Schedules Replacement of Parts
S 3, M2	In	S 2/3, L 2/3, P 2/3, M 2/3	In	m; M4
of requirements of materials	M 4	Distribution of materials	M 5	M 51 Ordering Suppliers Index Materials Index; M 52 Reminder Supplier Index
rveys by types and quan- terials and by sections	Out	Delivery cards or transport vouchers for movements within the organisation	Out	Preparation of Orders Statement of Orders
L3, P3, M3	In	S2, F2, L 2/3, P 2/3, M 2/3	In	F4; Suppliers Index
lanning	F 4	Payments Schedules	F 5	Payments
veys by:- in out	Out	Notifications of payments	Out	Preparation of means of payment
L3, P3, M3	In	S4, L4, P4, M4	In	as required
Plans	Sy 4	Progressing and Delivery Date Plans	Sy 5	Statistical Quality Control
d Credits Forecast ng projects	Out	Survey of Delivery Dates (and progressing)	Out	Control Plans or Surveys Control Directions Records of Control Results

its prepared manually.

ndex) or from the other programmes (e.g. Day-Book provides some data for the Accounts Receivable). Programme origins or index origins shown in brackets.

).

e details can be punch-carded directly).

Published by eGrove, 1969

ing. To attempt a move into a highly integrated system on the first introduction of ADP would be just as stupid as to overlook the possible advantages to be gained from using functional interdependencies.

The golden mean

In any case, prudence in approaching integration is advisable in view of the relatively severe demands it makes on the management and organizational ability and understanding of many employees. Highly integrated systems, for example, those in which a closed loop can be set up from the initial orders and their modifications through production to invoicing, costing, and bookkeeping, quite simply demand too much from employees for it to be possible to begin at that level. Few people can grasp the totality of relationships within a highly integrated system immediately. Thus, the usefulness of such systems would perforce be small at the outset. An additional problem is the continual emergence of need for modifications, for in large programs a "chain reaction" can be built up, and substantial expenditure of time is required.

Moreover, the greater the degree of integration the more serious are the consequences of a stoppage of the ADP system, whether because of a program error or because of late arrival of data at the computing center. The result of such a stoppage may be an appreciable interruption of processing, with an inevitable reduction in the profitability of the system.

For these reasons it is absolutely necessary in practice to make a modest beginning in integrating data processing to gather experience and then to raise the level of integration only gradually and with an eye to economy and to balancing the risks.

The golden mean is not easy to find. It is most important for all individuals in management concerned with ADP to have an adequate understanding of it because active cooperation and constructive proposals can be expected from those concerned only when they have an overall picture of the ramifications of different functions and the methods being adopted. So long as employees persist in their own personal interpretations of their jobs, taking no account of the changes introduced by the ADP system, such psychological obstacles as distrust and fear of job loss will inhibit cooperation.

Functional interdependencies

The table on pages 32 and 33 shows the programs for all functions of the accounting system and for a part of the areas related to it. Input and output information can be easily identified. The triangles indicate functional interdependencies where the input data units arise automatically from other programs. The figures in each triangle refer to the program of origin.

The layout of the table expresses the interdependencies among the programs in the accounting system in two different ways:

1. The division by program function shows which data units are required for a particular program and their origin.

2. The division by data unit function shows to which program in the whole system one particular data unit provides the input.

An important advantage of the layout is in its systematic divisions. The horizontal divisions by sectors of the accounting system (bookkeeping, statistics, planning, and distribution of resources) and the vertical divisions by sectors of production mean that related programs can be shown side by side. These relationships suggest that it can be useful to construct a multiple program out of several related programs. For example, the vertical grouping of programs for the planning of labor force, plants, and materials in one multiple program may provide all the basic details necessary for the management of the production process, provided that the operational requirements are simple enough to be accommodated in a single program.

Such a grouping of programs usually saves data processing time. However, the storage and computation capacity of the machine and the types of input and output equipment must be such as to permit such multiple programs.

The table also can be used to determine which data for nonroutine decisions may be obtained from individual routine programs in the accounting system. Thus, the reject figures registered in the output program may provide an essential basis for quality control; the past or foreseeable records of peak capacity may be used for calculations of investment; etc.

In principle, the table can be applied to operations of any size. Individual programs, however, differ in scope and weight, depending on the individual relationships within a given undertaking.

The table may also be helpful in cases in which a fundamental decision about the introduction of computer systems is being considered, for example:

- when a computer system is to be introduced into the company for the first time
- when an existing punched card system is to be converted to automatic data processing
- when an existing computer system is to be extended to cover new functions.

Integration and organization

The present-day aim of integration is to achieve the greatest possible mutual matching and definition of present and prospective areas in which information has to be handled, using appropriate and economic data processing systems, whether already installed or available on the market.

The integration of data processing will yield valuable returns only, of course, where its use can be extended throughout the whole organization.

Adapted from a speech given before the AICPA Fifth National Conference of Computer Users, held in Chicago in May. The Conference itself will be covered in the September-October issue—

SYSTEMATIC TECHNIQUES FOR COMPUTER EVALUATION AND SELECTION

By John R. Hillegass
Computer Conversions, Inc.

As you all know, there is a very wide variety of computer equipment and supporting software on the market today, with dozens of suppliers contending for your hardware and software dollars. You've probably heard more than one computer user say that it's all pretty much alike, and that there are few, if any, significant differences in the capabilities and features of the equipment and software available from the various manufacturers. On the basis of our own experience in equipment and software evaluation, we can say with great conviction that this simply isn't true—and chances are that the user who thinks it is will be spending a lot more money than he should to get the computing power he needs—as much as thousands of dollars more each month.

Among the available computers in any given class, there are very significant differences in their performance per dollar and their overall suitability for specific applications. Therefore, the use of systematic, objective procedures for computer evaluation and selection can save you and your clients a great deal of time and money. Moreover, it can guard against the serious disruptions that are occurring in all too many firms these days as a result of the installation of an inadequate computer.

Nothing would be more pleasing than to be able to tell you all about a simple, foolproof technique that would guarantee selection of the most suitable computer system for your needs. Unfortunately, no such technique is available today, and none is expected within the foreseeable future. The development of such a technique simply has not been possible—despite the great demand for it—because of the many nonhardware factors that have an important effect upon overall computer performance and economy but are extremely difficult to pin down in any quantitative manner, factors such as compatibility with your present equipment, expandability to handle new applications, ease of programing, quantity and quality of the manufacturer's support, availability and quality of maintenance service, back-up considerations in the event of equipment failure, and many more.

There are, however, a number of techniques available today that can aid very significantly in determining the most suitable equipment and software for your particular needs. This article will describe briefly some of these techniques and tell you about the advantages and drawbacks you can expect from each of them. It might be worthwhile to keep in mind that tht ideal computer evaluation technique would be easy to apply, inexpensive, comprehensive (in that no significant factors are overlooked), and totally valid (in that it always leads to the correct conclusion as to the most suitable hardware and software). Now let's see how close each of the available techniques comes to satisfying these criteria.

Standard benchmark problems, as featured in the widely used Auerbach EDP reference services, are designed to be representative of typical computer workloads in both business and scientific applications. The problems include file updating, sorting, matrix inversion, and polynomial evaluation.

Instruction mixes

First, there are the *instruction mixes.* To compare central processor speeds, several weighted mixes of instruction execution times have been developed.[1,2] Probably the most popular one is the Gibson Mix, originally developed by the Air Force. Each of these mixes is simply a weighted average of the execution times for a number of the most commonly used instructions. A weighting factor is assigned to each instruction in accordance with somebody's opinion of that instruction's frequency of occurrence in programs of a certain general type.

Instruction mix times are easy to calculate and compare, but they can only measure central processor speeds. Furthermore, these methods ignore the facts that the frequencies of different types of instructions vary widely in programs for different applications and that a single specialized instruction in one computer may be able to perform functions that require several of the basic instructions in other computers.

For the scientific computer user who applies them with due caution, instruction mixes can provide useful approximations of raw computing power. But for the business computer user who needs balanced computing and input/output power, they are likely to be misleading and virtually useless.

Second, there is the so-called *kernel* approach. A kernel is a simple problem, presumably representative of typical business or scientific computer applications, that is coded and timed for each of the computers under consideration.[1,2]

Kernels permit each computer's internal instruction repertoire to be used to best advantage, but, like the instruction mixes, they generally ignore input/output considerations and software performance factors. Moreover, it is usually difficult or impossible to relate the times for an assortment of kernels to a given user's real data processing applications.

Third, there are *standard benchmark problems,* as featured in the widely used Auerbach EDP reference services.[3] These standard problems are designed to be representative of typical computer workloads in both business and scientific applications. The problems include file updating, sorting, matrix inversion, and polynomial evaluation.

To help ensure objective comparisons, the standard problems are rigidly specified in terms of input data, computations, and results to be produced. On the other hand, factors such as master file arrangement and detailed coding methods are left flexible to permit optimum use of the distinctive capabilities of each computer. Finally, to assure realistic comparisons between competitive systems, the equipment configurations as well as the problems are standardized. Each computer's performance is measured in a number of different standardized configurations.

The execution time for each standard problem on each standard configuration is determined by calculating all input/output times and central processor times and then combining them with due regard for the system's capabilities for simultaneous operations. The results are presented in the form of graphs that show each computer system's performance over a wide range of problem parameters and equipment configurations.

These standard benchmark problems can give you a good idea of the overall performance characteristics of competitive computers on applications similar to your own. It is not always easy, however, to relate the standard problems and standardized equipment configurations to your own particular problems and equipment needs. Moreover, the important effects of software performance and of advanced operating techniques such as multiprograming, time sharing, and data communications are virtually ignored.

Fourth, there is an even more widely used type of benchmark problem which may be called *"live" benchmarks.* These are problems, designed to be as representative as possible of a specific user's workload, which are actually programed, compiled, executed, and timed for each of the computer systems under consideration.[4] Live benchmarks provide an excellent opportunity to observe each computer system's overall performance, including the effects of input/output simultaneity and software inefficiencies. They can also tell you a great deal about the ease or difficulty of programing and operating each system.

Drawbacks

There are three main drawbacks associated with the use of live benchmarks. First, they tend to be comparatively time-consuming and expensive to prepare. Second, it may be impossible to conduct live benchmark tests when the interest in a new computer system is highest—immediately after its introduction. Third, and most important, it is usually very difficult to accurately estimate a computer's overall performance on a user's entire workload on the basis of its performance on a few simple benchmark problems—particularly where the user has a wide range of applications or where some of these applications involve data communications or multiprograming.

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The fifth evaluation technique is *computer simulation.* This involves the use of a computerized model to determine the run times for predefined program runs and equipment configurations.[5] The two best known examples are Comress' SCERT (Systems and Computers Evaluation and Review Technique) and a newer technique called CASE (Computer Aided System Evaluation).

Each of these techniques consists of a complex computer program and a library of hardware and software factors describing the key characteristics of most of the commercially available computer systems. Given a series of program run specifications and a series of equipment configuration definitions, the program determines the estimated execution time for each run on each configuration. The detailed reports produced by the program also specify other useful information such as estimated memory requirements, programing time requirements, environmental requirements, and equipment costs.

These simulation techniques are probably the most elaborate ones yet developed to aid in computer selection. The estimates they produce appear to be generally valid for straightforward, batch-type applications but distinctly less reliable for more sophisticated operational modes such as those involving multiprograming or data communications. Preparation of the

It is not always easy to relate the standard problems and standard equipment configurations to your own particular problems and equipment needs. Moreover, the important effects of software performance and of advanced operating techniques are virtually ignored.

detailed input specifications is time-consuming, and the techniques are by no means inexpensive to use. Moreover, no simulation technique can produce valid results when supplied with invalid data, and some of the required data regarding software efficiencies and programing time requirements are difficult, if not impossible, to obtain.

All of these computerized run-timing techniques are essentially limited to the determination of estimated running times for user-defined runs on user-specified equipment configurations. Therefore, they cannot relieve you of the basic problem of designing an effective system and finding the best complement of equipment to implement it; they can only make it a lot easier for you to investigate a large number of alternative cases.

The sixth type of evaluation technique can be referred to as the *weighted factor methods*.[6,7] A number of techniques have been developed to systematize the process of computer selection by assigning weighted point scores to each significant factor within the general categories of equipment characteristics, programing, software support, pricing, etc. An appropriately weighted score is assigned to each factor for each competing computer system. Then the scores are added up, and the system with the highest point score ostensibly is the best choice.

Weaknesses of technique

The fatal flaw here is that the factors to be considered and the weights to be assigned to them are, by necessity, chosen arbitrarily. No objective guidelines exist for matching them to a particular user's needs. It is unlikely that any two analysts, given the job of independently establishing appropriate factors and weights to select the best computer for a particular installation, would arrive at similar conclusions. The weights can easily be juggled to lead to virtually any desired result. Furthermore, there is a real danger that by the time the analyst has performed all the necessary weighting and scoring calculations, he may tend to lose sight of their shaky foundations and attach undue significance to the results, which are subject to error.

The published articles describing the various weighted factor techniques can provide convenient checklists of factors that should be considered in computer evaluation studies. But in terms of their use as objective selection techniques they should be viewed with deep suspicion.

The seventh evaluation method, the *cost/value technique,* is a variation of the weighted factor methods.[8] It represents a significant improvement over them in that it strives to establish meaningful relationships between the items of value to the user and their costs. Proposals from the manufacturers are ranked by a scheme called cost/value accounting. This involves taking the total cost of a proposed system and deducting the estimated values of all the desirable extra features included in that proposal. The difference is then considered to represent the cost of satisfying the mandatory requirements set forth in the user's request for proposals. The system with the lowest cost for satisfying the user's mandatory requirements is then judged the best choice, because the values of the desirable extra features offered have already been taken into account.

The cost/value technique is quite sophisticated and comprehensive. But, like the weighted factors methods, it forces the user to assign quantitative values to many factors for which no objective guidelines exist. Consequently, there is a very real possibility that the results will be biased and misleading.

You can see that each of these seven evaluation techniques has significant advantages and drawbacks associated with it, and each falls far short of being ideal. Some of these techniques, such as instruction mixes and kernels, deal strictly with hardware performance. Others, such as live benchmarks and simulation, introduce the important element of software performance as well. Still others, notably the weighted factors and cost/value techniques, attempt to give proper consideration not only to hardware and software but also to the many other factors which are important in computer selection, such as reliability, compatibility, expandability, manufacturers' support, and contract terms.

Since all of the evaluation techniques discussed here obviously have significant disadvantages associated with them, the picture may seem rather bleak. Fortunately, it isn't nearly as bad as it looks. It *is* possible to make objective computer selections with a high degree of confidence that the equipment and software selected will truly be the most suitable and economical choice. What is needed is a combination of one or more of the formal evaluation techniques just described with a systematic overall selection procedure and a good deal of old-fashioned common sense.

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Much of this report is taken verbatim from a staff memo of a major accounting firm, showing how it found time sharing of computer services cheaper for some work than using its own in-house machine—

TWO—FOR LESS THAN ONE

by Robert M. Smith

RECENTLY, the New York office of a major accounting firm was faced with a problem that, although not common yet, could become so in the future. The firm has long had a home-office computer at its Midwestern headquarters, used mainly for internal functions. The New York office, like several of the other branch offices around the country, used a time shared computer service, in New York's case mainly for marketing information systems or operations research projects.

However, the firm recently decided to install its own in-house New York computer. The computer, to be used for client assignments, would not be occupied 24 hours a day. Quite logically, the management group informed the operations research staff that it would have to give up its time sharing arrangements and put all projects on the in-house computer.

The operations research people naturally weren't happy. They were used to the time sharing arrangement; they were versed in the easy conversational mode of dialogue with the computer over teletype lines. The new in-house computer, on the contrary, would process data by batches rather than on a random basis; they could foresee long delays in getting their work done.

Still no one could argue with the reasoning of management. An in-house computer is expensive. Its expense is justified by the amount of work it accomplishes in a given period. Obviously, sheer economics dictated that management was in the right here; it would be more economical to use the house computer for all the projects formerly done by time sharing.

Or would it?

Some doubts existed in one staff member's mind about the pure economics of the matter, entirely aside from the question of convenience to the operations research staff. He put the question to the partner in charge of management services—if he could prove that there was no substantial saving to be achieved by using the in-office computer, could his people retain their time sharing arrangements?

The partner agreed that, if he could prove his case, the time sharing arrangements would be continued, but he made it quite clear that he couldn't see how time sharing could possibly be cheaper than using a computer the firm was already paying for, which was idle part of the time.

The text of the final report to the partner details the work that was done and the results OR came up with:

Of the work performed on the time sharing facility during the past twelve months (represented by $10,000 in charges), we estimate that only about 20% (approximately $2,000) could be transferred to an IBM 360/30 system operating in the batch mode. The balance of the work (about $8,000) would either be completed manually or be curtailed.

We have reviewed the factors associated with (1) retaining the current time sharing facility located in the New York office, and (2) consolidating all time sharing functions on the proposed IBM 360/30 to be installed in the new office location. Based on this review, we have concluded that the first alternative, retaining the current time sharing capability, but operating it at a reduced level, would be the best selection.

Many of the applications in the Marketing Information Systems and Operations Research areas are one-time limited statement programs, or make use of stored library routines, where system flexibility and user interaction with the facility are of primary importance. Fast response time and rapid system access are generally desirable in these situations. We believe that many of the applications now performed on the time sharing facility would be severely restricted or even curtailed if the only alternative were to be an IBM 360/30 operating in the batch mode.

This would occur because of increased turn-around time and the lack of rapid access.

It is not possible to operate in the time sharing mode through the console typewriter, since no conversational language is available under which this can be done. According to IBM, a batch operation is the only possibility. This requirement thus virtually eliminates user interaction with the computer system.

It will be possible to convert some of the time sharing applications now being run, or planned, to the IBM 360/30. However, reprograming will be required, but this could be scheduled as part of the training program, or as fill-in work, for the programers.

Retaining the current time sharing facility would cost a minimum of $100 per month for the service, plus $85 monthly for telephone company charges. GE time sharing charges for the past 12 months have averaged about $850 per month, all of which has been chargeable to client work. Telephone company charges of $85 monthly are not included in the GE charge.

Of the work performed on the time sharing facility during the past 12 months (represented by $10,000 in charges), we estimate that only about 20 per cent (approximately $2,000) could be transferred to an IBM 360/30 system operating in the batch mode. The balance of the work (about $8,000) would either be completed manually or be curtailed.

Major disadvantages would be experienced if we were to provide time sharing service as part of the proposed IBM 360/30 system. These would include:

(1) The need for additional equipment, consisting of a 1050 Terminal System and a transmission control unit, costing in excess of $1,000 additional per month.

(2) Because of memory limitations, the 360/30 system can be run either in the batch mode or in the time sharing mode, but can not be run simultaneously in both modes. Because of the nature of the time sharing applications, this factor could result in utilization and scheduling problems. To overcome this problem would require additional core memory and additional hardware and software features.

Training value

The time sharing facility has proved to be a valuable training device. Staffmen with limited or no experience have been able to take the two-hour programed instruction course and within one or two days after completing it have utilized the facility for solving client problems.

The IBM 360/30 to be installed in the new office will contain about 65,000 bytes of memory (core size = 65K bytes) and will have the capability of running both scientific and commercial applications. It will be under control of a disk operating system (DOS) which will allow use of the commonly used programing languages such as BAL, COBOL, FORTRAN IV, PL1, and the like.

Time sharing, on the other hand, must be run under control of the Remote Access Computing System (RAX). The RAX and DOS control systems are mutually exclusive, which means that both control systems cannot be mounted concurrently (operated in the multiprograming mode. The DOS control system will allow multiprograming, but this discussion refers to multiprograming under both control systems simultaneously).

To operate in the multiprograming mode with both control systems simultaneously would require a minimum of 128K bytes of core memory, and thus a 360/40, since maximum core for a 360/30 is 65K bytes of memory. In addition, a hypervisor (a master control system requiring both hardware and software) would be required to partition memory between both control systems. This feature would require dedicated input/output devices (dedicated either to DOS or RAX), thus either limiting the current system or requiring additional devices. Additional expense would also be incurred if a hypervisor were required.

Since there is limited need for simultaneous operation of two control systems, scheduling the IBM 360/30 computer system currently on order could be arranged so as to operate in the time sharing mode at prescribed intervals during the day. At these intervals the RAX control system could be mounted, so as to allow the use of a conversational language. This, however, has disadvantages in terms of limiting the flexibility of the staffmen using time sharing as a problem solving tool, and of tying up the computer facility. Since the control systems are mutually exclusive, the 360 system must be dedicated either to batch operation under control of DOS, or to time sharing operation under control of RAX.

The capability of operating in a conversational mode (using RAX) would also require certain additional equipment. This would include an IBM 1050 Terminal System at a base cost of about $150 per month, and an IBM 2702 Transmission Control Unit at a base cost of $875 monthly, for an additional base cost of $1,025 over the expense of the proposed system. These are minimum costs; inclusion of certain features would result in higher charges. There are also one-time charges for private line installation, but we will assume them to be minimal for this discussion.

No conversational language can be used on the 360/30 through the console typewriter. The operating system (RAX) supporting the conversational languages requires remote stations supported by equipment such as that just described (1050, 2702). Thus, any access through the console typewriter can only be made under the batch mode environment.

Another problem concerns that of the programing language. Almost all of the time sharing work in New York has been programed in the BASIC language, because of the ease of programing, the rapid learning cycle, and its very close resemblance to the English language. This experience pattern has generally been duplicated in all of our offices utilizing time sharing. The BASIC language is not available under DOS, and can only be used under the RAX system. IBM does not support BASIC, and has made it available only because it was developed for application on the IBM 360 System by one of its customers. Therefore, language improvements and programing assistance would be available only on a limited basis.

Many of our applications are experimental in nature, and are designed to test specific hypotheses or to compute answers to questions of a one-time non-routine na-

The time sharing facility has proved to be a valuable training device. Staffmen with limited or no experience have been able to take the two-hour programed instruction course and within one or two days have utilized the facility for solving client problems.

ture. The flexibility provided by time sharing, and the interaction between the user and the system, have proved invaluable in analyzing problems in considerably greater depth than would be possible using hand calculators. There are specific instances where the quality of our work has improved because the staffman has had the opportunity to ask 'what if' questions and to immediately develop answers. This interaction and flexibility would likely be severely limited operating in a batch environment, even with express runs scheduled at relatively frequent intervals. A single error condition could require waiting until the next express run, whereas under the time sharing mode, immediate action and reaction are experienced.

Applications

Obviously, certain applications currently run on time sharing could be reprogramed and transferred to the IBM 360/30 system. Other applications, however, would be severely restricted and would in all likelihood be curtailed. Examples of each are given in the following sections:

A. *Applications Transferable to the IBM 360/30 System*

Some of the programs that have been developed for the Tax Division can readily be scheduled for running on the computer when required. Examples are:

(1) *NOTBOP, NOTSOP* (Net of Tax Bank Option, Net of Tax Stock Option). These programs deal with deferred executive compensation where the cash is put into a bank or given in the form of restricted stock, to result in lower tax payments.

(2) *PARDIS* (Partnership Distribution). This program distributes totals such as income, credits, deductions and the like according to the percentage share of each partner.

Additional programs can be listed but the examples serve to illustrate the type of short programs that can be run on a prescheduled basis. In each case significant reductions in staffman time have been experienced, thus illustrating the advantage of mechanization.

B. *Applications Not Readily Transferable to the IBM 360/30 System*

The examples shown here illustrate the type of applications which require considerable flexibility and for which the availability of the time sharing service has proven to be particularly useful.

(1) ——— ———— — We were asked by ————, ——— ———— to prepare a series of cash flow schedules as part of a capital expenditure evaluation. Initially we considered the use of time sharing marginal since approximately four man days were required to prepare the programs and develop a solution—about the same time as a manual effort would require. Subsequently, however, a number of 'what if' questions were posed to us, so that the programs were extremely useful in reducing both response time and the amount of staff time required to prepare the additional answers.

(2) ———— — This work involved a considerable amount of discounted cash flow analysis, as well as certain marginal analysis pertaining to the best planting and harvesting cycle for an agricultural product. This work was performed on the time sharing system because of the rapid response and the numerous alternatives requiring analysis. Many of these alternatives were not evident until the work was under way—a condition frequently encountered in research projects of this nature.

Again, other examples could be cited. It would be possible to perform some of this work in a batch operation but keypunching cards and waiting to get results from the run make this option considerably less attractive than the flexibility and interaction experienced in an on-line system.

The case rests

This was OR's case. No one would have argued that their type of work could be handled as well by batch processing as by remote access processing. Yet a little investigation had proved quite conclusively that adding the equipment necessary to make the in-house computer adaptable to remote access as well as batch processing would have cost a minimum of $1,025 a month as compared with the firm's average cost for the time sharing installation. This over a year's period had amounted to $10,000, or an average of about $850 a month. In addition to this cost, there were charges of $85 a month for telephone charges and equipment. The total was still far below the cost they would have assumed if they'd adapted the 360/30 so that it could handle both batch processing and remote access processing.

And they faced none of the delays that would have occurred if they'd had to use their own machine with added equipment that would have had to be rotated periodically.

Needless to say, management was astounded but convinced. The OR suggestion was adopted; the specialists have converted some of their work to their firm's 360/30; but the pure operations research questions, the ones that generate a whole series of 'what if' questions, remain on the time sharing installation, at a saving to the firm in out-of-pocket costs and an incalculable saving in staff time.

Lack of staff specialization often handicaps the small company, preventing it from trying advanced methods of deciding between alternative investment opportunities. Here's a simple method that can be used effectively by such concerns—

A METHOD OF INVESTMENT EVALUATION FOR SMALLER COMPANIES

by Bernhard Schwab
University of British Columbia

and Helmut Schwab
Canoga Electronics Corporation

In our competitive economy the efficient use of productive resources, and specifically of capital, is vital to the survival and success of a firm. The theory of capital budgeting has been developed rapidly in recent decades, making available to management a number of sophisticated tools for investment evaluation.

However, comparatively few of these tools so far have found their way to widespread operational application.

This is particularly true for the smaller companies, and yet it is these companies which often operate under the most severe competition and for which, therefore, efficient allocation of capital resources is most essential. With the increasing complexity of today's business environment, even the decisions faced by a small company attain a degree of intricacy that generally makes intuitive solutions at best suboptimal.

A number of reasons can be given for this paradox, among them lack of awareness and lack of management education. Perhaps the most important reason is the objection on small-company management's part that most of these "academic" tools involve such complicated analysis that their application is not feasible in the small organization that cannot afford expensive staff specialists. This article, based on a successful implementation of a sophisticated yet operational procedure for investment evaluation in a small company, seeks to show how small companies also can make use of and benefit from today's more advanced methods of capital budgeting. It gives a brief review of some basic elements of modern capital budgeting theory and then presents a proposed scheme for operational implementation of these ideas.

Return on investment

Total return per dollar invested (along with various closely related criteria such as average annual return per dollar invested and total profit per dollar invested) is probably still the most widely used criterion for evaluating business investments today. The total return which an investment will yield over the years is simply added and then divided by the intial investment. Thus, an initial investment of $10,-000 which will yield an annual re-

TABLE COMPARING DISCOUNTED RETURNS FROM TWO PROPOSED INVESTMENTS

	Year	1	2	3	4	5
Proposition 1	Initial investment	$10,000				
	Return		$8,000	$6,000	$1,000	$0
Proposition 2	Initial investment	$10,000				
	Return		$4,000	$4,000	$4,000	$4,000

. . . the first major adjustment which should be made by a firm in computing the total return per dollar invested is the inclusion of the time value of money, thus computing the present value of total returns in relation to the present value of initial investment.

turn of $2,000 for eight years will result in a total return of $1.60 per dollar invested.

A major shortcoming of such an approach is that it does not take into consideration what is called the time value of money. A dollar today is worth more than a dollar a year from now; if nothing else, the dollar which we have today can be put in a bank, and interest can be collected on it. The time value of money can be included in the analysis by discounting future costs and benefits to yield what is called their present values.

Assume that a company has the opportunity to invest money at an annual rate of return of 15 per cent: $10,000 invested today would grow to $11,500 a year from now, to $13,200 two years from now (compounding the interest), etc. Hence, the firm would be equally well off receiving $10,000 today, $11,500 a year from now, or $13,200 two years from now. In effect, the present value of $11,500 received a year from now is $10,000, and so is the present value of $13,200 received 2 years hence.

Discount rate

The rate of return which we used to derive these present values is called the discount rate. Generally, if we call the discount rate k, the present value of income n years from now is given by the standard compound interest formula to be:

$$\text{Present value of income n years hence} = \frac{\text{income n years hence}}{(1+k)^n}.$$

Extensive published interest tables are available to derive the value of $(1 + k)^n$.

The discount rate generally represents the "alternative opportunity rate," i.e., the average annual rate of profit per dollar invested available to the firm as an alternative to the investments actually undertaken. As we saw, a company can always put its money into the bank or buy short-term paper to earn an annual profit of 6 per cent. In most cases, however, for a healthy company the discount rate (i.e., the alternative opportunity rate) will be considerably higher; the company may actually forego investment opportunities yielding 10 per cent and higher simply because it has enough opportunities yielding above 15 per cent to fully utilize its management and capital resources.

Since the discount rate is based on the alternative investment opportunities, it clearly varies from one company to another;[1] furthermore, it will vary over time as the general climate of investment opportunities varies in any dynamic business environment. Consequently, a company will use an average discount rate to eliminate short-term fluctuations due to the ran-

[1] One can generally say that, other things being equal, the higher the alternative opportunity rate the better the performance of the company's management in locating lucrative investment opportunities.

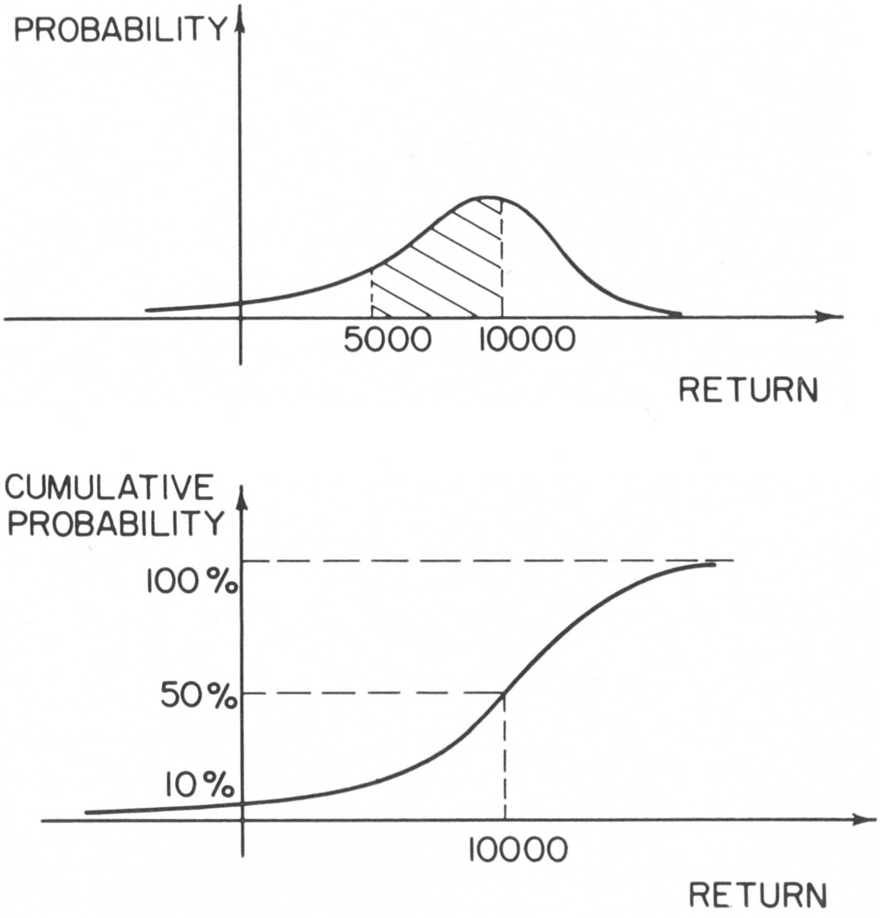

FIGURE 1
Probability Distributions

dom nature of the availability of investment opportunities; however, it will adjust this average periodically to reflect major changes in the general business environment, such as major changes in the industry or in the general economy.

Hence, the first major adjustment which should be made by a firm in computing the total return per dollar invested is the inclusion of the time value of money, thus computing the present value of total returns in relation to the present value of initial investment. For example, consider the two investment propositions described in the table on page 44.

The total returns per dollar of initial investment are 1.5 and 1.6, respectively; hence, by this criterion, Proposition 2 should be preferred. However, considering the time value of money and assuming a discount rate of 15 per cent, the present values of total returns per dollar invested are 1.06 and 1, respectively. We see that now Proposition 1 is the more desirable. The reason for this reversal in preferences is that in Proposition 1 the returns accrue at an earlier time; they can be reinvested immediately, thereby accumulating additional benefits.

Risk

Another major weakness of the standard return on investment criterion is its failure to account for the uncertainties inherent in any business forecast and hence in any prediction about the profitability of an investment. If we say that an investment of $10,000 will yield total returns of $15,000, we do not really mean that this return will be guaranteed. Rather, we may mean that the probability of achieving a return of $15,000 or better is 70 per cent. However, there may be a probability of 10 per cent that we will achieve no positive return at all, thus losing the initial investment of $10,000.

A manager is generally concerned not only with some expected return of a proposition but also with the risk inherent in it, in particular the risk of substantial losses. Hence, a manager should analyze investments in probabilistic terms. Thus, he may wish to know in the above example what the probability is of incurring losses rather than making a positive return, with what probability a return of at least $10,000 will be achieved, or what level of returns will be achieved with a probability of 80 per cent. Such probabilistic assessments are best conveyed in the form of graphs such as those shown in Figure 1 at left.

Both parts of the figure convey the same information in slightly different form. Thus, it is generally a matter of taste and convenience which of the two one wants to use. The upper graph in Figure 1 gives the probability of returns' falling within a certain range. This probability is simply proportional to the area under the curve within

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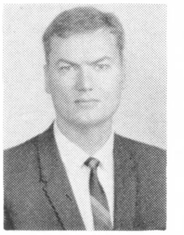


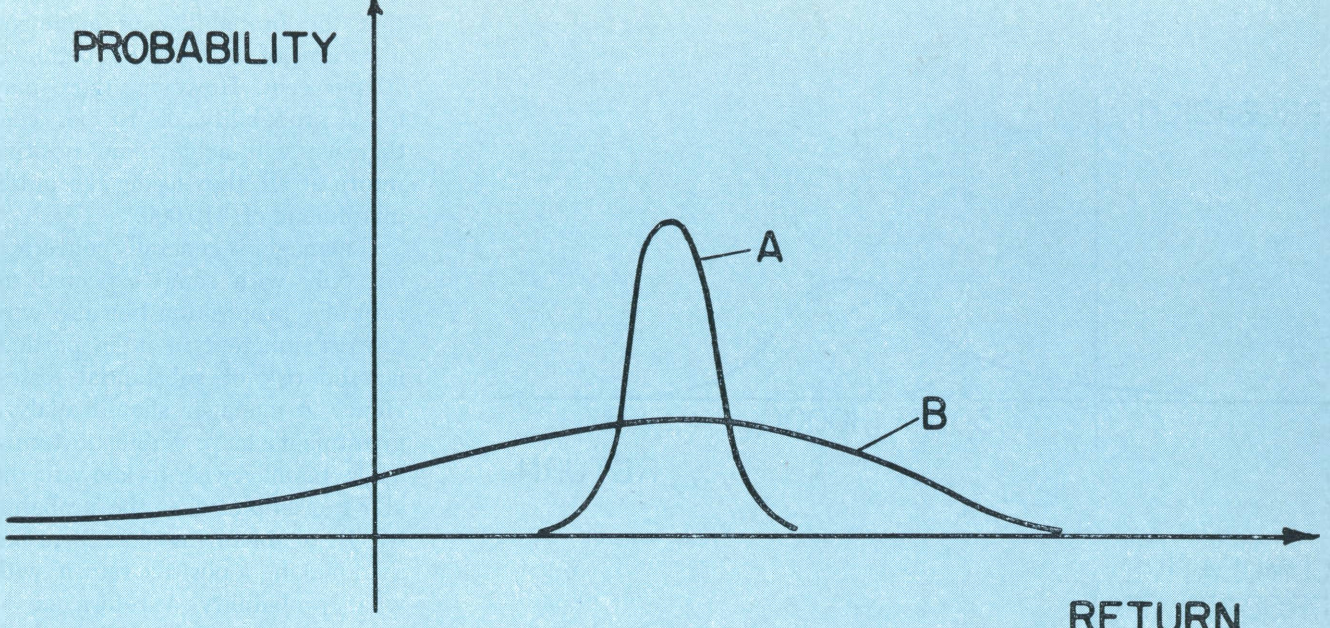


FIGURE 2
Comparative Probability Distributions

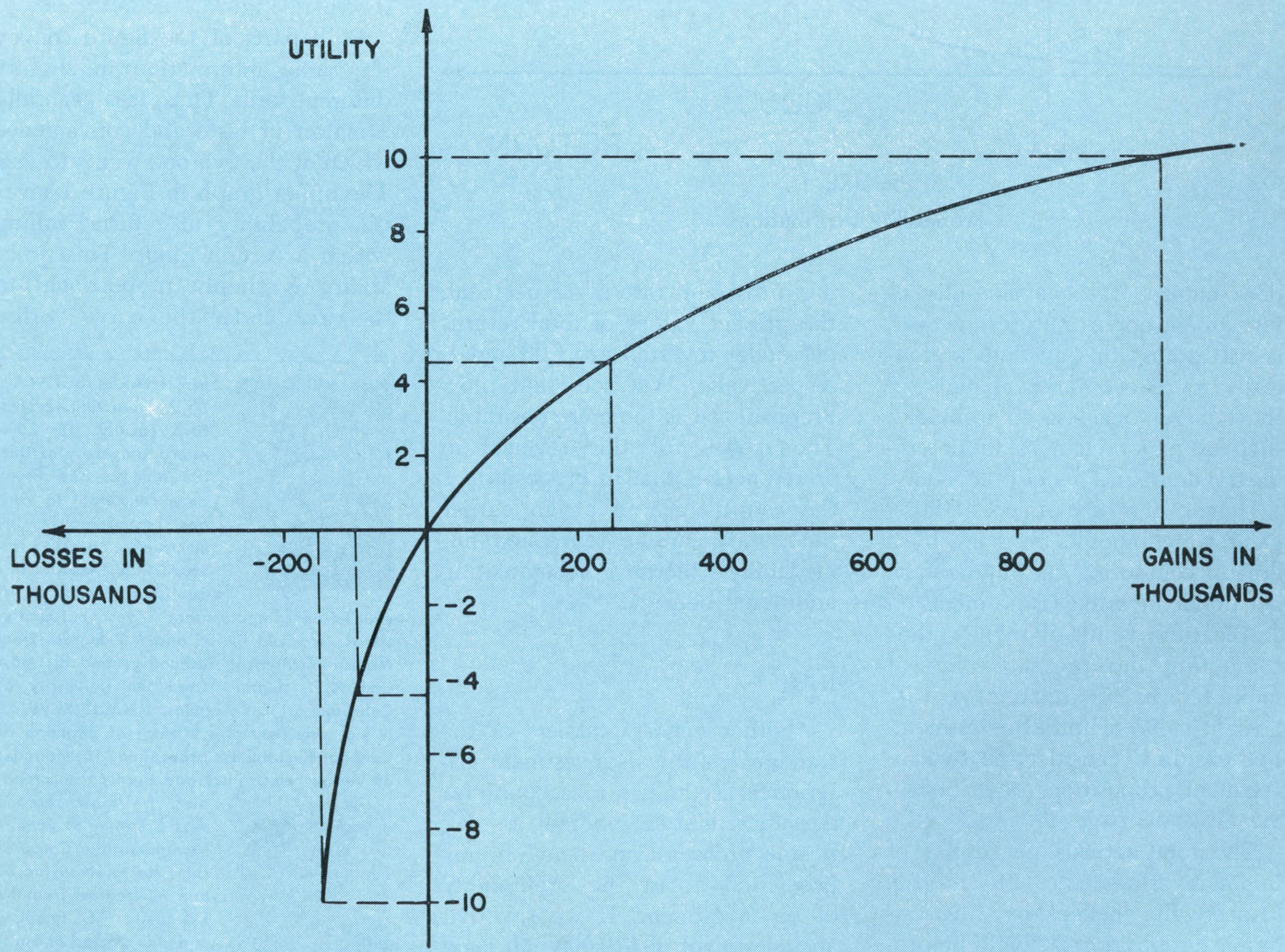


FIGURE 3
Utility Curve

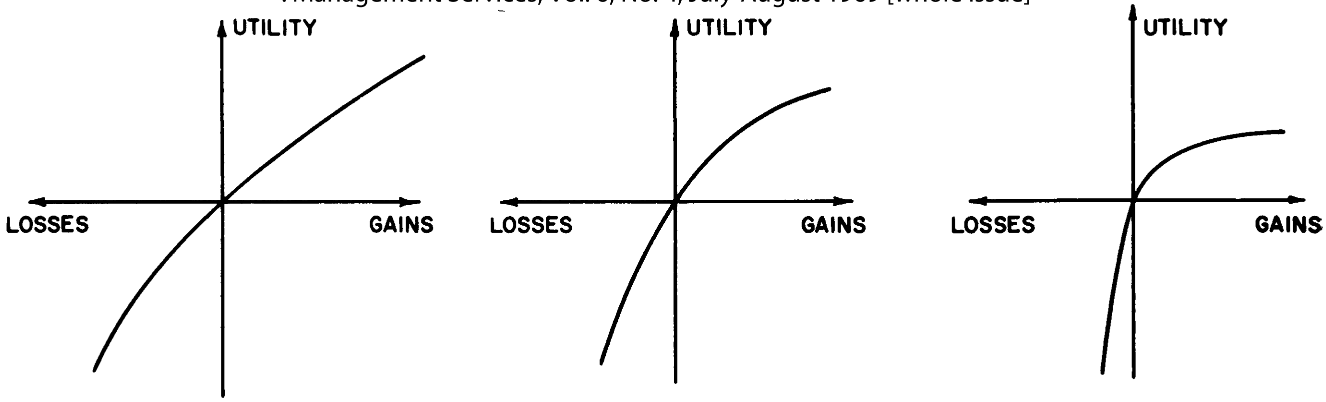


FIGURE 4
Comparative Utility Functions

the range (e.g., the shaded area in the upper part of Figure 1 represents the probability of returns' being between $5,000 and $10,000). The lower graph in Figure 1, called the cumulative probability distribution, gives the probability of returns' falling below a certain limit (e.g., according to this graph, the probability of returns lower than $10,000 equals 50 per cent, and the probability of returns below 0, i.e., a loss, equals 10 per cent).

If we consider only some average or expected return of investment propositions, the preference ranking is trivial: The higher the expected return per dollar invested the better the proposition. However, consider two investment propositions, called A and B, which are described by the probability curves shown in Figure 2 on page 46. Both propositions may in effect yield the same average return; however, Proposition B involves considerably more uncertainty than Proposition A—it represents much more of a gamble, with a possible potential for large gains but also for large losses. Thus, while the expected returns may be equal for both propositions, management may well not be indifferent between the two propositions (e.g., a conservative management averse to risk may reject Proposition B and accept Proposition A—and would do so even if Proposition B should yield a somewhat higher average return than Proposition A). In fact, the ranking of such investment alternatives wil be significantly influenced by management's attitude toward risk, or, in the language of modern decision theory, by management's utility of money gains and losses, i.e., by the relative value which management places on gains and on losses.

Utility curves

Again, such an attitude toward gains or losses is best represented graphically by deriving a "utility curve" as shown in Figure 3 on page 46. In this graph, the vertical distance between the curve and the horizontal line is a measure of the value placed on a given investment outcome (gain to the right or loss to the left). From Figure 3 it would follow that the positive value placed on the gain of the first $100,000 is greater than the value placed on the gain of $100,000 (i.e., the value placed on a gain of $200,000 is less than twice the value placed on a gain of $100,000). Furthermore, the negative value placed on a loss of $100,000 is just as large as the positive value placed on a gain of $250,000; i.e., a 50 per cent chance of making a profit of $250,000 would just be offset by a 50 per cent chance of losing $100,000, and management would be indifferent regarding such a proposition. Similarly, a 50 per cent chance of making a profit of $1,000,000 would be offset by a 50 per cent chance of losing $150,000.

Figure 4 above shows various possible utility functions. The graph on the right represents the most conservative position, i.e., the highest degree of risk aversion (the negative value placed on the loss of a given amount far exceeds the positive value placed on a gain of the same amount), and the graph on the left represents the most liberal position where almost equal values are assigned to gains and losses. The middle graph represents an intermediate position.

Thus, before being able to make intelligent and consistent investment decisions, management has to ask itself consciously what values it places on possible gains and losses. It will generally find that its utility curve is somewhat adverse to risk (i.e., follows the general curvature as shown in the middle and righthand graphs in Figure 4), placing higher negative values on losses than positive values on commensurate gains. Few companies would undertake an investment which will result in a 50 per cent chance of a $100,000 loss even if there is a probability of 50 per cent of making a profit of $100,000, and most will prefer Investment Proposition A over Proposition B in Figure 2. Again, the company's particular utility curve may vary over time—e.g., the negative value placed on losses is likely to depend on the general financial position of the company and hence should be revised periodically, especially if the company goes through a stage of rapid internal development.

It follows, then, that it is inadequate to evaluate investment propositions merely on the basis of their expected total return on investment as was illustrated in the table. Ideally, in evaluating an investment proposition, we would like to derive the probability distribution of the net present value of the benefits to be derived from the investment. We would then assign a personal value derived from our particular utility curve to the present value of each of the possible gains or losses as given by the probability distribution. From this, we could derive the expected value which the investment proposition has to us, thus obtaining a truly valid measure of our preferences in the evaluation of investment alternatives.

However, while it is very valuable to have a clear conceptual understanding of what it is one ideally wants to accomplish, from an operational point of view one might have to compromise such an ideal analysis simply because of the time and costs needed to carry it out. In following the well known rule, "as accurate as necessary—as simple as possible," one needs to balance the costs of carrying out an analysis with the benefits to be derived from it. Thus, simplifications will have to be introduced in the analysis to make it operational for everyday use, especially by the small company—preferably without losing the essential qualities inherent in such sophisticated analysis. It is in this light that the following procedure for investment evaluation—which is being used successfully in the everyday investment decisions of a small company—should be viewed.

INVESTMENT EVALUATION FORM

TITLE BLOCK

PROPOSITION ______ DATE ______ SHEET ____ OF ____
PREPARED BY ______ STUDY BASE ______
ESTIMATES BY: SALES ____ PROFIT ____ EQUIPMENT ____ OTHER ______
DISCOUNT RATE ______ DATA POINT ______ REMARKS ______

PROFIT

		1ST YR.	2ND YR.	3RD YR.	4TH YR.	5TH YR.
	COMPOUNDED DISCOUNT RATE AT 16%	87	76	66	57	50
1	VOLUME CONTRIBUTION					
2	PROFIT CONTRIBUTION, % BEFORE TAX					
3	PROFIT CONTRIBUTION, $ BEFORE TAX					
4	TAX (50% OF LINE 3)					
5	RETAINED PROFIT (LINE 3 MINUS LINE 4)					
6	DISCOUNTED PROFIT (YEARLY)					
7	DISCOUNTED PROFIT (CUMULATIVE)					

WORKING CAPITAL

8	ACCOUNTS RECEIVABLE (____ DAYS)					
9	INVENTORY (____ DAYS @ ____%)					
10	OTHER					
11	TOTAL WORKING CAPITAL (LINES 8, 9 + 10)					
12	DISCOUNTED WORKING CAPITAL (YEARLY)					
13	DISCOUNTED WORKING CAPITAL (CUMULATIVE)					
14	SALVAGE VALUE (YEARLY)					
15	DISCOUNTED SALVAGE VALUE (YEARLY)					

DEPRECIABLE CAPITAL INVESTMENT

16	FACILITIES AND EQUIPMENT (YEARLY)					
17	DISCOUNTED FACILITIES AND EQUIPMENT (YR'LY)					
18	DISCOUNTED FACILITIES AND EQUIPMENT (CUM.)					
19	DEPRECIATION (YEARLY)					
20	DISCOUNTED DEPRECIATION (YEARLY)					
21	DISCOUNTED DEPRECIATION (CUMULATIVE)					
22	SALVAGE VALUE (YEARLY)					
23	DISCOUNTED SALVAGE VALUE (YEARLY)					

START-UP EXPENSES

24	DEVELOPMENT	
25	PROMOTION	
26	OTHER	
27	SUBTOTAL (TAX DEDUCTABLE, LINES 24, 25 + 26)	
28	EFFECTIVE SUBTOTAL (LINE 27 MINUS 50% TAX SHIELD)	
29	MANAGEMENT (____ DAYS @ ____ $)	
30	TOTAL (LINES 28 + 29)	

FIGURE OF MERIT THIS DATA POINT

		1ST YR.	2ND YR.	3RD YR.	4TH YR.	5TH YR. + TOTAL
31	DISCOUNTED RETURN (CUMULATIVE, LINES 7, 15, 21 + 23)					
32	DISCOUNTED INVESTMENT (CUMULATIVE, LINES 30, 13 + 18)					
33	RETURN ON INVESTMENT (LINE 31 OVER 32, YEARLY)					
34	NET PRESENT VALUE (LINE 31 MINUS 32, YEARLY)					
35	UTILITY OF TOTAL NET PRESENT VALUE					
36	PERCENT PROBABILITY THIS DATA POINT					
37	FIGURE OF MERIT THIS DATA POINT (LINE 35 × LINE 36)					

FIGURE 5

Simplified procedure

As in many other cases, a certain degree of standardization in procedures is vital for successful implementation of new ideas. Hence, in order to make the application of a sophisticated approach to investment evaluation operational, standardized forms were developed to be filled out by managers throughout the company when proposing investments. These forms are shown in Figure 5 on page 48 and Figure 6 below.

It should be noted that these forms were developed for use in a small manufacturing enterprise. Thus, while the general concepts are widely applicable to a variety of investment situations, the particular layout of these forms is geared to investment decisions in a manufacturing environment.

Before giving a detailed description of the individual entries on these forms, let us briefly discuss their overall structure. In consideration of the probabilistic nature of investments, various data points are evaluated. In striking the balance between operational simplicity and accuracy, it was decided to evaluate discrete data points corresponding to various probability levels rather than a continuous probability distribution. Generally, three such points are evaluated[2]: a "most likely," a "pessimistic," and an "optimistic." These data points are chosen in such a way that the estimated probability of doing worse than the pessimistic data point or better than the optimistic data point is 10 per cent, as shown in Figure 7 on page 50.

One sheet is filled out for each data point, resulting in a figure of merit for this data point. These individual figures of merit are combined to give the overall figure of merit for the proposition on the summary sheet shown in Figure 6.

The individual evaluation sheet (Figure 8 on page 51) is divided into various sections. The title block simply serves to provide general information for purpose of identification. Various sections follow: Profit, Working Capital, Depreciable Capital Investments, and Start-Up Expenses. These sections are distinguished as a basis for deriving total return and investment for the proposition. Return is derived as the sum of profits, depreciation (from the section "depreciable capital investment"), and salvage values (from the sections "working capital" and "depreciable capital investments"), all appropriately discounted to give their present values. Total investment is given as the sum of start-up expenses, working capital, and depreciable capital investments, also all appropriately discounted. As is seen from the form, figures are only derived for the first five

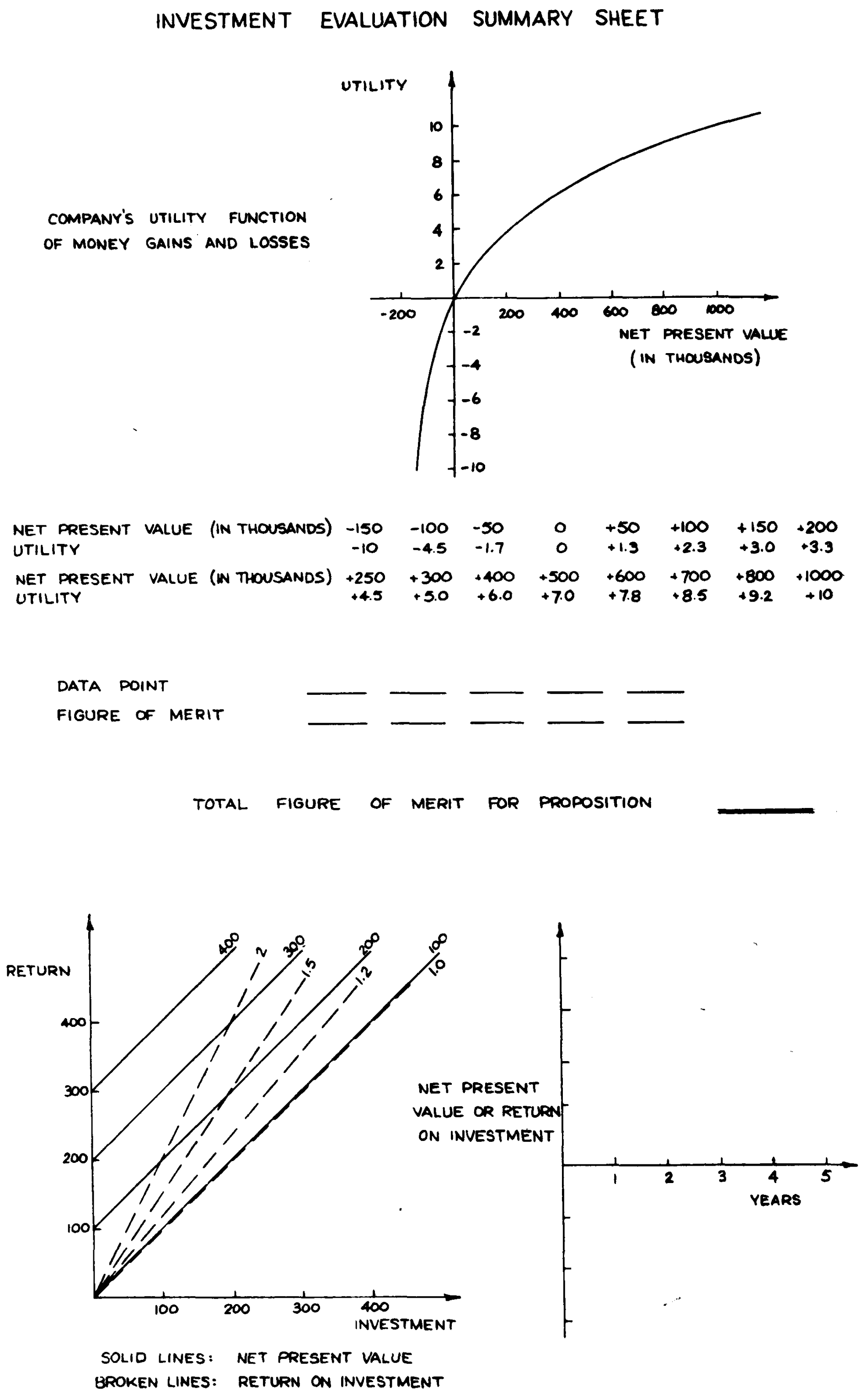


FIGURE 6

[2] Five data points are evaluated for ill defined propositions with particularly wide fluctuations of possible returns.

years; with the accelerated pace of technological development in the electronics industry for which this form was designed, few manufacturing propositions can be assumed to yield returns beyond that time span.

In the final section, the figure of merit for the data point is derived based on the present value of its potential gain or loss (the net present value given in Line 34), the utility of such gain or loss (as derived from the company's utility function, which is given on the summary sheet), and the probability of this data point. As we have already seen, the figures of merit for the individual data points are then transferred to the summary sheet (Figure 6), where they are added to give the overall figure of merit for the proposition. The summary sheet furthermore includes possibilities for various graphic representations which were found to be helpful in the final evaluation.

A short step-by-step description of the individual entries, illustrated with a numerical example as given in Figure 8, should clarify the operational use of this procedure:

Profit

1. *Volume Contribution*—The incremental annual sales volume of the company due to acceptance of the proposition: This may include not only the sales volume of the new product but also its effect on the sales volume of already established products. Entries are always in thousands.

2. *Profit Contribution, percentage before tax*—Average profit prior to taxes in percentage of the incremental sales volume (Line 1): Profits are given after deduction of depreciation and all current operating costs but without consideration of start-up expenses and capital investments.

3. *Profit Contribution, dollars before tax*—Line 1 times Line 2.

4. *Tax*—50 per cent of Line 3; tax reductions due to start-up expenses are accounted for separately in that section.

5. *Retained Profit*—Line 3 minus Line 4.

6. *Discounted Profit*—The yearly entries of Line 5 are multiplied with the compounded discount rate as specified in the title book. The compounded discount multipliers for an annual discount rate of 15 per cent are given in the section heading.

7. *Discounted Profit (cumulative)*—For each year, the sum of all previous annual entries from Line 6 (example: entry for Year 3 in Line 7 equals sum of entries for Years 1, 2, and 3 from Line 6): Gives the cumulative present value of profits earned until that year.

Working capital:

8. *Accounts Receivable* — An assessment is required of the payment habits of the customers under consideration (example: 45 days). Accordingly, as sales volume builds up, an increasing amount of accounts receivable has to be financed. The average investment applicable for each year is the *increment* of the yearly sales volume divided by 365, times the average collection period (in days).

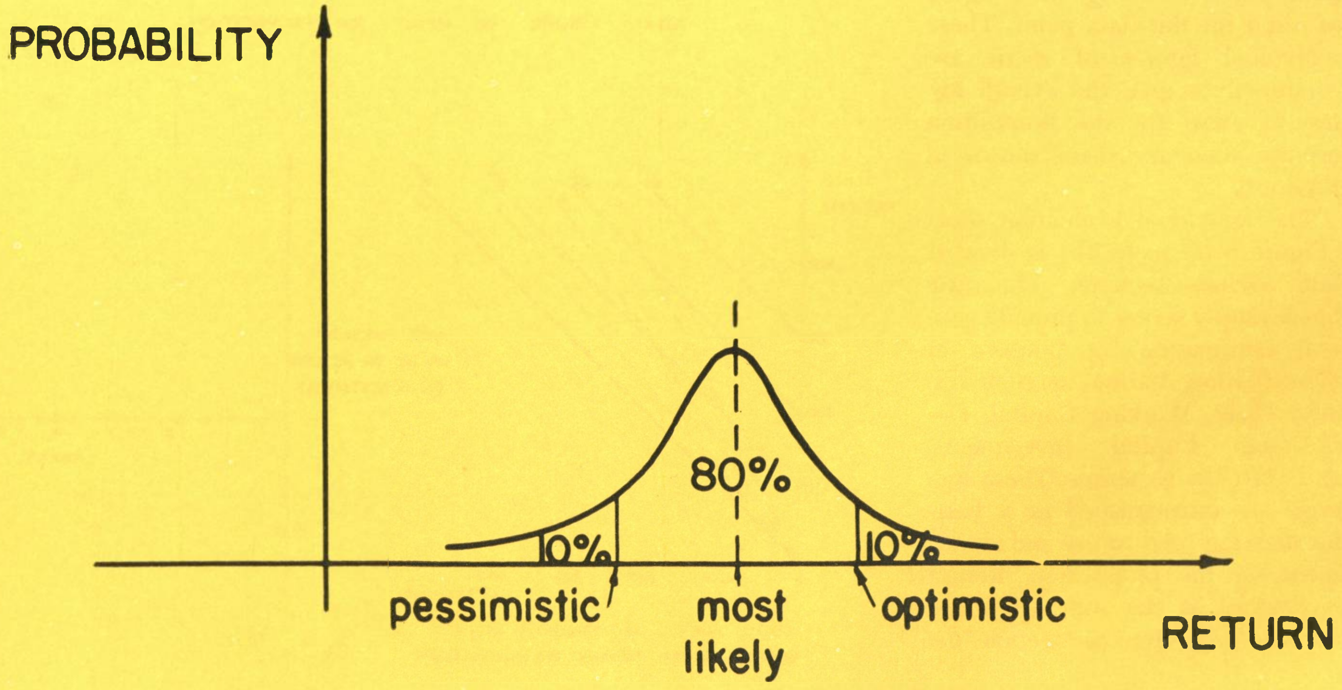


FIGURE 7
Evaluation of Data Points

9. *Inventory*—Included under inventory are raw materials, work in process, finished goods. Inventory is estimated in proportion to sales volume, inventory cost in relation to sales price (example: 30 days' sales volume at 50 per cent sales price). Thus, incremental inventory investment for each year can be estimated from sales figures given in Line 1.

10. *Other* — Include any other working capital requirements.

11. *Total Working Capital*—Total annual investment in working capital: Sum of Lines 8, 9, 10.

12. *Discounted Working Capital* —The yearly entries of Line 11 are multiplied by the compounded discount rate.

13. *Discounted Working Capital (cumulative)*—For each year, the sum of all previous annual entries from Line 12: Gives the cumulative present value of all working capital investment until that year.

14. *Salvage value (yearly)*—Estimated liquidation return upon close-out of this proposition if occurring at the end of each operating year from all of the items in Line 11.

15. *Discounted Salvage Value (yearly)* — The yearly entries of Line 14 are multiplied by the compounded interest rate.

Depreciable capital investments:

16. *Facilities and Equipment*—Covers all capitalized depreciable assets at initial book value as acquired during each year of operation proportional to use in this proposition or as transferred to the project from other previous uses (at proportional book value less depreciation upon transfer).

17. *Discounted Facilities and Equipment*—The yearly entries of Line 16 are multiplied by the compounded interest rate.

18. *Discounted Facilities and Equipment (cumulative)*—For each year, the sum of all previous annual entries from Line 17.

19. *Depreciation* — Total yearly depreciation against all items in Line 16.

20. *Discounted Depreciation* — The yearly entries of Line 19 are multiplied by the compounded discount rate.

21. *Discounted Depreciation (cumulative)*—For each year, the sum of all previous annual entries from Line 20.

22. *Salvage Value* — Estimated liquidation return upon close-out of this proposition if occurring at the end of each operating year

INVESTMENT EVALUATION FORM

TITLE BLOCK

PROPOSITION Plastic Spacer DATE 2-26-68 SHEET 2 OF 3
PREPARED BY S.B. STUDY BASE Annual Planning Meeting
ESTIMATES BY: SALES J.R. PROFIT S.B. EQUIPMENT B.F. OTHER —
DISCOUNT RATE 15% DATA POINT M.L. (80%) REMARKS —

PROFIT

		1ST YR.	2ND YR.	3RD YR.	4TH YR.	5TH YR.
		COMPOUNDED DISCOUNT RATE AT 15%				
		87	76	66	57	50
1	VOLUME CONTRIBUTION	10	50	100	[illegible]	[illegible]
2	PROFIT CONTRIBUTION, % BEFORE TAX	10	20	20	20	20
3	PROFIT CONTRIBUTION, $ BEFORE TAX	1	10	20	40	[illegible]
4	TAX (50% OF LINE 3)	0.5	5	10	20	20
5	RETAINED PROFIT (LINE 3 MINUS LINE 4)	0.5	5	10	20	20
6	DISCOUNTED PROFIT (YEARLY)	0.4	3.8	6.6	11.4	10
7	DISCOUNTED PROFIT (CUMULATIVE)	0.4	4.2	10.8	22.2	32.2

WORKING CAPITAL

8	ACCOUNTS RECEIVABLE (45 DAYS)	1.3	5	6.3	13	—
9	INVENTORY (30 DAYS @ 50%)	0.4	1.7	2.1	4	—
10	OTHER	—	—	—	—	—
11	TOTAL WORKING CAPITAL (LINES 8,9,+10)	1.7	6.7	8.4	17	—
12	DISCOUNTED WORKING CAPITAL (YEARLY)	1.5	5.1	5.5	9.7	—
13	DISCOUNTED WORKING CAPITAL (CUMULATIVE)	1.5	6.6	12.1	21.8	21.8
14	SALVAGE VALUE (YEARLY)	1.7	8.4	16.8	33.8	33.8
15	DISCOUNTED SALVAGE VALUE (YEARLY)	1.5	6.6	11	19.1	16.9

DEPRECIABLE CAPITAL INVESTMENT

16	FACILITIES AND EQUIPMENT (YEARLY)	6			6	
17	DISCOUNTED FACILITIES AND EQUIPMENT (YR'LY)	5.2			3.5	
18	DISCOUNTED FACILITIES AND EQUIPMENT (CUM.)	5.2	5.2	5.2	8.7	8.7
19	DEPRECIATION (YEARLY)	0.6	0.6	0.6	1.2	1.2
20	DISCOUNTED DEPRECIATION (YEARLY)	0.5	0.5	0.4	0.7	0.6
21	DISCOUNTED DEPRECIATION (CUMULATIVE)	0.5	1	1.4	2.1	2.7
22	SALVAGE VALUE (YEARLY)	4	3	3	7	6
23	DISCOUNTED SALVAGE VALUE (YEARLY)	3.5	2.3	2	4	3

START-UP EXPENSES

24	DEVELOPMENT	3
25	PROMOTION	6
26	OTHER	—
27	SUBTOTAL (TAX DEDUCTABLE, LINES 24,25+26)	9
28	EFFECTIVE SUBTOTAL (LINE 27 MINUS 50% TAX SHIELD)	4.5
29	MANAGEMENT (7 DAYS @ 3 $)	2.1
30	TOTAL (LINES 28+29)	6.6

FIGURE OF MERIT THIS DATA POINT

		1ST YR.	2ND YR.	3RD YR	4TH YR.	5TH YR. + TOTAL
31	DISCOUNTED RETURN (CUMULATIVE, LINES 7,15,21+23)	5.9	14.1	25.2	47.4	54.8
32	DISCOUNTED INVESTMENT (CUMULATIVE, LINES 30,13+18)	13.3	18.4	23.9	37.1	37.1
33	RETURN ON INVESTMENT (LINE 31 OVER 32, YEARLY)	0.44	0.76	1.05	1.27	1.48
34	NET PRESENT VALUE (LINE 31 MINUS 32, YEARLY)	<7.4>	<4.3>	1.3	10.3	17.7
35	UTILITY OF TOTAL NET PRESENT VALUE					0.46
36	PERCENT PROBABILITY THIS DATA POINT					80%
37	FIGURE OF MERIT THIS DATA POINT (LINE 35 x LINE 36)					37

FIGURE 8

from disposition of all items in Line 16 (if there is continued use by company or other projects, use book value after depreciation).

23. *Discounted Salvage Value*—The yearly entries of Line 22 are multiplied by the compounded discount rate.

Start-up expenses:

24. *Development* — Even when development costs are fully expensed against burden accounts, proper evaluation of the economics of new products requires indication of the development costs. If there are perpetual product engineering expenses, it is assumed that later years, past the first year of operation, absorb such costs in operations (reduce profits accordingly).

25. *Promotion* — Only start-up promotion or contribution to general promotion expenses is to be shown while current promotion expenses are to be deducted from profits (Lines 2, 3).

26. *Other*—All other start-up expenses except for management (separately in Line 29) such as one-time patent or license expenses, personnel recruiting and training, equipment relocation, etc.

27. *Subtotal*—Should include all tax-deductible start-up expenses: Sum of Lines 24, 25, 26.

28. *Effective Subtotal* — As the full amounts of Line 27 can be used to derive tax savings, the effective subtotal is given by subtracting these tax savings (generally 50 per cent) from the original amounts. Thus, the entries will be given by multiplying the entries of Line 27 by one-half.

29. *Management*—This cost item is most significant for small projects where the management distraction is large compared to the economic significance of the project. Depending upon management's attitude, one can apply management cost on a salary plus burden basis (more executives could be hired) or on an alternate profit potential basis (corporate profits divided by total management hours spent—example: $300 per day for personnel on management level). Since this is not an incremental cost item, it does not offset taxes.

30. *Total*—Includes all start-up expenses: Sum of Lines 28 and 29.

Figure of merit

31. *Discounted Return (cumulative)*—Gives the cumulative net return, appropriately discounted, for each year assuming close-out of the proposition at the end of that year, i.e., the total discounted return which accumulates up to the end of the year for which the entry is made. Derived as the sum of cumulative after tax profit (Line 7), cumulative depreciation (Line 21), and salvage values (Lines 15 and 23). Entry for fifth year gives total discounted net return for this data point of proposition.

32. *Discounted Investment (cumulative)*—Gives the cumulative investment, appropriately discounted, for each year, i.e., the total discounted investment to be made up to the end of the year for which the entry is made. Derived as the sum of cumulative working capital (Line 13), cumulative capital investments (Line 18), and start-up expenses (Line 30). Entry for fifth year gives total discounted investment for this data point of the proposition.

33. *Return on Investment*—Gives the present value of cumulative net return as a percentage of cumulative investment for each year assuming close-out of the proposition at the end of that year (Line 31 divided by Line 32, times 100). Entry for fifth year gives total present value of net return on investment for this data point of the proposition.

34. *Net Present Value (Line 31 minus Line 32)*—Gives the present value of cumulative gains (or losses) to be derived from this proposition for this data point, for each year, assuming close-out of the proposition at the end of that year. Entry for fifth year gives present value of total gains for data point.

35. *Utility of Total Net Present Value*—Utility figure for total net present value is derived from curve and table on summary sheet (Figure 6).

36. *Per Cent Probability This Data Point*—Enter probability for data point from title block.

37. *Figure of Merit This Data Point* — Probability of data point (Line 36) times utility of data point (Line 35); also called expected utility of data point.

The summary sheet (Figure 9 on page 53) starts with a graph and a table giving the company's utility as a function of net present value. It represents the consensus—after some discussion—of the company's top management team regarding the relative values which should be placed on gains and losses of various magnitudes.

In the section below, the figures of merit for each data point are entered from the individual evaluation sheets, and the total figure of merit for the proposition is derived as the sum of these figures.

Graph aids

Two graphs that have been found to be helpful to management in evaluating investments are given at the bottom of the sheet. In the graph to the left, the proposition — characterized by its total discounted net returns and its total discounted investment (Lines 31 and 32)—can be plotted as a point. This visual representation has been found to be especially valuable when various mutually exclusive propositions are evaluated concurrently. In the figure to the right, cumulative return on investment or cumulative net present value can be plotted as a function of time (from Lines 33 and 34), giving valuable information about the dynamic behavior of the proposition over time.

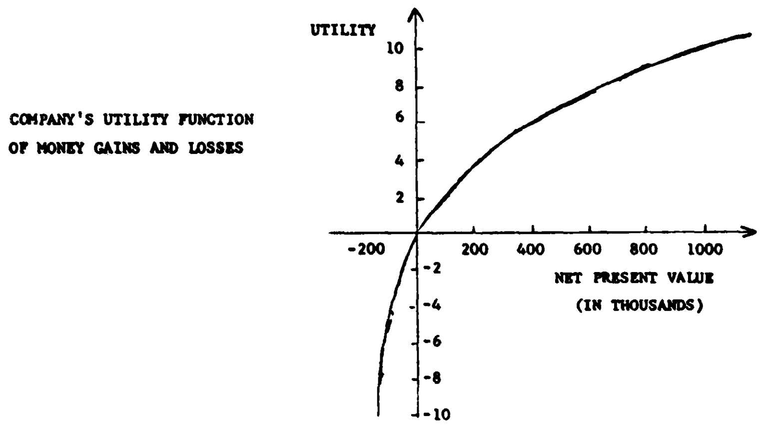
An actual example for the entries in the summary sheet is given in Figure 9. From Figure 8, we derived a figure of merit of 37 for the "most likely" data point. For the "pessimistic" and "optimistic" data points of this proposition we may have derived net present values of–$10,000 and +$30,000, respectively, with corresponding figures of merit of –3.4 (–0.34 utility × 10 per cent) and +7.8 (+0.78 utility × 10 per cent). The total figure of merit for the proposition becomes 41.4 per cent, or 0.414. Going back to the utility figure and table at the top of the sheet, we see that this total figure of merit corresponds to a net present value of $16,000, which is the net present value of this proposition after adjustment for risk, in the light of the company's attitudes toward risk as expressed in the utility function. This adjusted net present value sometimes is also called the proposition's certainty cash equivalent. In the graph at the bottom of the sheet, the net present value is plotted as a function of time for the "most likely" data point (from Line 34 in Figure 8). Immediately we can see that the proposition will require heavy investments in the first year. After the first year, the balance of cash flows is going to be positive, and shortly before the end of the third year initial investments will have been recovered. Thus, by use of this graph we can visualize conveniently the dynamic behavior of the proposition over time.

These figures aid in the creative interpretation of results, which is perhaps one of the most significant benefits to be derived from the whole procedure. For instance, the final figure of merit of a proposition changes quite apparently as investments are delayed and returns advanced in time. The availability of quantitative results stimulates middle management's resourcefulness in the search for better alternatives, inviting consideration of such alternatives as leasing vs. buying, sharing of investments between propositions, risk reduction possibly at the expense of volume reduction, etc.

The main problem in introducing this method was the training of second-echelon management in the underlying business theories of discounted cash flow, probability, and utility. As often happens, managers with leadership talent and good intuitive judgment were not necessarily inclined to express themselves numerically or to implement numerical procedures. The average training time was three meetings of about two hours each. (It should be mentioned that, when basic data are available, the numerical evaluation of a proposition by this procedure requires about two hours.)

The investment evaluation procedure described in this article was first introduced in 1967 in a company of then only $1 million sales per year. Since then, it has been successfully adopted by the parent company, a diversified medium-size enterprise, for corporate evaluation of divisional projects.

INVESTMENT EVALUATION SUMMARY SHEET



NET PRESENT VALUE (IN THOUSANDS)	-150	-100	- 50	0	+ 50	+100	+150	+200
UTILITY	- 10	-4.5	-1.7	0	+1.3	+2.3	+3.0	+3.3
NET PRESENT VALUE (IN THOUSANDS)	+250	+300	+400	+500	+600	+700	+800	+1000
UTILITY	+4.5	+5.0	+6.0	+7.0	+7.8	+8.5	+9.2	+ 10

DATA POINT	P(10%)	ML(80%)	O(10%)
FIGURE OF MERIT	-3.4	37	7.8

TOTAL FIGURE OF MERIT FOR PROPOSITION

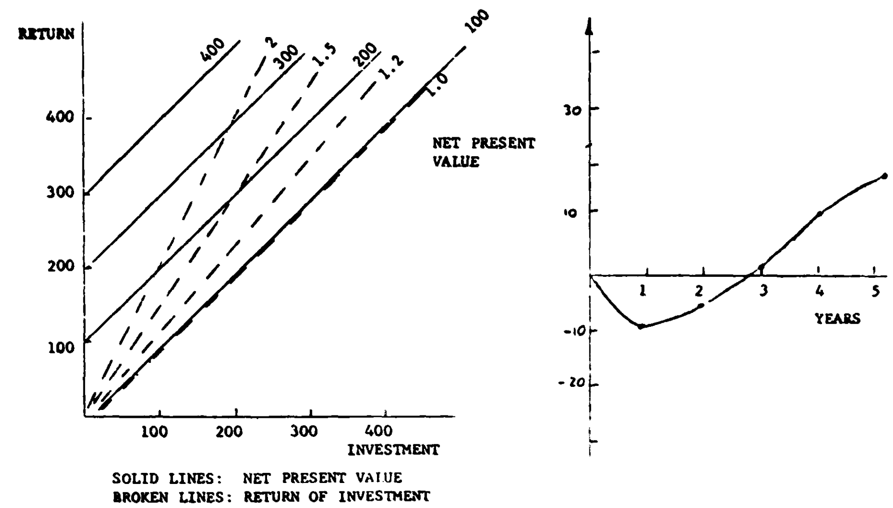


FIGURE 9

what people are writing about

BOOKS

Organizational Planning and Control Systems: Theory and Technology by JAMES C. EMERY, The Macmillan Company, New York, 1969, 166 pages, $2.95 (paperbound).

Great strides have been made recently in some of the fields that underlie management planning and control — organization theory, cybernetics, systems theory, decision theory, and information technology. Yet, says this author, we are victims of a cultural lag; these advances have not yet been sufficiently amalgamated to form a unified theory of planning. Somewhat ambitiously, he attempts to do just that in this book.

Information technology, Dr. Emery concludes, has now advanced to a point that makes large man-machine planning systems technically and economically feasible. The results would include closer coordination among organizational subunits, more consistent pursuit of organizational goals, and less waste of resources that now are devoted to "cushioning the effects of fragmented activities."

Such a system would require massive data handling, which in turn demands a means of collecting, transmitting, storing, retrieving, manipulating, and displaying large quantities of data with both generality and flexibility. It would have to be designed in such a way as to facilitate close communication between man and machine.

Thanks to advances in information technology — computer hardware and software—such a man-machine planning system centered around a common data base is now technically feasible, according to the author. In this brief book he does not attempt to present a design for such a system. Rather, he attempts to provide "a construct of planning" that could provide a framework for the implementation of formalized man-machine planning systems.

He starts by explaining the organization as a system and the role of the information system in it. An interesting chapter (but the most mathematical in the book) discusses the economics of information and presents a theoretical model for measuring its payoff. The final chapter attempts to synthesize current knowledge in the fields related to planning into a unified theory of planning.

All this sounds highly theoretical. It is (although Dr. Emery prefers the term "conceptual"). It is, however, something that must be done if "organizational planning" (by this term the author means planning to attain the goals of an organization, not planning of organization structure) is to become a real science. As Dr. Emery points out, "Nothing is so practical as good theory."

This is undoubtedly not the last word on the subject. But this book, logically organized and clearly and simply written, represents the direction in which the thinking of the new breed of management scientists is moving—and it is probably a direction in which managers and accountants will have to move eventually.

Progress in Operations Research, Volume 3: Relationship Between Operations Research and the Computer edited by Julius S. Aronofsky, John Wiley & Sons, Inc., New York, 1969, 561 pages, $18.75.

This book, a compilation of fourteen articles by operations researchers, computer specialists, and management information specialists, is the third anthology sponsored by the Operations Research Society of America. The first volume dealt with OR methods and the second with applications. This one deals with the role of electronic data processing in the practice of operations research — and vice versa.

Operations research and electronic data processing are among the fastest-growing components of today's expanding technology. And they are closely related. Computers are a valuable tool of operations research; OR can make a significant contribution to the design, manufacture, and use of computers.

Therefore, the editor of this volume concludes, the operations researcher needs to know more about computers (and the computer specialist about OR). The objective of the book, which is directed primarily to OR people, is to broaden their horizons on the subject of computers.

Among the topics discussed are computer systems for mathematical programing, integer programing, and heuristic programing; computer languages for simulation and for statistical problem solving; and the use of computers in the design of OR studies, in implementation of OR applications, and in design of management information systems.

Most of the chapters are too mathematical for the general business reader. A few, however, particularly a survey of the applications of simulation by Roger L. Sisson; the discussion of management information systems by James C. Emery; and the concluding chapter warning against dedication to the computer rather than to the managers it serves, written by R. L. Ackoff and Sir Stafford Beer, would be of value to anyone interested in management.

Briefly listed

Management Information Systems: An Annotated Bibliography by R. Ian Tricker, the General Educational Trust of The Institute of Chartered Accountants in England and Wales, London, 1969, 127 pages, paperbound, 10 shillings ($1.20).

This bibliography, indexed by descriptors, lists some 200 books and some 700 articles and papers on management information systems, along with the names of some 100 journals that publish relevant material and a directory of other useful sources, such as abstracting services and other bibliographies.

Decision Tables by M. L. Hughes, R. M. Shank, and E. L. S. Stein, Management Development Institute, Inc., 148 East Lancaster Avenue, Wayne, Pennsylvania 19087, 1968, 176 pages, $15.95.

Decision tables, say the authors of this book, are the best method for analyzing and documenting systems. In this generously illustrated volume they tell how to prepare and use them.

Forms Design and Control by Julius B. Kaiser, American Management Association, Inc., New York, 1968, 173 pages, $16.95.

Designed as a guide for "every person who is invested with the manufacture, preservation, routing, or destruction of business forms," this book contains more than sixty sample forms.

Computer Privacy by M. G. Stone, Ambar Publications Ltd., London, 1968, 39 pages, paperbound, 10 shillings ($1.20).

This little monograph devotes more attention to the dangers to privacy and freedom that may arise from the increasing use of computers for recording personal information than to possible solutions for the problem.

Systems Concepts and Data Processing Methods: An Introduction by Myra Enkelis, American Association of Medical Record Librarians, 211 East Chicago Avenue, Chicago 60611, 1968, 24 pages, paperbound, $3.25.

This booklet, which takes the hypothetical case of a hospital census listing and shows how to "evaluate and upgrade it by applying basic principles of systems analysis and data processing," was developed to help medical record librarians prepare for conversion to EDP. Others also may find it a useful introduction to EDP concepts.

MAGAZINES

Computers Versus Mathematics by A. Wayne Corcoran, *The Accounting Review*, April, 1969.

Must the accountant possess a knowledge of both computers and mathematics? Does expertise in either one of these disciplines obviate the need to have expertise in the other? These are the questions Professor Corcoran explores in this stimulating article.

Today's accountant must know "at least one" of the two disciplines: computers and mathematics, this author says. But this raises the further question of what degree of knowledge is necessary?

Professor Corcoran dismisses what he calls the "quarterback" interpretation of knowledge, i.e., that level of knowledge and experience which supposedly enables the accountant to manage but is insufficient to make him a "doer." He believes that it is not realistic to expect that supervision based on this level of knowledge will produce a viable relationship between the manager (non-doer) and those who are being managed (doers). He asks, "What would a quarterback manager contribute to his position?"

As for the interchangeability of these two disciplines, an apparent if not real trade-off is available to the accountant. In numerical problem solving, computer power can be substituted for mathematics. Professor Corcoran gives several specific examples of the computer versus mathematics phenomenon. Each example is solved first in a mathematical or formulative way and then in a procedural way made possible by the computer's high speed.

One area in mathematics for which the computer is a direct substitute is known as the calculus of finite differences. Problems such as those involving factorial notation and maximizing or minimizing costs are illustrated as examples where the problem solver has the option of using either the pencil-paper-formula approach or the program-computer approach.

Professor Corcoran observes that the computer programer need not know the solution techniques of finite calculus, although he must have at least a minimum grasp of the mathematics in order to model the problem in terms of his computer language. While "minimum" is still undefined, one thing is certain: Considerably less mathematics is needed where a computer is the solution vehicle. On the other hand, he states that we must not conclude that the computer is any more than a partial surrogate for mathematics. For example, a minimum knowledge of algebra is a prerequisite to set up a problem for a FORTRAN solution. Thus, the author, admitting to a bias in favor of applied mathematics, concludes that the trade-off available to accountants is certainly not a complete one. Finally, he says that without some familiarity with mathematics it is impossible to understand the current business literature.

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Valuing the Firm's Durable Assets for Managerial Information by Y. Goldschmidt and S. Smidt, *The Accounting Review*, April, 1969.

The current market price—*based on the criterion that assets should be valued commensurately with the objectives of the information system—provides the best data inputs for managerial decisions. The conventional methods of valuation—past transactions and present value of future earning power—provide other kinds of information, namely, ex-post reporting by original costs and ex-ante analysis by internal opportunity costs. This article deals with the "why" and the "how" of the current market price basis of valuing productive assets—their external opportunity costs—for internal purposes.*

For managerial decisions, the conventional valuation procedures for durable assets have some severe shortcomings. Under the accounting method, the reported value does not necessarily reflect asset condition or serviceability; the acquisition cost is distorted by price level changes; and asset value may not represent normal market price. The economic method is a subjective procedure because value is based on the generation of expected cash flow during the asset's productive life. In other words, both future cash flows and the discount rate are estimates. Moreover, cash flow must be attributed to the interdependence and aggregation of the total assets rather than to a single asset.

Since managerial decisions are concerned with opportunities, the current market price is a relevant basis for valuation. In the traditional sense of accounting, objectivity is violated. However, in the context of internal accounting, current prices furnish external opportunity information as inputs for decisions. In comparison with the present value method, the current market price method is more objective since it is based on current existing price data and simpler because it is less dependent on future conditions.

Complications

The current market price method is not without complications, however. That is, there may be a significant difference between the current acquisition cost and the liquidation value; a direct market valuation may be unavailable or irrelevant because of technological changes. Finally, existing assets often do not provide the same service as an equivalent new asset.

Operating periods

For analytical purposes, the continuous operations of a firm are divided into identifiable periods. During each period the firm trades commodities on the external market and uses assets internally. If an accurate market price for the internally used assets can be determined, an objective valuation results, providing a cost basis for the measurement of income earned. Management could "purchase" these assets for the current period from the prior period or on the market, but it is normally more economical to "purchase" assets from the prior period than on the market. Regardless of the decision, the objective of management remains the same: to maximize income in the current and future periods.

In the valuation of assets, liquidity is an important characteristic since the more liquid an asset, the more readily a value can be determined. A measure of liquidity is the ratio of the liquidation value (sales price) to the acquisition cost (replacement cost). When these two are identical, a single figure exists for an asset's value. When they diverge, two values for an asset exist.

Liquidity

Liquidity is also measured in terms of the planning horizon. If the planning horizon of the asset is shorter than that of the production process, then the asset is likely to be considered liquid. Consequently, the identical asset will have different liquidities for different firms. Ultimately, the value used depends on the purpose and plan of the firm. Part of the decision-making process lies in judging which basis is more relevant. In some cases, the acquisition cost is more important; in others the liquidation value will be the dominant consideration.

Durable assets

Although the value of nondurable assets is included in the computation of costs and revenue, the focus of attention here is on the valuation of *durable* assets. The related costs (mainly depreciation and interest) depend upon this valuation, which, in turn, is the basis for determining periodic income. Segmented periodic income is required for two reasons. First, in reference to product mix and scale of production, costs related to liquid assets are relevant, whereas those related to nonliquid assets are not. This happens because the planning horizon is so short that costs related to nonliquid assets exist regardless of the production alternatives and, thus, are nonavoidable. Second, unusually good or unusually poor operating results are important considerations for decisions concerning performance, operation expansion, and pricing policy. Because of the composition of data inputs, the costs related to liquid and nonliquid assets must be included in the calculation of income. And income measurement based on current market prices will provide meaningful information for managerial decisions.

Practical problems

From a practical point of view, a method of valuing assets by current market price is difficult to implement. Tax considerations arc so important that both the acquisition cost and the liquidation value should be adjusted for the tax effect. The after tax basis may differ from the current market price. However, this after tax value is the relevant figure for managerial decision making purposes.

Durable liquid assets, such as common stock, can be easily traded on the market. The value of these assets is their market price at the point of time under consideration, that is, their net liquidation value. Liquidation value, then, is the principal and practical figure for reporting durable liquid assets. The difference between the beginning and ending market values should be recorded as depreciation (appreciation). Thus, this procedure measures and records any change in value occurring during the period.

Nonliquid assets

Durable nonliquid assets present a different problem from that presented by durable liquid assets. Once nonliquid assets are acquired, their basis is a nonavoidable historical cost. Historical costs furnish useful information for comparing actual acquisition costs to present estimated ones. In terms of valuation, comparative acquisition costs provide information for decisions. The important measure here is the comparative values of potential service.

Potential service

A systematic process that includes technical and economic factors should determine an existing asset's potential service compared to a new asset. This determination of potential service represents an appraisal value that incorporates such factors as maintenance, serviceability, obsolescence, and price level change.

In a temporal framework, various activities will "compete" for a multipurpose existing asset. Assuming that an old asset provides a service similar to that provided by a new asset, the appraised value will approach the current market price. The implication is that the existing asset and the new asset will be equal in value.

Innovations

Innovations will have an effect on value. Minor innovations cause a decline in value because other more efficient assets become available. Major innovations may even cause a complete change in the production process, leading possibly to the disposal of the old asset. The degree of obsolescence may be so great that appraisal value approaches scrap value. Even with a new asset, appraisal value should be reported because it reflects relevant facts for decisions.

There is a complication in estimating market price by appraisal of future service potential. As in the economic method, future cash flows and discounted rates must be estimated. However, boundaries are set on the appraised value—the acquisition cost and the liquidation value. Also, valuation is based on incremental cash flows for an individual existing asset compared to its replacement, whereas the economic method utilizes an incremental cash flow of an entire set of assets.

In summary, all three methods should be used in decision making: past transactions for external ex-post reporting, present value of future earnings power for ex-ante decisions, and current market price for internal ex-post reporting. Past transactions and current market price methods provide inputs into the system, whereas present value of future earning power provides output data of the system.

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Plans and Planning by PATRICK J. REDDIN and JAMES C. COHRS, *Management Controls,* February, 1969.

The planning process is common to and essential to all activity. There are some basic principles which can be used to improve the quality of the planning and the soundness of the resulting plans. These basic principles are reviewed in this article.

The authors start by reviewing the management function, which can be portrayed as the following sequence of steps: Establish objectives, plan, organize, execute, evaluate, and replan. They approach the planning function by discussing inputs and outputs. The information fed into the planning process can be divided into two types of information: the objectives of the firm and the data base. The objectives include the desired growth, profit, and return on investment. The data base would include market data, sales statistics, production data, cost data, and historical performance. The planning outputs that result include a sales plan, a production plan, and a financial plan. The financial planning process is also discussed within an input-output framework.

The authors proceed to discuss planning for the planning function by answering the what, when, who, and how of planning.

This article, which provides a concise review of the planning process, would be useful as a reminder of the items to consider in initiating a formal plan.

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Quasi-Debt Analysis of Financial Leases by THOMAS H. BEECHY, *The Accounting Review,* April, 1969.

Professor Beechy proposes an alternative to the traditional means of evaluating financial leases. The proposed method calculates an effective interest rate, which is more helpful to decision makers than the traditional way of comparing a "discounted" cost with debt.

As outlined by Mr. Beechy, the traditional method of financial analysis of financial leases (those whose rentals provide for payment of substantially the entire cost of the asset during its lease term) generally involves calculating the cash flow (after taxes) of the lease and of the alternative loan and then discounting the cash flows at the cut-off or the cost of capital. The excess of the present value of the lease over the present value of the loan is then considered to be the added cost of the lease.

Method improper

Mr. Beechy contends that this method is incorrect, for it uses a technique of investment analysis to evaluate financing alternatives. That is, the cost of capital is determined by using the cost of debt as one of its components. It is therefore improper to turn around and use the cost of capital to evaluate the cost of debt. The cost of capital is the result of decisions on financing (among other factors) and is not the cause of financing decisions. The cost of a loan is its effective interest rate, not its discounted value.

Equally inappropriate

Since leasing is a form of debt financing and since debt cannot be evaluated by discounting the cash flow at the cost of capital, then it is equally inappropriate to evaluate leases by discounting the cash flow.

By the use of two illustrations (one of which is extremely simple), Professor Beechy shows that the effective interest rate is easily calculated by discounting the net cash flow of the lease payments until the discounted value of these flows is equal to the base cost of the asset. The discount rate that gives this result is thus the effective interest rate of the lease.

Preferable method

According to the author, this method of analysis is more meaningful "than attempting to evaluate the lease as though it were partly an investment, for the lease is a financing tool and not an investment. . . . Investment decisions must be made independent of financing decisions, and likewise financing decisions must be reached independent of the investments which they are financing. This method accomplishes this separation. . . . Thus the final result, an effective interest rate, can be evaluated on the same basis as any other debt financing instrument."

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The Armed Services Procurement Act of 1947 Should Be Reformed by ROBERT B. HALL, *National Contract Management Journal*, Spring, 1969.

The Armed Services Procurement Act of 1947 has had, and will continue to have, an important bearing on the lives of all Americans. Criticism of "waste in Pentagon spending" usually originates with reports released by the General Accounting Office (GAO), which has as one of its functions the auditing of activities under the act, and the author of this article is himself a part of GAO as assistant for planning on the procurement staff of the defense division. His article won the first prize in the annual contest conducted by the National Contract Management Association.

The act applies directly to the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and the Coast Guard. However, regulations of other government agencies and other government procurement statutes are patterned after this law, and the impact reaches further, through the tiers of subcontracting, so that, in effect, tens of thousands of companies in nearly every industry are directly or indirectly affected. A major assumption of the law is that there is one best way to buy anything—by formal advertising, that is, by formal closed bid based on specifications regarding hardware configuration, material, performance, delivery, method of payment, etc.

Mr. Hall begins his discussion with a brief history of procurement law from its beginnings in the early 1800s. He points out that up to World War II Congress was mainly concerned with the prevention of favoritism. Procedures were prescribed that required formal advertising as the one acceptable method of procurement. Exceptions were permitted, at first, only in case of "public exigency." But over the years as government procurement became more complex more exceptions were allowed, and by the time of World War II formal advertising was the least used method.

Shift to negotiation

The shift in emphasis to procurement by negotiation was inevitable. The old arsenal system through which weaponry was researched, developed, and often produced in house did not have the capability to produce a B-29 or an aircraft carrier. Certainly in these days of complex weapons systems only private industry possesses the technical capability to research, develop, and produce a B-52, an atomic submarine, or a trip to the moon. "Today, in order to prepare the adequate, complete, and realistic specifications necessary for formal advertising, the Government would have to duplicate industry's engineering competence." The author details several other limitations of this type of procurement. Then he points out some of the economies obtained by using negotiated and single-source procurement. "Negotiation does not . . . imply a reduction in competition or the number of companies invited to bid."

Ideas presented

Mr. Hall says, "A way must be found to bridge the gap between this reality and the Armed Services Procurement Act, which statutorily provides for one method—the least applicable one—while others are buried in the 'exception' process." He presents some ideas which he hopes will generate discussion and eventually a more realistic law.

One recommendation is to set up written criteria under which each of formal advertising, competitive negotiation, and sole-source procurement methods would be used. Included in the article are suggested lists of possible criteria. It is to be anticipated that this kind of straightforward wording would obviate the need for the present seventeen exceptions in the law.

How to do it

Mr. Hall concludes, "It seems clear that the act discriminates against, and has helped to create widespread congressional and public misapprehension over, perfectly normal and effective procurement methods." Then he lists eleven examples of the "many things" which would have to happen to bring about a change in the law. One of them is "resolving the basic policy issue of whether the Government is going to let the 'fear of favoritism', etc. be the overriding factor in dictating procurement procedures or let the needs of the procurements themselves dictate the procedures." Another is "establishing separate policies and regulations applicable to substantially different procurement arenas: small purchases; low-technology, standard items; and high-technology, nonstandard items." Lastly, he suggests that a separate set of regulations be formulated for each procurement arena.

The Comptroller General, head of the GAO, was quoted in testimony before a Senate subcommittee as saying, "Each of these methods (formal advertising, competitive negotiation, and single-source negotiation), when used in appropriate situations, is an acceptable method of procurement." People in the field of government contracting would certainly agree and welcome GAO help in supporting changes.

One of Mr. Hall's suggestions that should be considered carefully is the one recommending a separate set of regulations for the three major procurement arenas. The military services have been gradually eliminating their implementing instructions in favor of including them in and expanding the Armed Services Procurement Regulations

(ASPR). Thus, this suggestion would have the effect of breaking down again what has just taken a great deal of effort to consolidate. Granted that the breakdown would involve a different method and have a different goal, it still might generate the old problem of different sets of rules to be complied with by the same sellers. Realignment of some government procurement organizations might be necessitated if each of the procurement arenas were considered a separate activity —although this is probably not a serious problem. A possible compromise might be a revision of ASPR to effect the same goal. In any case, anyone with even a remote interest in government procurement will find the time it takes to read Mr. Hall's article well spent.

EDWIN BARTENSTEIN
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Input-Output Analysis for Cost Accounting, Planning and Control by JOHN LESLIE LIVINGSTONE, *The Accounting Review*, January, 1969.

Professor Livingstone builds upon the work of Williams and Griffin, among others, in demonstrating the uses of matrix algebra for interdepartmental cost allocations and other extensions of input-output analysis. To appreciate the article, the reader should have some familiarity with matrix algebra manipulations. Because matrix calculations are inherently laborious, practical application of the techniques presented will require the use of a computer.

The article begins with a restatement of the example of interdepartmental cost allocation used previously by Williams and Griffin (*Accounting Review*, July, 1964). After the restatement, the author demonstrates the power of input-output analysis by reaching a solution in one matrix multiplication rather than the three matrix operations used by Williams and Griffin. The problem involved five service departments and three operating departments. The service departments had cost allocations between them with all the service department costs finally allocated to the operating departments.

Assumptions

Professor Livingstone describes the basic input-output model as capable of analyzing transactions among economic activities whether the activities are industries, firms, departments, or cost centers. He strongly cautions that the analysis requires the strict assumptions of only one primary input (usually labor) and only one output for each activity. This balanced relationship (n activities and n output commodities) facilitates the application of matrix techniques. It is further assumed that "Production takes place through processes with fixed technological yields of constant proportionality. There is only one process used with no substitution in each activity." The author adds that the latter statement is not meant to imply that alternative processes do not exist but rather that an optimal process with a given set of prices has been selected.

The basis for the input-output model is a matrix of transactions, which may be in monetary or non-monetary terms, with a row and a column for each activity. The rows represent inputs and the columns represent outputs for each activity.

Matrix construction

Professor Livingstone constructs an input coefficient matrix from the primary input costs and the fixed technological coefficients which were assumed. Then a technology matrix is determined by subtracting the input coefficient matrix from an identity matrix. The final demand for each commodity is found by multiplying the technology matrix by the total output vector. If the final demand is given, the total output vector can be calculated by multiplying the inverse of the technology matrix by the final demand vector.

Applications

After developing the basic input-output model, the author describes some applications. In discussing applications to planning, the author notes that the standard transaction matrix is the transposition of the transaction matrix used previously; that is, the outputs become rows and the inputs become columns. With a given demand vector, the primary input resource requirements can be calculated. This procedure is analagous to the usual process of forecasting sales and determining the resources needed to meet the sales objectives. Professor Livingstone states that the input-output analysis provides internal consistency in the determinations that is not present in the normal budgeting procedures.

Professor Livingstone shows that setting up the transaction matrix in terms of physical quantities and unit costs will permit price and quantity changes to be analyzed in a fashion similar to standard cost variance analysis.

Example

The author demonstrates a useful application of input-output analysis by showing the effect on an interactive system when a constant changes. The vehicle he uses is a wage rate increase in one process of a multiprocess system. He shows that an incremental cost results in a larger cost (which he terms opportunity cost) through the multiplier effect present in an interactive system. A significant advantage in applying input-output analysis to such a system is that "it takes into account the effects on every other activity resulting from the single change . . .".

The author indicates that the transaction matrix can be expanded to include inventories and a breakdown of the various costs which constitute the primary input factors, thus increasing the capabilities of the model.

The input-output analysis described by Professor Livingstone appears to have significant applications in the areas mentioned. It also has potential for interfirm and interindustry analysis. It would be interesting to see a report on some testing of this powerful analytical tool in order to appreciate its full capabilities.

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The Compatibility of Auditing Independence and Management Services—An Identification of Issues by D. R. CARMICHAEL and R. J. SWIERINGA, *The Accounting Review*, October, 1968.

The authors consider the effect on an auditor's independence when he provides both audit and management services for the same client. The issue is discussed against the background of the existence of different phases of independence and differing types of research methods. Much of the difference in opinion is held to be attributable to differences in basic approach relating to research methodology.

This article is a review and identification of issues relating to an auditor's independence when the auditor also provides management services for his client. The authors believe that earlier articles have not developed all the phases of independence, and their purpose is to do so in this article by considering phases of independence, arguments relating to these phases, and the relationship of types of evidence to the phases and arguments. The authors believe that differences of evidential approach provide the basis for most of the disagreement and arguments.

The phases of independence are considered first. Professional independence is that approach and attitude that make the auditor self-reliant and free from control or influence of management in making decisions based on universal standards, specificity of professional expertise, and authority based upon expertise. Audit independence is freedom from any self-interest that might warp the auditor's judgment—either intentionally or unintentionally. Perceived independence is the appearance of independence to the reasonable and knowledgeable individual and to the general public as a whole.

Research methods

Three types of research methods are considered. Survey research is used to discover such things as relative incidence and interrelations of variables; experimental research attempts to determine causal relations among variables; and *a priori* research consists of serious and systematic thinking about problems which does not involve empirical methods.

Much of the difference in arguments as to the independence of an auditor who provides management services for his client is attributable to differences in basic approach relating to research methodology. Advocates of "incompatibility" have been satisfied to demonstrate that combining consulting and auditing has the potential for damaging the auditor's independence or at least damaging perceived independence: the advocates of "compatibility" have demanded absolute proof that independence has been lost. The other major premise on which the two groups differ is the relationship between independence and professionalism. Advocates of "incompatibility" have focused mainly on an absolute sense of independence; advocates of "compatibility," recognizing that independence is but one aspect of professionalism and that there are degrees of independence, have decided that the auditor can achieve the necessary degree of independence and act in the dual role of auditor and consultant.

A priori analysis indicates that performance of management services is entirely compatible with professional independence. While there seems to be no basic incompatibility between consulting and objective audit independence, the consulting relationship is potentially dangerous for maintenance of subjective audit independence. The extent of the danger can probably be determined by experimental research. Previous surveys have indicated that a significant number of observers believe perceived independence is impaired by performance of consulting and auditing for the same client. This aspect can be developed by additional surveys.

When additional research has been done to develop data in the needed areas, the compatibility issue will rest upon differences in approach of the research methods —namely, is the issue to be determined by potential risk, by risk as realized in loss, or by perceived loss in the eyes of the public?

PETER PAUL LOCKETT
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The Merger Movement Rides High by GILBERT BURCK, *Fortune,* February, 1969.

The rising tide of mergers and acquisitions is beginning to stir doubt and dismay, and no company seems really immune. The author, a financial writer, analyzes the growth of the conglomerate phenomenon and concludes that no formidable obstacles seem to confront the conglomerate movement now.

A great deal has been written in the financial press lately concerning the great conglomerate movement. Mr. Burck's article summarizes the more important positions that have been taken.

According to estimates by W. T. Grimm & Co. of Chicago, mergers of all kinds (financial, industrial, insurance, retail, etc.) totaled 4,462 during 1968 and will probably total 5,400 in 1969. According to another financial expert, Nicholas Salgo, by about 1980 there will be only 200 major industrial companies in the United States, all conglomerates.

Numbers game

Mr. Burck uses these statistics to launch his article. He contends that the process of putting conglomerates together tends to expand stock prices long before it expands the economic values on which stock prices ultimately depend, thus making the conglomerate-building process more of a numbers game than anything else. One important factor that makes conglomeration a numbers game is that in many acquisitions stock market prices increase. This can give the appearance of growth where none exists and often produces a chain letter effect whose terminal stages may be painful.

In most mergers the acquiring company has a higher price-earnings ratio than the acquired company, with the net effect that the earnings per share of the merged company in its first year of existence are inevitably higher than those of the acquiring company in the previous year. As long as the merged company, even if not growing, can keep on buying other companies with lower price-earnings ratios, even if they are not growing, its earnings per share will continue to rise. But the day inevitably will come when such a conglomerate will run out of acquisitions. Then, if there has been no internal growth in earnings, earnings per share will fall steeply. When that happens, the market price of the company's stock will probably fall even more as the growth expectations collapse, and the stockholders in the end will be left holding the bag.

Pooling of interest

The most popular method of accounting for acquisitions is the pooling-of-interest method, which tends to boost earnings per share. In 1965 only 30 per cent of all mergers were accounted for as poolings, but the percentage jumped to more than 60 per cent in 1968.

How it helps

An example of how pooling-of-interest accounting helped one company is the Gulf and Western acquisition program of 1967. During this year Gulf and Western issued securities with a market value of $185 million in exchange for several companies, including Paramount Pictures. Pooling-of-interest accounting enabled Gulf and Western to record these acquisitions at their previous book value, which was less than $100 million. In effect, this gave Gulf and Western a submerged income pool, i.e., in determining profits Gulf and Western did not use the actual price paid for Paramount and other properties, which means it was able to generate revenue without having full corresponding costs reflected in the income statement.

The author points out that even if many conglomerates fail to increase earnings on assets, they may still be able to increase earnings on equity by leveraging their capital—shunning new stock issues, reacquiring their own stock, assuming more debt, and otherwise reducing the proportion of equity in their capitalization.

Disturbing phenomenon

This article is an excellent synopsis of a disturbing and amazing financial phenomenon, the current conglomerate movement. The author's examples are interesting to follow, and he leaves no doubt that under existing laws nothing can stop the present merger movement.

However, since this article was written, both the legislative and executive branches of the federal government have shown intense concern with conglomerates. On the legislative front, Wilbur Mills, Chairman of the House Ways and Means Committee, has introduced a bill that would eliminate some parts of the IRS Code that provide for tax-free exchanges in mergers. From the executive branch, Richard W. McLaren, the new head of the Justice Department's Antitrust Division, has made it clear that the Justice Department is ready to employ existing laws to block mergers between large corporations in unrelated industries.

Thus, what will happen to the merger movement in the future appears to be very speculative at this point in time.

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Current Cost for Long-Lived Assets: A Critical View by HOWARD J. SNAVELY, *The Accounting Review,* April 1969.

Mr. Snavely presents arguments against the use of current cost data for long-lived assets in financial statements. Rather than pursuing the commonly used objections based on lack of objectivity, he attacks the use of current cost on the basis that it lacks relevancy, reliability, and understandability.

This analysis is based on the assumption that the current cost system for long-lived assets can be supported only because it is needed to reflect changes in prices/costs of specific assets apart from the changes in the general purchasing power. Changes in general purchasing power of the dollar can be reflected without departure from the use of historical cost. The following definitions are necessary to avoid communication problems:

Current cost of a long-lived asset = The least expensive cost of obtaining an equally productive asset at a given date.

Market value of an asset = The dollar amount that could be received for an asset sold as a separate item on a given date.

Real value to the owner = The amount for which the future net cash receipts attributed to the asset could be sold at a given date if the future were known.

Value of a firm = The real value of all assets, net of liabilities.

Real net income (or loss) = The increase in the value of the firm from period to period exclusive of addition or withdrawal of investment by the owners.

Accounting net income (or loss) = That amount reported as net income on the income statement.

All of the definitions assume an orderly market in which the number of similar assets actually ordered or sold at the given date would not be so large as to increase materially the cost or sales price.

For financial information to be relevant it must be useful. To be reliable, the information contained in the financial statement must be a reasonable representation of what it purports to be. To be understandable, the financial statement must be presented in a manner consistent with the concepts employed by the statement users in making decisions about the firm.

The most relevant cost system to use is the one that will best enable the user to estimate the real value of the firm. Neither historical cost nor current replacement cost is relevant since neither system permits an accurate look into the future. The appropriate question to pursue is: Which system will provide the statement user with the better means of estimating the firm's future value?

Holding gains or losses

Reported net income should indicate to the user that the firm has had an increase in real value, and, by the same token, a loss signifies a decrease in the real value of the firm. Under the system for using current cost recommended by the American Accounting Association Committee on Basic Accounting Theory, holding gains and losses are to be reported on the income statement when the current cost of an asset is more or less than at the beginning of the period; however, a real holding gain or loss will result only if the real value of the asset has changed. A pertinent question to ask is: Does a change in the current cost indicate that the real value of the asset has changed? Furthermore, if the current cost does reflect a change in real value, does the current cost accurately measure the change? The answer to both of these questions is "No."

An increase in the current replacement cost of an asset does not mean that the real value has increased. The replacement cost at a given date can be changed by such factors as threat of war, strike, freight rates, substitute products, etc., only part of which may change the future cash receipts or disbursements of the firm. Furthermore, if current costs do indicate a change in real value, the amount of change or the direction of the change may not be determinable.

Holding gains as generally presented represent an additional amount over an asset's depreciated historical cost that would have been paid if the asset had been purchased in the current period. This holding gain is a type of opportunity saving or the additional expense that would have been the result of a current purchase. Unlimited opportunity gains or losses exist in most business situations. What would the savings have been if the company had had a different line of products, hired different executives, or taken any one of the numerous alternatives available? The real holding gains and losses that exist are not limited to those that result from a change in the current cost of the productive assets; therefore, even when a current cost system is used, the real holding gain or loss is not fully recognized.

Relevance of current cost

Current cost reflects the cost that will be paid to replace an asset under current supply and demand conditions at the present point in time. Current cost does not reflect historical cost, nor does it represent the replacement cost that will be required by the firm in the future. Also, current cost does not fully reflect all factors that determine the asset's current economic significance, which is the real value of the asset.

Understandability

Financial statements that cannot be compared on an interperiod and interfirm basis are not understandable. Interperiod comparison of balance sheets that show an increase or decrease in the dollar amount of assets will convey the impression that the firm has had an increase or decrease in assets. If the statement shows an increase in the dollar figures for the firm's assets, the implication is that the firm is "better off." Financial statements that show changes in asset balances due to an increase or decrease in the current cost while the number of assets remains unchanged may be lacking in realism. Furthermore, recognition of the holding gains and losses will affect the rate of return trends since both net income and owner's equity will have been altered.

In interfirm comparisons, the use of current costs will bring assets of the same kind into comparable dollar terms regardless of the date of purchase. However, the improvement in balance sheet comparability is somewhat offset by the effect on the income statement.

Example

Take for example two firms, A and B, both of which own the same type of asset and are using a current cost system. If both purchase the asset in the same accounting period, Firm A after a cost increase and Firm B before the increase, Firm B must recognize a holding gain in order to reflect better performance than A. In this case, Firm B did perform better than A so far as asset acquisition is concerned. If the same situation occurred but Firm B had purchased the asset in a prior period, recognition of the holding gain for Firm B will still imply that Firm B had better performance than Firm A during the current period. The superior performance by Firm B would more reasonably be attributed to the period of the purchase—not the current period.

In a managerial sense, the current period performance of the two firms is identical; the difference is completely attributable to an outside occurrence—that of a price change. The recognition of the holding gain will tend to misrepresent the relative performance of Firms A and B except in the limited case where they both purchase their assets in the same period but at different cost levels. Thus, it is possible to conclude that the use of current cost data improves the interfirm comparability of the *balance sheet* but not the *income statement*, with an overall loss in comparability because of the greater significance of the income statement.

A good case

Mr. Snavely has made a good case against the use of current cost for long-lived assets. His presentation against current cost might have been strengthened by stressing more strongly that the only useful current cost is the amount that management is willing to pay at the current time. This amount may be affected by technological innovations, market conditions for the firm's product, or input costs for services necessary to use the asset. Since many factors can affect the future output value of a productive asset to a particular firm, there is no real evidence that current replacement cost less depreciation is a better value than historical cost less depreciation. An increase in replacement cost is not necessarily valid evidence of an increase in service potential.

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